

Jan. 20, 1970

S. WARSHAW ETAL

3,490,707

STRAND OR YARN FORMING WINDER

Filed June 7, 1968

5 Sheets-Sheet 2

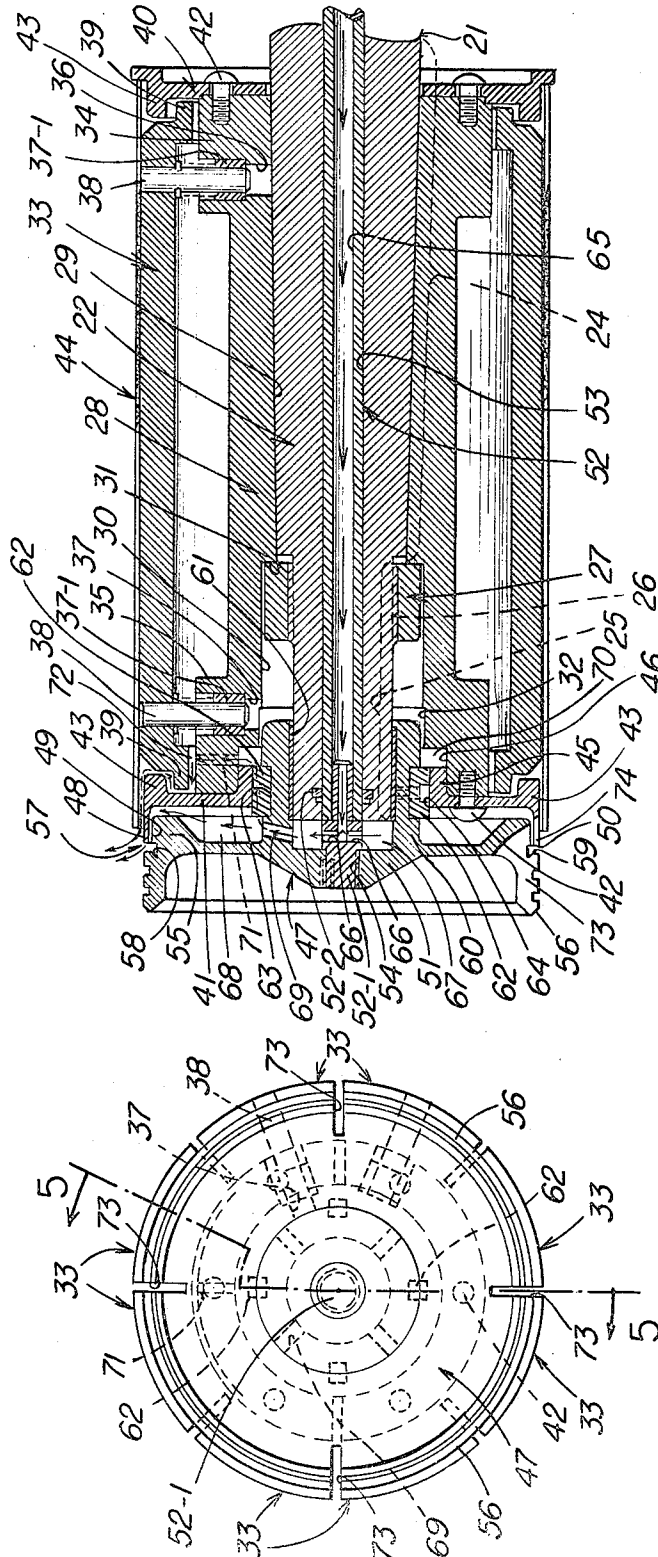


FIG. 5

FIG. 4

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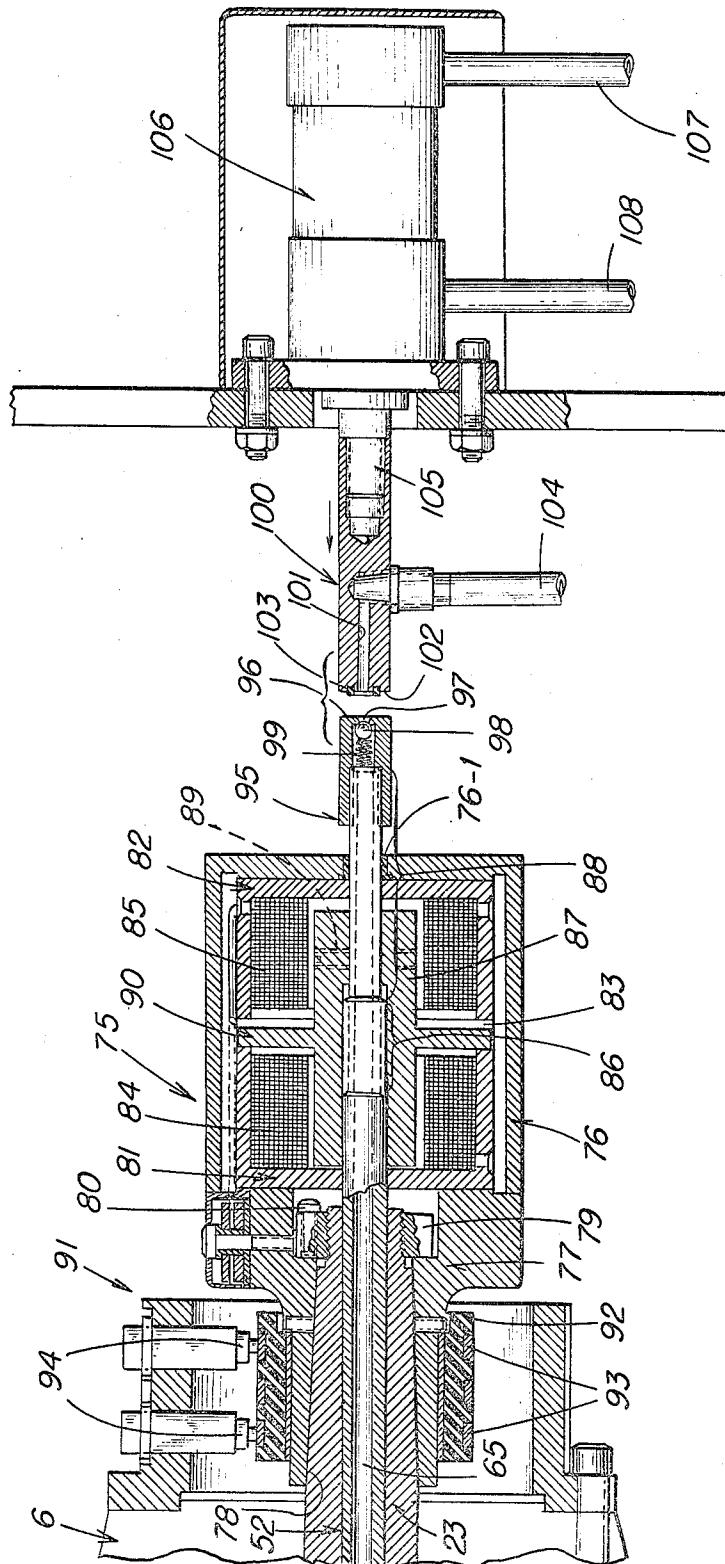


FIG. 6

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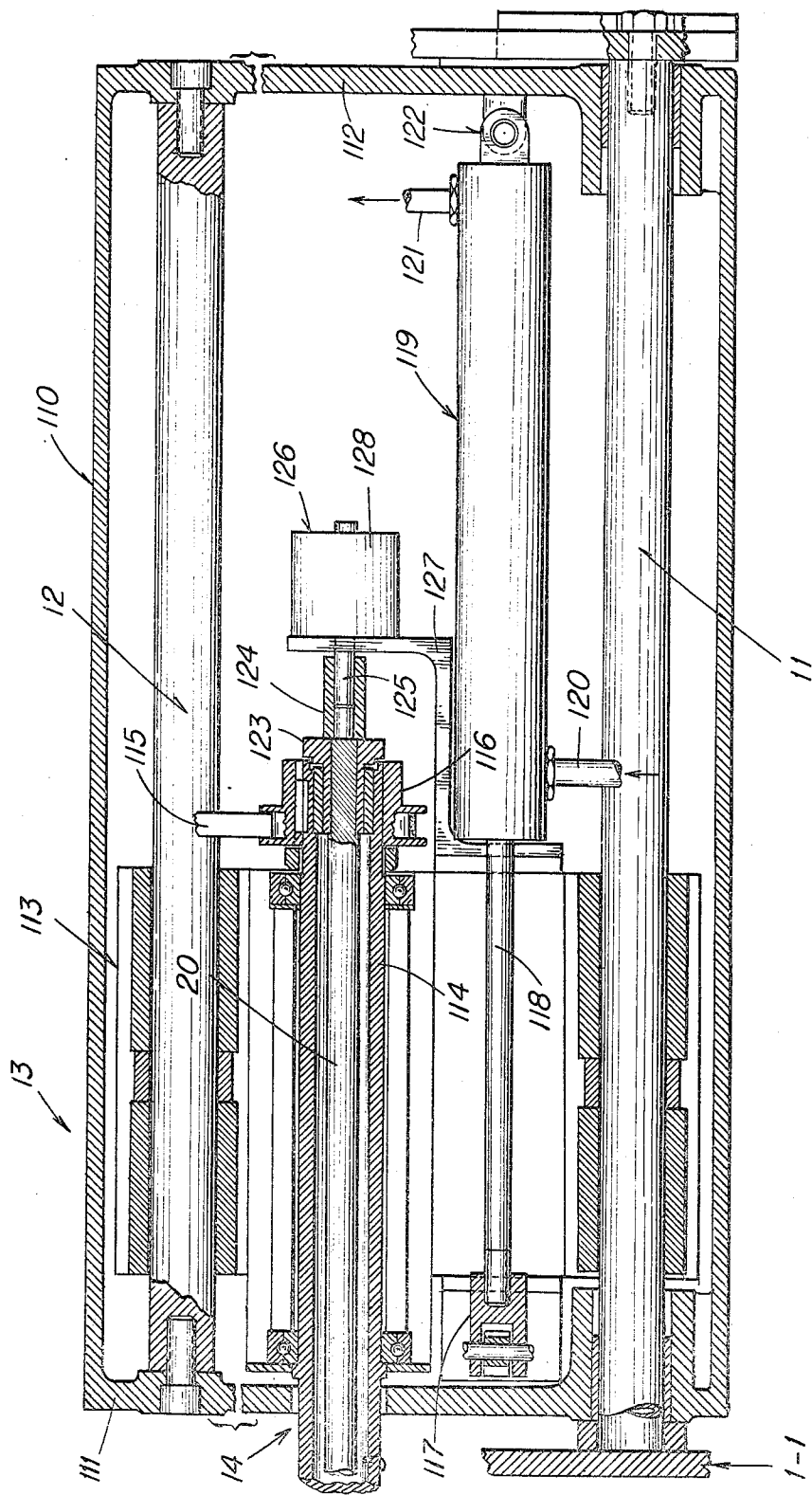
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FIG. 7



