Dec. 20, 1966 R. L. HAYDEN 3,292,872

METHOD AND APPARATUS FOR TRAVERSING STRAND MATERIAL

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Fig. 1.

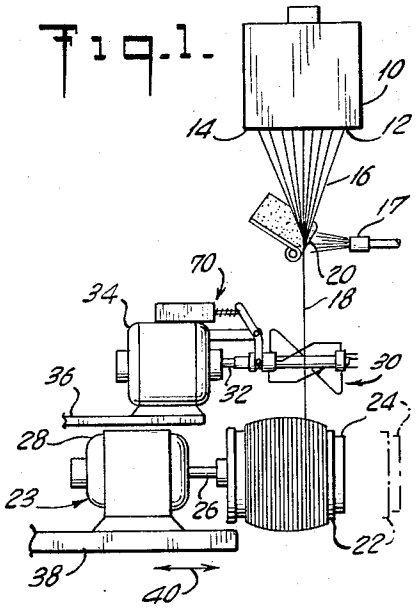


Fig. 5.

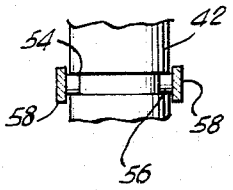


Fig. 2.

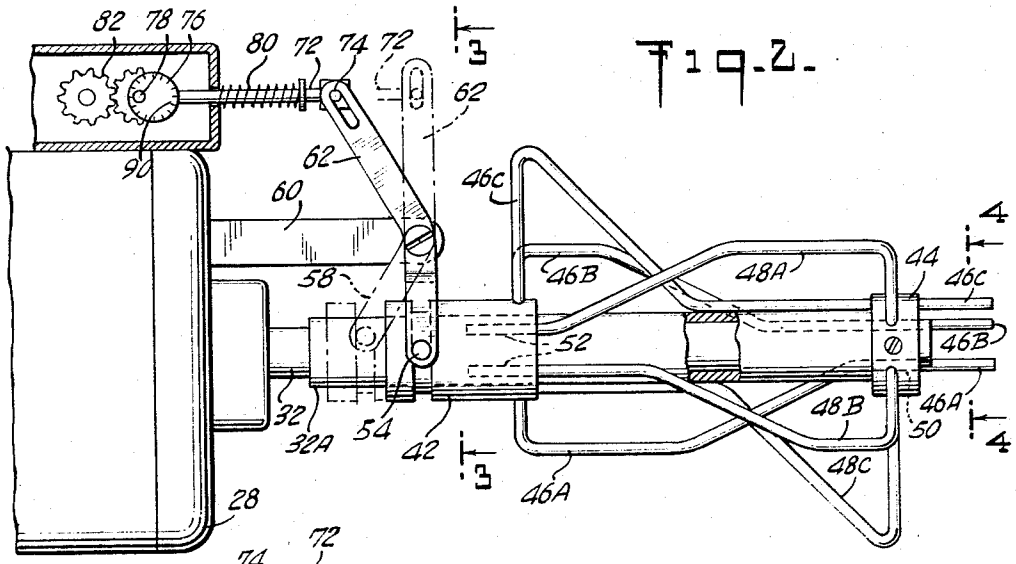


Fig. 3.

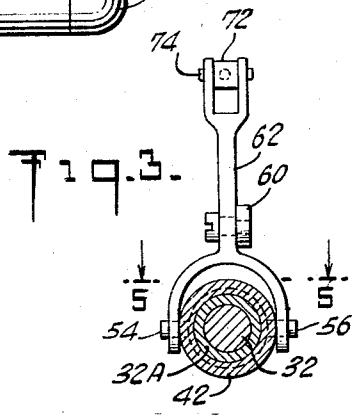
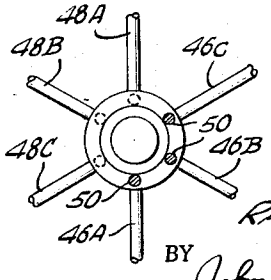


Fig. 4.



