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3,408,713

PREPARATION OF FILTER TOW

Filed Jan. 24, 1966

2 Sheets-Sheet 1

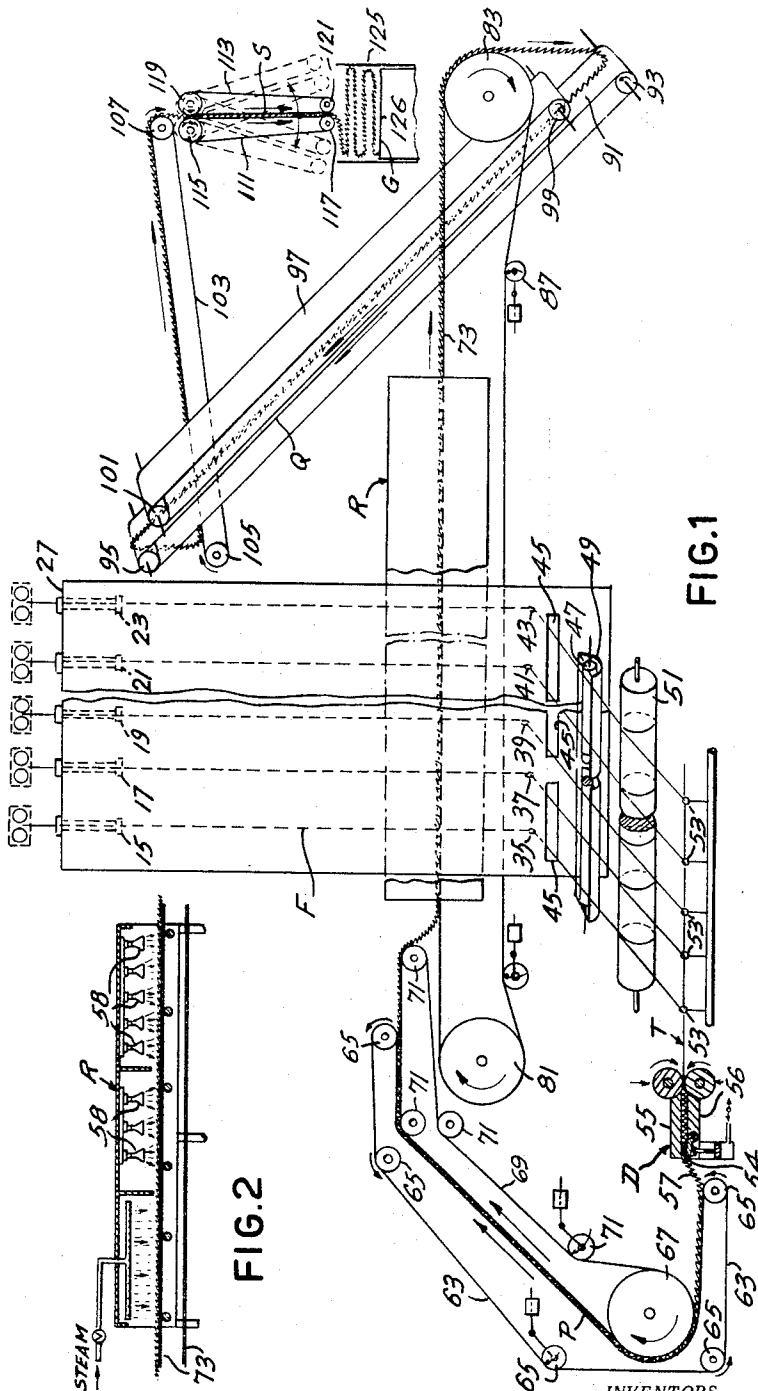


FIG.1

FIG.2

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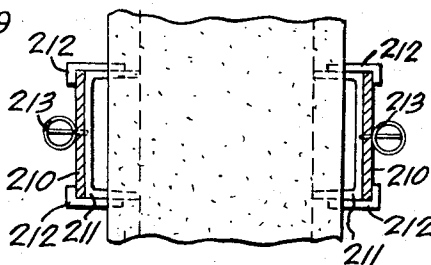
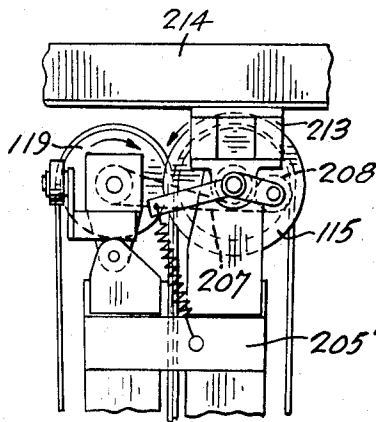
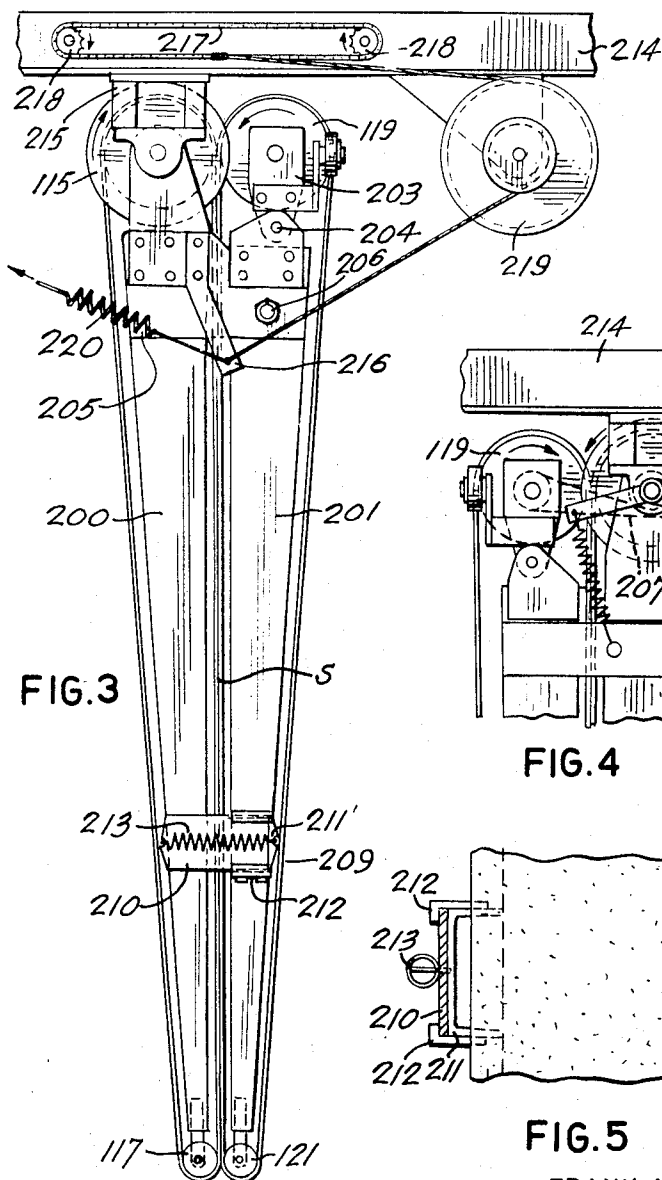
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2 Sheets-Sheet 2



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PREPARATION OF FILTER TOW

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8 Claims. (Cl. 28—1)

ABSTRACT OF THE DISCLOSURE

An apparatus for conveying under tensionless conditions a continuous length of crimped tow into a packaging container, where pairs of endless conveyor belts having juxtaposed surfaces are arranged to move together at the same speed with the material gripped therebetween. At the end a pair of belts are mounted on a pivotal frame; the frame is allowed to reciprocate, and thus the material is folded while preventing undue tension.