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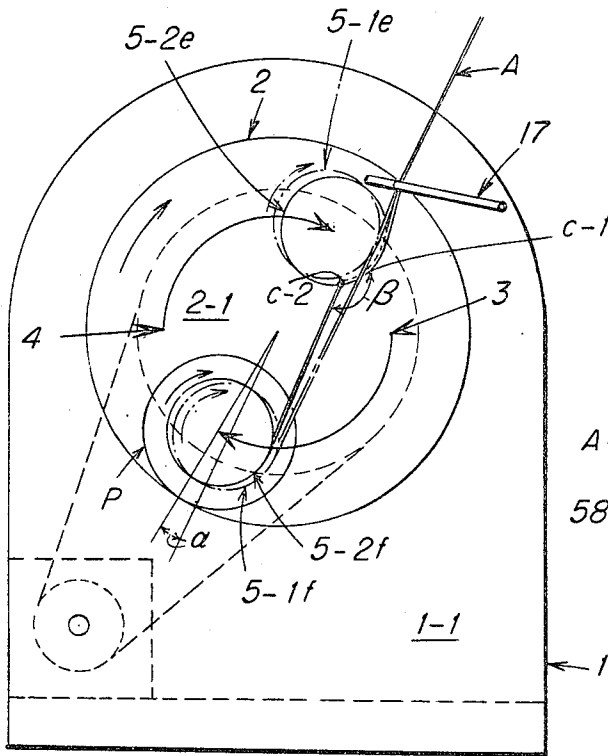


FIG. 8

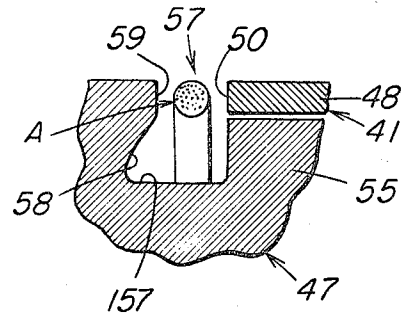


FIG. 10

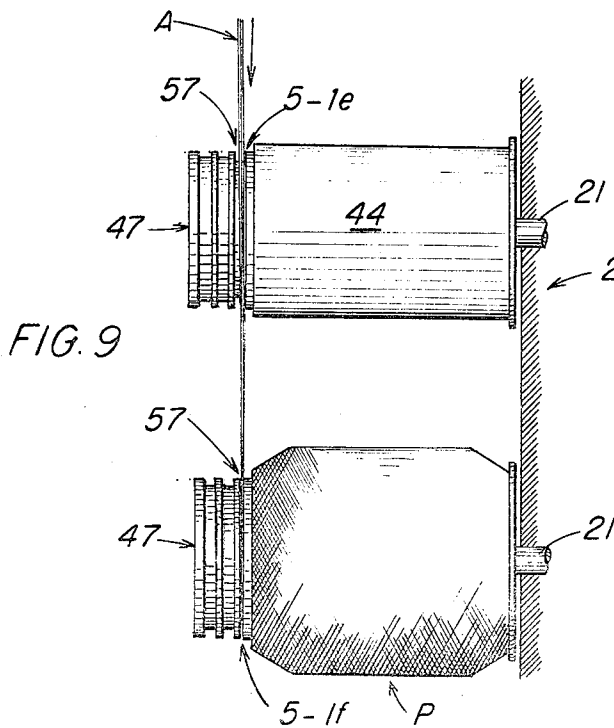


FIG. 9

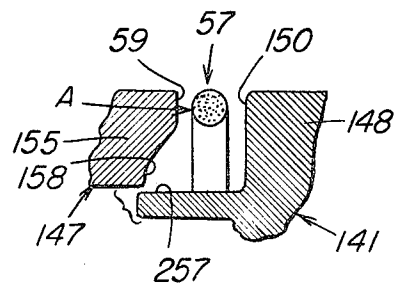


FIG. 11

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STRAND OR YARN FORMING WINDER

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Filed June 7, 1968, Ser. No. 735,378

Int. Cl. B65h 54/26

U.S. Cl. 242—18

14 Claims

ABSTRACT OF THE DISCLOSURE

This invention pertains to yarn or strand forming
winders successively to produce wound packages from
running yarns or strands of certain diameter. This ma-
chine includes generally conventional equipment in the
form of a rotatable turret head which carries thereon a
plurality of circumferentially spaced, rotatably driven,
winding collets.

Novel features of the invention include equipment of
the outer end of the collet with a positively actuated
clamping plate which when thrust axially outward dur-
ing machine operation defines with adjacent structure of
a second one of the collets in an oncoming or following
position while it is empty an open, annular clamping
channel wider than the diameter of the strand for free
running of the latter therethrough as it is drawn forward
to a first or leading one of such collets in a leading po-
sition and on which a package is being wound at the wind-
ing station.

At the doffing station is provided equipment to flush
out by suitable purging liquid such annular channel after
it is opened and the package doffed, and the duct system
of such purging equipment may include an axial passage
through the shaft which rotates the collet.

The present invention relates to strand or yarn form-
ing winders, each such machine being designed suc-
cessively to produce packages or cakes of a continuously
running strand or yarn, which may be a bundle of glass
fibers or filaments continuously drawn from orifices of a
suitably heated furnace or bushing. Each package con-
sists of a cylindrical collector or paperboard core tube
on which is wound successive layers or plies of the strand
laid down in each layer or ply in criss-cross fashion, with
the layers or plies progressively foreshortened as each
thereof is wound over those previously laid down on the
core tube, so that the finished package has tapered end
shoulders. The forming winder includes a journaled tur-
ret head equipped with a plurality of circumferentially-
spaced and rotatably driven winding drums or collets
to be swung successively to a winding station and then
on to a doffing station where, respectively, each package
is wound up or laid down on a core tube removably
carried on one of the collets and, after package comple-
tion, is removed with its core tube, the next collet sup-
porting another empty core tube being swung forward to
the winding station when the collet carrying the com-
pleted package is swung forward from the latter to the
doffing station. At the winding station the machine is
equipped with suitable way winder equipment including
rotary and reciprocative traversing mechanism to guide
the progressively wound strand for laying it down in a
criss-cross pattern in each layer and to traverse it simul-
taneously from one end to the other of a longitudinal
path defined by the particular layer being wound. Also,
at the winding station is provided strand diverting hold-
off means to move at the completion of a package the
running strand out of the zone of influence of the travers-

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ing mechanism and to guide its transfer to the next on-
coming rotated collet and the empty core tube carried
thereby for re-engagement by the traversing mechanism
at the winding station so as to permit repetition of the
package winding operation.

A forming winder has been previously proposed in
Patent No. 3,298,621 in which the outer end of the drum
of each of a plurality of winding collets has removably
attached thereto a cupped end plate. This end plate has
a disk-shaped base circumscribed by a cylindrical flange
of a diameter substantially the same as that of the drum
with the juncture thereof rounded off to provide a circu-
lar, convex corner. The circular end edge of the drum
which is opposed to this convex corner is also rounded
off, so that they provide therebetween a shallow, annular,
strand-snagging, V-shaped groove. The base of this cup
is abutted to the end of the drum and held there against
by magnetic means or a spring clutch to be rotatable
therewith while permitting forced separation thereof. In
the operation of this winding machine, after a package
has been wound on a sleeve carried by the rotating drum
at the winding station, with use of suitable traversing
mechanism, a strand diverting arm is manipulated to
move the running strand outward to the outer end of
this drum.

