Nov. 14, 1967 W. B. CARTER 3,351,992

METHOD FOR PACKAGING TOW

Original Filed Feb. 4, 1964 8 Sheets-Sheet 1

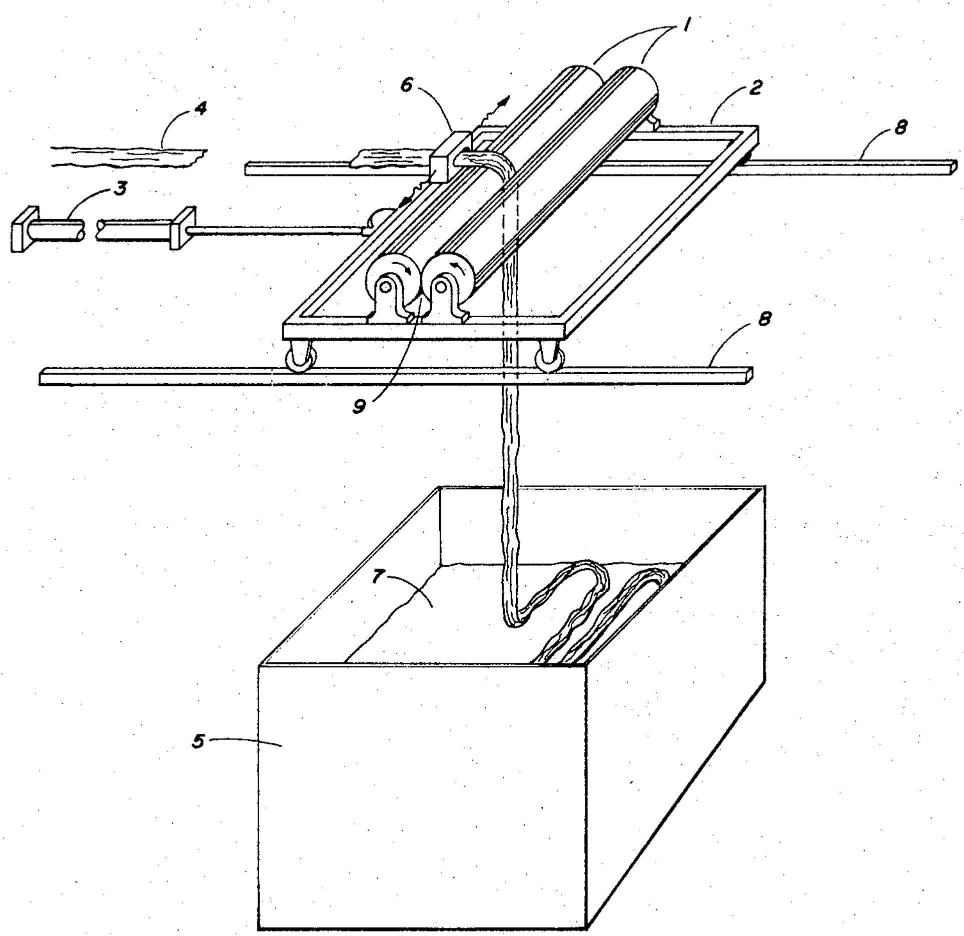

FIG. 1.
(PRIOR ART)

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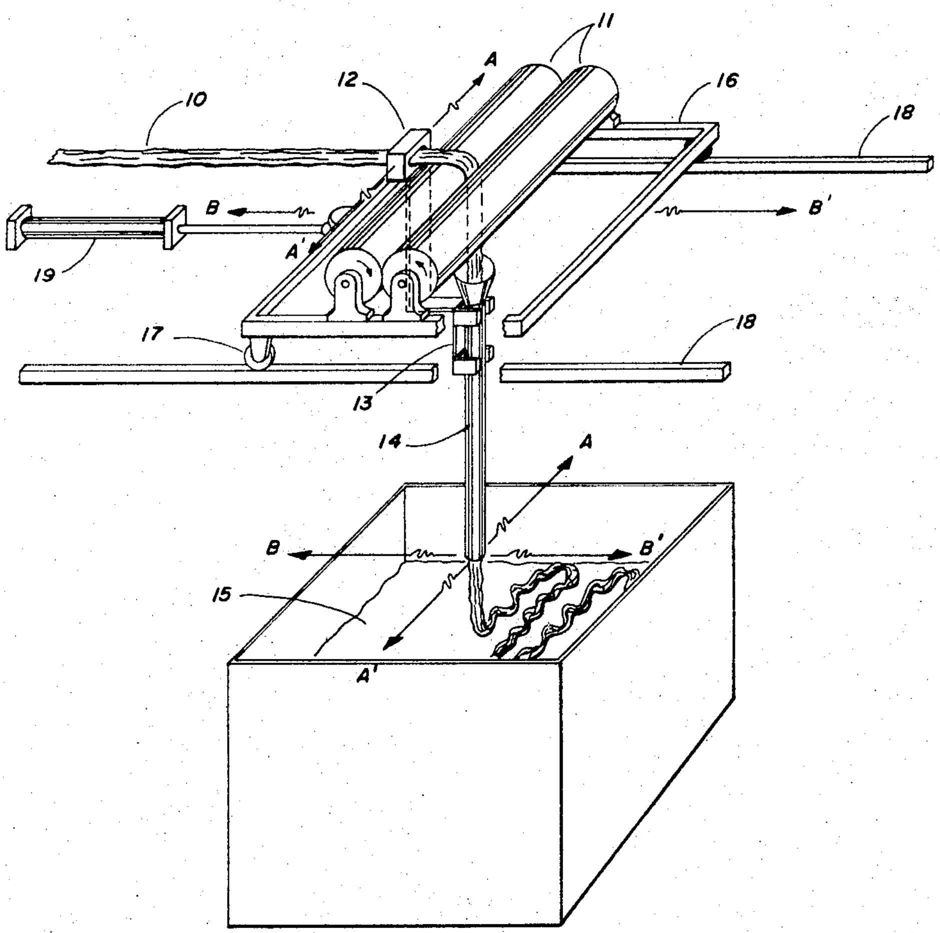

FIG. 2.