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Fig. 6.

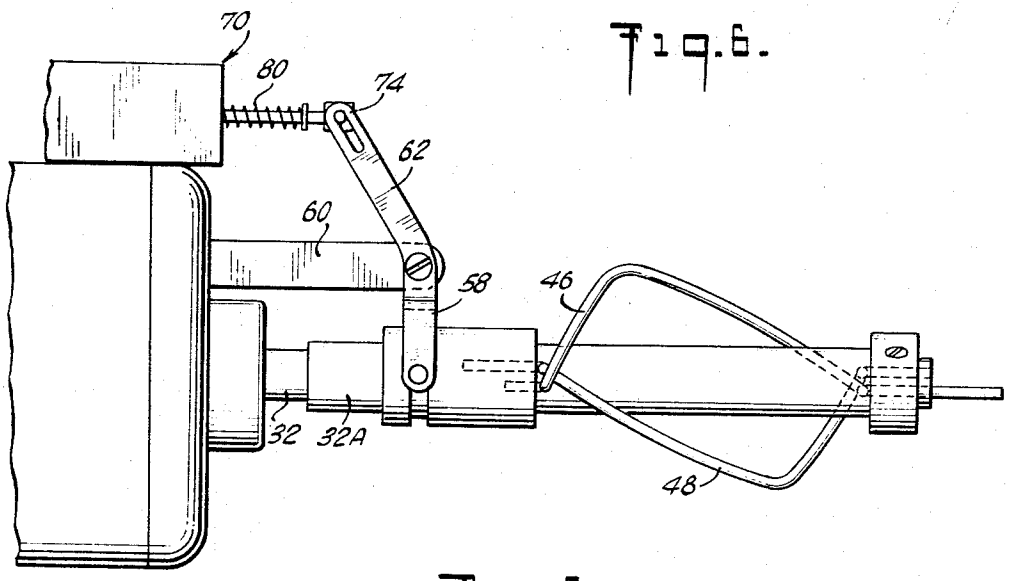


Fig. 7.

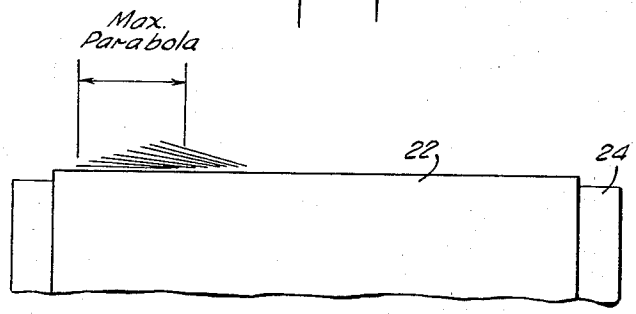
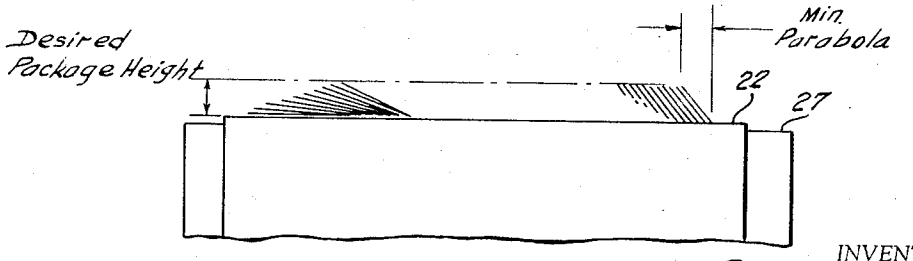


Fig. 8.



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3,292,872

METHOD AND APPARATUS FOR TRAVERSING STRAND MATERIAL

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9 Claims. (Cl. 242—43)

This invention relates generally to improved method and apparatus for packaging strand material. More particularly, this invention relates to improved traversing mechanism for traversing strand material being wound on a rotating support.

