Sept. 19, 1967 J. W. SMITH 3,341,911

APPARATUS FOR PACKAGING CRIMPED MATERIALS

Filed Nov. 12, 1965

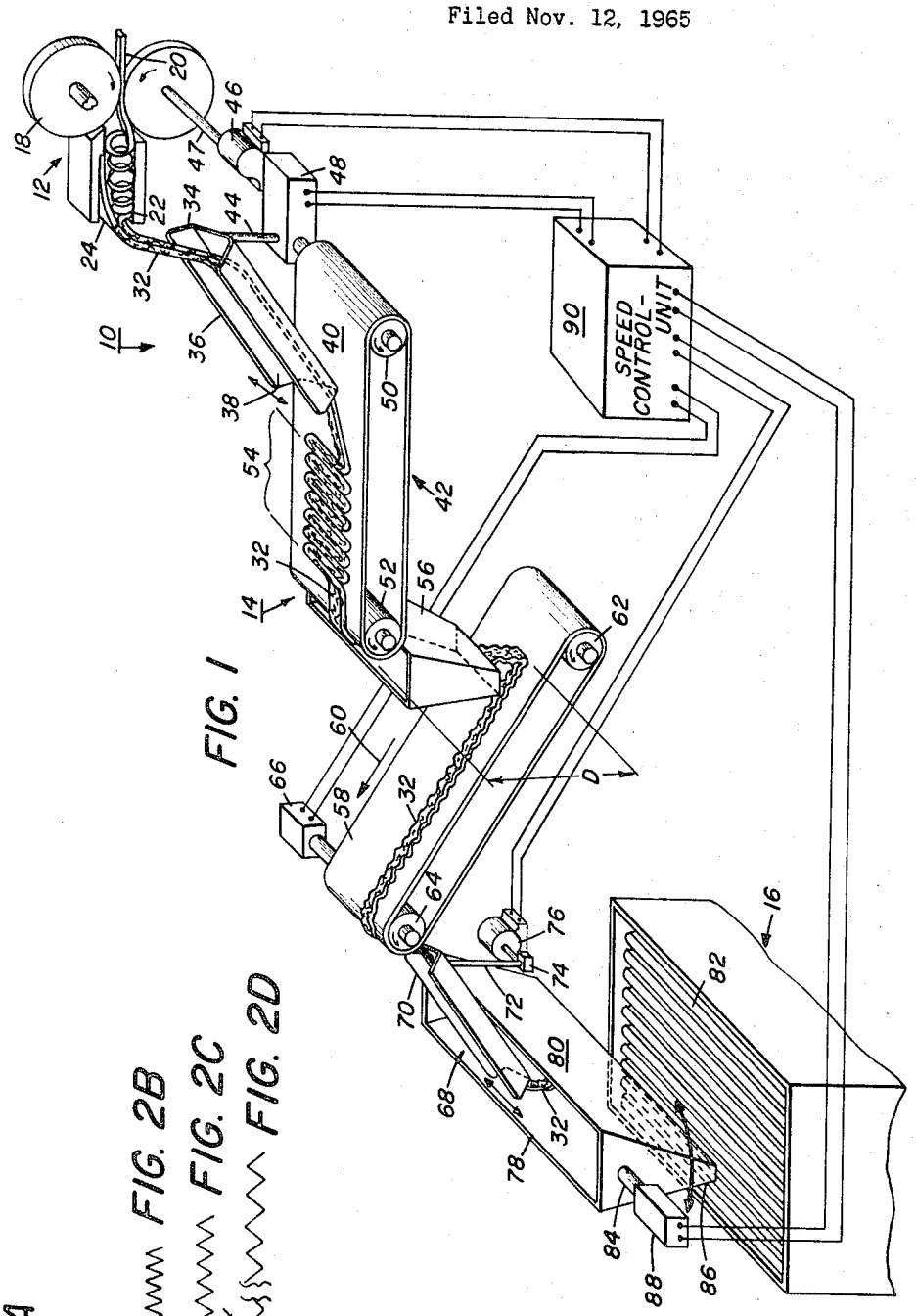


FIG. 1

FIG. 2A

FIG. 2B

FIG. 2C

FIG. 2D

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United States Patent Office 3,341,911 Patented Sept. 19, 1967

3,341,911

APPARATUS FOR PACKAGING CRIMPED MATERIALS

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Filed Nov. 12, 1965, Ser. No. 507,443
9 Claims. (Cl. 28—1)

ABSTRACT OF THE DISCLOSURE

In a filamentary material packaging and treating system, a plurality of conveyors, chutes, and guides are so arranged to direct and guide a crimped tow product from the crimping device onto a dryer belt, from which it is pulled by its own weight onto a second conveying means which subsequently deposits the product through a dual chute and funnel arrangement into a package type container.

