Oct. 17, 1967 E. M. STERNBERG 3,347,478

TRAVERSE WINDING MECHANISM

Filed Feb. 26, 1965 2 Sheets-Sheet 1

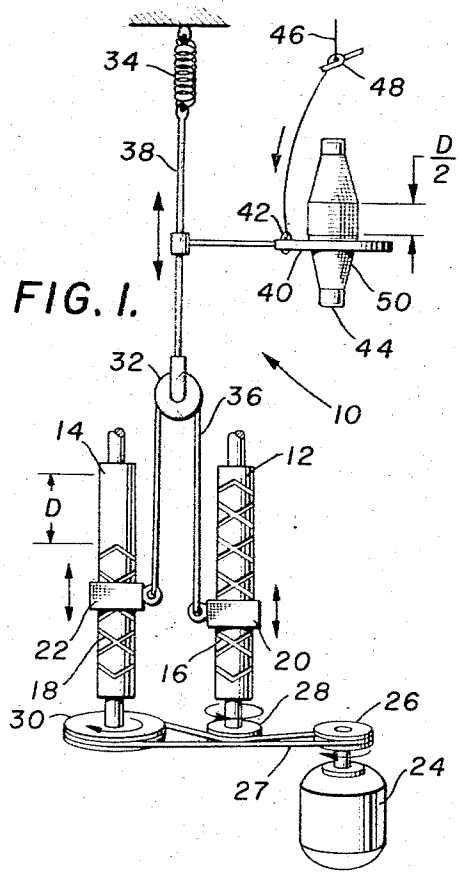


FIG. 1.

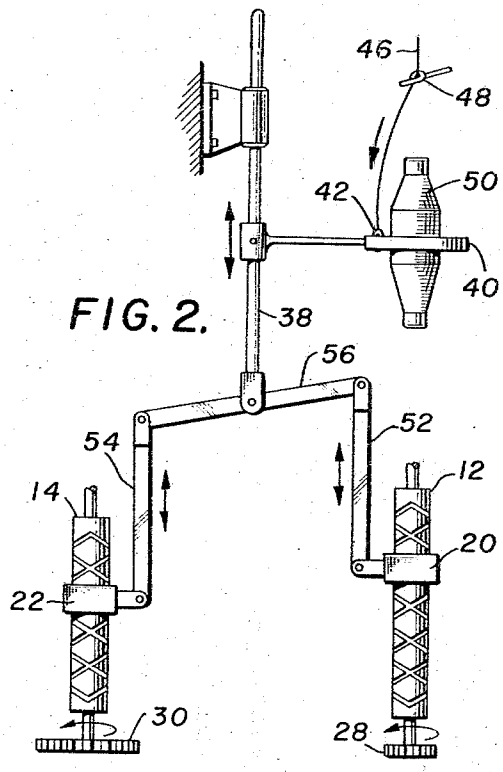


FIG. 2.

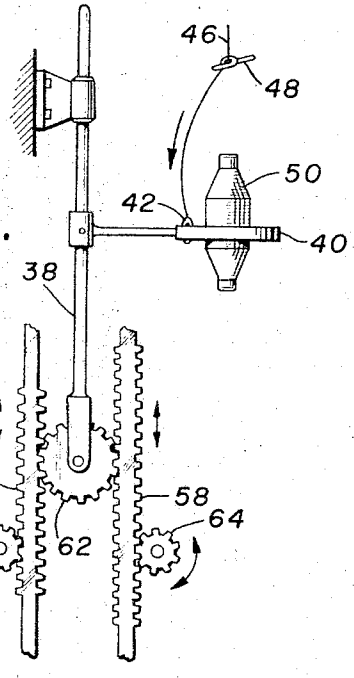


FIG. 3.