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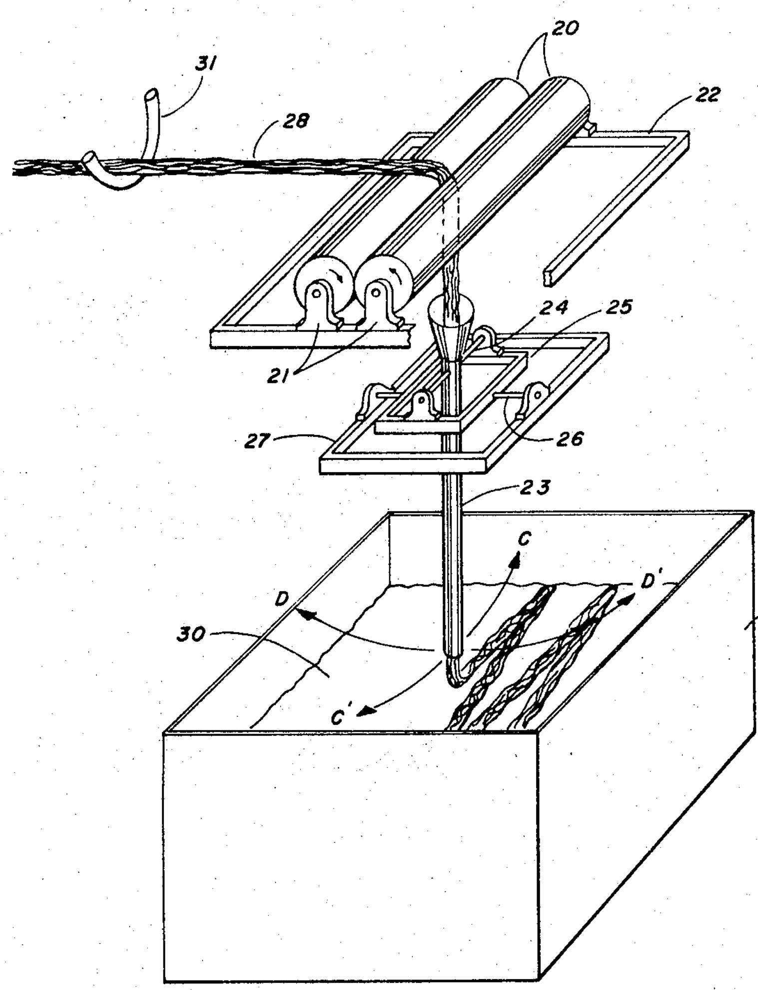

FIG. 3.

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METHOD FOR PACKAGING TOW

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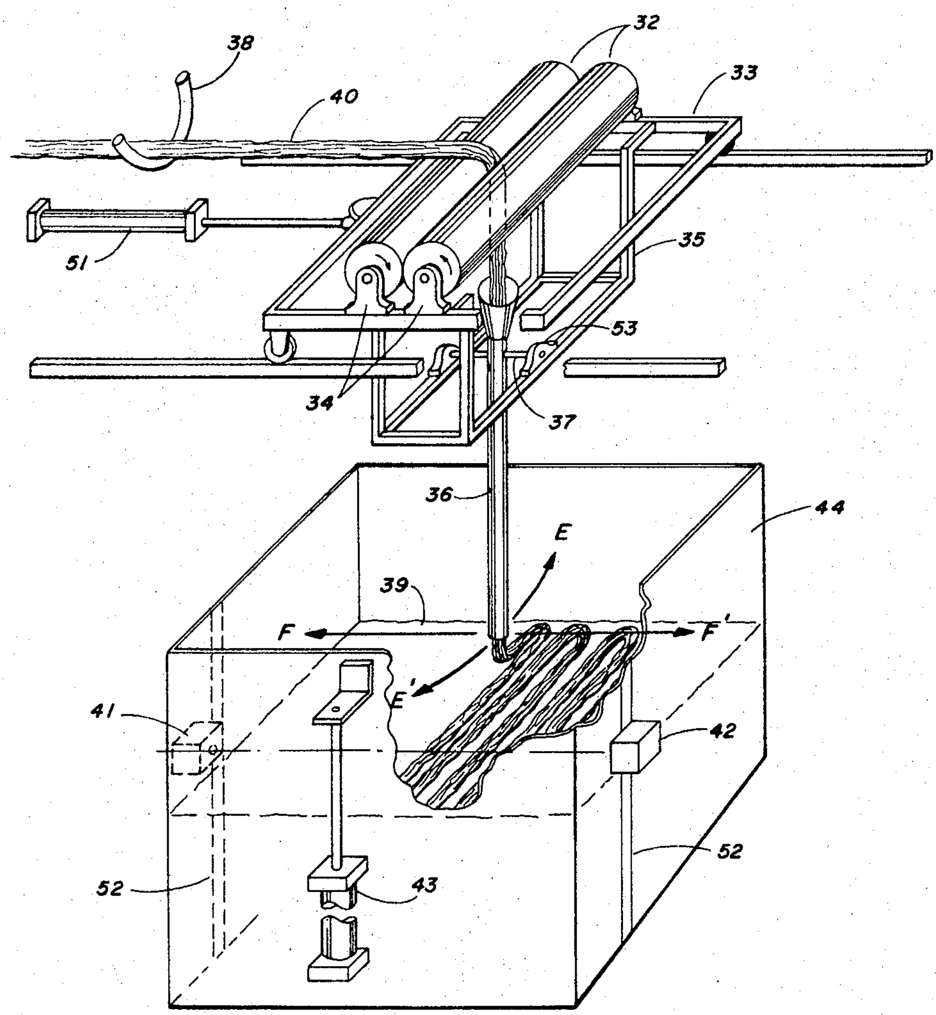

FIG. 4.

