March 1, 1966 C. R. MACK 3,237,364

METHOD OF PACKAGING ARTICLES IN A TUBE

Filed Sept. 29, 1961

2 Sheets-Sheet 1

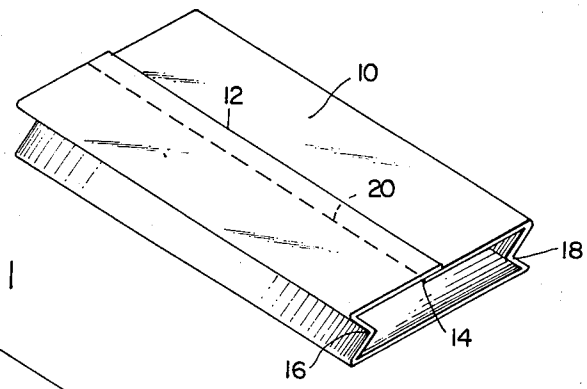


FIG. 1

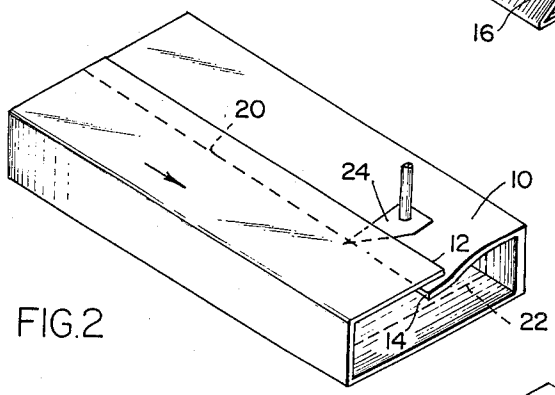


FIG. 2

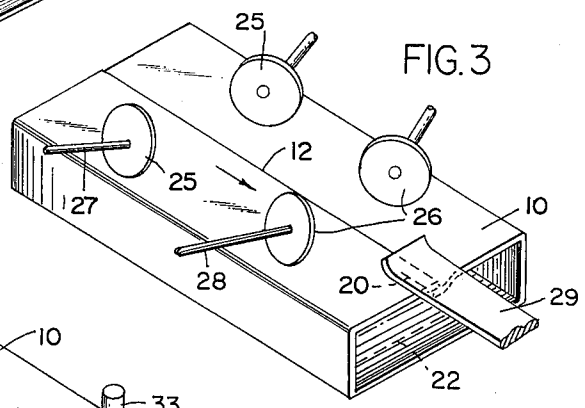


FIG. 3

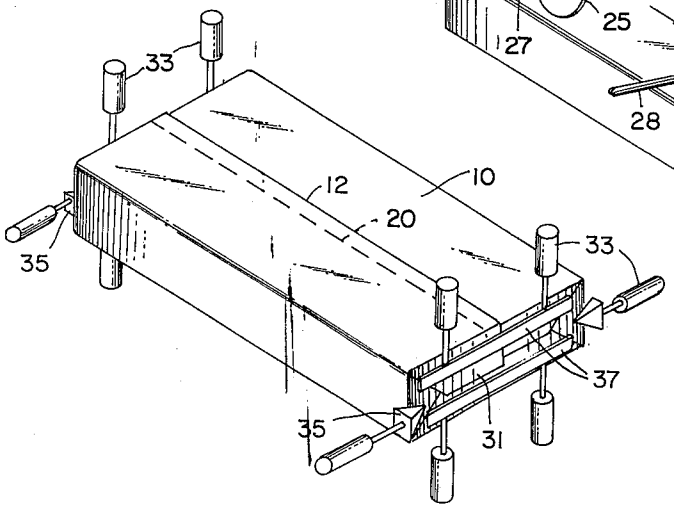


FIG. 4

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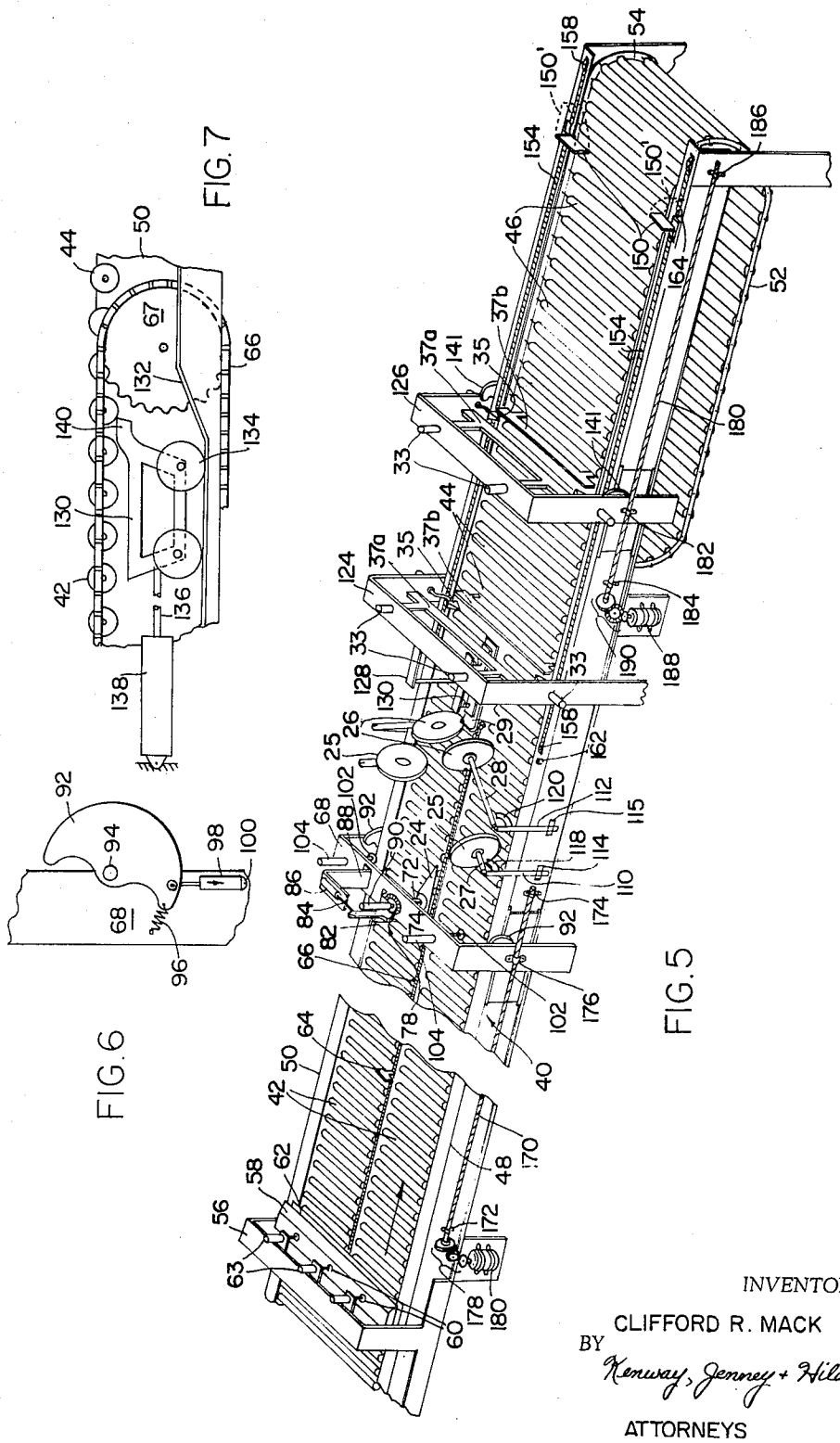


FIG. 5

FIG. 6

FIG. 7

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3,237,364

METHOD OF PACKAGING ARTICLES IN A TUBE

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3 Claims. (Cl. 53—29)

This invention relates to packaging tubes and more particularly to an improved tube, and a method and apparatus for packaging materials.