This invention relates to an improved apparatus for depositing highly crimped filamentary material in an orderly arrangement to permit the same to be withdrawn in a uniform manner and without entanglement. More particularly, this invention relates to an improved apparatus for depositing a highly crimped filter tow into a container in such a manner as to substantially eliminate any opening of the crimps during the packaging process.

It is well known that both the textile and cigarette industry uses large quantities of synthetic filamentary materials which have been crimped or buckled to eliminate their otherwise inherently straight characteristic. In these industries the word "crimped tow" describes a product comprised of several ends of continuous filaments brought together and crimped to form a continuous ribbon-like mass. The size of this crimped tow may vary over wide ranges depending on the use for which it is intended, but is usually from 25,000 to 2,000,000 denier with individual filaments ranging in size from 1.6 denier to 16 denier.

In general, the mode of collecting crimped strands or filamentary materials, either as a self-supporting package or in cartons for transport, has heretofore been dependent upon two primary considerations; namely, the provision of a compact package, and one which permits the crimped filamentary material to be withdrawn uniformly and without entanglement. However, very little if any consideration has been given to how the crimped filamentary material can be handled and packaged so that crimp retention of the material will be kept as high as possible. As a result of this neglect in considering crimp retention, complete satisfaction has not been achieved in tow packaging apparatus heretofore used from the standpoint of retaining the maximum bulk factor for any given crimp level. Accordingly, a primary object of this invention is to provide an improved high crimp retention apparatus for collecting crimped filamentary material as a compact package from which the filamentary material may be easily and uniformly withdrawn.

Another object of the invention is the provision of a simple and improved crimped tow packaging apparatus which substantially eliminates the application of any longitudinal pull or tension on the tow and thus assures the highest possible crimp retention factor.

A still further object of this invention is to provide a packaging apparatus for folding crimped filamentary material into a series of superimposed layers for shipment in such a manner that the maximum bulk factor of the material is retained.

The primary object of this invention is to provide a

packaging apparatus which is capable of processing highly crimped filter tow material so that the high bulk factor and closed crimps of the tow are retained.

These and other objects and advantages of this invention will be more apparent upon reference to the following description, appended claims, and drawings wherein:

FIGURE 1 is a perspective view of a processing and packaging apparatus constructed in accordance with this invention which is being used to condition and package a highly crimped filter tow; and

FIGURES 2A through 2D illustrate the relaxed condition of several threads or filaments of a tow that has been subjected to varying amounts of elongation during a processing and packaging operation.

In general, the apparatus of the present invention is designed to progressively arrange crimped filamentary material into a series of superimposed layers within a package or container without opening the crimps or decreasing the bulk factor of the material. The handling of the crimped filamentary material so as to prevent the opening of the crimps formed therein is accomplished through the use of a movable guide means that places the crimped material in a predetermined pattern upon a moving conveyor unit. Both the movement of the guide means and the speed of the conveyor unit are adjusted so that the crimped material being conveyed is placed, without any elongation thereof, upon a second movable conveyor unit which feeds a placing means. The position of the first and second conveyor units are so selected that the crimped material is exchanged from one to the other without any appreciable tension being applied thereto. The placing means is mounted for pivotal movement and operates so as to place the crimped material within the container in superimposed layers. The operating speeds and movements of all the movable conveyor units and guide means are interrelated so that no elongating forces are placed upon the crimped filamentary material throughout its handling thereby permitting the maximum bulk factor of the material to be maintained.

In order to better understand the construction and use of this novel packaging apparatus it will be described in connection with its use in processing a highly crimped filter tow. It is to be understood, however, that various other filamentary materials such as yarns, threads or other like crimped materials can be processed with the packaging apparatus of this invention. Other uses for an apparatus of this type will also be readily apparent to those skilled in the art.

With continued reference to the accompanying figures wherein like reference numerals designate similar parts throughout the various views, and with initial attention directed to FIGURE 1, the reference numeral **10** is used to generally designate a packaging apparatus constructed in accordance with the concepts of the present invention. For purposes of illustration this packaging apparatus is shown to consist of three main units, namely; (1) a crimper unit **12**, (2) a packaging unit **14**, and (3) a container unit **16**.

