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STRAND PACKAGING APPARATUS

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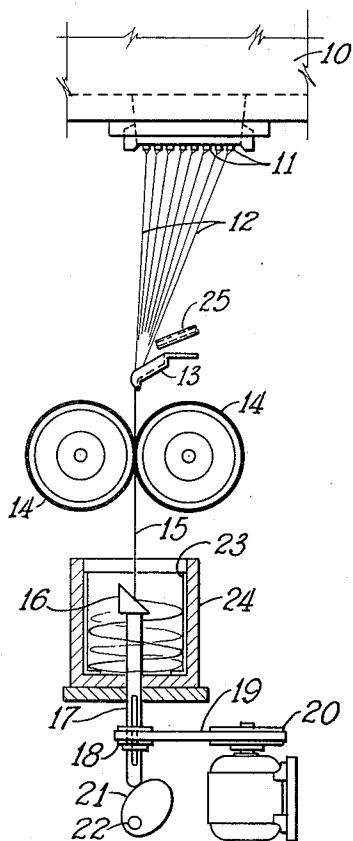


Fig. 1

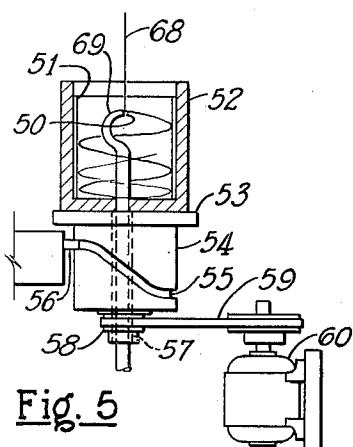


Fig. 5

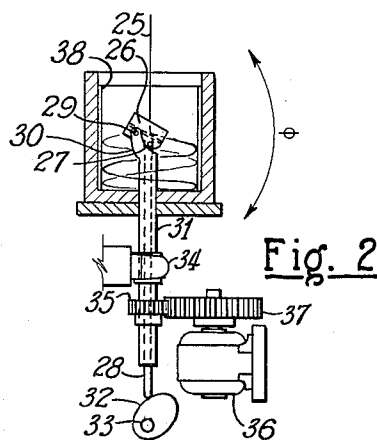


Fig. 2

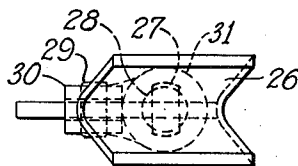


Fig. 3

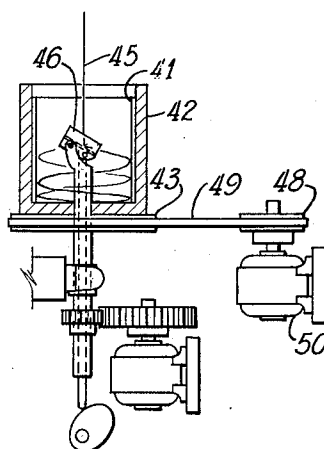


Fig. 4

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1

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STRAND PACKAGING APPARATUS

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8 Claims. (Cl. 28—21)

This is a continuation-in-part of application Serial Number 544,162 filed on November 1, 1955, now abandoned.

This invention relates to packaging of material in strand form and particularly to high speed packaging of strands in forming processes although it may be readily utilized for winding of strand-like forms which have already been made.

In certain strand-forming processes, such as that of forming strands of continuous glass fibers, the forming may be done at such high speeds that it is difficult to find packaging mechanisms which will collect the fibers as fast as they are produced. Conventional winding apparatus is somewhat limited in high speed fiber-forming operations because in the usual winding mechanism the spool or tube upon which the strand is wound must generally move at the same linear speed as that at which the fibers are produced. Besides limitations in strength of materials at high speeds, increased speeds require compensation for inertia forces of the rotating winding elements which entails increased complexity of all too often already complex control means so that the maximum rotational speed attainable with this type of equipment is far below the rate at which fibers incorporated in a strand can be produced.

In view of the foregoing, it is an object of the present invention to provide a simple, economical high speed winding mechanism for packaging material in strand-like forms.

It is another object of the invention to provide a strand packaging means adaptable to use in high speed strand forming processes with a minimum requirement for change in existing forming equipment.

It is still another object of the invention to provide a high speed strand packaging method and means in which the package producible is adapted to use in conventional after-processing equipment with no requirement for change therein.

The present invention is based upon the finding that packaging equipment for strand-like forms need not move at peripheral or linear velocities as great as the velocity of the strand to effect packaging of strands. Briefly, this is accomplished by deflecting a strand moving in a linear path from its original path of motion and depositing it on the interior walls of a package container and effecting a relative rotation between the container and the deflection device which is such that will not require peripheral or linear speeds of the winding elements as high as that of the strand itself to effect the formation of a package in the container. In this respect, fibers in the form of a strand can be collected according to this invention at velocities in the range of from 2000 feet per minute to 30,000 feet per minute or more.