The present invention relates to a process and apparatus for conveying a continuous length of material made up at least partly of fibres in stretchable condition. The invention relates more particularly to the conveyance of crimped fibrous tow, such as cellulose acetate tow which may be used, for example, in the manufacture of cigarette filter tips.

During the course of manufacture of such tow, the material is in a stretchable condition. In the normal course of events, the tow has to be moved between a sequence of manufacturing zones, which may be distributed over more than one floor of a factory. The means hitherto employed for conveying such tow has included simply drawing the tow upwardly from floor to floor over rollers. Such a system of conveyance tends to stretch the tow and tends to straighten out the crimps and thus produce an unsatisfactory product.

Accordingly, in accordance with the one aspect of the present invention, there is provided, in a process wherein a continuous length of material made up at least partly of fibres in stretchable condition is advanced through a sequence of treatment zones, the improvement consisting of advancing the material, at least between a pair of such zones, in substantially tensionless condition.

Preferably, the material is conveyed between such zones confined between juxtaposed surfaces moving at the same speed. The material may be confined and gripped for conveyance between the zones, preferably under controlled pressure, between continuous juxtaposed surfaces of a pair of conveyor belts moving at the same speed.

According to a more specific aspect of the invention, there is provided a process for manufacturing tow for the preparation of cigarette filter tips comprising the steps of continuously extruding filaments of cellulose acetate downwardly from a plurality of spinnerettes, gathering the filaments into a tow, advancing the tow through a stuffer box to crimp the filaments, engaging and gripping the crimped tow between a first pair of juxtaposed conveyor belt surfaces moving in the same direction and at the same speed, conveying the crimped tow between the belts in substantially tensionless condition upwardly to a dryer, disengaging the tow from said first belt surfaces onto a belt moving horizontally through the dryer, treating the tow in the dryer with steam and radiated heat to provide a controlled moisture content, gripping and conveying the dried tow by a second pair of belt surfaces similar to said first pair upwardly in tensionless manner to a packaging level,

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disengaging the tow from said second pair of belts onto a general horizontal conveyor, re-engaging the tow between a third pair of belt surfaces similar to said first pair, the belts of said third pair extending downwardly and being mounted in a pivotable frame, and reciprocating the lower end of said third pair of surfaces to fold tow emerging therefrom into a container.

The invention also includes apparatus for conveying a continuous length of material made up at least partly of fibres in a stretchable condition in a tensionless manner irrespective of the slope or otherwise of the direction of conveyance, the apparatus comprising a pair of juxtaposed surfaces of endless conveyor belts, means for guiding the surfaces to move in juxtaposed relationship in the same direction, and means for driving the belts at the same speed.

The invention also includes apparatus for manufacturing crimped tow comprising the above conveying apparatus in combination with manufacturing means constituting the zones between which the tow is conveyed.

According to yet a further more specific aspect of the invention, there is provided apparatus for advancing a body of filamentary material in stretchable condition, in a tensionless manner into a packaging container, the apparatus comprising a pair of endless conveyor belts having juxtaposed surfaces arranged to move downwardly together at the same speed with the body of material gripped therebetween, a pivotable frame upon which the belts are mounted so that the juxtaposed surfaces extend downwardly, and means for reciprocating the lower end of said frame so as to fold the body of material successively as it emerges and falls into such packaging container.

In a plant for the manufacture of crimped tow from, for example, cellulose acetate, conventional manufacturing units, such as an array of spinnerettes, a stuffer box, a dryer, and a baler, may be used. The tow can be, and preferably is, conveyed in a tensionless manner from the crimper to the dryer, which may be on different floors. Tensionless conveying means can also be used in conveying the dried crimped tow from the drying zone to the baler. As previously outlined, it is also preferably reciprocated into the baler by a special tensionless reciprocating conveyor.

The tensionless conveying of the material ensures a more uniform crimp in the final tow and less snarling and tangling of the tow in the bale.