In substantially all spinning processes which are presently being used to produce synthetic filamentary materials for use in manufacturing tobacco smoke filters, the fine streams of spinning solution immediately upon leaving the spinnerette orifices, and before any substantial solidification has taken place, are subjected to a certain amount of tension which is normally imposed by a positive drawing of the filaments from the spinnerette. This tension causes substantial elongation of the fine streams of spinning solution before and during transformation into self-sustaining filaments. The imposed tension and the internal strain set up in the filamentous structures at the time of their birth

bring about substantial orientation of the molecules along the filament or fiber axis. The formed filaments are, therefore, inherently straight and can be drawn or otherwise arranged into substantially parallel relationship to form a tow or web.

However, as is well known in the tobacco smoke filter art, the straight, parallel fibers of the tow from which the filter is to be formed must be crimped or crinkled if the best possible filtering action is to be obtained. The purpose of adding such crimps to the continuous filaments is to give it a curl or crinkle such as that which exists in the natural fibers. These crimps in the fibers effectively block any straight channels which might otherwise exist in the interstices between the fibers and thus causes the smoke flowing through the filter to follow a meandering path. Therefore as the bulk factor or drop in permeability of the filter increases, the filtering action of the filter will also increase. Thus this increase in the bulk factor of the fibers is of considerable importance in tobacco smoke filter plug manufacture since as the bulk factor is increased the amount (in weight) of tow used in the filter can be reduced and yet a given pressure drop or filtering action will be maintained. As will be apparent, this use of less tow to achieve the same degree of filtering results in a reduction in material cost.

Various methods and apparatus have been devised for placing any desired crimp count (defined as one-half the number of fiber bends per linear inch) into a substantially straight filamentary material. For instance, these crimps may be produced mechanically by means of intermeshing gear-like elements, by means of a "stuffer-box" type crinkler, or by twisting the fibers, setting the twist, and then untwisting. A stuffer box type crimper unit **12** is shown in FIGURE 1 wherein nipped feed rolls **18** forcibly deliver, or inject, the uncrimped substantially straight filaments **20** into a confined space that has a throttled exit **22**. The amount of crimp added to the filaments **20** is controlled by the size of the chamber or throttled exit **22**. When a high crimp count is desired, the exit **22** is throttled down or made smaller through, for example, the use of a movable plate **24**. On the other hand a low crimp count is obtained when the exit **22** is opened so that there is a minimum restriction to flow of the crimped tow through the confined space.

As will be apparent, if the bulk factor of a filamentary material such as shown at **20** is to be increased, not only must the substantially straight material be crimped, but the crimped tow **22** thus produced must not be subject to any elongating force during the packaging or processing of the tow which would remove these newly formed crimps. This fact is more vividly shown in FIGURE 2 wherein four equal lengths of a single filament yarn with eight crimps per inch are shown after being subjected to varying degrees of elongation. The filament **24** of FIGURE 2A has not been elongated and is thus in substantially the same condition it was in when it left the crimper unit while the filaments **26–30** of FIGURES 2B–2D are in a relaxed state after having been stretched 5%, 10% and 15% respectively. It is obvious that as the crimp angle A increases, or is opened up, the bulk factor decreases and filament **30**, while it still has eight crimps per inch, is approaching the bulk factor of uncrimped yarn. Therefore, an ideal crimped tow processing or packaging apparatus would be one that is capable of handling the tow in such a manner as to prevent the crimps in the tow from being opened due to an elongating force being applied thereto. However, such tension free handling of a crimped tow is impossible on prior known handling apparatus since they require the use of tension rollers and long tow drop areas for their operation. The severity of these tension factors will be dependent upon the friction, speed, weight of the tow and other related variables, but will all accumulate to a point where the crimp angle of the tow is greatly increased.