A feature of the invention is the fact that the package container need not be revolved at a high peripheral velocity and, in fact, can be stationary in instances as described hereafter. The deflection member may be relatively small and therefore may be rotated at very high rotational speeds to effect a rotation of the path of deflection of the

2

strand without attaining particularly high peripheral velocities. Accordingly, the inertia forces in both the deflection member and the package container are low and the driving control elements can be more simply and substantially constructed than in the conventional winding apparatus.

Other objects and advantages will be apparent from the description which follows, reference being had to the accompanying drawings in which:

Figure 1 is an elevational view of an assembly of apparatus for producing fibrous glass strands and one form of packaging apparatus incorporating the principles of the present invention;

Figure 2 is an elevational view partially in cross section of another form of the apparatus for packaging strand-like forms of material according to the present invention;

Figure 3 is an enlarged top plan view of the deflector member of Figure 2;

Figure 4 is an elevational view partly in cross section of apparatus similar to that of Figure 2 modified so that the package container is rotatable; and

Figure 5 is an elevational view partially in cross section of still another form of the apparatus for packaging material in strand-like form according to the principles of the present invention.

A somewhat simplified showing of apparatus for performing the strand packaging operations appears in Figure 1 in which a glass melting unit 10 is illustrated having an associated feeder 11 in which a plurality of orifices are provided from which streams of molten material flow for attenuation into continuous fibers 12. The continuous fibers are gathered into a strand 15 by passing them over a size-applicating gathering member having a supply tube 25 associated therewith which feeds sizing fluid to a trough-like channel in the gathering member inclined downwardly toward the fibers to provide the fibers gathered thereover with sufficient sizing fluid to bind and lubricate them against abrasive interaction. The force for attenuation and gathering the fibers is provided by a pair of coating rotating pulling rollers or wheels 14 between which the strand 15 is drawn for subsequent projection into a deflector plate 16.

The deflector plate 16 is fixed to a shaft 17 which is rotated and arranged for reciprocation in a vertical direction to effect a controlled deflection of the strand in a lateral direction. Rotation of the shaft 17 is effected through splined teeth on the end of the shaft which engages an internal spline on a pulley 18 which is driven by a belt 19 through an electric motor driven pulley 20. Reciprocation of the shaft 17 in a vertical direction is effected by a cam 21 which engages the underside of the shaft 17 and is driven about its axis 22 by suitable driving means.

The strand of fibers 15 upon impinging on the plate 16 is given an acceleration so that the velocity of the strand after leaving the plate 16 has a direction lateral to its original direction. The new velocity of the strand in being lateral to the original direction of the strand causes the strand to strike and to be deflected from the plate 16 for collection on the internal periphery of the package container 23. The container is a cylinder which may be made of paper, metal, plastic or any other suitable material which will constrain the fiber into the desired package shape and which can be fitted for removable insertion in a stationary package receptacle 24.

The strand 15 in being supplied sizing fluid from the size supply tube 25 is still moist upon passage through the pulling wheels 14 as well as upon deflection from the deflector member 16 so that upon initial contact with the package container 23, the strand adheres to the container wall for start of the package buildup. After a layer or

3

more of accumulations of the strand in the form of loops are provided on the interior of the container, the strand deflected to the container wall is in effect driven into the accumulations and the loops are integrally associated into the package by reason of the force of each successive loop being driven into the material already gathered. In other words, the strand is driven by the pull wheels 14 with sufficient force that upon deflection a package integrating compaction or interlocking of the strand is effected within the container without the need for centrifugal force.

As an alternate, if the strand is not wet upon deflection from the member 16, such as in non-fiber forming operations, the container 23 can be provided with a moist interior surface, such as by spraying lightly with water or an adhesive applied on a line extending over the interior of the container generally parallel to the container axis to effect adherence of the strand to the container walls for initial start-up of the package. The initial layers of the strand then form a base for subsequent buildup of the following loops of strand which are driven into integrated compacted relation with the initial base loops.

As a further alternate, the strand can be made to build up on the interior of the container 23 by causing a rotation thereof so that centrifugal force operates to hold the loops in place for start of the package buildup. The container can then subsequently be halted or can be continued in rotation to effect a wider circumferential distribution of the strand therein.

Since the deflector member 16 is moved with both a vertically reciprocating and a rotary motion, the strand is deposited on the internal periphery of the package container 23 as a helix. The pitch of this helix is dependent upon the relative values of the velocity of the strand 15, the vertical reciprocating velocity of the plate or trough 16 and the rotary velocity of the plate 16 all of which can be variably controlled to produce a package of the type desired.