Crimped tow made in accordance with the invention finds application, not only in the manufacture of cigarette filter tips, but also in the manufacture of staple fibre yarns. In such an application, the crimped tow is first baled for storage and thereafter at convenience it is chopped, separated into fibres and spun.

Preferred embodiments of the invention are hereafter more particularly described with reference to the following drawings, in which:

FIGURE 1 is a schematic layout of a plant for the manufacture of crimped, cellulose acetate tow, illustrating three forms of tensionless conveyor in accordance with the invention;

FIGURE 2 is a schematic horizontal section through the dryer, illustrating the drying process;

FIGURE 3 is a front elevational view of a tensionless reciprocating conveyor in accordance with the invention;

FIGURE 4 is a part back elevational view of the conveyor of FIGURE 3; and

FIGURE 5 is a cross-section through the side of part of the conveyor of FIGURE 3.

Referring to the drawings, at the upper right hand corner, several conventional cellulose acetate spinnerettes 15, 17, 19, 21 and 23 are shown, each provided with a

number of filament-forming orifices. Each spinnerette is supplied with a solvent dope of cellulose acetate from a metering pump 25. A drying cabinet 27 surrounds the spinnerettes and extends downwards from them, so that the filaments coming from the spinnerettes are subjected to drying influences and the solvent removed in accordance with established practice.

The thus-formed strands of filaments pass about guides 35, 37, 39, 41 and 43 and out through doors 45 of the drying cabinet. The strands pass over a common applicator roll 47 by which a conventional lubricating liquid is applied to them from a trough 49. The strands of lubricated filaments then pass about a common feed roll 51 and then through respective guides 53 which guide the filaments into a composite tow T which is fed to a crimper D.

The guides 53 are preferably offset slightly one from another so that the tow T takes the form of a horizontal ribbon. If the tow is not intended for cigarette filter tips, the guides 53 need not be off-set so that the tow is passed to the crimper D in the form of a rope. Between the guides 53 and the crimper D the tow is under substantial tension.

If the crimper is remote from the extrusion machine, there is a tendency for the filaments to lose their ordered array and the resulting crimped tow is not uniform. So, the crimper is preferably in close proximity to the extrusion machine. Particularly where the dryer is not immediately in series with the crimper, it becomes important for the crimped tow to be conveyed to the dryer in substantial absence of tension.

The crimper D may be of any conventional type, for example, a stuffer box, as illustrated, having a spring or pneumatically loaded wall 54 forming a constriction through which the tow is forced by feed rollers so that the tow is hindered in its passage and compressed between the sides 55, 56 of the box and thus crimped.

From the crimper D, the crimped tow is laid free onto the surface of an apron 57, forming a part of the crimper, by which it is guided onto the surface of a belt 63 which passes about a driven drum 67 and supporting idler rolls 65. A belt 69 passing about the drum 67 and idler rolls 71 is juxtaposed for part of its length with the belt 63 so as to form a confining path P starting beneath the drum 67, about which it changes direction from the horizontal to a diagonally upward direction and thence about an idler roll 71 to a horizontal direction and ends under the top right-hand roll 65. The belt 63, which may be of rubber impregnated cotton duck, as sold under the trade name "Fabreeka," is driven by friction from the driving belt 69. The pressure between the two belts may be adjusted by means of idler rolls 71 and 65, which have threadably displaceable mountings and is generally only enough to obviate slippage. The idler rolls 65, 71, may alternatively be under adjustable spring tension. Within the path P the tow is held between the belts 63 and 69 and conveyed from a starting position adjacent to the crimper D to an end position adjacent a drying and conditioning oven R in a substantially tensionless condition. The crimper D may be on one floor level and the dryer R on an upper floor.

The fabric of the belt is non-absorbent and unaffected by acetone.