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METHOD FOR PACKAGING TOW

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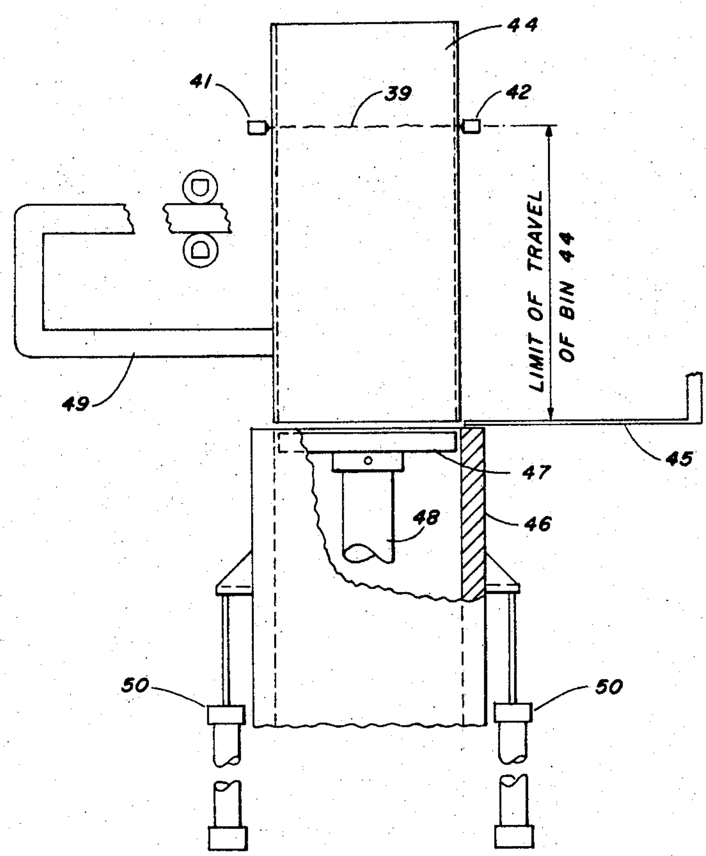

FIG. 5.

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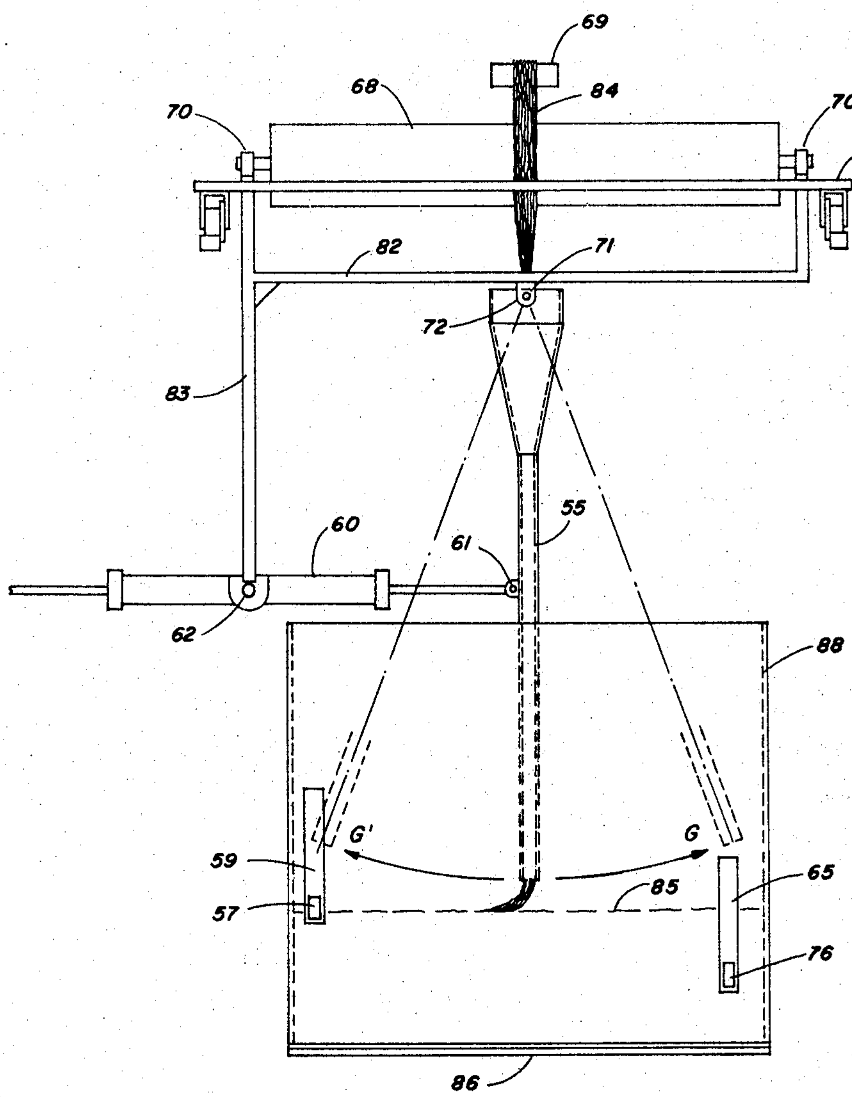

FIG. 6.