The packaging or processing unit **14** of this invention has been found to be capable of moving the highly crimped tow **32** produced by the crimping unit **12** through various treatment steps and into the container unit **16** without opening the crimp angle therein by any appreciable amount. As seen in FIGURE 1, the crimped tow **32** being discharged from the crimping unit **12** is fed directly into the upper end **34** of trough like chute or guide **36**. The lower end **38** of the chute is positioned directly above the top surface **40** of a moving conveyor belt **42**. The chute **36** is pivotally mounted at or near its upper entrance end **34** by means of a shaft **44** that is movably mounted normal to the chute. The lower end of the shaft is connected to a power drive unit **48** which drives the free lower end **38** of the chute in a reciprocating or oscillating motion in a plane perpendicular to the shaft **44**. This results in the discharge end **38** of the chute **36** being moved with a linear movement back-and-forth across the width of the top surface **40** of the conveyor belt **42**. From this it is seen that the crimped tow **32**, which is produced by the crimper unit **12** as it is driven by a variable speed motor **46** via shaft **47**, will slide down the inclined chute **36** and be layed in a zigzag or continuous "S" pattern upon the moving surface **40**.

The conveyor belt **42** is preferably of the open mesh type and is mounted on pulleys **50–52**. The pulley **50** is connected to the power driven unit **48** and serves to drive the belt **42** at a speed proportional to the speed with which he chute **36** is being moved. Any treatment of the crimped tow **32** carried on the belt **42**, such as subjecting it to a drying operation, normally occurs within an area or zone designated by the bracket **54**. However, for purposes of clarity no dried hood or like tow conditioning unit is shown, nor are the bearings for supporting the pulleys **50–52**.

After the tow **32** has been carried through the conditioning zone **54** it arrives at the discharge end of the conveyor belt **42** and falls by gravity through a tapered feed chute or funnel **56** onto a conveyor belt **58**. The conveyor belt **58** is moving in the direction indicated by the arrowhead **60** and at a speed substantially equal to that by which the crimped tow **32** is moving down the inclined chute **56**. The distance "D" that the crimped conditioned tow **32** falls between the discharge end of the conditioning belt **42** and the surface of the conveyor belt **58** is very important since, to prevent opening of the crimp angles in the tow, it is necessary that the amount of free-falling tow be adjusted so that it develops, by its own weight only, sufficient tension to pull the tow from the edge of the belt **42**. By this arrangement the tow speed is accelerated gradually whereby the zigzag layer is removed and the tow **32** emerges from the funnel **56** in a "straight" line that is centered on the conveyor belt **58**. Thus at no time during the transfer of the tow **32** from the conditioning belt **42** to the conveyor belt **58** is the tow subjected to any external drawing tension which would adversely affect its crimp retention.

The conveyor belt **58** is employed for carrying the conditioned and crimped tow **32** to the place of packaging without any tension being applied to the tow. Therefore the conveyor belt may be of any desired length or width and is carried on a suitable number of rollers **62–64**. An adjustable speed drive unit **66** is shown connected to the roller **64** for powering the conveyor belt **58**. As the tow **32** is discharged from the end of the conveyor belt **58** it falls into the upper end of a trough-like incline chute **68**. The chute **68** is rigidly attached at its entrance end **70** to a support shaft **72** that is rotatably mounted through a right-angle drive and bearing unit **74**. A suitable drive unit **76** is connected through the right-angle bearing unit **74** to the shaft **72** for causing the chute **68** to reciprocate in a plane perpendicular to the shaft and with a linear movement sufficient to transverse the length of the mouth **78** of the spreader bin **80** being fed.

As the tow **32** is discharged from the inclined chute **68** it drops into the mouth **78** of a tapered spreader bin **80**. Due to the reciprocation of the chute **68** the tow **32** will be discharged or laid in folds along the entire length of the bin **80**, or to the right and left as viewed in FIGURE 1. Thus the moving chute **68** serves to distribute the tow lengthwise of the bin **80**.

However, to provide the desired lay or pattern of successive superimposed layers **82** of the tow within the bale or container **16** it is necessary also to move or reciprocate the tow **32** in a direction normal to that provided by the reciprocating chute **68**. To secure this result the spreader bin **80** is mounted for rocking or pivoting movement about a pair of aligned shafts **84**, which project laterally from the opposite end walls **86** of the bin **80**, by a suitable power unit **88**. For purposes of clarity the support bearings are not shown, but may be of any suitable type. Thus, it can be seen that the inclined chute **68** reciprocates the tow **32** along what may be referred to as the length of the bale **16** without any appreciable tension being applied thereto while the "rocking" of the spreader bin **80** reciprocates the tow across what may be referred to as the width of the bale. The length of the bale is normally 46 to 48 inches while its width is usually from 2 to 3 feet.