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TRAVERSE WINDING MECHANISM

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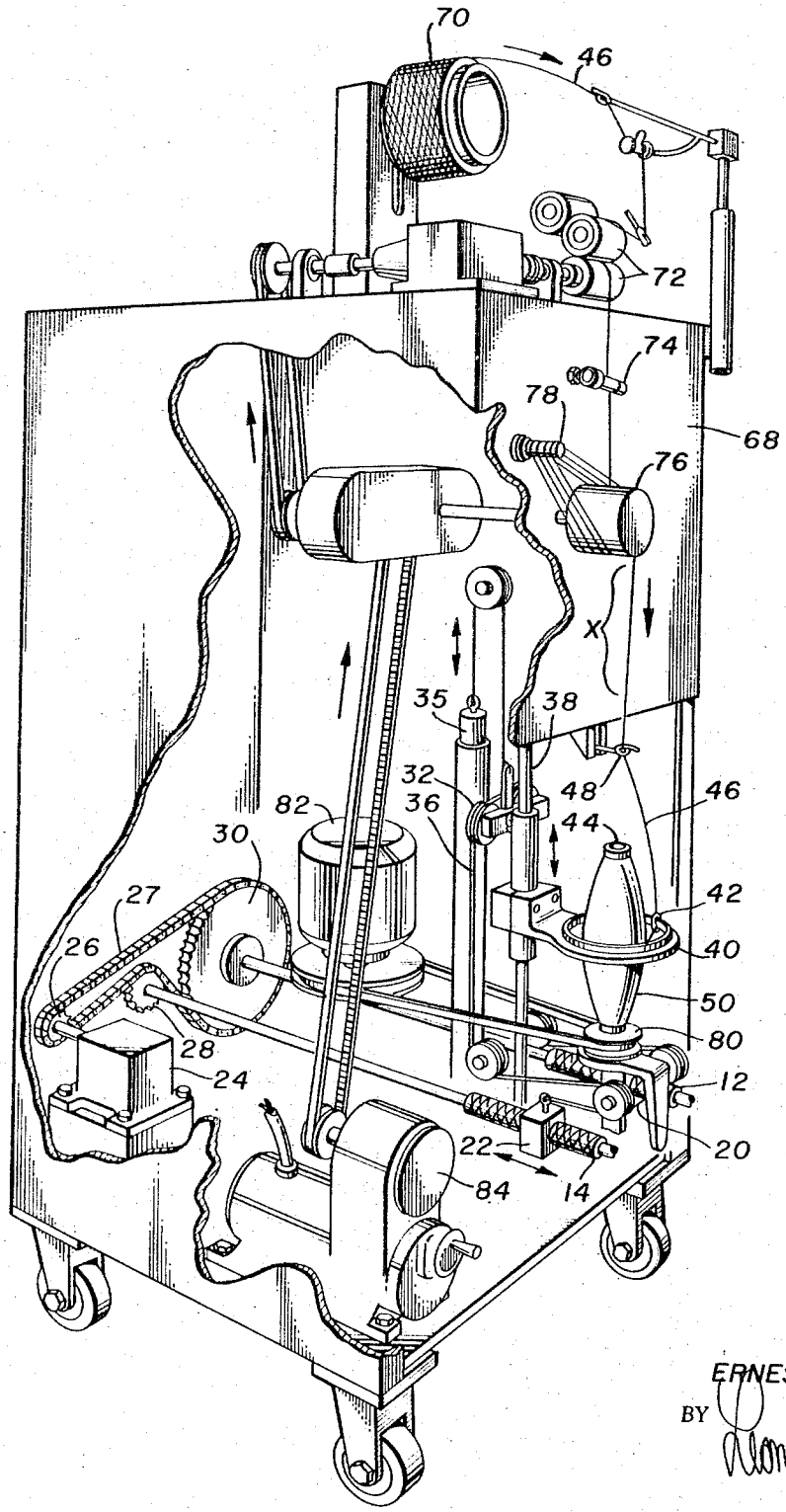


FIG. 4.

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TRAVERSE WINDING MECHANISM

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ABSTRACT OF THE DISCLOSURE

A traverse mechanism featured by a pair of input elements linked to drive the traverse in a direction and at a velocity according to the algebraic sum of the individual velocities of the input elements. In a preferred embodiment, the input elements are in the form of a pair of fishing-reel-type winding screws driven at differential rotational velocities and having differential strokes.