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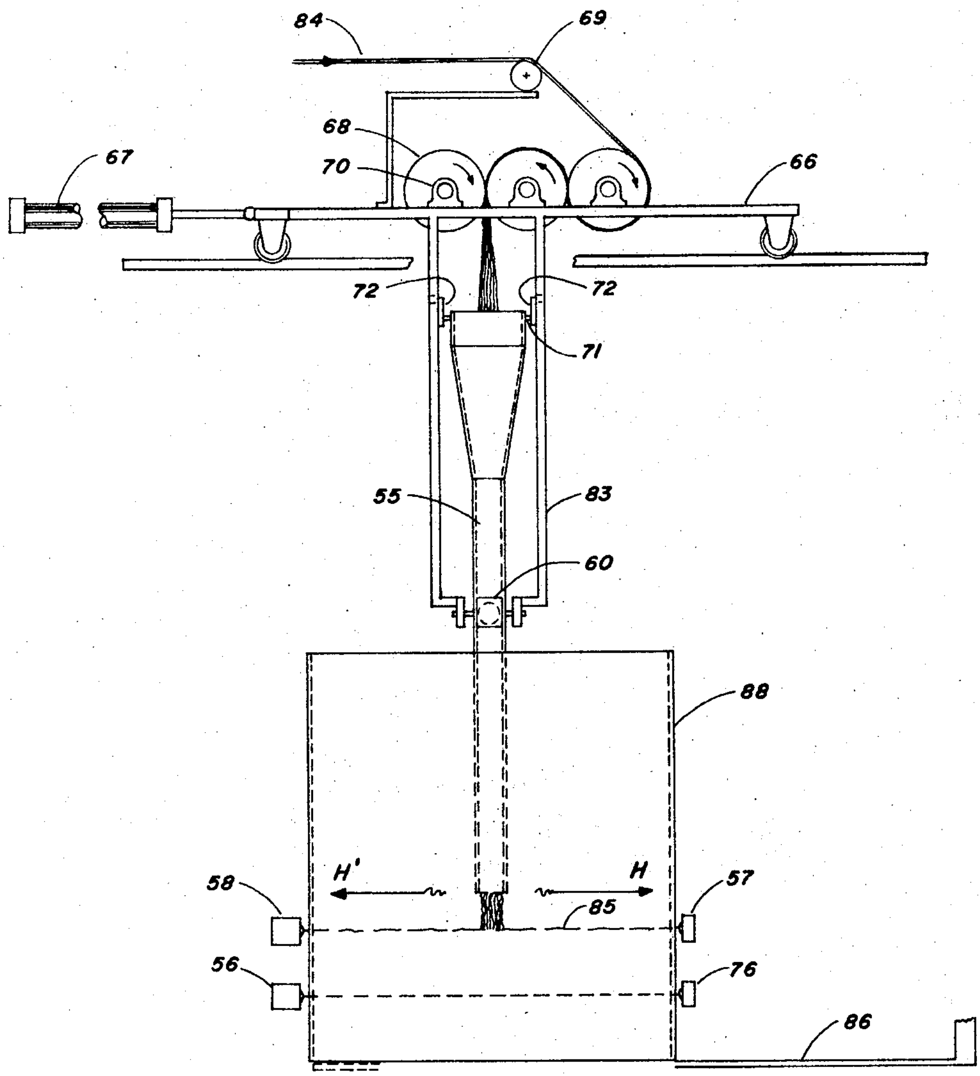

FIG. 7.

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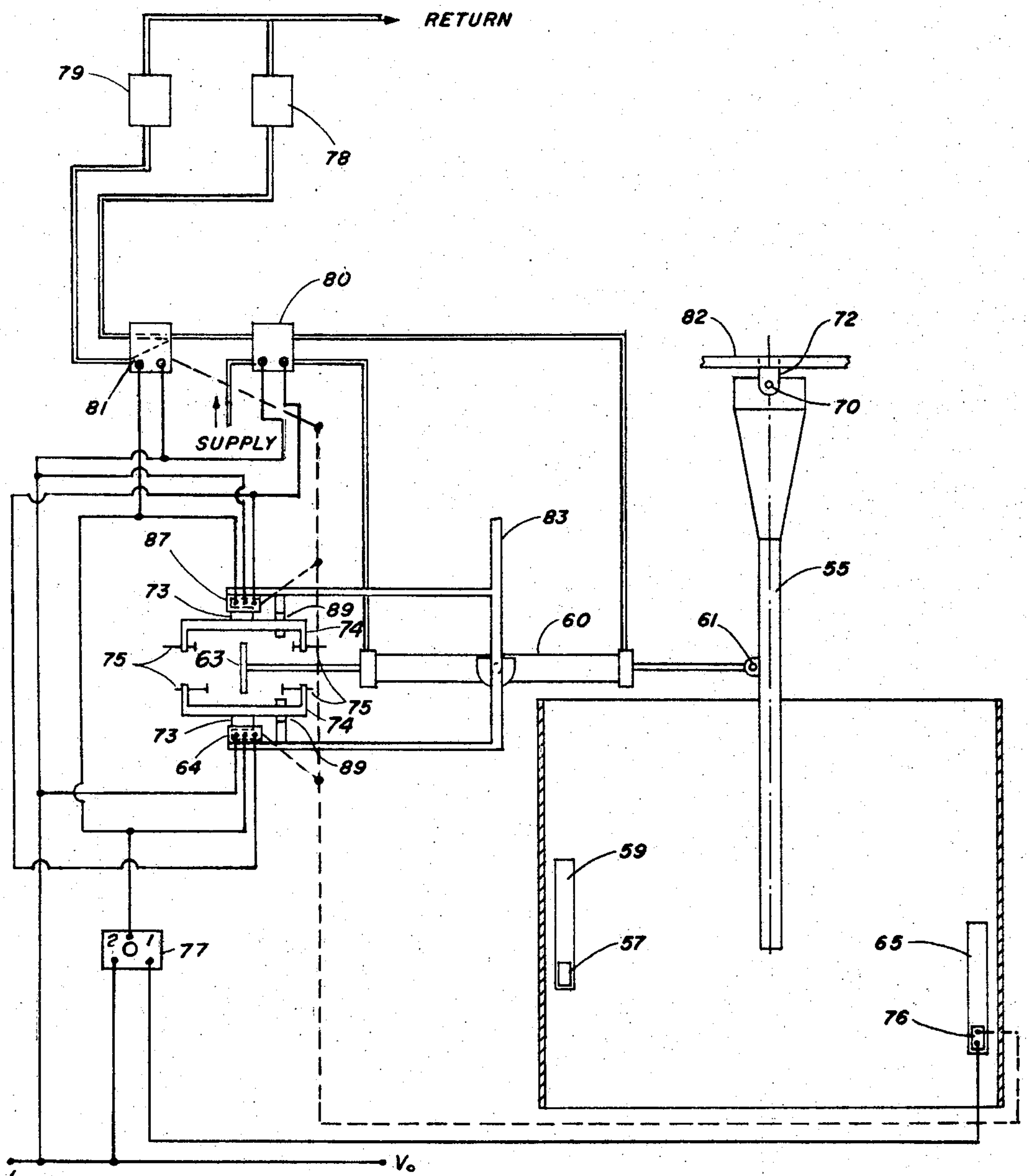

FIG. 8.