As would be expected, the inclined chute **68** must move somewhat faster than the bin **80** so that this dual movement of the tow **32** will serve to lay the latter in reversing, side-by-side folds as shown in FIGURE 1. It is also apparent that the crimper unit **12**, chutes **36** and **68**, and the moving conveyor belts **42** and **58** must be operated at different but interrelated speeds if the crimped tow **32** is to be moved through the apparatus **10** without any elongation pressure being applied thereto. Therefore a central speed control unit **90** is provided for controlling the speed of the various movable components of the apparatus **10**. This control unit **90** can be of any suitable type or combination of control elements as long as it serves to accurately control the relative speeds of the various movable components of the apparatus.

From the foregoing it is readily seen that the filamentary material handling apparatus of this invention is capable of processing and carrying a highly crimped material without in any way adversely affecting its crimp retention. Thus for the first time complete advantage can be taken of the high bulk factor that can be imparted to a filamentary material and which had heretofore been at least partially destroyed in the processing and/or packaging of the material.

This invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by the United States Letters Patent is:

1. A packaging apparatus adapted for handling and processing highly crimped filamentary materials without adversely affecting the bulk factor thereof comprising first conveyor means for carrying the filamentary material through a conditioning zone, positioning means for laying the filamentary material on said first conveyor means in a zigzag pattern without subjecting the material to an elongating pressure, second conveyor means for transporting the conditioned filamentary material from the discharge end of said first conveyor means to a packaging means, the receiving end of said second conveyor means being positioned below the discharge end of said first conveyor means by a predetermined distance so that

the filamentary material at the discharge end of said first conveyor means is pulled therefrom and layed in a substantially straight line upon said second conveyor means by the weight of the filamentary material that is falling onto said second conveyor means, and packaging means positioned to receive the highly crimped filamentary material as it leaves the discharge end of said second conveyor belt for arranging the material in a superimposed position.

2. A packaging apparatus according to claim **1** wherein control means is provided for controlling the speed with which said first and second conveyor means and said positioning means are operating in respect to one another.

3. A packaging apparatus according to claim **2** wherein a funnel means is provided between the discharge end of said first conveyor means and the receiving end of said second conveyor means for positioning the crimped filamentary material upon said second conveyor means.

4. A packaging apparatus according to claim **2** wherein said packaging means consists of a guide means adapted to reciprocate in a first plane, and a bin means adapted to reciprocate in a plane normal to said first plane, the filamentary material being fed from the discharge end of said second conveyor means through said guide means and said bin means so that it is arranged in superimposed layers within a container.

5. A packaging apparatus according to claim **4** wherein said positioning means is an inclined conduit that is arranged to reciprocate back and forth across the width of said first conveyor means.

6. A packaging apparatus according to claim **5** wherein said filamentary material is fed directly from a crimping means into the receiving end of said inclined conduit positioning means.

7. A packaging apparatus according to claim **6** wherein said filamentary material is a continuous tow that is adapted to be formed into tobacco smoke filters.

8. A packaging apparatus for processing and packaging a highly crimped continuous traveling filter tow in superimposed layers within a container comprising crimping means for receiving and placing crimps within a tow material thereby producing a crimped tow with a predetermined bulk factor, a movable belt positioned below said crimping means for receiving and carrying said crimped tow through a conditioning zone, reciprocating guide means positioned between the exit part of said crimping means and the receiving end of said movable belt for laying said crimped tow in a zigzag manner at right angles to the direction in which said movable belt is being driven without decreasing the bulk factor thereof, movable conveyor means for transporting said crimped tow from said belt to a container, said conveyor means having its receiving end positioned a predetermined distance below the discharge end of said belt so that the last fold in said crimped tow is pulled from said belt by the tension exerted by that portion of said crimped tow which is falling onto said conveyor means so that the bulk factor of said crimped tow remains substantially constant, a tapered funnel positioned between the discharge end of said belt and the receiving end of said conveyor means for positioning said crimped tow as it is pulled from said belt onto said conveyor means by gravity, and a hopper which is reciprocating over the length and width of said container for receiving and positioning the crimped tow from said conveyor means in superimposed layers within said container.

9. A packaging apparatus according to claim **8** wherein said hopper consists of a reciprocating chute positioned to receive said tow as it falls from the discharge end of said conveyor means and direct it into a bin which has its exit end positioned within said container and is reciprocating in a plane normal to the reciprocating plane of said chute.

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