Figure 2 is a showing of another arrangement for accomplishing this invention. The strand 25 is shown after leaving a suitable mechanism for imparting a linear velocity thereto such as pneumatic pulling means or a pair of pulling wheels like those shown in Figure 1. The strand 25 then impinges against a deflection member such as a plate or as shown, a deflector trough 26. This trough is fastened by means of a horizontal pivot pin 27 to a vertical shaft 28 and by means of a pin 29 to ears 30 of a tubular shaft 31 within which the shaft 28 is concentrically disposed. The vertical shaft 28 is given a reciprocating vertical motion by the action of a rotationally driven cam 32 which contacts the lower end of the shaft 28. The tubular shaft 31 is suitably supported in bearings 34 and is driven rotationally about its longitudinal axis by a gear 35 keyed to the lower end of the shaft 31. The gear 35 is in turn driven by an electric motor 36 through a suitable pinion gear 37. The deflector 26 is thus given a rotary motion on a vertical axis colinear with that of the shaft 31. The trough 26 is arranged to be tiltable about the horizontal axis of the pivot pin 29 by the action of the shaft 28. This tilting motion permits any point on the deflector 26 not on the axis of the pin 29 to have a reciprocating vertical motion. Therefore, the curve everywhere tangential to the vectors of the relative velocity of any point on the deflector 26 with respect to the stationary package container 38 is also a helix. Thus, the relative velocity of the strand 25, after being deflected, with respect to the package container 38 will cause the strand to be deposited on the package container 38 in approximately a helical curve. The pitch of the helix is dependent upon the relative values of the velocity of the strand 25, the reciprocating rotational velocity of the deflector 26 about the axis of the pin 28 and the rotational velocity of the deflector 26 around the vertical axis of the cylinder 31.

Figure 3 is an enlarged view of the deflector trough 26

4

of Figure 2. This deflector is of suitable size so that it will catch and deflect the impinging strand regardless of slight variations in the velocity of the strand. The material of the deflector is such as to withstand the action of the strand deflected thereagainst.

Figure 4 shows an arrangement of apparatus similar to that of Figure 2 with the exception that the container is driven rotationally in addition to rotation of the deflecting member. A strand 45 impinges the deflecting member 46 and is collected on the interior of a container 41 inserted in a rotatable receptacle 42. The receptacle 42 is supported on a rotating platform 43 driven by a motor 50 connected to the platform by way of a pulley 48 and belt 49. Thus, it can be seen that the arrangement of Figure 2 can be made to provide a package start-up in accordance with the principles of Figure 1 wherein moisture on either the strand or container is utilized to effect an adherence of the strand in direct contact with the container walls for subsequent buildup of the following strand loops in compact integrated relationship, or the centrifugal force of the accumulations on the interior of the rotating container 41 can be utilized to start the packaging operation.

Figure 5 is a fragmentary schematic drawing of a pneumatic means for accomplishing this invention. The strand 68 is shown after leaving suitable pulling means such as the pull wheels of Figure 1. An acceleration is given the strand 68 when it is struck by a jet of gas such as air directed through the orifice 50 in the end of a rotatable tube 69. After being accelerated by the jet of air, the strand 68 has a component of velocity lateral to its velocity being accelerated by the jet of air.

The package container 51 into which the strand is deposited is loosely fitted into a package receptacle 52 open at the top end, closed at the bottom end and fixedly mounted on a rotatable support plate 53. The plate 53 is fixed to a driving cam-type cylinder 54 which has a follower groove 55 provided in its periphery. The groove completely encircles the cylinder 54 and makes a suitable lateral traversal thereover so that a fixed cam follower 56 extending therein can make contact with the sides of groove 55 to cause the cylinder 54 to reciprocate vertically a predetermined desired distance whenever the cylinder 54 is rotated around its axis. The cylinder is driven rotationally about its own vertical axis by a splined shaft which engages teeth on the interior surface of the cylinder. The splined shaft is in turn connected to and driven by a pulley 58 connected by a belt 59 to an electric drive motor 60.

The package container 51 is therefore provided a relative velocity with respect to the orifice 50 which is the vector sum of a rotary motion about the vertical axis of the container 51 and a reciprocating vertical motion. The strand after being deflected by the orifice 50 will be deposited on the package container in a substantially helical configuration, the pitch of which is dependent upon the relative values of the reciprocating vertical velocity and the rotary velocity of the package container.

While I have shown particular embodiments of my invention, it will, of course, be understood that I do not wish to be limited thereto, since many modifications may be made, and I, therefore, contemplate by the appended claims to cover all such modifications as fall in the true spirit and scope of my invention.