Although the method and apparatus of this invention are applicable to the winding and traversing of many types of continuous strands, they are particularly adapted for use with the packaging of thermoplastic materials such as glass strands, and hence will be described in that connection.

Continuous glass fibers are commercially produced by exuding a multiplicity of molten streams from a feeder and applying sufficient pulling force to the streams to attenuate them into fine filaments. A number of filaments are converged to form a strand which is wound into a package on a rotating support. Initially, the glass streams are manually drawn and a few turns wound onto the support to start the winding operation.

As the diameter of the package being wound increases, there exists the tendency for the filaments to decrease in diameter size due to the greater attenuating force created. Also, as a consequence of the non-uniform tension built into the package, the strand will not unwind freely. In most prior art devices, in an attempt to minimize entanglement, the strand is wound on the rotating support in a helical pattern. With a constant stroke across the package to form the helical pattern, a build-up in thickness occurs at the points where the strand reverses directions, particularly at the ends of the package being formed. In order to prevent the build-up at the ends of the package being formed, it has heretofore been suggested to progressively vary the length or stroke of the traverse so that the build-up of the strand at the ends of each stroke is progressively moved along the winding drum. This is accomplished by progressively pivoting the frame supporting the traversing mechanism along an arc of a circle having its center coinciding generally with the axis of the winding drum. As the traversing mechanism is moved along the arc, the distance between the traverser and the converger, where the several filaments are converged into a single strand, varies and consequently there is an increased tendency for the strand tension to vary as it is being wound into the package.

It is an object of this invention to provide method and apparatus for winding strand packages of uniform quality.

It is another object to provide method and apparatus for winding strand packages in a program wherein the lay of the strand is selectively adjusted.

It is a further object to provide method and apparatus whereby the adjustment of the winding program is automatically conducted.

According to the invention, the length of primary traverse stroke is adjusted or programmed during the build-up of the package to deter the formation of a parallel lay of adjacent windings. The stroke is adjusted by moving cam surfaces, defining a primary traverser, in an axial direction, parallel to the axis of rotating of the primary traverser.

In a specific embodiment, the primary traversing mechanism comprises a centrally related supporting and rotatable axle disposed adjacent and parallel to the support upon which the strand package is being formed. The

traversing mechanism further comprises cam means, in the form of rods, for moving the strand along the periphery of the support in a cycle including what may be termed a progressive and a regressive motion. A first rod set, which may comprise but a single rod, is attached to a first flange, or hub member, which flange is axially movable along said axle. A second rod set, which may comprise but a single rod, is attached to a second flange, or hub member, which flange is preferably secured against axial movement in respect to said axle. Each of the rod sets defines a major and a minor diameter. The major diameter of one set is diametrically opposed to the major diameter of the other set. Likewise, the minor diameters of each set are mutually and diametrically opposed. Thus, the cam surfaces of each set are in inclined facial opposition to those of the other set to provide means for producing the progressive and regressive motions of the fast or primary traversing action. Concomitant with the fast traverse, a slow or secondary traverse takes place. This slow traverse is accomplished by either moving the rotating package in an axial direction while maintaining the fast traversing mechanism relatively stationary in an axial sense or by moving the primary traverse slowly in an axial sense.

Further details and other objects and advantages of this invention may appear from the following description of preferred species of this invention and from the accompanying drawings.

FIG. 1 is a schematic elevational view of apparatus for forming and winding strand material;

FIG. 2 is an enlarged fragmentary view of the primary traversing mechanism shown in FIG. 1;

FIG. 3 is a cross-sectional view taken along line **3**—**3** of FIG. 2;

FIG. 4 is a cross-sectional view taken along line **4**—**4** of FIG. 2;

FIG. 5 is a fragmentary view taken along line **5**—**5** of FIG. 3;

FIG. 6 is a view similar to FIG. 2 but of an alternate form of primary traverse;

FIG. 7 is a schematic representation of the lay of the strand during the initial winding stage; and

FIG. 8 is a schematic representation illustrating the lay of a completed package.