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3,351,992
METHOD FOR PACKAGING TOW

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Original application Feb. 4, 1964, Ser. No. 342,347. Divided and this application June 17, 1965, Ser. No. 476,225
5 Claims. (Cl. 28—72)

This application and invention is a division of application Ser. No. 342,347 filed Feb. 4, 1964 and relates to the packaging of filamentary textile material. More particularly, this invention concerns a process for packaging a textile material referred to as continuous filament crimped tow.

The packaging of various textile materials has occupied the attention of interested parties for many years. It is readily apparent that an efficient compact package has considerable advantage in the ease of handling, shipping and protection of the textile product.

In early U.S. Patent No. 1,003,114 several useful principles concerning the packaging of textile materials were illustrated. Some of these concern the feeding of the textile material through a tube means which extends over and traverses the packaging chamber, as well as exhaustion of the chamber and other features. Since tow as presently available involves different handling procedures, various traversing mechanisms as illustrated in 2,403,311 and 2,971,244 have been proposed. The latter mentioned patent, however, suggests that for ribbon-like textile materials funnel tubes have disadvantages in that they require considerable structural height making accessibility, maintenance, and mechanical control thereof very difficult. Notwithstanding the foregoing, some recently constructed devices as well as publications have disclosed apparatus and methods wherein tubular conduit devices are utilized, which conduits are actuated on universal, ball-joint type swivels and are adapted to traverse in several directions. However, in these constructions the tube has extended only to the upper edge of the package formation.

From a study of the prior art and prior constructions it will be observed that there is still uncertainty in the prior art as to the most efficient apparatus and method of handling tow for the packaging thereof. After extended investigation and operation of several units on a sizable scale I have now discovered an apparatus and method which I believe permits the packaging of textile material, as exemplified by continuous filament tow, more uniformly, smoothly and efficiently than apparatus and methods heretofore available.

This invention has for one object to provide an apparatus and method arrangement for packaging tow whereby the tow may be laid into the package in a particular uniform and regular manner which is superior to the uniformity and regularity obtainable by prior constructions and methods. Another object is to provide apparatus as aforesaid which is capable of operating for extended periods without repair and still continue to give good uniformity and regularity by permitting the production of a high quality package in a consistent manner. A further object is to provide apparatus construction of the class indicated wherein the tow is conducted well into the packaging unit through a conduit arranged to traverse in one direction within the packaging unit while substantially simultaneously there may be obtained traverse in another direction by other means. Still another object is to provide a construction with the aforesaid traverse whereby automatic means are provided so that at a predetermined position within the packaging unit the extent of tube traverse may be altered thereby accomplishing better uniformity of the package. Other objects and items of construction will be apparent as the description proceeds.

Still another object is to provide a systematized method of operating apparatus as aforesaid to accomplish rapid yet uniform and smooth operation. A further object is to provide a package construction in which the density of the packaged textile material at the corners of the package is approximately the same as at other zones or areas within the package. Other objects will be apparent as the description proceeds.

In the broader aspects of my invention I have found that at least some of the prior objections to using a moving conduit for carrying the tow a substantial distance into the package may be obviated by suitable traverse construction. That is, certain prior constructions wherein the conduit or tube was constructed to rotate through a complete 360° arc, considering the many thousands of rotations and extended operation was prone to wear and introduce irregularities into the operation. Hence, such prior tube would not be readily adaptable to be inserted within the package formation where certain additional benefits of the use of a tube are obtained. The value of having the tube extend into the package forming area will be apparent from disclosure hereinafter. I also have found by confining my conduit or tube traverse to one plane that such is not only more stable but is more readily susceptible of special control as will be discussed hereinafter. Accordingly, I have developed a novel combination which will be observed as the description proceeds wherein, while the conduit is traversed in one plane within the package zone, other means are provided for securing a traverse in another direction. I have found that such construction as just referred to more efficiently lends itself to combination and co-ordination with automatic controls whereby at least one of the traverses may be altered as may be predetermined thereby contributing to better package constructions.

For assistance in a further understanding of the instant invention reference is made to the attached drawings forming a part of this application. In these drawings,

FIG. 1 is a semidiagrammatic perspective view of a prior art device for packaging tow into a container. By considering such prior construction in connection with the figures which follow and which figures embody features of the present invention, it is hoped a better understanding of the present invention will be attained.

FIG. 2 likewise is a semidiagrammatic perspective view generally similar to FIG. 1 but showing the incorporation of a tube or conduit in accordance with the broader aspects of the present invention.

FIGS. 3 and 4 are views similar to FIG. 2 but illustrate certain preferred ways of traversing the tubular conduit.

FIG. 5 is a semidiagrammatic side elevation view of the lower portion of the baler, the upper portion of which will be referred to in connection with the description of FIG. 4.

FIG. 6 is a front elevation view of one of the preferred embodiments of my invention, utilizing in cooperative relation the several elements which I have found to give excellent bale formation.

FIG. 7 is a side elevation view generally corresponding to the embodiment shown in FIG. 6.

FIG. 8 is a schematic side elevation view for showing certain features of the reversing mechanism and hydraulic system which may be utilized in the above combinations.

Referring to FIG. 1, the prior apparatus for packaging tow therein shown consists of a pair of feed rolls **1** mounted on a frame **2** which is reciprocated by a hydraulic cylinder **3** and which draws tow **4** from a source and pulls it through the roll nip and discharges the tow into a bin **5** or other receptacle, in which case the tow free falls vertically downward for some distance before reaching the tow bed **7**. The prior art apparatus also incoporates a traversing guide **6** which moves back and forth parallel to the feed roll axis, and which slides the tow edgewise along the surface of one feed roll. Traversing the tow in this manner causes the tow to occasionally fold in the area between the traversing guide **6** and the roll nip **9**. When this fold is pressed in at the nip it usually remains permanently folded, which presents difficulty in the withdrawal operation.

Prior procedures such as the one under discussion in which the tow is caused to free fall, unguided, from the roll nip to the tow bed **7** presents several difficulties. A certain amount of drag from air resistance acting on the tow causes the tow at the point where it alights on the tow bed **7** to lag behind the traverse guide **6**. As a result of this drag the linear speed at which the tow can be traversed is limited to about one-thirtieth the linear rate at which the tow is drawn between the feed rolls. At speeds greater than this the lag is so great that the tow fails to fill out to the edge of the bin before the guide has reversed directions.