This invention relates to package winding mechanisms for winding strands, yarns, threads, slivers, or the like, of filamentous materials on cones, tubes, bobbins, or other similar revoluble package supporting members at high speeds. More particularly, the invention relates to novel traversing mechanisms for use in winding continuous filamentous material on a spool, bobbin or like holder in a uniform, controllable manner.

Throughout the instant specification and claims, the term "strand" is intended to include thread, yarn, sliver, fiber, filament, wire, ribbon, fibrous or filamentary bundles, and the like.

In the textile industry, strands obtained by various processes are wound into packages on bobbins or like revoluble supporting members. In such winding operations, it is necessary to employ some means of axially traversing the strand back and forth along the package. Various and sundry traversing means have heretofore been proposed for use in such winding operations. These prior devices have ordinarily comprised a reciprocating member or guide which travels back and forth adjacent the surface of the rotating package support member on which the strand material is being wound. In general, the reciprocating motion of the guide member has been accomplished by means of a cam, or the like. As is widely recognized, such prior cam arrangements suffer from undue wear, are limited and cumbersome in the manner of their manipulation, and lack the degree of compactness desired in many limited scale operations, particularly those encountered in testing and experimentation.

With these desires and prior art shortcomings in mind, it therefore becomes a general object of my invention to provide improved traversing mechanisms for use in strand winding and packaging operations, which mechanisms possess a compactness of arrangement, flexibility in manipulation and precision of result heretofore unattained.

A further object are such traversing mechanisms which may be economically manufactured in the form of one or more packaging stations.

According to the present invention, the foregoing and other objects are attained by providing an improved traverse mechanism of newfound compactness of arrangement and flexibility of operation, a mechanism which effects a uniquely advantageous use of the basic principle of converting two independent inputs into a combined differential output to thereby control the program of movement of a traverse guide along a strand package to obtain a high precision of widely variable package configurations. Basically, such a mechanism takes the form of a pair of input elements driven through reciprocal paths of pre-selected lengths at a pre-determined difference in velocities, which input elements are linked to drive a reciprocably mounted output element and an associated traversing guide in a direction and at a velocity according to the algebraic sum of the individual velocities of the input elements. A preferred embodiment of the invention takes the form of a pair of parallel rotating "fishing-reel-type" winding screws driven at different velocities of rotation, the enclosed helical grooves of which are each engaged by one of a pair of input elements to be urged therealong through reciprocating strokes to drive a resiliently biased, reciprocably mounted output pulley according to the algebraic sum of the input element velocities. Floating lever or rack arrangements may as well as employed in lieu of an output pulley, though the latter is preferred. A further important aspect of this invention essential to optimum package configurations resides in the provision for a high ratio of input speeds productive of greater uniformity in traverse guide speed and in the provision that such input speeds are relatively prime to one another, a feature which minimizes the number of coincident reversal points experienced in the travel of the traverse guide. As employed in the instant specification and appended claims, the term relatively prime input speeds connotes that relationship wherein one of the input speeds is not divisible by the other (an example of such relationship being in the numbers (or speeds) **12** and **25**). That is, the input speeds are so related as to have no common divisor save unity.

With regard to the feature of maintaining a high ratio of input speeds, it has been found impractical to operate the present device at ratios of less than 3:1 where optimum package configurations are to be obtained. At input speed ratios less than 3:1, it has been found that the resulting package often exhibits objectionable ridge formations because of an undue lack of uniformity of traverse guide speed. This result becomes readily apparent when one considers the program described by a traverse guide driven according to the present invention at an input speed ratio of, for example, 2:1. The traverse guide will experience a variation in velocity between a maximum factor of 2 and a minimum of 0.5, a considerable and intollerable variation; however, at a ratio of input speeds of, for example, 11:1, traverse guide velocity will only vary between the limits of a factor of 6 and 5; similarly, at still higher input ratios, the percentage variation in guide velocity becomes proportionately smaller. It is therefore preferred to operate the herewith disclosed traverse mechanism at as high a ratio of input speeds as is practicable.