Apparatus of the type suitable for commercial production of glass fibers is illustrated in FIG. 1 wherein a molten glass feeder or bushing is generally designated by the numeral **10**. The bushing **10** is provided with a plurality of orifices **12**, in its bottom wall **14**, from which molten streams of glass are exuded into filaments **16**. The filaments **16** are converged into a strand **18** at converging and treating pad **20**. Means may also be provided for applying a bonding agent, or other treating material, to treat the filaments **16** and integrated strand **18**. The treating material may be applied by a nozzle **17** or other suitable apparatus. The strand **18** is advanced to package support **22** mounted on the winder **23** which includes a rotatable mandrel **24** rotated by shaft **26** powered by motor **28**.

A traversing mechanism, generally designated by the numeral **30**, of the type shown in the Hayden et al. U.S. Patent No. 3,040,999, except for certain improvements hereinafter described, is positioned between the pad **20** and the winder **23** to traverse the strand **18** across the face of support **22**.

The traversing mechanism **30**, which may be designated as a primary traverse, is illustrated as being mounted for rotation on shaft **32** of motor **34** supported on a base **36**.

As shown in FIG. 1, the shafts **26** and **32** are preferably positioned horizontally in parallel spaced relation and

the motor **28** is mounted on a rail **38** for reciprocating the package support **22** longitudinally along its axis in the direction of arrow **40** to effect what may be termed a secondary traverse. When package support **22** is centered within the limits of reciprocal movement of the secondary traverse, the strand **18** extending from the converging pad **20** bisects the primary traversing mechanism **30** and the support **22** in a generally vertical plane. The pad **20** is displaced slightly in a diameter generally perpendicular to the plane of the paper as shown in FIG. 1 from a straight vertical line extending from the center of bushing **10** to the outer periphery of support **22** so that the strand **18** is always slightly biased against one of the cam faces of traverse **30**. In one embodiment, the primary traverse **30** moves the strand **18** approximately three inches along the axial extent of the package support **22** and then returns the strand to define a bight. The progressive and regressive movements of the strand **18** are alternately repeated to define a series of bights. The series of bights are advanced from one end of the package to the other end by the secondary traversing action or axial movement of the winder along rail **38**, as indicated by arrow **40**, to produce a package approximately five and one-half inches long.

It will be understood that the secondary traversing action may also be effected by holding the package support **22** stationary and moving the primary traverse **30** in an axial direction along the base **36**.

The form of the primary traversing mechanism **30**, shown in detail in FIG. 2, resembles a reel in substantially concentric relation with first hub **44** secured to extension **32A** of shaft **32**. At an opposite end of the shaft **32** or extension **32A** a second hub **42** is mounted for slidable movement in an axial direction. Intermediate the two hubs **42** and **44** are two series of cams **46** and **48** defined by rods **46A**, **46B**, **46C** and **48A**, **48B** and **48C**, respectively. The series of rods designated by the numeral **46** are secured to the hub **42**. The opposite end of the rods **46** extend into apertures **50** of hub **44** for slidable movement in relation with said hub. The rods **48** are secured to hub **44** at one end. The opposite ends of the rods fit slidably in apertures **52** of the hub **42**. The rods or cams **46** consecutively contact the strand in order of rotation to traverse the strand in a right-hand direction as viewed in FIG. 2 to collectively move the strand approximately three inches. The second series of cams designated by the numeral **48** consecutively contact the strand in order of rotation to progressively advance the strand to the left and collectively move the strand approximately three inches.

In further regard to the specific embodiment illustrated in FIG. 2, the cam sets **46** and **48**, comprising three cams each, are angularly spaced at 60° intervals around the hubs **42** and **44** with the cams of each set being in facial opposition to the cams of the other set. The portion of the cam surfaces remote from the axis of the shaft extension **32A** generate a major diameter. The cam surfaces more closely adjacent to the axis of the shaft extension **32A** generate a minor diameter. The cams **48A**, **48B** and **48C** are identical in configuration to cams **46A**, **46B** and **46C** respectively, but are reversed to be of opposite hand and so the strand contacting surfaces of the two cam sets are inclined in opposition.