Another problem of prior art procedures is due to the method in which the tow is presented with respect to the direction of traverse. More specifically the tow is traversed edgwise along the roll nip. Not only may this encourage folds as pointed out above, but because the tow consistently turns a flat surface toward the air resistance, a short length of the tow just below the roll nip is in a transistion stage in which case the surface of the tow band describes a helicoid. Because of this warped surface, the air resistance acts on the tow and tow is caused to deviate from the desired path.

Another undesirable effect of the prior art is the problem of static electricity generation. A substantial part of static generation it is thought can be attributed to traversing the tow edgewise along the roll nip. It is believed this static is generated by mechanically working the tow, one fiber against adjacent fibers as the tow is forced along the roll nip. The static charge on the filaments tend to break up the ribbon of tow or cause it to flare either continuously or irregularly along the length of tow. This static charge appears to accumulate in the tow bed and tends to repel the next layer of tow before it alights along the desired path. Since the free falling tow is attracted by the metal bin walls, the result in prior art packaging as presently under discussion is the tow bed takes on a dished out appearance as successive layers of tow are fed into the bin. I have found that it is desirable to maintain the tow bed consistently level throughout the production of a bale or like package.

In the broader aspects of the present invention I have found: (a) the tow is free of folds which are pressed in by the roll nip, (b) the problems caused by drag from air resistance have been overcome, (c) the troublesome static electricity has been largely eliminated, (d) the traverse speeds have been substantially increased, (e) the condition of the tow in the finished bale retains a greater amount of secondary crimp. In general I have found my invention will improve the tow laying characteristics of continuous filamentary tow which in turn results in an improvement to the tow package and withdrawal characteristics therefrom.

In the simplest construction of the present invention (FIG. 2), the tow **10** is drawn from a source (not shown) by rotating driven feed rolls **11** through the reciprocating traverse guide **12**. Rigidly attached to traverse guide **12** is the tube support bracket **13** which in turn is rigidly fastened to the tube **14**. The traverse guide **12**, support bracket **13**, and tube **14** move as a unit, making continuous, constant speed, reciprocating traverses across the length of the tow bed **15**. When a tow **10** is threaded through guide **12**, the nip of rolls **11** and tube **14** as shown in FIG. 2, the tow **10** is caused to free fall vertically downward, but is guided along axis A–A′, by tube **14**, as it is deposited on the surface of tow bed **15**. As may be noted from the drawing, the tow bed consists of previously deposited tow. Guide **12**, support bracket **13**, tube **14**, and feed rolls **11** are connected with, and reciprocate as a unit, along direction B–B′ with frame **16**. Frame **16** is supported by casters **17** which ride on tracks **18** and is reciprocated along axis B–B′ by a horizontally mounted, double acting hydraulic cylinder **19**. Tube **14** completes approximately eight traverse cycles in direction A–A′ while simultaneously making one cycle in direction B–B′, thus causing the tow **10** to be deposited in nearly straight parallel ribbons on the tow bed **15**. At the beginning of a bale filling cycle the free falling tow **10** is unguided from the discharge end of the tube to the bottom of the bin. This simplest version of the present invention provides added control over the free falling tow in that it directs the tow more nearly to the desired place on the tow bed. However, the traverse speeds in direction A–A′ are limited to about one-thirtieth the sped at which the tow is drawn through the feed rolls, due to drag which occurs in the roll nip and the inertia effect of the cantilever supported tube.

The further improvement of the present invention (FIG. 3) consists of a pair of feed rolls **20**, mounted in bearings **21**, which are rigidly fixed to the stationary frame **22**. Below the feed rolls **20**, is tube **23** which is pivotally mounted at shaft **24** to the movable frame **25**. Frame **25** is in turn pivotally mounted at shaft **26**, to the stationary frame **27**. The discharge end of tube **23** is caused to oscillate repeatedly through arc C–C′ and arc D–D′ simultaneously, by mechanically driving the shafts at axes **24** and **26**. Tube **23** can be traversed along arc C–C′ with the linear speed at the discharge end of the tube at speeds of, for example, one-fifth the linear speed at which the tow is drawn through the feed rolls and obtain very satisfactory filling out at the ends of the stroke. The speed of the tube **23** traversing through arc D–D′ is timed to make one cycle while the traverse through arc C–C′ completes six to ten cycles. The tow **28** is fed through feed rolls **20** and discharged into tube **23**. The tow is deposited in the bin **29** on tow bed **30** in the pattern illustrated in FIG. 3. Guide **31** serves to align the tow properly with the centerline of tube **23**.

Attention is now turned to the more complicated construction of FIG. 4, which embodies some of the features from both FIGURES 2 and 3, and is one of my preferred constructions. FIG. 4 consists of a pair of rotating feed rolls **32** fixed to traversing frame **33** by bearings **34**. Support frame **35** is rigidly fixed to frame **33**. Tube **36** is connected to frame **35** by shaft **37** and bearings **53**, and is caused to oscillate, by a drive (not shown) about shaft **37**. The lower tip of tube **36** repeatedly traverses through arc E–E′, within the bin while the entire frame **33** reciprocates, causing the tip of tube **36** to move from F to F′. The speed of the tube **36** is normally adjusted to make six to ten cycles in the E–E′ direction while one cycle is completed in the F–F′ direction. The tow **40** is drawn through stationary guide **38**, into feed rolls **32**, where it makes a free fall descent through tube **36**. Due to the traversing motion of the tube **36**, the tow is caused to lay in the pattern illustrated on two bed **39**.

The construction of FIG. 4 also incorporates photoelectric switch **41** and light source **42**, which are placed in a fixed position below the lower end of tube **36**. Photoelectric switch **41** is connected to the hydraulic system which operates the bin cylinders **43**, so that the bin is lowered at gradual intervals and the tow bed level is kept at a constant height throughout the filling interval of bin **44**.