I claim:

1. Apparatus for packaging strands of fibrous material and the like comprising means for imparting a linear velocity to a strand, a package container disposed in the path of said strand into which said strand is arranged to be introduced, deflection means within said container for redirectioning each successive adjacent portion along the length of said strand from its original path of travel to the internal periphery of said container lateral to said path, and means for rotating relative to each other said deflection means and container to effect deposition of

5

said strand in the form of a winding on the internal periphery of said container.

2. Apparatus for packaging strands of fibrous material and the like comprising means for imparting a linear velocity to a strand, a package container disposed in the path of said strand into which said strand is arranged to be introduced, deflection means within said container for redirectioning said strand from its original path of travel to the internal periphery of said container lateral to said path, means for rotating said deflection means and container relative to each other to effect deposition of said strand in the form of a winding on the internal periphery of said container, and means associated with said deflection means for changing the level of deposition of the strand on the interior of said container to form a package distributed over a distance generally parallel to the direction of linear movement of said strand toward said deflection means.

3. Apparatus for packaging strands of fibrous material and the like comprising means for imparting a linear velocity to a strand, a generally cylindrical packaging container disposed in the path of said strand into which said strand is arranged to be introduced, deflection means within said container for redirectioning said strand from its original path of travel to the internal periphery of said container lateral to said path, means for rotating said deflection means to effect a deposition of said strand into a package on the internal periphery of said container about said deflection means, means effecting an adherence of the initial portion of strand for such a package on the interior of said container, and means for varying the angle of deflection of said strand from said deflection means to effect a formation of said package over a distance generally parallel to the direction of linear movement of said strand toward said deflection means.

4. Apparatus for packaging strands of fibrous material and the like comprising means for imparting a linear velocity to a strand from a generally cylindrical packaging container disposed in the path of said strand into which said strand is arranged to be introduced, means including a deflection surface within said container for redirectioning said strand from its original path of travel to the internal periphery of said container, means effecting an adherence of the beginning portion of strand for a package on the interior of said container, and means for rotating said deflection surface on an axis colinear with the axis of said container to effect a deposition of said strand as a generally cylindrical package on the internal periphery of said container about said deflection means.

5. Apparatus for packaging strands of fibrous material and the like comprising means for imparting a linear velocity to a strand, a generally cylindrical packaging container disposed in the path of said strand into which said strand is arranged to be introduced, deflection means within said container comprising a deflector trough against which said strand is directed and for redirectioning said strand from its original path of travel to the internal periphery of said container lateral to said path, means for rotating said deflector trough to effect a disposition of said strand into a package on the internal periphery of said container about said deflection means, means effecting an

6

adherence of the beginning portion of strand for a package on the interior of said container, and means for varying the angle of inclination of said deflector trough relative to said strand and toward said internal periphery to effect a deflection of said strand to a package on said internal periphery over a distance generally parallel to a direction of linear movement of said strand toward said deflector trough.

6. Apparatus for packaging strands of fibrous material and the like comprising means for imparting a linear velocity to a strand, a generally cylindrical packaging container disposed in the path of said strand into which said strand is arranged to be introduced, deflection means comprising a pneumatic deflector within said container for redirectioning said strand from its original path of travel to the internal periphery of said container lateral to said path, means for rotating said pneumatic deflector to effect a disposition of said strand into a package on the internal periphery of said container about said deflector.

7. Apparatus for packaging material in strand form comprising a means for imparting a linear velocity to a strand, a means for deflecting the strand into any radial line on a plane substantially perpendicular to the original direction of motion of the strand, said deflecting means being disposed substantially in the pathway of the strand, said deflecting means being rotatable so as to deflect the strand into any radial path within the plane substantially perpendicular to the original motion of the strand, said deflecting means also being reciprocable on an axis parallel to the original direction of motion of the fiber strand, a cylindrical surface concentrically disposed to the axis of the deflecting means surrounding said deflecting means and having a length at least as great as the reciprocating traverse of the deflecting means.

8. Apparatus for packaging strands of fibrous material and the like comprising wheeled instrumentalities for imparting a linear velocity to a strand, means for deflecting the strand into any radial line on a plane substantially perpendicular to the original direction of motion of the strand, said deflecting means being disposed substantially in the pathway of the strand, said deflecting means being rotatable so as to deflect the strand into any radial path within planes substantially perpendicular to the original motion of the strand, said deflecting means being reciprocable on an axis parallel to and substantially in line with the original direction of motion of the strand, a cylindrical surface concentrically disposed to the axis of the deflecting means surrounding said deflecting means and having a length at least as great as the reciprocating traverse of the deflecting means, said cylindrical surface supporting a cylindrical package container of suitable material.

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