The roll 67 is the driving roll for the first "sandwich" conveyor. This roll should be as large as possible to reduce unit drive friction and also to limit unnecessarily abrupt flexing of the belts. The fact that the crimped yarn is not subjected to a sharp bend but is carried around a comparatively gentle curve is advantageous. The reversal of direction and movement diagonally upward in the layout shown is dictated mainly by physical location of the equipment. However, the direction of movement dictates that special means be employed to avoid the tension that would otherwise occur. The pressure to which the crimped tow is subjected in the path P

varies to some extent by nature of the mechanical arrangement. The important thing is that there be continuous moderate pressure which helps to maintain the crimp and prevents it being removed.

The crimped tow is released from between the belts 63 and 69 after it passes from beneath the final rolls 65. It is then passed free onto the surface of a perforated belt 73 preferably of stainless steel which conveys it through the drying oven R. The belt 73 passes about rolls 81 and 83, one of which is driven. Idler rollers 85 and 87 act against the lower run of the belt and can be moved upward or downward to adjust its tension.

The belt 73 preferably moves at about 50% to about 60% of the speed of the belts 63 and 69 of the sandwich conveyor, so that the crimped tow garlands to some extent as it is laid on the belt 73. A preferred speed of the belts 63 and 69 is 255 feet per minute. In the drying operation it is desirable that the belt be horizontal or nearly so in order that the garlanded tow remain on its surface, the coefficient of friction of this belt being low.

In the oven R, the tow is dried under conditions which set the crimp. The dryer is preferably of conventional type divided into several zones, for example, three zones R₁, R₂, R₃ as shown in FIGURE 2, each with optimum temperatures for setting the crimp, removing excess liquid and feeding a uniform stabilized tow to the bales. In the case of cellulose acetate tow a first stage of the dryer (zone R₁) is sparged with live steam to reduce the acetone content of the tow to a maximum of about 1%. The second and third stages (R₂, R₃) have temperatures adjusted, for example, by radiant heaters 58, to reduce the total volatile material in the tow to about 6% or 7%.

The speed of the dryer belt 73 is determined by a combination of physical length and required drying time. A certain amount of garlanding of the tow is desirable for efficient use of available heat. It does not remain garlanded but is drawn out of the dryer by a conveyor running at a speed approximately the same or slightly faster than the speed of the conveyor leading to the input end of the dryer.

The tow is delivered from the belt 73 onto the upper surface of a conveyor belt 91 running about rollers 93 and 95. A companion belt 97 running about rollers 99 and 101 has its lower run juxtaposed to a part of the upper run of the belt 91, the runs of the respective belts forming therebetween a confining passage Q for the tow. One of the rollers 93 or 95 and 99 or 101 is a driven roller. The tow passes through the confining passage R and is released to the upper run of the belt 91 which extends beyond this passage. The belts 91, 97 are driven at substantially the same speed as belts 63, 69 so that the tow is ungarlanded as it leaves the belt 73.

The pressure between the juxtaposed surfaces of the belts 91 and 97, forming the confining passage Q, is pre-set by the tension between the rollers of each one of the belts and by the distance set between the respective pairs of end rollers of the two belts and should be just sufficient to carry the tow without slip.

The tow is delivered from the upper run of the belt 91 onto the upper run of a belt 103 passing about rollers 105 and 107. The tow rests freely on the top run of the belt 103 which may run horizontally or at a slight upward angle as illustrated. The tow is delivered from the end of the belt 103 downward to between a pair of belts 111 and 113 whose inner runs are juxtaposed to form a confining passage S, the belt 111 passes about rollers 115 and 117 and the belt 113 passes about rollers 119 and 121. The rollers 117 and 121 are smaller than the rollers 115 and 119 respectively. The rollers 115, 119, 117 and 121 are mounted on a frame which is pivoted near its upper end for reciprocal movement so that the bottom end of the passage S describes an arc above the baling press 125 to which the tow is delivered in garlands G.