This diversion of the running strand moves it into
alignment with the annular V-shaped groove of the next
following rotating empty collet as the latter is swung
forward to the winding station, so that the running strand
will be wedged thereinto to be caught or gripped by the
opposed sides of the groove. This attachment of the run-
ning strand to the rotating empty collet may occur at
some indefinite time, and thereafter the portion of the
running strand which extends between the package-car-
rying rotating collet and the empty rotating collet will be
broken.

While this rotating empty collet is being swung to the
winding station the rotating filled collet is swung to the
doffing station and, after the running strand is broken
therebetween, the filled collet is stopped by a hand brake
to allow the operator to remove the finished package
therefrom while the second package is being wound on
the second drum at the winding station. During this
period he then manually separates the cupped end plate
from the outer end of the stopped drum and removes
the strand turns that had accumulated in and over the
intervening V-shaped groove for discard. The operator
finally replaces the end plate and mounts an empty core
sleeve on the stopped drum to ready the latter for laying
down thereon another package when this empty drum is
swung forward to the winding station. This procedure
entails a considerable number of hand operations and
features anchorage of the running strand to the oncoming
empty collet at an uncertain time, characteristics which
may be undesirable and are effectively eliminated by the
present automatic forming winder.

The improved forming winder of the present invention
includes any suitable turret structure provided with a
journaled turret head equipped with a plurality of indi-
vidually driven collet drive shafts located equal distances
apart. In a preferred embodiment the turret head carries
a pair of such collet drive shafts respectively supporting
collet structures of unique construction which are located
180° apart. For this purpose the turret head may provide
a frame which is rotated progressively through 180° dur-
ing each advance from the winding station to the doffing
station. This frame may be rotatably supported on suit-
able ring bearing structure and each half thereof supports
one of a pair of collet driving motors. In the preferred
embodiment such motor is of the infinitely variable
change speed type so as to keep the peripheral speed of

the cake or package, as it is being built up by the winding equipment, uniform whereby the speed of draw of the filaments from the bushing will be uniform. Each collet driving motor includes its housing suitably mounted within the turret head frame structure that, in turn, houses its rotor carried by a through hollow core shaft. The back end of this shaft projects from the motor housing to carry mechanism for operating through the bore of this hollow shaft strand clamping means provided at the outer free end of collet structure that is supported by the front end of this shaft; and, when desired, liquid flushing equipment to force pressurized cleaning liquid through this hollow shaft so as to keep the clamping structure and adjacent collet interior clean, all as will be detailed later.

The clamping means includes in preferred embodiments of the invention an axially movable, transverse end plate mounted to the outer free end of the winding section of each collet in a manner to permit the peripheral inner edge thereof to be opposed to the end edge of this winding section for defining therebetween in an axially outer position of this clamping plate an annular strand-receiving channel of a width appreciably greater than the diameter of the strand so that the latter may run freely therethrough. This clamping means also includes controlled operating mechanism to retract the clamping plate for reducing the width of the annular strand-receiving channel to less than the diameter of the strand for securely clamping the latter therein when freely running therethrough, and to extend this plate axially to open up the channel sufficiently for freeing the clamping strand portion and allow easy clean out while again permitting reception of the strand in free-running condition for the next cycle of package formation. Thus, the operation of the machine of the present invention can be reliably efficient, and it is an object of the present invention to provide such a machine that avoids or solves the above-indicated problems attendant upon the operation of the McCoy forming winder.

Practical embodiments of the present forming winder desirably may include, as another object of the invention, unique collet clean-out equipment which may employ liquid jet means at the doffing station, where each filled collet is stopped for doffing the package thereof, to supply pressurized cleansing liquid to the interior of the collet and its strand clamping structure through the hollow core shaft that rotates the collet, and a novel duct system therefor.

While a variety of types of strand-diverting means may serve to transfer the running strand from the zone of a collet of the present invention that carries a finished package at the winding station outward to alignment with the open clamping channel of the succeeding on-coming empty collet, it is a further object of the invention to provide novel strand diverting means in the vicinity of the winding station which by rotary action may engage the running strand as it runs against the traversing mechanism and force it away from the latter. Such novel strand diverting means is of a construction as to cam outward effectively the running strand as the latter runs in contact therewith, after it has been forced away from the traversing mechanism, to alignment with the transverse plane in which are disposed the constricted annular clamping channel of the filled collet and the open annular clamping channel of the next on-coming empty collet. This strand diverting means also provides guidance for the so-diverted running strand in this plane until the on-coming empty collet reaches the winding station for commencing the repeat of the package winding operation. Uniquely, this strand diverting means may be provided desirably with an operating shaft which extends coaxially through the shaft which rotates and reciprocates the strand-contacting traversing mechanism.

Other objects of the invention will in part be obvious and will in part appear from reference to the following

detailed description taken in connection with the accompanying drawings, wherein like numerals identify similar parts throughout, and in which:

FIG. 1 is a diagrammatic and front elevational view, to reduced scale, of an embodiment of the forming winder of the present invention, with parts broken away, illustrating operation thereof in drawing filaments of fiber glass from a heated bushing, bunching them together to form a strand and directing the running strand to a rotating collet located at a winding station;

FIG. 2 is a side elevational view, with parts in section and broken away, to larger scale, of the strand diverting structure or bail and its operating means embodied to advantage in the machine depicted in FIG. 1;

FIG. 3 is a diagrammatic layout to increased scale of the sub-assemblies which are aligned at the doffing station, including means for cleaning or flushing the interior and the strand annular clamping channel of one of the collets;

FIG. 4 is an elevational view of the outer end, to about three-fifths scale, of one of the winding collets shown in FIG. 1;

FIG. 5 is an axial section taken substantially on line 5-5 of FIG. 4;

FIG. 6 is an axial section of the rear end of the hollow core motor driving shaft on which the winding collet of FIGS. 4 and 5 is carried for rotation thereby, the intervening electrical motor for driving this shaft being broken away, and showing power supplying slip ring structure carried by this shaft and associated brushes supported by the collet-driving motor frame to supply electrical energy to solenoid structure (also shown in axial section therein) for manipulating the strand clamping mechanism of the collet, and additionally the flushing equipment with parts in section and others in side elevation;

FIG. 7 is a side elevational view to enlarged scale, with parts in section and broken away, of structure embodied in the way winder assembly for rotating and reciprocating the traversing mechanism and imposing periodic rotary action or swing upon the strand diverting bail of FIG. 2;

FIG. 8 is a front elevational diagrammatic view of the frame and turret head structure shown in FIG. 1, illustrating the pair of rotating collets mounted on the turret head and indexing of the latter to carry a finished package away from the winding station toward the doffing station, and the operation of the strand diverting means or bail in association with the operation of the strand clamping means mounted on the collets during shift of the collet which carries a finished package from the winding station toward the doffing station and the other following empty collet as the running strand is clamped to the latter and then snapped free from the preceding finished package;

FIG. 9 is a diagrammatic side elevational view of the collets and turret head shown in FIG. 8 with parts of the latter broken away;

FIG. 10 is a detailed sectional view to enlarged scale with parts broken away, of the collet and clamping plate structural parts which together define the annular strand clamping channel illustrated in FIG. 5; and

FIG. 11 is a sectional view similar to FIG. 10 of a modified form of the structure at the outer end of the collet and the opposed inner side of the clamping plate structure which define a like annular clamping strand channel.

As will be noted from the diagrammatic and front elevational view of FIG. 1, the winding collet and associated mechanism of the present invention may be embodied in an indexing turret machine 1 having a rotatable turret head 2 which rotatably supports at diametrically opposite points 3 and 4 a pair of such collets 5. The locations 3 and 4, when turret head 2 is in a temporarily stopped position for package winding, will be herein-

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after respectively identified as the winding station and the doffing station. The rotatable turret head construction 2 may include a faceplate or disk 2-1 that supports behind this faceplate, a pair of collet driving motors 6 with each carrying on its driving shaft in front of the faceplate one of the pair of winding collets 5. Thus each collet 5 is provided with its own individual driving means.

The framework of the machine 1 may include a faceplate 1-1 having a circular hole 1-2 therein in which is rotatably supported (such as by ring bearing structure, not shown) turret head disk 2-1, and this framework internally supports a suitable driving motor and speed reducer unit 7 equipped with a driving pulley or sprocket 8 about which is lapped a suitable endless flexible driving belt or chain 9 that, in turn, is lapped about a driven pulley or sprocket 10 fixed to the rotatable turret head 2 for indexing the latter progressively through 180° between the winding station 3 and the doffing station 4 during each of a plurality of successive steps of half rotations.

The framework of the machine 1 also incorporates a pair of longitudinal guide bars 11 and 12 on which is slidably supported a way winder assembly 13. The way winder assembly 13 rotatably supports at 14 any suitable traversing mechanism 15 of traverse equipment designed to perform by reciprocation and rotation thereof a known technique of guiding the laying down of turns of a yarn or strand, indicated at A and comprising a plurality of gathered filaments, in criss-cross helices about each collet 5 as the latter is rotating at the winding station 3. Examples of conventional forms of such rotary traversing mechanisms are disclosed in the prior art U.S. patents to Beach No. 2,391,870 of Jan. 1, 1946 and Stream No. 2,433,304 of Dec. 23, 1947. The way winder assembly 13 also carries a motor 16, that preferably may be of a constant speed type, which drives the traversing mechanism 15.