The light source **42** passes a light beam to the photoelectric switch **41** through the plastic windows **52**. When the bin **44** is full of tow, it is at its lowest position, and the hydraulic cylinders **43** fully retracted. A sliding door **45** (see FIG. 5) which serves as the bottom of the bin

44, is extended away from the bin bottom, as shown thus transferring the weight of accumulated tow to the platen 47. The platen 47 at this point is positioned about one inch below the surface of the bottom sliding door 45.

The action of the photoelectric switch 41 is now transferred from the cylinders supporting bin 44 to the hydraulic ram 48, so that the ram 48 drops at gradual intervals as signals are received and thus maintaining a constant tow bed level throughout the manufacture of a bale. As the ram 48 is lowered, the column of tow is lowered into the stripper bin 46. When a bale cycle is completed, the tow bed 39 is lowered into the stripper bin 46; slide 45 is closed to start a new bale filling cycle in bin 44. The bin 44 is raised to its upper limit of travel to maintain the constant tow bed level at the photoelectric switch 41. At this point, the previous bale is pressed out in the stripper bin, wrapped and strapped, and removed from the baler. For further information on the package (bale) per se reference may be made to Guenther and Smith Ser. No. 120,461, now U.S. Patent No. 3,120,893. It is mentioned at this point that the stripper bin 46, the platen 47, the ram 48, press out platen 49, and hydraulic cylinders 50, are not limitations on present invention but are shown to clarify the complete function of the bin 44. Certain other constructions may be used although the foregoing is highly satisfactory.

In order to illustrate the operation of my apparatus. I have used the constructions disclosed above to improve the tow laying characteristics of four different tows. The following table describes these tows:

Denier per Filament	Total Denier	Crimps per Inch	Ratio of Traverse Speed to Linear Tow Speed at Feed Rolls
1.6	37,000	16	1/5
3.3	46,000	13	1/8
4.5	68,000	9	1/7
8.0	80,000	8	1/5

The traverse speed, along arc C–C′ at the tip of the tube 23 (FIG. 3) has been operated at linear speeds from one-fifth to one-tenth the linear rate at which the tow is drawn through the feed rolls. In the above examples the linear rate at which the tow is drawn through the feed rolls is in excess of 900 feet per minute. The tube tip speed along arc D–D′ is adjusted to make one cycle per six to ten cycles of arc C–C′. One caution is not to traverse the tube tip at speeds much faster than 4 feet/second. At speeds greater than 4 feet/second the tow band may be caused to flare or bloom due to air resistance at the point between the tube discharge end and the tow bed.

Another item of control which it is desirable to follow is the distance between the lower end of the tube and the tow bed. My devices just described appear to obtain best results when this distance is from three to eighteen inches.

On the other hand there are several variations that can be made, for example, as follows: The relationship between cycles of the tube 36 (see FIG. 4) along arc E–E′ to each cycle along direction F–F′, can be varied outside the previously noted six to ten cycles. The linear velocity range at the tip of tube 36 of one-fifth to one-tenth the linear rate at which the tow is drawn through the feed rolls were found to be the most desirable. Slower speeds might well be desirable.

The type drives which power the moving parts in this invention could be either mechanical, hydraulic or air powered. My device may be used to package tow, yarn or other filamentary material into a container either for shipment or for subsequent processing. The size of the bin or container need not be of any particular dimension, and hence size of package is not a limiting factor.

In packaging a filamentary material which is to be subsequently withdrawn, the withdrawal characteristics are closely related to the uniformity and evenness with which the tow was laid into the package. I have found that a primary factor in a desirable tow laying technique is to lay the tow in a package so that a given normal length of tow is laid to its full length across the surface of the package. While this ideal condition has not been entirely attained in the present invention, a significant improvement has been made in this direction. As previously pointed out, the air resistance acting on the tow, limits the speed which the tow can be traversed. This limiting factor has been overcome to a great degree by the use of this tube laying device, because the tube serves to physically guide the tow in a precision like path, at much increased speeds which nullifies the effect of air resistance.

While the foregoing constructions are thought novel, useful and to constitute an improvement over prior art devices and methods, it is possible to modify the construction of my apparatus to render it more flexible of operation, to fit existing space in a plant or for other purposes. The embodiment of my invention to be described in connection with FIGURES 6, 7 and 8 consists of a group of three feed rolls 68 fixed to traversing frame 66 by bearings 70. Tube 55 is pivotally fastened to tube support frame 82 by shaft 71 and bearings 72. Tube 55 is caused to traverse repeatedly through arc G–G′ by cylinder 60 which is pivotally connected at shaft 62 to support 83, and is pivotally connected at shaft 61 to tube 55. Support frames 82 and 83 are rigidly fixed to and move as an integral part of main support frame 66. The main support frame is reciprocated by cylinder 67 such that the tube 55 and rolls 68 move along path H–H′; simultaneously with the movement of tube 55 in direction G–G′. The speed of tube 55 is normally adjusted to make five to fifteen cycles in direction G–G′ to one cycle in direction H–H′. The tow 84 is continuously drawn from a source (not shown) across guide 69, passes around the rolls through both roll nips as shown, and feeds downward into tube 55, where it then makes a free fall descent through tube 55. The traversing motion of tube 55 causes the tow to be laid on the tow bed 85 in approximately parallel ribbons.

In order to better lay the tow in the baler bin at different distances below the end of tube 55, it may be desirable to change the stroke length G–G′. In other instances better results may be obtained by altering the traverse speed of tube 55. Either of these two modes of operation may be selected by manually operating switch 77 which has internally included therewith suitable control circuitry (not shown).

With the selector switch set in position 1, the length of the stroke will be changed automatically when the tow in the bale reaches a predetermined height. With the selector switch set in position 2 the traverse speed of tube 55 will be changed automatically when the tow in the bale reaches the predetermined height. Generally as the level of the tow in the baler bin rises toward the tip of tube 55 it is desirable to lengthen the traverse stroke. Alternatively, the traverse speed may be increased which will provide an approximately equivalent result. Of course, if desired, the change can be made in the opposite direction. The means by which the changes are made will now be explained in detail.