Where it is desired to produce package configurations exhibiting flat mid-portions, a further important aspect of this invention resides in the provision of a differential in stroke lengths of the input elements, an arrangement which causes the traverse guide to travel uniformly over the mid-portion of the package being constructed. Additionally, where it is desired to construct a package exhibiting a difference in tapers adjacent each end, such as is expressed by the efficient "tear drop" configuration, the helix angle formed in at least one of the fishing-reel-type winding screws is caused to decrease to a minimum adjacent one lengthwise extremity of the stroke of the input element, and arrangement which causes the traverse guide to accelerate its travel over that portion of the package being constructed.

To facilitate a better understanding of the details of construction of some possible embodiments of my invention, reference shall now be had to the drawings as being illustrative, but not limitative, thereof, wherein like reference numerals refer to like parts and in which:

FIG. 1 is a simplified schematic of the preferred form of my traversing mechanism showing fishing-reel-type

driven input elements acting through a belt member to drive a combined differential output pulley;

FIG. 2 schematically depicts a second embodiment of my invention characterized by a free-floating, combined differential output lever;

FIG. 3 schematically depicts a possible third embodiment of the invention characterized by a pair of reciprocably mounted, free-floating rack elements driving a combined differential output gear, and

FIG. 4 is a perspective view of a portable, single station draw-twister arrangement which embodies the principles of my traverse mechanism.

Referring now to the schematic representation of FIG. 1 as depicting a preferred embodiment of my invention, the traversing mechanism, generally indicated by numeral **10** is seen to comprise a pair of parallel extending, fishing-reel-type traverse winding screws **12, 14**, which screws are each characterized by endless, reverse helical cam grooves **16, 18**, respectively, formed in the surfaces thereof, such that a follower inserted therein will trace the groove from one end of the screw to the other in a continuous fashion as the screw is caused to rotate. Each of the winding screws **12, 14** has coaxially mounted thereon and in sliding engagement therewith a sleeve-like input elements **20, 22**, respectively, each having a follower shoe protruding from its inner surface and sized to snugly engage the endless grooves **16, 18**. It will be apparent that, upon causing the screws to rotate about fixed axes, the input elements will be caused to travel along the length of the screws at a rate dependent upon both the speed of screw rotation and the helix angle at a given point along the groove, which angle is that described by a tangent to a given point along the groove with a line parallel to the axes of rotation of the screw.

A most advantageous arrangement for driving the screws at optimum speed ratios is found in the provision of a variable speed motor **24** driving a timing belt, chain or the like through power take-off **26**, the belt being entrained around sprockets **28, 30**, driving screws **12, 14**, respectively.

A most beneficial feature of the present invention resides in the provision of a reciprocating mechanism (which, in the arrangement illustrated in FIG. 1, comprises motor **24**, take-off **26**, timing belt **27**, sprockets **28, 30** and winding screws **12, 14**) which is so designed as to drive the input elements **20, 22** at a high velocity ratio at speeds relatively prime to one another, i.e. indivisible by one another. For example, this may be accomplished by providing a 19-tooth sprocket for element **28** and a 61-tooth sprocket for the element **30**, an arrangement resulting in a speed ratio, for a given identity of helix angles, between the input elements greater than the 3:1 ratio considered requisite to optimum package formation, as well as being a speed ratio possessing the relationship of being relatively prime to one another. It is, of course, contemplated that a suitable gear train may be incorporated between the motor **24** and the sprockets **28, 30** designed to produce still higher ratios of input velocities and a concomitant more uniform velocity of output through the combined differential output element **32**, which, in FIG. 1, takes the form of a resiliently biased, free-floating output pulley.

The combined differential output pulley **32** is constrained to reciprocate along a substantially linear path through the combined influence of, on the one hand, a resiliently biasing force imparted by constant tension spring **34** or weight **35** (see FIG. 4) and, on the other hand, a linkage which, in the FIG. 1 embodiment, takes the form of a flexible cable **36** entrained over the output pulley **32**, each end of the cable **36** being affixed to one of the output elements **20, 22**. The biasing force on pulley **32** serves to maintain a substantially constant tension at all times in flexible cable **36**.

The motion of the combined differential output element **32** is transmitted by suitable means, such as a rod or wire **38**, to a conventional ring-traveler arrangement normally comprising a ring member **40** and a strand traveler **42** mounted to slide along the ring with a minimum of friction. Bobbin **44** is driven at high rotative speeds by any suitable means, not shown, to cause the supply strand **46** to travel through balloon guide **48**, thence through traveler **42** to then be enwrapped about the forming strand package **50**. By operation of the described traversing mechanism, the ring-traveler assembly is caused to traverse bobbin **40** axially at a speed equal or proportional to and in a direction according to the algebraic sum of the velocities of the respective input elements **20, 22**. It will be appreciated that, by operation of the instant traversing mechanism, there is produced a package characterized by a differential fill winding wherein the traverse of the yarn traveler guide axially of the package is of uniform, successively displaced strokes lengthwise of the package during the winding operation.

A further important feature of my invention, as previously mentioned, lies in an arrangement productive of packages exhibiting uniform flat mid-portions. This is accomplished by sizing the longitudinal dimensions of grooves **16, 18** to have a predetermned difference in effective stroke lengths, as indicated in FIG. 1 by the distance labeled D. By this arrangement, it will be appreciated that the builder motion described by the ring traveler will experience a uniform residence period over the mid-portion of the package equal to one-half the difference in effective stroke lengths of the input elements **20, 22**. By varying this difference in stroke lengths, a package having any desired length of flat mid-portion may be formed.

Turning now to a second possible embodiment of my traverse mechanism, as depicted in FIG. 2, the arrangement is substantially identical to that of FIG. 1, save that, in lieu of the flexible linkage **36** and output pulley **32**, there are provided linkages **52, 54**, each interconnecting one of the input elements **20, 22** with one end of a floating, combined differential output lever **56**, the motion of which is transmitted to the ring-traveler arrangement **40, 42** via transmitting wire or rod **38**. The operation is similar to that of the embodiment illustrated in FIG. 1, save that, by this arrangement, output variations may expediently be effected by, inter alia, varying the ratio of the lever arms through which linkages **52, 54** act upon floating lever **56**.

A third embodiment of my traversing mechanism is illustrated in FIG. 3 in the form of a pair of reciprocably mounted, free-floating rack members **58, 60**, which may be reciprocated, like output elements **20, 22** in the embodiments of FIGS. 1 and 2, by means of individual fishing reel-type screws previously described. The racks **58, 60** may, therefore, be arranged to interconnect one of the equivalent of input elements **20, 22** with a combined differential output gear **62** which, again, functions in a fashion equivalent to that performed by floating lever **56** in the embodiment of FIG. 2 and output pulley **32** in the embodiment in FIG. 1; otherwise, the operation is identical to that of the previously described embodiments.

In lieu of the fishing-reel-type winding screws **12, 14**, the racks **58, 60** may as well be reciprocated through their desired differential velocity programs by means of pinion gears **64, 66**, which are arranged to be driven at either or both differential velocities or degrees of oscillation, though this arrangement is not to be preferred because of accelerated wear due to the inertia of the rack members **58, 60**.

Turning now to FIG. 4, there is shown in perspective a highly compact, portable draw-twister arrangement utilizing one embodiment of the traverse mechanism comprising the present invention. Such an assembly is seen to comprise a suitable housing **68** mounting a conventional draw-twister arrangement and enclosing an embodiment of my traversing mechanism similar to that illustrated in FIG. 1. Additionally, such an arrangement may comprise a supply package **70** from which there is

withdrawn a supply strand **46** to be fed, via suitable guides, to nipped feed rolls **72**, thence about draw pin **74**, about draw roll **76** and separator roll **78** a suitable number of wraps to retard slippage, then through the zone indicated by the bracket labeled X, to then be taken up by the ring-traveler. The zone X is provided to facilitate the implementation of desired experimental devices. The spindle or bobbin **44** is driven at high speed through the belt-pulley arrangement **80** by variable speed motor **82**. The feed draw rolls are driven by motor **84** through conventional timing belts and gear boxes.

It will now be appreciated that there has been herewith disclosed a novel and beneficial traversing mechanism of compact construction and flexible, precise operation, which mechanism embodies the principles and attendant advantages of a combined differential output motion transmitted to the traveler guide. Obviously, numerous modifications and variations of the present invention, both as to its construction and mode of operation, are possible in the light of the above teachings. It is therefore to be understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically described herein.

What is claimed is:

1. In a winding mechanism for use in strand winding operations, a traversing mechanism comprising a pair of reciprocably mounted input elements, means to reciprocate said elements through paths of pre-selected lengths at a pre-determined difference in velocities, said means for reciprocating said input elements comprising a pair of rotatably mounted fishing-reel-type winding screws, each characterized by an endless, reverse helical groove formed along its surface, each of said input elements engaging one of said grooves to be urged therealong upon rotation of the screw to thereby describe said reciprocating paths, a reciprocably mounted output element, a reciprocably mounted strand traversing guide responsive to movement of said output element, linkage means interconnecting said output element with each of said input elements and operative to move said output element according to the individual movements of said pair of input elements, whereby said traversing guide is caused to move in a direction and at a velocity according to the algebraic sum of the velocities of said input elements.

2. The mechanism as recited in claim **1** wherein the helix angle described by at least one of said grooves decreases to a minimum adjacent one lengthwise extremity thereof, whereby said traversing guide reaches a maximum velocity substantially at one extremity of its reciprocation.

3. The mechanism as defined in claim **1** wherein said reciprocating means is further characterized by a drive means operative to drive said screws at rotative speeds relatively prime to one another to thereby minimize the number of coincident reversal points in the travel of said traversing guide.

4. The mechanism as defined in claim **2** wherein said reciprocating means is further characterized by a drive means operative to drive said screws at rotative speeds relatively prime to one another to thereby minimize the number of coincident reversal points in the travel of said traversing guide.

5. The mechanism as recited in claim **1** wherein said output element is characterized by a resiliently biased pulley means and said linkage means comprises a flexible, substantially non-extendable cable entrained over said pulley, each end of said cable being affixed to one of said pair of input elements.

6. The mechanism as recited in claim **3** wherein said output element is characterized by a resiliently biased pulley means and said linkage means comprises a flexible, substantially non-extendable cable entrained over said pulley, each end of said cable being affixed to one of said pair of input elements.

7. The mechanism as recited in claim **4** wherein said output element is characterized by a resiliently biased pulley means and said linkage means comprises a flexible, substantially non-extendable cable entrained over said pulley, each end of said cable being affixed to one of said pair of input elements.

8. The mechanism as defined in claim **1** wherein the reciprocal paths of said input elements are of differential lengths whereby said traversing guide experiences a maximum residence period during the mid-portion of its travel to thereby generate a package exhibiting a substantially flat mid-portion equal to one-half the difference in path lengths of said input elements.

9. The mechanism as defined in claim **3** wherein the reciprocal paths of said input elements are of differential lengths whereby said traversing guide experiences a maximum residence period during the mid-portion of its travel to thereby generate a package exhibiting a substantially flat mid-portion equal to one-half the difference in path lengths of said input elements.

10. The mechanism as defined in claim **4** wherein the reciprocal paths of said input elements are of differential lengths whereby said traversing guide experiences a maximum residence period during the mid-portion of its travel to thereby generate a package exhibiting a substantially flat mid-portion equal to one-half the difference in path lengths of said input elements.

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