Preferably, on the axis of the traversing mechanism 15 is pivotally supported a radial device 17, which may be identified as a strand or yarn guiding "bail" of hold-off arm that is swung between a retracted position indicated in dotted at 170 in FIG. 1, and the full line position shown therein at 17. This bail is swung arcuately counterclockwise as viewed from the front, as in FIG. 1, to engage the drafted yarn or strand A for axial diversion thereof as is explained more fully hereinafter.

Since the present invention has been particularly designed for winding up into cakes or packages fiber glass strand of yarn A, although its usefulness is not limited to the production and packaging thereof, the filaments of the strand may be produced by conventional manner, such as by drawing them from tip orifices in the bottom of a heated bushing B of known construction. The resulting converging array C of filaments are then drawn downwardly past a binder spraying nozzle D as they are gathered together over suitable gathering means or shoe E, to continue from that point onward toward one of the rotating collets 5 at the winding station 3.

As will be seen from FIGS. 1 and 3 the rotatable turret head structure 2 includes a face disk 2-1 which, together with suitable framework thereof that is not shown therein, supports and carries the pair of winding collets 5, and the pair of electrical motors 6 individually associated with each of the latter for driving it by a forward projecting section of a through, hollow steel core shaft 21. The projecting back end section of this through shaft carries thereon a slip ring assembly 91 for supply of electrical energy to a double acting solenoid 75 conveniently mounted on this projecting back end section. The solenoid 75 alternately thrusts the clamping plate 47 axially outward and retracts it, in properly timed relation, by any suitable means, such as a shaft carrying the solenoid armature and extending through the bore of the hollow shaft 21 for solenoid reciprocation. Such a solenoid is preferred for this purpose due to its rapid acting capability; although other suitable means may be employed for this

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purpose, such as push-pull rod means translated axially by suitable lever or cam mechanism, or such lever or cam translated rod for effecting either the thrust or retraction of the rod with the alternate axial movement thereof being imposed by suitable biasing spring means, or by double-acting pneumatic or hydraulic means.

Referring to FIGS. 4 and 5, it will be seen that the hollow core driving shaft 21 has a front end section 22 which projects appreciably forward from the housing of collet driving motor 6 and may include an intermediate tapered section 24 that is stepped to provide a terminal end section 25 which is substantially cylindrical. Preferably, the cylindrical end section 25 is provided with an externally-threaded zone 26 to receive thereon an internally-threaded mounting nut 27 for holding the collet structure thereon.

The collet structure 5 preferably includes a hub sleeve 28 that has a tapered bore 29 which receives the tapered section 24 of the motor shaft 21 for jam mounting on the latter. The collet hub sleeve 28 is counterbored at 30 to provide an annular shoulder 31 against which the inner end of the locking nut 27 presses as it is threaded into the counterbore for providing and maintaining a press fit between the driving shaft tapered section 24 and the tapered bore 29 for drive of this collet sleeve by the motor shaft 21. The counterbored section 30 of the collet hub sleeve 28 has a terminal counterbored portion 32.

The collet hub sleeve 28 provides means for supporting thereon, in annular array, a plurality of arcuate collet segments 33, which may be eight in number, and which may be machined from material of suitable lightweight and substantially rigid composition, such as an aluminum alloy or the like. For the support of the collet segments 33 the collet hub sleeve 28 is provided with a pair of axially-spaced, annular back and front lands 34 and 35. Each collet segment 33 is supported on such lands for free radial movement, such as by means of a pair of radial bores 36 and 37 with each equipped with an anti-friction sleeve 37-1 in which is slidably mounted one of a pair of pins 38 fixedly carried by the collet segment to project inwardly therefrom for glide in these sleeves. As a result, when the collet structure is rotated centrifugal force tends to move the plurality of so-mounted segments 33 radially outward. The opposite ends of each collet segment 33 is reduced in diameter to define thereon an arcuate shoulder 39. In order to restrict the radial outward movement of the plurality of segments 33 a pair of restraining end rings 40 and 41 are respectively fixedly mounted to the collet hub sleeve lands 34 and 35, such as by a plurality of threaded studs 42. On its inner face each of the restraining rings 40 and 41 carries an annular, axially-extending flange 43 which overhangs the shoulders 39 of the plurality of collet segments 33 to limit radially outward movement of the latter under centrifugal force.

Such segmental construction of the collet permits ready reduction in diameter for easy reception thereon of a collector or paperboard core tube 44 (shown in FIG. 5, but omitted from FIG. 4), on which the strand is to be wound to build up the cake or package. It will thus be understood that as the collet structure 5 is rotated rapidly and the collet segments 33 consequently tend to move outward under centrifugal action they will jam into the bore of the collector or core tube 44 snugly to secure it to the collet structure for drive therewith, and that when the collet is stopped the permitted radially inward movement of the segments allows ready doffing of the package of the strand which has been found upon such tube.

The outer restraining ring 41 is provided on its inner side with an axially-extending, annular footing 45 in the form of an annular flange which is received within an annular recess 46 coaxially formed, such as by additional counterboring, in the mouth of the counterbored section 32 of the collet hub sleeve 28. The outer restraining ring 41 conveniently serves as a part of the strand clamping equipment.

As will be understood from FIGS. 5 and 10, the clamping equipment of each collet structure 5 includes the outer restraining ring 41 and an axially translatable end plate 47. The restraining ring 41 has an axially-extending, annular flange 48 which projects outward and defines therein a cylindrical surface 49. The circular outer edge 50 of the annular flange 48 constitutes an annular transverse marginal face providing an element of the strand clamping means.

The end clamping plate 47 has an actuating hub 51 fixedly mounted upon the outer end of a thrust and retracting rod or bar 52 which is slidably mounted through axial bore 53 of the motor drive shaft 21. For the purpose of fixing the clamping plate 47 upon the rod 52 the plate hub 51 may have an internally threaded hole 54 in which is threadably received the externally threaded outer end structure of the rod, with the latter preferably defined by a plug 52-1 press-fitted into an axial bore 65 provided through this rod for a purpose later indicated, and a key seated in a keyway or a dutchman may be provided to prevent relative rotation during drive and braking of the collet structure 5.

The clamping plate 47 has its circumferential surface stepped to define a shouldered rim having an inner annular portion 55 which rides freely within the restraining ring flange 48 with close tolerance to the cylindrical inner surface 49 of the latter. The stepped annular rim of the clamping plate 47 also provides an outwardly extending annular flange 56 which is greater in diameter than and is axially defined from the inner annular portion 55 by an annular strand-receiving channel 57. The annular channel 57 preferably has its transverse bottom surface 157 (see FIG. 10) located on a diameter less than the outer diameter of the portion 55, and this channel may have in the bottom thereof an annular undercut 58 to provide a recess for catching dirt and fiber particles that may be subsequently cleaned out in a manner described hereinafter. The annular channel 57 includes strand clamping means in the form of an annular radial edge 59 of the clamping plate opposed to the annular edge 50 of the restraining ring flange 48 cooperatively to define opposed annular clamping elements in the sides of the annular channel.

It is to be understood that the provision of the annular strand clamping channel 57 is not limited to the structural details shown in FIGS. 5 and 10, wherein it is indicated that the outer sidewall of this channel and its annular transverse bottom 157 are defined in the inside face of the clamping plate 47. For example, if the running strand A is so guided as to run freely through only a short arc of the opposed sidewalls of the channel, such as the opposed transverse annular faces 50 and 59, while the empty collet is indexed around by the turret head 2 up to the moment of constricting this channel by quickly retracting the clamping plate 47, as will be explained more fully hereinafter, it may not be necessary due to proper timing of such clamping action to provide an annular bottom surface for the channel to limit the depth of reception of the running strand A thereinto. Further, as is illustrated in FIG. 11, such an annular transverse bottom surface of the channel, such as that indicated at 257, may be provided on outer end parts of the main section of the collet structure, such as its restraining ring 141, that is similar to the restraining ring 41 illustrated in FIGS. 5 and 10 except for the modified shaping thereof to provide this annular channel bottom surface as an angular continuation of the radial clamping face 150 which is opposed to the annular marginal clamping face 59 of the clamping plate 147. Consequently, the annular portion 55 of the inside face of the clamping plate and the outside face of the restraining ring may be reshaped, as is indicated at 155 and 148 in FIG. 11, so that the transverse annular bottom surface 257 is provided on the restraining ring 141 and the annular undercut 158 in the bottom of the annular channel 57 is cooperatively de-

fined by the shaping of the inner face of the modified clamping plate 147 and the annular transverse bottom surface 257 of the channel here provided on this outer restraining ring.