The reciprocating conveyor defining the passage S comprises a pair of mounting formers 200 and 201. The

former 201 terminates at its upper end short of the former 200 to leave space for a pivoted mounting 203, pivoted at 204, the pivoted mounting 203 carrying the roller or pulley 119. The roller 115 is fixedly mounted at the upper end of the former 200 so that the rollers 115 and 119 are on substantially the same level. The formers 200 and 201 are held together near their upper ends by crosspieces 205, 205'. The crosspieces 205, 205' are fixed to former 200 but are held to former 201 by a sprung bearing 206 which allows a very slight pivoting action to the former 201.

One of the rollers 115, 119 is driven, and the rollers are interconnected by a belt 207 which runs around a pulley co-axial with roller 119 and is pressed against a pulley co-axial with roller 115 by a tensioning roller 208, which serves the additional purpose of pivoting roller 115 against roller 119 and maintains the rollers 115 and 119 in contact, while allowing the mounting constituted by the formers and rollers to reciprocate about an axis co-incident with the axle of roller 115.

At the lower end of the unit, roller 117 is mounted at the end of former 200 and roller 121 is mounted at the end of former 201. Near their lower ends, the formers 200 and 201 are spring held together by a slide unit 209. The slide unit 209 comprises a pair of slide bars 210, 210', adapted to slide in retaining channels mounted on former 209 and constituted by the floor pieces 211, 211' and overlapping side pieces 212. Springs 213, 213' are interconnected between the slide bar and the floor piece in each respective side, so that some lateral displacement of the ends of formers 200 and 201 is permitted without allowing the formers to be displaced longitudinally.

The axle of roller 115 is mounted to a suitable beam 214 by a bracket 215. A lever 216 is fixed to crosspiece 205 and connected to the reciprocating means. The reciprocating means is designed to reciprocate the unit at uniform speed throughout each stroke and comprises a driven roller chain 217 passing around a pair of rollers 218.

To the chain is connected a cable, the other end of which is connected to the periphery of a double pulley 219. A second cable interconnects the lever 216 to the periphery of the smaller pulley of the double pulley 219. Spring means 220 are provided to urge the lever 216 away from pulley 219. The arrangement thus provided ensures that the lever 216 is moved at uniform speed across the stroke determined by the distance between the pulleys 218.

The beam 214 is itself mounted upon rollers for reciprocation slowly in a horizontal direction at right angles to the direction of reciprocation of lever 216, so that the tow is distributed evenly across the platen 126 of the baling press (FIGURE 1). At the same time, the platen 126 is moved slowly downwards between the sides of the baling press as the latter fills up.

The applicants have found that improvement in the overall crimping operation is achieved by conveying the crimped tow from the crimping operation to the drying operation in a substantially tensionless condition so that a better tow results, particularly for cigarette filter use.

The speed of the belts 63 and 69 is adjusted to the same or slightly less than the emerging speed of the crimped tow to avoid the possibility of tension being applied to the tow. The speeds of the crimp rolls and sandwich conveyor have independent adjustment but are normally tied to the speed of the feed rolls on the extrusion machine and vary in direct relationship to tow speed.

The process is generally the same as applied to yarns other than cellulose acetate although crimping conditions as well as drying conditions may have to be adjusted for changes in denier and number of filaments.

In the case of cellulose acetate, the total denier of the tow handled may range from about 20,000 to about 200,000, preferably between about 40,000 and 120,000. The denier per filament may range from about 1.5 to about 20, preferably between about 1.8 and 12. The number of filaments may range from about 1,000 to about

130,000, generally between about 2,000 and 65,000. The cross-sections of the filament may differ in shape according to the shape of the spinnerette holes and extrusion conditions.

The filaments delivered to the crimper may contain from about 5% to about 40% water, from about 5% to about 15% acetone and from about 0.1% to about 5% lubricant. The water and acetone render the filaments plastic and easily deformable by the crimper. The plastic crimped filaments are particularly susceptible to further deformation by tension.