Packaging tubes are commonly used for the shipment of bulky articles of a finished nature requiring protection against abrasion or other accidental injury. It is convenient to preform such tubes prior to the insertion of the articles to be packaged therein, and to store the tubes in a flat condition pending their use. However, ease of insertion of an article in such a tube requires that there be considerable clearance space about the article within the tube. Consequently, the article may shift about to a substantial extent during handling and shipment, and damage frequently results, particularly in the case of heavy and brittle articles such as tiles. Furthermore, the looseness of the package permits flexing and crushing of the tube to take place.

It is an object of the present invention to afford an improved packaging tube and method of packaging which provides for the tube to be tightened about enclosed articles after their insertion therein, to form a snugly-fitting protective package.

It is a further object of the invention to provide an improved packaging tube and method of packaging articles therein, which allows a completed tube, initially of a size to loosely and freely receive predetermined articles therein, to be subsequently tightened about the enclosed articles.

It is a further object of the invention to provide an improved packaging apparatus for performing the packaging method of the invention.

It is still another object of the invention to afford an improved method and means for tightening a previously-completed tube about an article inserted therein, and for sealing the tube in the tightened condition.

Briefly stated, my improved packaging method may be carried out in a preferred manner by the initial step of preparing a packaging tube by forming a sheet of suitable packaging material into a tubular form having overlapping longitudinally-extending edges, and by adhesively securing or "tacking" these edges along longitudinally-spaced areas thereof, to form a seamed tube of sufficiently large size to freely receive a predetermined article longitudinally inserted therein. I prefer that the overlapping edges be secured by a resealable material of sufficient strength to firmly retain the seam, and also that this material be heat-sealable; such sealing agents include polyethylene, polyvinyl chloride, polypropylene, and other thermoplastic materials such as paraffin. However, other adhesives such as glue or casein may be used alternatively. A desired article is subsequently loaded in the tube, and the adhesively-secured tacked seam is then slit longitudinally to break the adhesive bond. The tube is next tightened about the packaged article by drawing the longitudinal edges together, after which the seam is resealed in the tightened condition. The ends of the tubes are finally tucked about the ends of the article to form closures which are then sealed to complete the package.

My invention further contemplates the provision of an improved apparatus for carrying on the aforementioned process of loading the tube, slitting the seam, subsequently tightening the package and resealing the seam. The apparatus preferably includes conveyor means for supporting the tube for loading, and for transporting the loaded tube through a series of work stations which are arranged

to operate sequentially. At a first work station, means are provided for expanding a previously-flattened tube for loading. A second work station has means including a knife extending transversely to the path of movement of the tube in such juxtaposition as to slit the tacked seam. The tube is then carried to a third station having a set of rolls mounted for rotation on axes parallel to the plane of tube movement, but skew to the longitudinal extent of the tube. These rolls serve to tighten the loosened tube about the article and to pass the tube to another work station at which heat and/or pressure sealing means (according to the nature of the resealable adhesive used; or adhesive applying means, in the event that a resealable adhesive is not employed) reseal the longitudinal seam in the tightened condition of the tube. The tube is carried thence to a final work station in which two sets of conventional tucker and folding blades are operated to fold both ends of the tube about the article, and to seal these end closures by means of heat and/or pressure, or by the application of adhesives or other fastening means, as desired.

According to a further feature, the improved machine incorporates means for adjusting the position of the slitting knife work station along the bed to accommodate packages of various lengths, and for automatically and simultaneously adjusting the spacing between the two sets of tucker and folding blades correspondingly, for simultaneous engagement with the opposite ends of the package. According to an additional feature, a conveyor for carrying the tube through the station comprises a series of rolls whose corresponding ends are connected by flexible chains or the like, for simultaneous movement about closed oval tracks upon relative adjusting movement of the two sets of tucker and folding blades along the path of tube movement; by these means, a group of the rolls are positioned to maintain continuous tube support along the path of the conveyor, in spite of the adjusting movement along the same path of the blades, which project between adjacent rolls.