It is desirable that the movable clamping plate structure, comprising the outer clamping plate 47 and its mount, have accurate sliding guidance and secure support upon the cylindrical end section 25 of the motor driving shaft 21. For this purpose, the inner face of the clamping plate 47 is provided with an axially-extending and annular hub flange 60 which carries interiorly thereof a slide liner sleeve 61 of any suitable bearing material, such as nylon, for free glide upon the motor shaft end section 25. The inner end of the hub flange 60 is received in the counterbored portion 32 of the hub sleeve 28.

The annular hub flange 60 of the clamping plate 47 is telescoped into the footing flange 45 of the outer restraining ring 41 in a close fit that permits relative axial slide therebetween, and relative rotation is prevented by any suitable means, such as a plurality of circumferentially-spaced and longitudinally-extending keys 62. Each such key 62 is seated within a localized recess 63 formed in the outer annular surface of the hub flange 60 and extends radially outward thereof to be received in an axial slot 64 in the bore of the restraining ring footing flange 45. For this purpose the recesses 63 and the slots 64 are paired and aligned radially.

The clamping plate thrust and retracting rod 52 (which may be identified more simply as the clamp actuating rod that slidably extends through the axial bore 53 of the motor drive shaft 21) has, as has been previously indicated, an axial bore 65, and the latter may constitute a flushing liquid passage which extends forward to the vicinity of the hub 51 of the clamping plate 47. It is there blocked by the inserted plug 52-1 which may serve as a delivery nozzle by being provided with radial ports 66 that are communicated with the rod bore 65. The radial ports 66, in turn, communicate with an annular space 67 within the clamping plate hub flange 60, which is defined between the inner side of the clamping plate hub 51 and the outer end of the motor drive shaft 21. Radially outward of the clamping plate hub flange 60 is defined, between the web of the clamping plate 47 and the outer radial face of the restraining ring 41, an annular chamber 68 which is communicated with the annular space 67 by means of a plurality of ports 69 that are circumferentially spaced and extend through the clamping plate hub flange. The annular chamber 68 is in communication with an annular relief of a few thousandths of an inch between the cylindrical inner surface 49 of the restraining ring 41 and the clamping plate shoulder portion 55 nested therein, so that pressurized flushing liquid in this chamber may be forced by centrifugal action through this relief spacing into the annular clamping channel 57 for purging the latter to atmosphere.

Purging liquid, when supplied through actuating rod bore 65, may tend to creep in between the bore of the restraining ring hub 45 and the circumferential surface of the clamping plate hub flange 60, intermediate the guide keys 62, into an annular channel 70 defined in the outer end of the collet hub sleeve 28 in which this ring hub is telescoped. Thus it is desirable that this annular channel 70 be communicated by a plurality of circumferentially-spaced, radial relief ports 71 extending through the annular boss 35 of the collet sleeve, hub and annular spacing 72 between the outer ends of the collet segments 33 and the restraining ring 41, as well as radially outward between these segments in the absence of core tube 44, to atmosphere for freeing the purging liquid otherwise trapped therein.

Since the annular clamping channel 57, when open, is designed to receive in free running condition the strand A of filaments as it is guided therethrough for commencement of a winding operation of the empty collet

(when the latter is swung to the winding station 3) a problem of abrasion exists when such strand is formed of glass fiber. Such fiberglass strand is extremely abrasive even when dry and when wet the abrasiveness thereof is greater. The binder which is sprayed on the filaments as they are drawn from the bushing and collected to form the strand provides such wetness. Accordingly, since it may be desirable because of the high speed rotation of collet segments 33 and clamping plate 47, to form at least these collet structure parts of lightweight material, such as aluminum composition, it may be advantageous to coat the walls of the annular channel 57, i.e., the faces of the parts that make up the latter, with abrasion resistant material, such as a chromium or nickel composition, or other material having similar abrasive-resistant characteristics. Further, conventional binders, such as those formed of a starch and oil composition, have a tendency to adhere to surfaces contacted thereby during the winding operation and this presents a problem, particularly with respect to such surfaces that are not readily accessible for cleaning. For this reason, a flushing operation, to be performed at the doffing station, may be desirable, and the flushing liquid may be water or other suitable liquid solvent. In order to reduce the tendency for the binder to stick to such inaccessible surfaces it may be desirable to coat them with a composition which reduces such adherence, such as a Teflon coating composition. Also, to prevent ingress of such flushing liquid between the relatively sliding surfaces of the exterior of the axially bored clamp actuating rod 52 and the internal surface of the axial bore 53 through the motor drive shaft 21 the latter is preferably provided in the throat of its bore with an annular recess in which is seated a suitable annular rod wiper 52-2.

In anticipation of the possibility of pieces of the strand becoming caught in the clamping mechanism and turns thereof wrapped around the clamping plate rim 56, the latter and the restraining ring clamping flange 48 preferably are provided with a plurality of circumferentially-spaced aligned slots 73 and 74. Such aligned slots are designed to receive a bladed instrument, such as a knife, to sever such strand pieces and facilitate their removal at the doffing station 4.

It has been indicated that the clamp actuating rod 52 is designed to be reciprocated axially for thrusting the clamping plate 47 outward to the open position of the annular channel 57 and alternatively to retract it for constricting the width of the mouth of the channel to clamp the free running yarn therein periodically. While this reciprocating function may be performed by a variety of mechanisms it is desirable to effect this operation by means which have a lesser tendency to load the collet driving motor shaft to a degree that may effect momentary slowing of the speed of rotation of the collet structure, such as may result from certain types of camming mechanism. It is thus desired to perform this function by a double acting solenoid which has a lesser tendency objectionably to load the collet driving motor shaft and which may have an inherently faster action. Such a solenoid is illustrated at 75 in FIG. 6. Housing 76 of the solenoid 75 is equipped with a mounting sleeve or hub 77 which is preferably provided with a tapered bore 78 that is jammed upon the tapered projecting back end section 23 of the through motor shaft 21 by a nut 79 suitably prevented from backing off, such as by a set screw 80. Housing 76 is made of suitable non-magnetic material, such as aluminum. Within the housing 76 are fixedly mounted, in opposed relation, suitable cup-shaped pole pieces 81 and 82 of paramagnetic material, such as iron, between the rims of which is defined an annular space 83. The pole piece 81 houses an electromagnetic winding 84 to impose thrust upon the clamp actuating rod 52 and the pole piece 82 houses a similar winding 85 to impose retractive pull thereon, for respectively opening the annular clamping channel 57 to

receive the running strand A therein and constricting it to clamp the strand as it runs freely therein.

The clamp actuating rod 52 is stepped to provide an externally threaded section 86 within the solenoid housing 76 for threadably carrying thereon an armature sleeve 87 of paramagnetic material. Beyond the threaded section 86 the clamp actuating rod 52 is provided with a terminal stepped section 88 opposite which the armature sleeve 87 may carry suitable fixing means, such as one or more set screws 89. As a result of such threaded mount of the armature sleeve 87 on the clamp actuating rod 52 and the set screw equipment thereof the position of the armature structure thereon may be adjusted axially. The armature sleeve 87 carries a radially-extending, annular disk or plate 90, preferably formed integral therewith, to serve as an armature, which rides freely in the annular space 83 between the opposed edges of the pole pieces 81 and 82. Thus, when the coil 84 is energized the armature disk 90 is drawn forward to abutment of the annular edge of the pole piece cup 81 and when it is de-energized and the winding 85 is energized the armature disk is retracted to abutment of the annular edge of the pole piece cup 82, so as to effect the desired reciprocation of the clamp actuating rod 52. For the purpose of supplying electrical energy to the coils 84 and 85 the hub 77 may carry suitable slip ring structure 91. The slip ring structure 91 includes a suitable insulating ring 92 mounted on the neck of the supporting hub 77 and carrying a plurality of collector rings 93 suitably connected to terminals of the solenoid coils 84 and 85. Brushes 94, which may be conveniently supported by the back end of the housing of the collet driving motor 6, ride in contact with the collector rings 93 and are in turn connected to suitable energy supplying circuitry.

The rod end section 88 extends out through a bushing 76-1 in the back end of the solenoid housing 76 and therebeyond is provided with external threads threadably to support thereon the housing cup 95 of a check valve having in its back end 96 an inlet port 97 controlled by a valve ball 98 backed by a biasing spring 99. Thus, pressurized liquid may be supplied to the axial bore 65 of the clamp actuating rod 52 through this ball check valve at its back end when a source of pressurized liquid is applied to the check valve end 96.

As has been previously indicated, flushing through the thrust rod bore 65 past the check valve 95 is to be performed at the doffing station 4, following the removal from the collet structure 5 located thereat of the completed cake or package. For this purpose, there is mounted in fixed position at the doffing station 4 a suitable injector nozzle 100, in axial alignment with the axis of the collet structure 5 located thereat. This injector nozzle 100 has an outlet axial bore 101 terminating at the nozzle tip end 102 and surrounded thereat by a projecting ring gasket 103, supported by this tip end, for engagement of the surface of the check valve end 96 about the inlet port 97 therein for leakproof flow intercommunication. A flexible flushing liquid supply conduit 104 is connected to the side of the injector nozzle 100 and the passage therethrough communicates with the nozzle outlet bore 101. Suitable pressurized flushing liquid supply means is connected to the conduit 104 through control valve means (not shown) that is manipulated by suitable timer equipment, so as to supply pressurized flushing liquid through the check valve unit 95 and the clamp actuating rod bore 65 at the proper time, and to terminate such flow after the flushing action has been completed prior to indexing the empty collet structure 5 at the doffing station 4 forward to the winding station 3.