As the cellulose acetate tow passes from the crimper D to the path P, it is wet with excess water and acetone and is warm (from 30° C. to 40° C.) from the mechanical energy of the crimper. In this condition, it is particularly susceptible to deformation by tension. Ambient air conditions are generally warm (25° C. to 30° C.) and not particularly humid.

A fibre of secondary cellulose acetate is required for cigarette tow on contemporary filter rod machines, because most filters are spot bonded by a plasticizer which makes secondary acetate self-adhesive. While the tensionless conveying concept of the present invention is specially useful in handling such cellulose acetate filter tow, it also has broader application which is not limited to cigarette tow nor to acetate, but can be applied to any continuous length of material subject to deformation by tension.

It will be appreciated that the manner of conveying the tow removes practically all tension including the weight of the tow hanging on itself when, for example, the tow is moving vertically or diagonally upwards.

So that the invention will be further understood, and example is given illustrating specific conditions used for cellulose acetate.

Example

A tow of secondary acetate fibres is formed by extruding 27,000 filaments of 1.8 denier per filament, lubricating them with a 20% emulsion of a mineral oil in water to give a pick-up of about 1% lubricant and 5% water on the filaments, gathering the filaments by means of guides into a flat ribbon to which an additional 5% of water is added by means of moist pads, and feeding the ribbon of filaments to a stuffer box. The stuffer box applies a crimp on the ribbon amounting to 90% of the original length and consisting of an average 21 primary crimps per inch on which are superimposed a coarse secondary crimp of about 5 to 7 crimps per inch. As delivered from the crimper at a speed of approximately 250 feet per minute the tow is wet, unstable, and is readily subject to deformation by even low tensions. In order to convey the crimped, unstable tow to a dryer which is remote, of necessity, from the crimper it is fed directly from the crimper to the tensionless conveyor above described.

The tow is garlanded by the conveyor onto a dryer consisting of an endless perforated stainless steel belt which carries the tow through drying chambers at a speed of approximately 130 feet per minute. The first chamber is at a temperature of 175° F. and is sparged with steam at 8 p.s.i.g. to remove all or most of the residual acetone extrusion solvent remaining in the tow. The second and third drying chambers are heated to 120° F. and 105° F. to complete the drying and stabilizing of the tow and to reduce the water content to 5% to 6%. The dried tow is then delivered to a baling press by means already described and is found to be uniform, easy to handle, not subject to entangling, and suitable for processing of machines used to form cigarette filter tips.

We claim:

1. A process for manufacturing tow for the preparation of cigarette filter tips comprising the steps of continuously extruding filaments of cellulose acetate downwardly from a plurality of spinnerettes, gathering the filaments into a tow, advancing the tow through a stuffer box to crimp the filaments, engaging and gripping the crimped

tow between a first pair of juxtaposed conveyor belt surfaces moving in the same direction and at the same speed, conveying the crimped tow between the belts in substantially tensionless condition upwardly to a dryer, disengaging the tow from said first belt surfaces onto a belt moving horizontally through the dryer, treating the tow in the dryer with steam and radiated heat to provide a controlled moisture content, gripping and conveying the dried tow by a second pair of belt surfaces similar to said first pair upwardly in tensionless manner to a packaging level, disengaging the tow from said second pair of belts onto a generally horizontal conveyor, re-engaging the tow between a third pair of belt surfaces similar to said first pair, the belts of said third pair extending downwardly and being mounted in a pivotable frame, and reciprocating the lower end of said third pair of surfaces to fold tow emerging therefrom into a container.