At the start of each bale of tow the hold-up slide 86 is closed to form a bin bottom, while the previous completed bale of tow is being compressed, wrapped, and removed from the baling press (see FIG. 5). At this point, photoelectric cell 76, is acted on by light 56 so that the circuit is made through selector switch 77. Selector switch 77 is a two position switch, which is manually set as indicated above. When in position 1 the selector switch 77 is caused to feed limit switch 64 when the photoelectric cell 76 has a clear beam of light from light 56. When the light beam is interrupted from the build up of tow being deposited in the bin, photoelectric cell

76 then activates limit switch 87. Limit switches 64 and 87 are operated by slight displacement of iron vane 73. The displacement of vane 73 is accomplished when switch operator arm 63 strikes switch stops 75 at either end of the stroke of cylinder 60. Mounting brackets are free to slide in slider bearings 89. Switch stops 75 are adjustable so one switch can be set up with a longer stroke. Both limit switch 64 and 87 are connected electrically to four-way, solenoid controlled, pilot pressure operated valve 80. Valve 80 serves to alternately reverse the flow of oil through cylinder 60, which imparts the motion of tube 55 in direction G–G′.

When selector switch 77 is set in position 2 and the light beam to photoelectric cell 76 is not broken, diverter valve 81 is energized and the flow of oil is directed through flow control valve 79. Flow control valve 79 is set to obtain the desired traverse speed of tube 55, during the interval when the tow is building in the bin below the level of photoelectric cell 76. When the tow builds sufficiently high to black out the light beam to photoelectric cell 76, diverter valve 81 is deenergized and the flow of oil is diverted through flow control valve 78, which is set at a faster speed of traverse than is valve 79.

Prior to the time the tow bed builds up to the lower end of tube 55, the previous bale of tow is removed from the press section as already mentioned. At this time the bins are positioned as shown in FIGURE 5 and the hold-up slide is moved to its outward position, thus transferring the weight of the deposited tow to the main ram 47, 48. After this transfer, the tow bed 85 builds up to the level of photoelectric cell 57. Photoelectric cell 57 is connected electrically with the hydraulic valves controlling the main ram, such that when the photoelectric cell is blocked by tow, the ram is lowered until the light beam is clear of tow. This operation is repeated throughout the remainder of the filling time for the bale, such that the tow bed 85 is kept at a constant level at photoelectric cell 57 once it fills to that elevation.

While a hydraulic cylinder drive has been shown and is the preferred means of traversing tube 55 a mechanical or air powered drive could be used. The four-way valve 80 used is a solenoid controlled, pilot pressure operated valve with pilot choke attachment. This type valve provides for a very smooth reversal in the stroke of tube 55. The three-way valve 81 is a conventional type quick acting hydraulic, solenoid operated valve. Limit switches 64 and 87 are vane operated, magnetic type limit switches, and are selected because of their long life characteristic. A more conventional type limit switch could be used.

The rectangular cross-section of tube 55 is generally preferred since the rectangular tube eliminates false twist in the tow ribbon. A round cross-section tube is suitable where false twist is not a consideration. Maintaining a constant distance between the lower end of tube 55 and the tow bed 85 (as previously discussed in connection with FIG. 4) is not essential in the constructions of FIGS. 6, 7 and 8. The hydraulic cylinder 60 may be a conventional type cylinder with a double rod end. The extra rod end is not essential, but provides a convenient means to operate the reversing mechanism.

Several other alternate arrangements involving different parts of my invention are possible. With suitable type of manual selector switch and other combinations of photoelectric cells, the stroke length could be changed at one point and the stroke speed could be changed at another or both could be changed simultaneously. Alternatively the position of stops 75 could be changed gradually and automatically as for example by an electric motor drive which was programmed through a predetermined cycle. Likewise the traverse speed could be altered continuously through a specific portion of the baling cycle by automatic, power operated means to vary the flow rate of the hydraulic fluid to cylinder 60.

The embodiment just discussed in connection with FIGS. 6, 7 and 8 has likewise been employed to package several different size tows as follows:

1.6 denier per filament 37,000 total denier
3.3 denier per filament 46,000 total denier
4.5 denier per filament 68,000 total denier
8.0 denier per filament 80,000 total denier

The tow laying and withdrawal characteristics observed appear to be much more uniform than with the prior art device. The tow is essentially free of folds since the tow is not dragged edgewise between the feed rolls. The slow traverse speeds caused by air resistance in the prior art have been greatly increased. The problem of static electricity has been virtually eliminated by the present invention, because of the reduction in fiber to fiber friction.

Although the invention has been described in considerable detail with particular reference to certain preferred embodiments thereof, variations and modifications can be effected within the spirit and scope of the invention as described hereinabove, and as defined in the appended claims.

I claim:

1. A process for uniformly depositing a filamentary material into a package form which comprises the steps of feeding the filamentary material from a source of supply, directing the material through a guiding means into the package, simultaneously effecting a plurality of traversing movements between said package and said guide, and adjusting at least one of said plurality of movements responsive to the amount of material in the package.

2. The process of claim 1 wherein the package and the guide means are adjusted relative to one another responsive to the amount of material in said package.

3. A process for uniformly depositing a filamentary material into a package form which comprises the steps of feeding the material from a source of supply, directing the material through a guide means into the package, simultaneously traversing said guide means in a plurality of directions over the area of said package, and adjusting the traverse of said guide means in at least one direction responsive to the material build-up within said package.

4. A process for uniformly depositing filamentary material into a bin which comprises feeding said material between a plurality of feed rolls into an elongated conduit which extends a substantial distance into said bin, permitting the filamentary material to free fall through said conduit and into said bin, traversing said rolls and conduit in a first direction over the bin bottom and simultaneously oscillating the conduit in another direction different from said first direction, adjusting the conduit oscillation and further adjusting the vertical position of the bin both in response to the amount of filamentary material deposited in said bin.

5. A process for uniformly depositing a filamentary material into a package form which comprises the steps of feeding the filamentary material from a source of supply, directing the material through a guiding means into the package, simultaneously effecting a plurality of traversing movements between said package and said guide, and adjusting the package position in response to the amount of filamentary material deposited therein.

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LOUIS K. RIMRODT, *Primary Examiner.*