The injector nozzle 100 is suitably supported for axial reciprocation so that it may be thrust forward to effect the flow communication through the check valve unit 95 and, after termination of supply of the pressurized flushing liquid through the nozzle bore 101, to retract this nozzle from engagement of its tip end gasket 103 against the check valve end 96 for permitting the indexing of

the collet structure from the doffing station 4 forward to the winding station 3 without interference. For this purpose, the back end of the injector nozzle 100, beyond the point of communication of the supply duct 104 to the nozzle bore 101 thereof, is mounted upon a projecting piston rod 105 of a fixedly mounted, double-action, pneumatic cylinder 106, which may be of conventional construction. Since the pneumatic cylinder 106 is of the double-action type it contains a reciprocative piston which carries the projecting piston rod 105, with head chambers located on opposite sides of this piston to sub-divide the interior into a pair of end head chambers. Suitable conduits 107 and 108 communicate respectively with the end head chambers of the pneumatic cylinder 106, alternately to serve as means to supply the pressurized air to one of these head chambers while the other is being exhausted through the other conduit. As a result, the pneumatic cylinder 106 will thrust its piston 105 forward to move the tip end 102 of the injector nozzle 100 to communication of its bore 101 through the check valve unit 95, and then to retract this nozzle, after supply flow through conduit 104 is cut off, for permitting the forward indexing of the collet structure 5 from the doffing station 4 to the winding station 3.

In FIG. 7 are illustrated parts of the transverse equipment or way winder assembly 13, indicated in FIG. 1. This traverse equipment includes a suitable framework 110 provided with end walls 111 and 112 which support the longitudinally-extending guide rods 11 and 12 on which are reciprocally mounted a carriage 113. This carriage is provided with a rotatable, hollow core shaft 114 which projects forward for free axial motion through a hole in the frame end wall 111 to carry thereon rotary traversing mechanism 15, the axis of which is arranged substantially parallel to the axis of the driven collet structure 5 at the winding station 3 and is located opposite the main section of this collet structure thereat for guiding the strand A in the criss-cross winding of the latter on the core sleeve 44 carried by this collet structure. The hollow core shaft 114 is suitably driven at substantially constant speed by the motor 16 (shown in FIG. 1, but omitted from FIG. 7), supported in a conventional manner on the carriage 113, such as by a belt 115 lapped about a pulley 116 fixed upon the back end of this shaft. While the hollow core shaft 114 is being rotated by the motor 16 and its belt and pulley drive 115-116 this carriage is slowly reciprocated along the guide rods 11 and 12 with gradual foreshortening of the strokes thereof to lay down the successive layers of the strand A within the package in criss-cross pattern, so as to provide such package, indicated in broken lines at P in FIG. 3 with tapered end shoulders S. For this purpose, the carriage 113 supports a knuckle 117 to which is connected an axially reciprocated shaft or piston rod 118 that is driven back and forth by a suitable fluid motor or hydraulic cylinder 119 with gradually foreshortened strokes dictated by control mechanism (not shown). Thus the hydraulic cylinder 119 is of the double-action type and its end chambers are connected by suitable conduit means 120 and 121 to a source of pressurized liquid and venting equipment. The back end of the hydraulic cylinder is suitably connected at 122 to the back end wall 112 of the frame structure 110. According, when the carriage 113 is in its extreme forward position illustrated in FIG. 7 it will be retracted by piston rod 118 alongside of the hydraulic cylinder 119 when liquid is supplied to its front end head chamber by conduit 120 with venting of its back end chamber through conduit 121. And this carriage will then be driven forward by reversal of flows through the conduits 120 and 121.

The strand diverting bail 17 (shown in FIG. 2) that is designed to be arcuately oscillated, i.e., rotated forward and back through an arc, by means of its shaft 20 preferably has the latter coaxially supported in the bore of the traverse equipment operating shaft 114 by suitable bearing structure, one of which is indicated at 123 in

FIG. 7, to permit relative rotary action of shaft 20. This strand diverting bail shaft has its back end suitably coupled at 124 to shaft 125 of a suitable actuator 126 that is mounted in any desired manner upon the carriage 113, such as by a bracket 127. The rotary actuator 126 may be of the type in which stator housing 128, fixedly carried by the bracket 127, rotatably supports in a chamber thereof a vane rotor which is periodically driven in properly timed relation back and forth by fluid feed to and vented from this chamber by suitable valving equipment (not shown). Consequently, the strand diverting bail 17 will be rotated in a counterclockwise direction from its retracted position 170, shown in FIG. 1, forward to its full line position shown therein, upon completion of the winding of the package P upon the collet structure 5 at the winding station 3, so as to divert the running strand A from contact with the side of the rotating traversing mechanism 15 within the package winding zone of the collet structure and to carry this strand axially out beyond this zone to an end zone of the collet structure, into transverse alignment with the closed clamping channel 57 of this collet structure that is located in a transverse plane in which is disposed the like clamping channel, in open condition, of the following empty collet structure. Thus, as this empty collet structure is swung forward toward the winding station 3 by indexing of the head 2 the diverted running strand A will be freely received in the open clamping channel 57 of this on-coming empty collet structure.

The strand diverting bail 17, details of which are shown in FIG. 2, preferably includes, in addition to its substantially radially-extending arm 19 and the rotary shaft 20 on which it is fixedly carried for rotation thereby, an elongated or attenuated terminal bail member 18, which may be in the form of a length of shaped, round rod, that may be desirably arranged generally in a radial plane in which extends the axis of the rotary shaft 20. One end of this bail rod 18 is suitably fixed to the outer end of the arm 19 and, therebeyond, is bent first back to extend rearward generally normal therefrom. Immediately beyond this backward bend the rod is bent downward to provide with the backward bend a bail shoulder loop 18-1. The remainder of the bail rod 18 is then bent upward to define a strand-guiding, bail notch at 18-2 beyond which the terminal portion 18-3 thereof extends obliquely back and flares outward. It is this latter flared portion 18-3 which is adapted to engage against the forwardly traveling strand A as it laps against the rotary traversing mechanism 15 to force it away from the latter so that it may then ride down and forward into the notch 18-2 for diverted run.

Let it be assumed that at the completion of the package P upon the rotating collet 5, about the core tube 44 carried thereby, at the winding station 3 the carriage 113 is in an intermediate position between the terminal ends of its maximum path of reciprocation, and that the running strand A is in contact with the intermediate zone of the rapidly rotating traversing mechanism 15, such as in the broken line position A-1 indicated in FIG. 2. As the strand diverting bail 17 is rotated or swung counterclockwise as viewed in FIG. 1 from its retracted broken line position shown at 170 forward toward its full line position shown at 17 therein, the running strand in its position at A-1 will be engaged by the oblique or flared section 18-3 of the bail so as to run down along the far side thereof to its notch 18-2, through the distance x, to be temporarily held while running in this position, shown in full lines at A, by the bail shoulder 18-1. It will be noted from FIG. 2 that the completion of the package winding operation may occur when the carriage 113 that manipulates the traversing mechanism 15 is more fully advanced, such as to the outer end of its forward path of travel as may be the case in a preferred embodiment, so that the running strand may be in the broken line position of A-2. The oblique section

18-3 of the strand diverting bail 17 will be of a length sufficient to permit it to engage the running strand when in such position A-2 for diverting this strand forward through the distance y to the full line position A at the bail notch 18-2. Thus the bail 18-3 will pick up the strand A in any position of the latter at and between the A-2 and A positions shown in FIG. 2.

Since this position shown in full lines at A in FIG. 2 is in the plane of the closed annular clamping channel 57 of the collet 5 at the winding station 3 and this open annular channel of the next oncoming collet, as the latter is to be swung forward in a clockwise direction from the doffing station 4 to the winding station, this open annular clamping channel of the oncoming empty collet is properly aligned with the running strand to receive it in free running condition therein.

As will be better understood from the diagrammatic showings in FIGS. 8 and 9, as the running strand A has been diverted outward to its full line position shown in FIG. 2 by the forward rotation of the bail 17, after this running strand has been lifted thereby from contact with the rotating traversing mechanism 15, the turret head 2 is rotated clockwise or indexed forward to carry the filled collet from the winding station 3 to a position about that indicated in broken lines at 5-1f (FIG. 8). The empty collet will then be about in the position of 5-1e, shown in broken lines in FIG. 8, with the running strand A freely traveling through its open annular clamping channel. Then the timing equipment (not shown) will dictate retraction of the clamping plate actuating rod 52 (FIGS. 5 and 6) so as to cause a section of the free running strand to be clamped between the opposed clamping plate and collet annular surfaces 59 and 50. This clamped section of the running strand A may extend through a radial angle of a few degrees to about 90°. This clamping anchorage of the running strand A will transfer it from the outer end zone of the rotating filled collet to the outer end zone of the oncoming rotating empty collet in the following manner. As the turret head 2 travels to farther forward through a few degrees (the angle α) to carry the collets 5 from their positions shown in broken lines in FIG. 8 to the full line positions thereof at 5-2f and 5-2e, the forward point of clamping at c-1 on the periphery of the constricted clamping channel of the oncoming empty collet may travel through an angle, such as that indicated at β , to point c-2, so as to bend the strand A sharply at point c-2 and there snap it off. Thereafter, as the turret head continues its swing through 180° to carry the rotating empty collet to the winding station 3 while the other filled collet is being advanced thereby to the doffing station 4 the strand diverting bail 17 will be retracted or swung back in clockwise direction, away from contact with the running strand A, to permit the latter to return to its winding path and to contact the rotating periphery of the traversing mechanism 15 for laying down about the core tube on the empty collet in criss-cross pattern the successive layers to build up a new package thereon at the winding station.