An important feature of this invention is the adjustment of the distance the strand travels in the progressive and regressive motion of the fast traverse. The fast traverse is designed to permit a gradual waywind change over a period of time until the desired package diameter is produced. After the desired diameter is reached, the degree of traverse remains constant until the completion of the package. This is accomplished by employing what is known as a filling wind type of package build-up.

In order to effect the waywind change, means are provided to slidably move the rods **46** in respect to the rods **48** in an axial direction. A movable hub **42** is provided with a circumferential groove in which rollers **54** and **56** extend. The rollers **54** and **56** are mounted on yoke **58**, which yoke is pivotably mounted on support **60**. An arm **62** forming an extension of yoke **58** is connected to power actuating means generally designated by the numeral **70**.

In the embodiment described above, the axial extent of the fast traverse is changed from approximately three inches continuously until a minimum fast traverse axial extent of ¾ of an inch is attained.

While the power actuating means **70** may take various forms, for purposes of illustration, it is shown to comprise a movable rod **72** having a pin **74** for direct but slidable connection with arm **62**. The rod **72** is actuated by the rotational movement of cam **76** about shaft **78**. The rod **72** is kept in constant engagement with cam **76** by tension spring **80**. The shaft **78** may be suitably driven by commercially available clocking mechanism as exemplified by the gear train **82**. The shape of cam **76** will, of course, be contingent upon the program that is desired to be effected or imparted to the primary traverser **30**. The time and programming necessary to provide the desired package may be determined by experimentation.

It will be understood that the arm **62** may also be actuated manually by the attendant operator. However, it is preferred to conduct the programming on an automatic time cycle basis. It will also be understood that the cam **76** may be manually reset in the event the winding operation is disrupted, for whatever reason, before the end of the preselected time cycle and when it is desired to commence the winding of a new package.

Indicia means, such as gradation marks **90**, may also be provided in connection with cam **76** to give a visible indication of the cam position so that the attendant operator may, if desired, stop the clock mechanism and manually program the winding pattern within the limits of the selected cam **76**.

It may be advantageous in some instances to vary the number of cams in the primary traverse **30**. FIG. 6 discloses an alternate embodiment wherein only two rods or cams are employed. However, the operating principles in regard to the slidable arrangement and for varying the pitch and/or the axial distance between the cams is identical to that as described in connection with the embodiments illustrated in FIGS. 1 and 2.

In FIG. 7 there is illustrated schematically the lay of the strand during the initial winding stage. In the preferred embodiment, the cam sets **46** and **48** are furthest apart axially during the initial winding stage and thereby produce a lay defining the maximum parabola.

FIG. 8 illustrates schematically the lay of a package completed in accordance with the preferred method wherein the maximum parabola is wound during the initial winding stage, as in FIG. 7, and wherein the axial position of the cam sets **46** and **48** is adjusted to produce a minimum parabola during the final stages of the winding operation.

In summary, it will be observed that this invention provides a method for continuously winding a continuous strand about a rotating support and traversing the strand between cams which impart consecutively a progressive and a regressive motion to define a bight within a given stroke of the primary traverse and means for altering the stroke of traverse during the winding cycle by changing the relative axial position of the cams so as to permit a gradual waywind change during the initial winding period and then converting to a filling wind type of package build-up.

It will be understood that the programming of the winding operation may be selectively altered by selecting a profile for cam **76** which will produce the desired pattern. The cam profile may be such to produce a gradual continuous change in the lay pattern across the face of the package; to produce a first constantly fixed pattern during the initial winding stage and a different second constantly

fixed pattern during the final winding stage; or to produce a constantly fixed pattern during one winding stage and a constantly varying pattern during another winding stage.