2. Apparatus for manufacturing crimped tow comprising a plurality of spinnerettes arranged for extruding filaments of cellulose acetate, downwardly, means for gathering the filaments into a tow, a stuffer box adapted to crimp the filaments of the tow and means for advancing the tow through the stuffer box, a first pair of endless conveyor belts having a pair of juxtaposed surfaces arranged for movement together in the same direction, means for driving the first pair of conveyor belts at the same speed, the first pair of conveyor belts being arranged to grip the crimped tow therebetween and to convey it in substantially tensionless condition upwardly to a drying zone, a conveyor belt arranged to collect tow emerging from the first pair of belts and to convey it substantially horizontally through the drying zone, means for driving the conveyor belt of the drying zone at a speed less than the speed of the first pair of conveyor belts whereby the tow is fed in garlanded condition onto the dryer conveyor belt, means in the dryer for treating the tow with steam and with radiated heat so as to provide a controlled moisture content in the tow, a second pair of conveyor belts having juxtaposed surfaces similar to said first pair and arranged to collect tow emerging from the dryer and to convey it upwardly in tensionless manner to a packaging level, a conveyor arranged at the packaging level to collect tow emerging from said second pair of endless belts and to convey it generally horizontally to a packaging zone, a third pair of conveyor belts having juxtaposed surfaces similar to said first pair, said third pair of belts being mounted in a pivotable frame, the juxtaposed surfaces of said third pair of belts being arranged to extend downwardly, and means for reciprocating the lower end of said frame so as to fold the tow emerging from said third pair of belts, and means for collecting the folded tow as it falls.

3. Apparatus for advancing a body of filamentary material in stretchable condition, in a tensionless manner into a packaging container, the apparatus comprising a pair of endless conveyor belts having juxtaposed surfaces arranged to move downwardly together at the same speed with the body of material gripped therebetween, a pivotable frame upon which the belts are mounted so that the juxtaposed surfaces extend downwardly, and means for reciprocating the lower end of said frame so as to fold

the body of material successively as it emerges and falls into such packaging container.

4. Apparatus as claimed in claim 3 wherein the said frame comprises a pair of elongate mounting formers rigidly interconnected at their upper ends and urged together by resilient means at their lower ends, the lower pulleys for the pair of endless belts being respectively mounted at the lower end of each said former, the upper pulley for one of the endless belts being mounted at the upper end of one of the formers, a lever pivotally mounted at the other end of the other of the formers, the other upper pulley being mounted to said lever, resilient means urging the pivotally mounted pulley against the upper rigidly mounted pulley, mounting means for suspending the formers and belts by the axle of the rigidly mounted pulley whereby the formers are free to swing together about said axle, means for driving both belts simultaneously, and means for pivoting the two formers together.

5. A process of manufacturing tow characterized by a high order of retained crimp comprising the steps of continuously extruding filaments of cellulose acetate from a plurality of spinnerettes, gathering the filaments into a tow comprising at least 1000 individual filaments, advancing the tow through a stuffer box at a given speed to crimp the filaments, engaging the crimped tow in substantially tensionless condition with conveyor means, conveying the crimped tow at the same speed as that obtaining through said crimper, in substantially tensionless condition, to a drying zone.

6. The process of claim 1, also comprising the steps of continuously conveying said tow, having a fully developed superimposed crimp, in substantially tensionless condition through one or more subsequent processing operations, and forming said tow into a bale.

7. The process of claim 2, wherein said conveyor means constitutes a pair of juxtaposed conveyor belt surfaces moving in the same direction and at the same speed.

8. In a process wherein a continuous tow of cellulose acetate filaments is crimped in a stuffer box in the presence of moisture, advanced to a dryer, dried, advanced to a packaging operation and packaged, the improvement which comprises effecting the steps of advancing the tow to the dryer from the stuffer box crimper, drying the tow, and advancing the tow to a packaging zone in substantially tensionless condition, effected by gripping and conveying the tow between juxtaposed surfaces of two endless belts moving at the same speed.

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LOUIS K. RIMRODT, *Primary Examiner*.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,408,713

November 5, 1968

Frank A. Parker et al.

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 8, line 32, claim reference numeral "1" should read
- 5 --; line 37, claim reference numeral "2" should read --
--.

Signed and sealed this 17th day of March 1970.

SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

WILLIAM E. SCHUYLER, JR.

Commissioner of Patents

[REDACTED]