As this empty collet is swung to the winding station 3 the filled collet is swung forward to the doffing station 4 and brought to a complete stop there to permit doffing of its package P. The drive of the filled collet at maximum speed by its driving motor 6 is continued until the filled and empty collets reach their full line positions 5-2f and 5-2e indicated in FIG. 8, i.e., this motor is not de-energized to slow down the filled collet at least until after the running strand A is clamped to the empty collet and snapped off at the point c-2 on the periphery of the outer zone of this collet as it is being rotated at the same speed by its own driving motor 6.

The doffing operation at the doffing station 4, after the filled collet structure is swung thereto by the completion of the 180° indexing of the turret head 2 and stopped, includes removal of the package with its core tube 44 from the stopped collect structure, as is permitted by

radial inward motion of the now non-rotating collet segments 33, and then forward thrust of the clamping plate actuating rod 52 by the solenoid 75 when manipulated to attain the relative positions of the parts illustrated in FIG. 6. Thereafter, an empty core tube 44 is telescoped over this undriven collet structure and flushing operation is performed. For the latter purpose the nozzle 100 is thrust forward by its actuator 106 to communicate nozzle bore 101 through the check valve unit 95 to the bore of the clamping plate actuating rod 52 for flushing out the interior of the now empty collet and its open channel 57. The flushing operation is attained by proper valving of the supply of pressurized flushing liquid through the conduit 104 leading to the nozzle 100. After termination of the flushing operation the nozzle 100 is retracted. There doffing, core tube replacement, cleaning and nozzle retraction actions are completed at the doffing station 4 while the next package is being wound upon the collet that is now located at the winding station 3. The motor of the empty collet at the doffing station 4 is started up to bring the latter up to full speed before it is swung by the next indexing motion of the turret head 2 to the broken line position 5-1e illustrated in FIG. 8. A more complete understanding of the relatively timed operations of the various parts of a preferred embodiment of the forming winder machine may be had by reference to the following operational sequences which are attained by action of the operator and the automatic timing equipment when the machine is first placed in operation, and this includes first "Manual Operation" and then "Full Automatic Operation."

SEQUENCE OF MECHANICAL OPERATIONS

(I) Manual operation

(1) Before electric power is suitably supplied to the circuitry of the forming winder 1 illustrated in FIG. 1 this apparatus is in the fully indexed, rest position, with the parts and sub-assemblies thereof in the following conditions. The spindles or driving shafts of the pair of rotary collets 5 respectively at the winding and doffing stations 3 and 4 are stopped. The traverse carriage 113 of the way winder assembly 12 is in its fully retracted position, i.e., as far back as its reciprocative travel permits. The strand diverting member or bail 17 is in its rotatably retracted or disengaging position shown in broken lines at 170 in FIG. 1. The collet 5 at the doffing station 4 has its clamping end plate 47 axially extended so that its annular strand-receiving channel 57 controlled by the axial translation of this end plate is wide open. The clamping end plate 47 of the other collet 5 at the winding station 3 is retracted axially to constrict the annular strand-receiving channel 57 thereof.

(2) When operation is to be initiated a selector switch is manipulated to a manual setting to supply power to the circuitry of the forming winder 1 when a starting trip switch in this circuit is closed.

(3) The operator places an empty package collector or paperboard core tube 44 on the collet 5 at the winding station 3 and he then closes the starting trip switch. As a result the following actions take place:

(a) The spindle of the collet 5 at the winding station 3 is rotated by its motor 6 with rapid acceleration of this collet to the maximum r.p.m.;

(b) The way winder motor 16 then begins rotatably to drive the way winder or traversing mechanism 15;

(c) The hydraulic cylinder 119 starts to reciprocate the carriage 113 to advance the rotating way winder or traversing mechanism 15 forward alongside of and parallel to the rotating collet 5 at the winding station 3;

(d) The operator manually guides the running strand A of glass fibers from the outer end of the rotating collet 5 at the winding station 3 back to lap it against the medial throat of the rotating way winder 15 so as to commence the laying of the strand on the collector or tube 44 being

rotated by collet 5 at the winding station 3, and the winding of the package is continued to completion.

(II) Full automatic operation

(4) In order to shift the manual operation to automatic operation the operator then shifts the selector switch to automatic setting.

(5) The operator places an empty core tube on the non-rotating collet 5 at the doffing station 4.

(6) The pneumatic cylinder 106 at the doffing station 4 thrusts the injector nozzle 100 forward to engagement of the check valve unit 95. Pressurized cleansing liquid or water is then forced through the check valve unit 95 and the bore 65 of the clamping plate actuating rod or draw bar 52 for pressurized delivery out between the extended clamping plate 47 and the outer restraining ring 41 of this non-rotating collet at the doffing station for purging the open annular clamping channels 57 thereof.

(7) The spindle of the collet 5 at the doffing station 4 is then driven by its motor 6 for acceleration to maximum r.p.m.

(8) As the cake or package of the strand A is completed on the rotating collet 5 at the winding station 3 the following sequence occurs:

(a) As the way winder or traversing mechanism 15 is moved outward by its carriage 113 to the outer limits of its path of travel this carriage will stop to hold the way winder in this outward position;

(b) The strand diverting member or bail 17 will be rotated counterclockwise by its actuator 126 from its retracted broken line position 170 to its advanced full line position shown in FIG. 1, so that its oblique end section 18-3 will engage the running strand A and divert the latter away from contact with the rotating way winder 15. This permits the running strand A quickly to work down outwardly into the guide notch 18-2 (FIG. 2) where the strand is aligned with the closed annular clamping channel 57 of this collet at the winding station 3. As a result the running strand A will be aligned with the like open annular clamping channel 57 of the oncoming empty collet when the turret head 2 is rotated clockwise for substitution of this empty collet for the filled collet at the winding station 3;

(c) The indexing motor 7 then drives through sprocket 8, endless chain 9 and head sprocket 10 the indexing head 2 forward to swing the filled collet at the winding station 3 toward the doffing station 4 with simultaneous swing forward of the empty collet at the doffing station 4 toward the winding station while this empty collet is being rotated at maximum r.p.m.;

(d) As the indexing head 2 rotates forward in a clockwise direction a few turns of the strand A are wound up on the outer transfer end zone of the collet carrying the completed package from the winding station 3. Simultaneously, this indexing action swings the oncoming empty collet toward the winding station 3. Appreciably before the empty collet arrives at the winding station its outer end or nose will intercept the running strand A so that the latter will ride into the open annular clamping channel 57 of the oncoming empty collet, due to the previous alignment of the running strand with this open annular channel, for free running therethrough as the indexing head rotates farther forward;

(e) As the oncoming empty collet 5 is swung by the indexing head 2 still further forward toward the winding station 3, with the strand A running freely in its annular clamping channel 57, the clamping plate 47 thereof is retracted by its draw bar 52 to constrict the channel and clamp the strand tightly therein. Thus, a section of the strand extends from the outer end of the rotating collet which carries the finished package as it moves toward the doffing station 4 back to the point of clamping in the now closed annular clamping channel 57 of the rotating empty collet so that immediately this section of the strand at the forward point of clamping is bent sharply back to break

it off while the strand back of this clamped section commences to be wound around the outer end zone of the empty collet, as is indicated graphically in FIG. 8;

(f) The driving motor 6 of the filled collet thereafter is dynamically braked, so as to bring it to a full stop at the doffing station 4;

(g) While the filled collet is held undriven at the doffing station 4 during the winding of the next package on the following driven collet now held at the winding station 3 the annular clamping plate 47 of the filled collet is thrust axially outward to open its clamping channel 57 and the operator doffs the completed package from this collet. He frees this now empty undriven collet at the doffing station from the strand wound about its end zone by severance with a knife inserted in the slots 73 and 74;

(h) The operator then places on this doffed undriven collet another empty collector tube and the now open clamping channel 57 of this collet is then purged in the manner indicated in item (6) above;

(i) Following this purging the driving motor 6 of this purged collet, while the latter is still at the doffing station 4, begins rotating it to bring it rapidly up to maximum r.p.m. at least by the time this collet is swung forward by the indexing head 2 to interception of the running strand A and reception of the latter in the open versing mechanism 15; and

(9) As the turret head 2 simultaneously swung the oncoming empty collet finally to the winding station 3 while a few turns of the strand A that is clamped to its outer end are being wound about the latter the following sequence of actions occurs:

(a) The strand-diverting member or bail 17 is retracted by clockwise swing from its full line position to its broken line position 170 in FIG. 1 so as to return the strand A to the medial throat of the rotating way winder or traversing mechanism 15; and

(b) The carriage 113 begins retracting from its outermost position to initiate the reciprocation of the continuously rotating way winder or traversing mechanism 15.