Although the method and apparatus have been described in detail as to their component steps and parts, it will be understood that such detail is for the purpose of illustration and not by way of limitation. The appended claims are therefore intended to cover any such modifications coming within the true scope of the invention.

What I claim is:

1. In a method of packaging strand material which includes the steps of winding a continuous strand about a rotating support, imparting a primary traversing action, including progressive and regressive primary traversing motions to the strand as it is being wound to define a series of bights, and imparting a secondary traversing action to the strand to advance the series of bights across the face of the package being formed, the improvement which comprises:

altering the stroke of the primary traversing action during the winding cycle and thereby vary the width of the bights being formed.

2. The improvement described in claim **1** which further comprises:

progressively altering the stroke of primary traverse during one part of the winding cycle and maintaining a given stroke of primary traverse during another part of the winding cycle.

3. In a method of packaging strand material the steps of:

(a) winding a continuous strand about a rotating core support during a winding cycle;

(b) defining a series of bights across the face of the package being formed by imparting a fast traversing action to the strand;

(c) traversing said strand with a relatively long stroke of fast traverse during the initial portion of the winding cycle;

(d) traversing said strand with a relatively short stroke of fast traverse during a final portion of the winding cycle; and

(e) simultaneously with said fast traversing action, imparting a slow traversing action to the strand, which slow traversing action progressively advances the series of bights.

4. In winding mechanism, including rotatable support for receiving a continuous strand thereon, primary traversing means presenting a pattern of progressive and regressive motions, and having an axis of rotation, a first cam surface, and a second cam surface, each of said cam surfaces being inclined in respect to and in facial opposition to each other. the improvement which comprises:

means for moving at least one of said cam surfaces along said axis and in respect to the other of said cam surfaces to thereby vary the axial extent of the progressive and regressive motions imparted by said cam motions.

5. Apparatus for winding strand material into packages according to a predetermined program, which apparatus comprises:

(a) a rotatable mandrel on which the strand is wound during a winding cycle while subjected to a primary and a secondary traversing action;

(b) an adjustable primary traversing device presenting a pattern of progressive and regressive motions varying in width throughout the range of adjustment according to a desired predetermined program for traversing the strand across the face of the package being formed;

(c) an actuating device for adjusting the traversing device to vary the width of the progressive and regressive motions; and

(d) means for moving one of said mandrel and said primary traversing device in a linear path parallel to the axis of rotation of said mandrel to effect the secondary traversing action.

6. In a winding mechanism, including a rotatable support for receiving a continuous strand thereon, traversing means for engaging and traversing said strand axially along said support, said traversing means including a plurality of cams, each of said cams having a major and a minor diameter, and at least one of said cams having its major diameter diametrically opposed to the major diameter of another of said cams, the improvement wherein at least one of said cams is axially movable in respect to an opposing cam, to selectively vary the length of traverse as the strand is built up on said support.

7. Apparatus for winding strand material into packages, which apparatus comprises:

(a) a rotatable mandrel on which the strand is wound during a winding cycle while subjected to a progressive traversing motion and a regressive traversing motion;

(b) progressive traversing means for engaging and traversing said strand axially along said support with a progressive motion;

(c) regressive traversing means for axially traversing said strand along said support with a regressive motion;

(d) at least one of said progressive traversing means and said regressive traversing means being mounted on a flange member, said flange member being selectively adjustable along an axis corresponding to the central axis of said progressive traversing means and said regressive traversing means; and

(e) actuator means for actuating said flange member in said axial direction.

8. The apparatus as described in claim **7** wherein said actuator means comprises:

(a) a pivotable yoke member operatively associated with said flange member through a pair of rollers positioned within a circumferential groove of the flange member;

(b) a reciprocal rod member connected to an end of said pivotable yoke member opposite to the flange engaging end; and

(c) means for reciprocating said rod according to a predetermined program.

9. The apparatus as described in claim **8** wherein said means for reciprocating said rod comprises a rotating cam element.

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