While the specification concludes with claims particularly pointing out and distinctly claiming the subject matter of the invention, it is believed that a clearer understanding may be gained from the following detailed description of preferred embodiments, referring to the accompanying drawings, in which:

FIG. 1 is a pictorial view of a packaging tube prepared according to the invention;

FIG. 2 illustrates the slitting of a seam of the tube;

FIG. 3 illustrates tightening the tube about an inserted article and resealing the seam;

FIG. 4 illustrates the formation of end closures in the completed package;

FIG. 5 is a pictorial view of improved apparatus for carrying out the process of the invention;

FIG. 6 is a sectional view of a fragmentary portion of the apparatus, showing a tube-stop mechanism; and

FIG. 7 is a sectional view of another fragmentary portion of the apparatus, showing a tube-positioning mechanism.

Referring to FIG. 1, an improved packaging tube **10** adapted for use in my improved packaging process is shown flattened for temporary storage prior to use. The tube is formed of a sheet of suitable packaging material, such as corrugated paper, folded into a tubular form having longitudinally-extending marginal edges **12** and **14** overlapping on one of its faces, and indented with gussets **16** and **18** along its side surfaces. I prepare the tube with a tacked seam **20**, by applying suitable adhesive material to longitudinally spaced-apart areas of the edges **12** or **14**. The adhesive material must be of sufficient strength to firmly secure the seam, and according to a preferred practice, is selected to be resealable by means

of heat and/or pressure; suitable materials include polyethylene, polyvinyl chloride, polypropylene, and other thermoplastic materials such as paraffin or wax. However, my packaging method may alternatively be practiced with other types of adhesives, such as glue or casein.

For packaging an article in a tube of this nature, it is necessary that substantial clearance be provided for longitudinal insertion of the article. However, a loose package is undesirable because of the flexing of the tube and shifting of the article which looseness will permit during handling and shipment. In FIG. 2, an article **22** is shown inserted in the tube **10**, which has been initially expanded to permit the article to be loaded. In conventional practice, the ends of the tube would then be folded and sealed to form closures to complete the package. According to my improved process, however, I longitudinally slit and open the seam **20** by inserting a suitable knife **24** between the marginal edges **12** and **14**, and move the package relative to the knife in the direction shown by the arrow. I then tighten the package about the enclosed article by drawing the marginal edges transversely. While this step may be carried out by hand, I prefer to utilize opposed pairs of tightening rolls schematically illustrated at **26** and **27** in FIG. 3, which are arranged to engage the opposite margins of the packaging sheet, and are rotatably mounted by axles **28** and **29**, respectively, on axes which are parallel to the major surface of the package and skew to the longitudinal extent thereof. The rolls slidably engage the surface of the package to produce a drag which is a function of the horizontal angle defined between the axles and the longitudinal extent of the package. It will be understood that if the axles are arranged normal to the longitudinal extent of the tube, no tightening effect will be produced, since the rolls will rotate without drag. As the included angle decreases, however, the lateral drag force exerted on the packaging sheet will increase correspondingly, so that a tightening effect is produced which may be closely controlled by adjusting this angle. The pairs of rolls **26**, which first act upon the tube, are preferably spaced a greater distance from the marginal edges **12** and **14** than a subsequently-acting pair of rolls **27**, so that slack gathered by the first-acting rolls is passed to the more closely spaced pair and thence to the region of the seam. In this manner, the tube is drawn tightly about the article **22** to a controlled extent.

While the tube is held in the tightened condition by the rolls **26** and **27**, I reseal the seam by suitable means, such as a heated shoe **30**, pressed against the upper surface of the edge **12**. In the preferred practice in which heat-resealable adhesives are employed, heating means (not shown) for the shoe are selected which afford sufficient heat to firmly reseal the seam, with due consideration given to the speed of movement of the package, and the thickness and rate of heat transfer of the packaging material. Suitable pressure is applied to secure firm contact between the edges **12** and **14** to obtain a firm bond. However it will be understood that non-resealable adhesives or fasteners may alternatively be applied to the seam to the same end.

To complete the package, I fold the ends in a conventional manner to form overlapping flap closures **31** at either end. As shown in FIG. 4, this step is preferably carried out by two sets of blades actuated by means such as air cylinders **33**, each set including an opposed pair of tucker blades **35** which are first actuated to form lateral tucks, and a pair of folding blades **37**, which are subsequently extended toward one another to form overlapping flaps overlying the tucks. Adhesive material is preferably applied to suitable areas of the ends of the tube during its initial preparation to seal these closures, and one or more of each of the sets of folding blades may be heated in a well-known manner to seal the flaps. Alternatively, suitable adhesives or fasteners may be applied concurrently with the folding operation.

While the process which has been described may be carried out manually, I prefer to utilize an apparatus which forms a portion of the subject matter of this invention, and of which a preferred embodiment is illustrated in FIGS. 5–7. This apparatus generally comprises conveyor means for transporting a packaging tube through a series of work stations adapted to sequentially perform the steps of the process. The conveyor includes a supporting frame **40**, in which are rotatably mounted a series of rolls **42** each of which extends partially across the width of the frame, and further series of rolls **44** and **46** which extend fully across the frame. The confronting ends of rolls **42** at the center of the frame are supported upon a suitable longitudinal member (not shown) in roller bearings or the like, and the outer ends of each roll **42** and **44** are supported in longitudinal rails **48** and **50** by means of similar bearings. The rolls **46** are rotatably supported in oval tracks **52** and **54** in a manner and for a purpose to be more fully explained hereinafter. The rolls cooperate to form a substantially horizontal plane support for movement of a packaging tube in the direction shown by the arrow in FIG. 5.

A first work station is organized about an arch **56** mounted over the frame **40**, and comprises means for opening a flattened packaging tube of the type previously described, for convenience in inserting a desired article. These means include a duck bill **58** extending transversely over the conveyor and mounted in the arch **56**, and a plurality of suction clamps **60**, suspended in vertically-spaced relation to the duck bill. The duck bill has a beveled leading edge **62**, which an operator first introduces into the trailing end of a flattened tube placed upon the rolls **42**. The suction clamps **60** are connected to a suitable vacuum source through a series of cooperating air cylinders **63**, which are then elevated to raise the clamps for expanding the tube for loading. Suitable operator-actuated control means (not shown) are provided for energizing the air cylinders **63**; however, such means may be of any type well known in the art, and in themselves form no part of the present invention. The operator then inserts a desired article longitudinally into the tube, which is selected of such a size that the article fits freely therein, with horizontal and vertical clearances of fractions of an inch.

For propelling the loaded tube to a second work stage, a pusher plate **64** is carried upon an endless chain **66** which extends intermediate the rolls **42** over the full length of their run, and is drivingly supported upon suitable sprockets, one of which is shown at **67** in FIG. 7.

A second work stage comprises means for slitting the longitudinal seam of the tube, as previously described in connection with FIG. 2, and is organized about an arch **68** supported over the conveyor. This stage includes a knife **24**, which is rotatably supported in the center of the arch upon a vertical shaft **72** having a beveled gear **74** engaged in axially-slidable relation thereon by means of a key (not shown) slidably received in a keyway. The knife, which normally extends longitudinally of the conveyor path as shown, is rotatable to a transversely-extending position by means of a gear sector **78** pivotally mounted upon a member **82** affixed to the arch, and connected to an actuating rod **84** of a pneumatic motor **86** supported upon a bracket **88** affixed to the arch. A further pneumatic motor **90** is mounted upon the arch, and drivingly engages the shaft **72** to elevate the knife **24** when the station is not in operation, as when an empty tube is being positioned on the conveyor prior to loading, and to locate the knife vertically in alignment with the seams of tubes of various sizes.

The seam-slitting station further includes a stop mechanism for precisely positioning the loaded tube prior to insertion of the knife **24** into the seam. This mechanism, more fully shown in FIG. 6, comprises a pair of mutilated disks **92** which may be extended upwardly to engage the leading edge of the tube. The disks **92** are rotatably supported upon a suitable transverse shaft **94** in the arch **68**, and are normally urged toward a retracted

position by means of tension springs **96** secured to the arch and to the lower extremities of the disks. A pair of air motors **98** are each pivotally supported at **100** on the legs of the arch, and are arranged to drive the disks into the extended position shown for engaging the tube. Limit switches (not shown) are positioned in the arch to engage the leading edge of a tube to actuate the air motors **98** to extend the disks **92** upwardly, and concurrently to actuate a pair of suction clamps **102** to grip the upper surface of the tube. Air cylinders **104** are supported in the arch and arranged to raise the suction clamps to open the support end of the tube to allow entrance of the stop disks **92**, and to hold the leading edge of the seam in alignment with the knife **24** for entrance of the knife into the seam. The air cylinder **86** is then actuated to rotate the knife transversely of the seam, to the position shown in FIG. 2. The drive of the pusher plate **64** is interrupted during the interval of these operations. Upon actuation of the air motor **86**, operation of the air motor **98** is discontinued, and the pusher **64** is reactivated, so that the tube is released by the stops and driven forwardly to effect slitting of the seam by the knife **24**.

The tube passes thence to a third work station in which pairs of tightening rolls **25** and **26** engage the loose margins of the tube to tighten them transversely about the enclosed article. The tightening rolls **25** and **26** are rotatably supported on shafts **27** and **28**, respectively, which are supported by standards **110** and **112** mounted in brackets **114** and **115** upon the rails **48** and **50**. The shafts **28** and **29** are pivotally supported on the upper ends of the standards **110** and **112**, respectively, so that they are urged downwardly against the upper surface of a tube by their own weight and that of the shafts. Rests **118** and **120** are secured to the standards to limit the downward movement of the rolls against engagement with the conveyor. The standards are angularly adjustable in the brackets **114** and **115**, so that the axes of rotation of the rolls may be adjusted to give a desired degree of tightening to the package. It will be understood that the tightening effect will be related to the cosine of the horizontal angle included between the axles and the longitudinal extent of the tube. The rolls **25** are spaced apart laterally a greater distance than the rolls **26**, so that the upper surfaces of the tube are first engaged adjacent to the lateral edges of the package, and subsequently in the vicinity of the marginal edges **12** and **14**.

Upon passing through the tightening rolls, the package is received by a work station organized about an arch **124**, which carries means **29** for resealing the seam in the tightened condition, and also carries a set of tucker blades **35** and folding blades **37***a* and **37***b*, which serve to form a trailing end closure in the package. A final work station is organized about an arch **126**, and carries a further set of tucker blades **35** and folding blades **37***a* and **37***b* for forming a leading end closure in the package, concurrently with the operation of the first set of tucker blades and folding blades.

For carrying out the process in a preferred manner in which heat and/or pressure resealable adhesives are employed, the resealing means comprise a heated shoe **29** suspended from the arch **124** by a bracket **128**, and biased by means of spring **130** downwardly against the seam.

The tube is carried through the sealing stage by the pusher plate **64**, whose conveyor chain terminates in such a position that the trailing end of the package lies just ahead of the folding blades carried by the arch **124**. In order to position the leading and trailing ends of the package for cooperation with the tucker blades and folding blades of the final work stations, a positioning truck **130** shown in FIG. 7 is supported upon an inclined track **132** upon wheels **134**, and is connected by an actuating rod **136** to a pneumatic ram **138**. The ram is actuated by suitable limit switches (not shown) upon the passage of the trailing edge of the package, to drive the truck up the inclined ramp. The truck is formed with a fork **140** which engages the trailing edge of the package, and drives it forwardly toward a pair of stop discs **141** mounted in the arch **126**. These stop discs and their actuating mechanism are similar to those of FIG. 6, previously described, and stop the tube in predetermined juxtaposition with the blades of the arches **124** and **126**. As the tube arrives in this position, limit switches of suitable control circuitry (not shown) first reverse the ram **138** to withdraw the truck **130**, and then actuate pairs of air motors **33** to drive the tucker blades **35** inwardly to form tucks in the lateral edges of the tube, as previously described and shown in FIG. 4. Subsequently, the control mechanism energizes further pairs of air motors **33** to actuate the folding blades **37***a* downwardly and **37***b* upwardly to form overlapped flaps in a manner also shown in FIG. 4. I prefer to provide suitable heating elements (not shown) in the lower folding blades **37***b* for sealing the end closures by means of pre-applied heat-sealable adhesive.

For transporting the completed package from the final work stations to a delivery point at the end of the run of rolls **46**, I provide a pair of additional pusher plates **150** mounted upon a pair of endless chains **154**, each of which is drivingly engaged with a pair of sprockets **158** supported in frame **48** or **50**. The chains **154** are arranged to reciprocate the pusher plates **150** longitudinally of the conveyor rolls. The plates are pivotable to positions overlying the rolls as shown in solid lines, or to retracted positions shown in dotted lines at **150'**. Pairs of stops **162** and **164** are secured along the run of the blades in the rails **48** and **50** to reverse the positions of the plates at the ends of their runs. As the plates strike the stops **164**, they are pivoted to the retracted positions **150'**, and suitable limit switches (not shown) reverse the direction of travel of the chains **154** to carry the plates to the left as viewed in FIG. 5. Upon striking the stops **162**, the plates are rotated to the extended position **150** for engaging the rear end of a completed package, which is then carried thereby over the rolls **46** to the end of the conveyor for discharge.

According to an ancillary feature of the apparatus, the arches **68** and **126** are arranged to be concurrently adjusted in longitudinal position to accommodate tubes of various lengths. To this end, the arch **68** is mounted upon a pair of longitudinally-extending jack screws **170** rotatably supported upon the rails **48** and **50** by means of pairs of brackets **172** and **174**. A pair of brackets **176** threadedly engage each jack screw and are secured to the arch, and the jack screws are drivingly connected by suitable gearing **178** to reversible motors **180** mounted upon the frames **48** and **50**. In a similar manner, the arch **126** is threadedly engaged upon a pair of jack screws **180** by means of threaded brackets **182**. The jack screws **180** are rotatably supported in brackets **184** and **186**, and a pair of reversible motors **188** are drivingly connected with the jack screws by suitable gearing **190**. The motors **180** and **188** are connected for synchronous actuation of the jack screws **170** and **180**, so that the arches **68** and **126** are concurrently and precisely adjustable to accommodate packages of various lengths.

The longitudinal movement of the arch **126** with its lower folding blade **37***b*, which projects between adjacent ones of the rolls **46**, requires that means be provided for shifting the rolls longitudinally, in order to maintain a continuous run ahead of the arch for supporting packages. To this end, I rotatably mount the ends of the rolls **46** in oval tracks **52** and **54**, and connect the ends of the rolls by means of continuous chains or the like (not shown), which are drivingly connected with the arch **126**, so that as the arch is adjusted longitudinally by the jack screws **180**, the rolls **46** are correspondingly adjusted about the oval tracks to maintain a continuous run.

While I have described preferred embodiments of my improved packaging tube and apparatus, and a preferred mode of carrying out the packaging method of the inven-

tion, it will be readily understood by those skilled in the art that various changes and modifications may be made therein without departing from the true spirit and scope of the invention. I therefore intend to define the invention in the appended claims without limitation to specific details herein described by way of illustration.

What I claim is:

1. A method of packaging articles comprising the steps of; preparing a packaging tube having overlapping longitudinally-extending marginal edges, securing said edges with a pre-selected degree of overlap by a seam extending longitudinally of the tube, loading the tube with an article to be packaged therein, slitting the seam longitudinally, tightening the tube about the packaged article by overlapping the marginal edges to a different degree as required by the dimensions of the article, and resealing the seam in the tightened condition of the tube.

2. A method of packaging articles in a packaging tube having overlapping longitudinally-extending marginal edges secured by adhesive material applied to longitudinally-extending areas of the edges, which comprises the steps of; loading the tube with an article to be packaged therein, slitting the seam longitudinally, tightening the tube about the packaged article by overlapping the marginal edges of the degree required by the dimensions of the article, resealing the seam in the tightened condition of the tube, and tucking the ends of the tube about the packaged article to form end closures in the completed package.

3. A method of packaging articles which comprises the steps of; preparing a packaging tube by folding a sheet of packaging material into a tubular form having overlapping longitudinally-extending marginal edges, forming a tacked seam extending longitudinally of the tube by applying resealable adhesive material to longitudinally-extending areas of the edges and closing the seam, loading the tube with an article to be packaged therein, slitting the seam longitudinally, tightening the tube about the packaged article by overlapping the marginal edges to the degree required by the dimensions of the article, and resealing the seam in the tightened condition of the tube.

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