(10) The next cycle of automatic operation is then repeated for completion of the next cake or package and the ultimate doffing thereof.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

Having described our invention, what we claim as new and desire to secure by Letters Patent is the novel subjects matter defined in the following claims:

1. A forming winder successively to produce wound packages of a running strand of certain diameter comprising, in combination,

(A) rotatable turret head means carrying a plurality of circumferentially spaced, rotatably driven, winding collets;

(B) means to rotate said turret head means step-by-step to advance each empty collet to a winding station and there guide the running strand to the rotating collet to build a package of the strand thereon; and

(C) means defining a doffing station to which each collet filled with a wound package is then swung from the winding station to permit removal of the package there while this filled collet is not rotating and as the next succeeding, rotatably driven, empty collet is being wound at the winding station with another package of the strand; wherein the improvement comprises

(a) a collet structure including a generally cylindrical collet body that is rotatably drivable

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about its own axis and has a main annular zone on which a package of the strand is to be wound with this zone terminating in an annular, transverse, marginal face, and also an axially outer end zone beyond said annular transverse face;

- (b) an axially translatable, transverse, strand clamping means embodied in said end zone which rotates with said package winding zone and has on its inward side an annular, transverse, marginal face opposed to that of the main annular zone defining with the latter an open, intervening, annular strand clamping channel in an axially outer position of said clamping means of a width greater than the strand diameter for free run of the strand in this channel when diverted axially outward from alignment with the annular package winding zone of a preceding collet body on which it is being wound and guided along a diverted path of supply extending through said channel; and
- (c) means axially to thrust outward and retract inwardly said clamping means irrespective of the rotation of said collet body alternately to open up said channel for the free run of the strand therethrough while the latter is guided along the diverted supply path to the preceding winding collet body and axially to constrict said annular channel to clamp a section of said guided running strand between said opposed, transverse, marginal faces while said collet body is rotating to bend sharply at a point of clamping the section of the strand that extends between this clamping collet body and the preceding winding collet body for break at this point.

2. The forming winder as defined in claim 1 in which said collet structure includes solenoid actuated mechanism as the means to thrust outward and retract inwardly said clamping means.

3. The forming winder as defined in claim 1 in which said collet structure includes a rotated, hollow, driving shaft having a through longitudinal bore, and said means to thrust and retract said clamping means is a reciprocated rod extending coaxially through the driving shaft bore.

4. The forming winder as defined in claim 3 in which said thrust and retract means includes a double acting solenoid mounted on the back end of said collet driving shaft and connected to said rod for reciprocating the latter.

5. The forming winder as defined in claim 1 in which said collet structure includes a rotated, hollow, driving shaft having a through bore, and means are provided to deliver through the bore a flushing liquid to said annular clamping channel.

6. The forming winder as defined in claim 5 in which said clamping means is in the form of a circular end plate having the inward side thereof cooperating with opposed structure of said collet body defining an intervening annular space communicating with said annular clamping channel, said means to deliver flushing liquid being communicated to said annular space for centrifugal discharge out through said channel.

7. The forming winder as defined in claim 6 in which said means to deliver a flushing liquid through the collet driving shaft bore is tubular conduit means reciprocally extending through this shaft bore to communication with said annular space, and said conduit means is of sufficient rigidity to comprise the means for thrusting and retracting said clamping plate.

8. The forming winder as defined in claim 7 in which said tubular conduit means has a back end section extending rearwardly out of the bore of said collet driving shaft, and the clamping plate thrusting and retracting means includes a double acting solenoid into which said back

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end section extends with said solenoid having an armature mounted on said back end section selectively to reciprocate said tubular conduit means.

9. The forming winder as defined in claim 8 in which said back end conduit section extends through said solenoid to provide an accessible tip end beyond the latter, and which includes flushing liquid supply means at the doffing station movable forward to engagement of said conduit tip and for flow communication with said conduit means and away therefrom for disconnection to permit said collet structure to be advanced from the doffing station.

10. The forming winder as defined in claim 9 in which the passage through said conduit is equipped with a check valve, and said flushing liquid supply means includes an axially reciprocative nozzle communicative with the conduit passage when thrust forward to contact of the conduit tip end for pressurized delivery into the passage of the flushing liquid through said check valve, retraction of said nozzle freeing the latter from contact of said tip end.

11. In a forming winder successively to produce wound packages of a running strand of certain diameter comprising a plurality of circumferentially spaced, rotatably driven, winding collet structures upon a rotary turret head structure for progressively swinging them consecutively to a winding station for there criss-cross winding a package of the strand on an annular zone of each collet structure with the aid of suitable reciprocative traverse equipment including a rotated strand-guiding traversing member as the strand travels forward along a winding supply path, and then forward to a doffing station for removal of the package from each collet structure, wherein the improvement comprises

- (a) collect means defining axially outward of the annular packaging zone of each collet structure an annular end zone including axially translatable, transverse, strand clamping means rotatable with the remainder of the collet structure and capable of being alternately axially thrust outward away from and retracted toward the latter, and defining in an axially outward position thereof between an annular inward side face of it and an opposed annular outward side face of the adjacent collet structure an open, intervening, annular strand clamping channel of a width greater than the diameter of the strand for free run of the latter therethrough when diverted to transverse alignment therewith; and

(b) strand diverting means at the winding station mounted for arcuate oscillation about an axis substantially parallel to the axis of such collet structure when located at the winding station and comprising

- (i) a transversely-extending means to be rotatably swung alternately forth toward and back away from the winding supply path of the running strand; and

- (ii) a terminal member carried by said transversely-extending means for swing therewith shaped to provide successively back in a longitudinal direction away from the annular channel of each collet structure at the winding station a stop shoulder limiting forward diversion of the running strand to transverse alignment with the collet channel, a notch adjacent said shoulder in which the diverted strand is adapted ultimately to run in alignment with the open annular channel of the following empty collet structure as the latter is being swung toward the winding station, and an oblique and outwardly flared portion extending back across the winding supply path of the running strand to engage the latter when said transversely-extending means is swung forward and then to guide the strand therealong into the notch.

12. The strand diverting means of claim 11 in which the transverse equipment includes a reciprocating car-

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riage upon which said strand diverting means is rotatably carried and which also supports means to swing said transversely-extending means forth and back.

13. The strand diverting means of claim 12 in which said transversely-extending means is in the form of an elongated arm, said carriage rotatably supports a first driven hollow shaft for supporting and rotating the traversing member with said shaft having its longitudinal bore arranged substantially parallel to the axis of such collet structure when at the winding station, and said strand diverting means includes a second rotatable shaft extending through the bore of the first driven shaft with the outer end section of the second shaft extending forward beyond said first shaft and fixedly carrying said arm thereon for arcuate swing thereby outward of the traversing member with the strand diverting flared portion extending back alongside of the latter, and said swinging means is in the form of an actuator to rotate said second shaft arcuately forth and back.

14. In a forming winder successively to produce wound packages of a running strand means to divert the running strand from a winding supply path forward to a transfer path at a winding station, wherein the improvement comprises.

- (a) a rotatable shaft,
- (b) an actuator arcuately to oscillate said shaft through less than a complete revolution thereof,
- (c) a radial arm having one end fixedly carried by

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said shaft for arcuate swing of its outer other end thereby, and

- (d) a length of rod stock having one end fixedly mounted on the outer end of said swinging arm, this rod being bent to extend generally normal to said arm and back away therefrom generally parallel to said shaft, then inward generally parallel to said arm to define with the first bend an outwardly extending loop shoulder to limit travel of the running strand therealong, and then outward to define a strand guiding notch adjacent said loop shoulder and an elongated terminal portion which extends obliquely back away from the notch and flares outward to engage the running strand and cause the latter to advance therealong down into the notch.

References Cited

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U.S. Cl. X.R.

242—46.5

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,490,707

Dated January 20, 1970

Inventor(s) Saul Warshaw, Arnold J. Eisenberg, Winton Loveland and
Jaime Guilbe-Jimenez

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

Column 3, line 31, for "clamping" read --clamped--;
column 5, line 41, after "dotted" insert --lines--; column 5,
line 48, for "of" read --or--; column 6, line 67, for "found"
read --wound--; column 11, line 23, for "collect" read --collet--
column 12, line 41, after "rod" insert --18--; column 13, line 2
for "stand" read --strand--; column 13, line 40, strike out "to"
column 14, line 42, for "12" read --13--; column 14, line 45,
for "disengaging" read --disengaged--; column 15, line 25, for
"limits" read --limit--; column 16, line 26, for "versing
mechanism 15; and" read --clamping channel 57 of this collet.--;
column 18, line 34, for "collect" read --collet--; column 18,
line 37, for "rotatable" read --rotatable--; column 18, line 75,
for "transverse" and "reciprocating" read --traverse-- and
--reciprocated--; column 19, line 5, for "transfusely" read
--transversely--; column 19, line 13, for "the", first occurrence
read --an--.

SIGNED AND
SEALED
JUN 23 1970

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents