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METHOD AND APPARATUS FOR TYING PACKAGES AND WRAPPING MATERIALS

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Fig. 26

Fig. 24
METHOD AND APPARATUS FOR TYING PACKAGES AND WRAPPING MATERIALS

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The present invention generally relates to packaging closures and more particularly to an improved method and apparatus for gathering and tying flexible packages and wrappers. This application is a continuation-in-part of my copending application, Serial No. 152,512, filed November 15, 1961, now abandoned, the disclosure of which is incorporated herein by reference as a part thereof.

In the packaging art, many methods have been employed for closing and sealing the ends of flexible packages and wrappers. For example, in the baking industry, it is customary to package bread or other bakery products in cellophane or wax paper by folding the ends of the wrapper tightly about the packaged product and thereafter sealing the folded ends by heat or a suitable adhesive. However, once the finished package is opened by the consumer, it cannot be resealed to insure freshness of the contents. Moreover, in opening this type of wrapper, it is usually necessary to initially tear the package in order to gain access to its contents.

In contrast, the packaging closure which is disclosed herein facilitates removal of a portion of the packaged contents, as for example, a few slices of bread, and subsequent reclosing of the package with little effort, thereby assuring freshness of the packaged material while affording ease of opening and subsequent closure whenever desired.

Although numerous machines have been developed for tying the ends of packages after they have been filled with material, these machines are usually extremely complex in construction and generally unsuitable for mass production systems which utilize lightweight flexible packaging material. In package tying equipment of the type disclosed in Gray Patent No. 2,711,278, the open end of the package must first be constricted into a neck between a pair of complicated forming dies so that the wire can be forced through an encircling groove formed in the die before being tied.

Accordingly, an important feature of this invention is to provide an improved method and apparatus for tying the open end of a package or wrapper with a deformable wire-like ribbon tie that may be tied under controlled tension without damage to the package or wrapping material.

A primary object of the present invention resides in the provision of an improved method and apparatus by which the ribbon for tying a package or wrapper is maintained under controlled tension throughout the gathering and tying operation so as to assist in constricting the open end of the package or wrapper preparatory to tying.

A further object of this invention resides in the provision of an improved method and apparatus for forming a tied closure about the ends of flexible packages and wrappers in order to seal the contents therein at an output rate commensurate with existing production requirements.

Another object of the present invention relates to a package tying apparatus which may be readily incorporated in existing mass production systems without modification or alteration of production equipment.

A still further object of this invention is to provide an improved conveying system for continuously feeding a plurality of packages to a tying station without interruption of the conveying cycle and thereafter ejecting the tied packages at an output rate which exceeds that performed by existing equipment.

Still another object of the present invention is to provide a package tying apparatus in which a segment of the ribbon tie is positioned under tension across the path of a moving package to gather the open end of the package into a constricted neck, and thereafter twisting the ribbon to form a detachable closure which may be subsequently removed and re-applied without damage to the package.

An additional object of this invention is to provide a method and apparatus for constricting the open end of a flexible package filled with produce, or the like, encircling a ribbon of wire around the constricted end of the package while retaining the wire under tension, severing the wire from a supply of ribbon, twisting the severed ends together to detachably secure the encircling wire to form a closure in which the constriction, encircling, severing and twisting steps are carried out at a single station in one continuous operation.

Still another object of the present invention relates to an improved method and apparatus for sequentially advancing the opened end of successive packages to a tying station in timed sequence with the tying operation so as to permit continuous operation of the equipment without interruption.

A further object of this invention relates to an improved package tying apparatus of the above character which is thoroughly reliable, effective and completely automatic in operation, relatively simple in construction, adaptable to meet varied conditions encountered in closing flexible packages and wrappers, and capable of performing the objects for which the same is intended.

Other objects and the entire scope of the present invention will become apparent from the following detailed description and by reference to the accompanying drawings. It should be understood, however, that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent as the description herein progresses. Reference now will be made to the accompanying drawings which form a part hereof, wherein like numerals refer to similar parts throughout, and in which:

FIGURE 1 is a top plan view of a package tying apparatus which forms the subject matter of the present invention;

FIGURE 2 is a side elevational view of the apparatus taken along lines 2—2 of FIGURE 1;

FIGURE 3 is a side elevational view taken from the side opposite that of FIGURE 2 along lines 3—3 of FIGURE 1;

FIGURE 4 is an enlarged perspective view of a portion of the package gathering and wire tying assemblies;
FIGURE 5 is an end view partially in sections taken along lines 5—5 of FIGURE 3; 

FIGURE 6 is a schematic perspective view of the package conveying system and related drive train for operating the apparatus illustrated in FIGURE 1; 

FIGURE 7 is an enlarged side elevational view of the apparatus illustrated in FIGURE 2; 

FIGURE 8 is a partial top plan view taken along lines 8—8 of FIGURE 7; 

FIGURE 9 is a sectional view taken along lines 9—9 of FIGURE 8; 

FIGURE 10 is an enlarged side elevational view taken along lines 10—10 of FIGURE 8; 

FIGURES 11, 12, 13 and 14 are detailed sectional views taken along lines 11—11, 12—12, 13—13 and 14—14, respectively, of FIGURE 9; 

FIGURE 13A is a detailed view taken along lines 13A—13A of FIGURE 13; 

FIGURES 15 through 19 are detailed sectional views taken along lines 15—15, 16—16, 17—17, 18—18 and 19—19, respectively, of FIGURE 5; 

FIGURE 15A is a view similar to FIGURE 15 showing the drive clutch in actuated position; 

FIGURES 20A through 20E are diagrammatic views illustrating the sequence of operations performed by the apparatus illustrated in FIGURE 1 for gathering and tying the open end of a package; 

FIGURE 21 is a side elevational view of a package tying apparatus containing further embodiments of the present invention; 

FIGURE 22 is a side elevation view of the package tying machine illustrated in FIGURE 21, but taken from the opposite side thereof; 

FIGURE 23 is a top plan view of the bag tying mechanism illustrated in FIGURE 21; 

FIGURE 23A is a schematic view of the clutch and drive arrangement shown in FIGURES 21 and 22; 

FIGURE 24 is a perspective view showing the open end of the bag being brushed into a slotted plate prior to gathering in accordance with the teachings of this invention; 

FIGURE 25 is a view in perspective showing the open end of the bag fully inserted within the slotted plate and being engaged by the gathering means; 

FIGURE 26 is a view in perspective showing the package located upon the conveyor and in position for having the wire applied to its open end; 

FIGURE 27 is a perspective view similar to FIGURE 26, illustrating a needle encircling the wire about the periphery of the open end of the bag and the cutter positioned to sever the wire at a predetermined length; 

FIGURE 28 is a perspective view similar to FIGURE 27 and showing a further step with the needle withdrawn and the wire retained in position by the gripping members to receive the next bag; 

FIGURE 29 is a perspective view showing the rotating brush and the tying mechanism as viewed from the side illustrated in FIGURE 21; 

FIGURE 30 is a perspective view as seen from the end of the package tying machine showing the rotating brush and the tying mechanism thereof from the right hand end as illustrated in FIGURE 21; 

FIGURE 31 is a top detailed view showing the gathered end of the package passing through the slotted plate and the wire being attached thereto; 

FIGURE 32 is a sectional view taken approximately along lines 32—32 of FIGURE 31; 

FIGURES 33A through 33F show the various steps of transporting the bag along the conveyor deck, brushing the open end thereof within the slotted plate, and gathering the open end of the bag together into a fold; 

FIGURES 34A through 34F are successive end views of the bag as it passes along the conveyor and as it is operated upon at the various steps shown in FIGURES 33A through 33F; 

FIGURE 35 is a side view of a packaged loaf of bread shown in FIGURES 33A and 34A prior to having its open end gathered; 

FIGURE 36 is a side view of a packaged loaf of bread as shown in FIGURES 33F and 34F subsequent to having its end gathered; 

FIGURES 37A through 37F illustrate the various steps involved in encircling a predetermined length of wire about the periphery of the gathered end of the bag to be sealed; 

FIGURES 38A through 38F illustrate successive end views of the bag at the various stages of applying the wire to the open end thereof shown in FIGURES 37A through 37F; 

FIGURE 39 is a side view of the bag as shown in FIGURES 37A and 38A; 

FIGURE 40 is a side view of the bag with its end tied as shown in FIGURES 37F and 38F; 

FIGURES 41A through 41D show the various stages involved in brushing the end of the bag within the slot, moving a restraining dog into receiving engagement about one side of the open end of the bag, reciprocating a gathering plunger into engagement with the other side of the open end of the bag and finally ejecting the closed bag from the tying apparatus; 

FIGURES 42A through 42H illustrate in end section views a number of successive stages involved in two successive operations of holding and cutting a wire by a cooperating holding finger and associated abutment plates, and feeding of the wire thereto by the needle; 

FIGURES 43A through 43G are top views showing the lateral movement of the holding finger from side to side and rotating sequence of the twister hook; 

FIGURES 44A through 44G are side views generally corresponding to the views of FIGURES 43A through 43G and showing the successive movements of the needle, holding finger, and twister hook; 

FIGURE 45 is a perspective view showing schematically the application of the wire to the open end of the bag to be sealed; 

FIGURE 46 is a perspective view showing the end of a packaged loaf of bread having the wire tied to the end thereof and completely sealing the package; 

FIGURES 47A through 47D show the various stages involved in gathering together the open end of the bag, but employing a retaining dog modified from that shown in FIGURES 41A through 41D; 

FIGURE 48 is a schematic end view of a package tying apparatus tiltedly mounted upon a movable carriage; 

FIGURE 49 is a diagrammatic view of still another modified package gathering mechanism and related conveyor system; and 

FIGURE 50 is a diagrammatic view of an alternate conveyor system. 

SUMMARY OF OPERATION

The main structural components of the apparatus illustrated in FIGURES 1 through 20, as well as the sequence of operation are briefly summarized hereinafter followed by a detailed description of the various components and assemblies as well as alternate embodiments.

Referring now to FIGURES 1, 2 and 3, the apparatus disclosed herein generally includes an endless conveyor 59, which continuously moves in a longitudinal direction for transporting a package A from the input end of the unit to a gathering station where the open end B of the package is initially flattened between a pair of counter-rotating brushes 264 and 266 and then gathered into a neck C by a continuously moving belt 77 which advances the flattened end to the tying station 97 against a wire-like ribbon tie 144a that is maintained under controlled tension, as schematically shown in FIGURES 20A and 20B. Thereafter, the gathered end of the package is tied by moving a needle 135 transversely to encircle the ribbon about the gathered neck and constrict the open end through the ap-
plication of tension to the ribbon which is subsequently severed and tied in the manner sequentially illustrated in FIGURES 20C and 20D.

For stopping the forward momentum of the packages as they reach the tying station and subsequently ejecting them from the tying station upon completion of the tying operation a stop-ejector mechanism identified generally by reference numeral 125 (FIGURE 6) is mounted on a shaft 118 rotatably supported between side frame members 11 and 13a beneath conveyor 59. With reference to FIGURE 6, the tying mechanism 131, stop ejector 125 and gathering belt 77 as well as conveyor 59 are driven by chains 368, 352, and 336, respectively, through a clutch and drive train 325. The clutch and drive train 325 includes a drive shaft 326, time delay shaft 328 and an actuating shaft 330. Time delay shaft 328 is coupled with drive shaft 326 by means of a drive clutch 374, and actuating shaft 330 may be coupled with shaft 326 by means of time delay clutch 376. When clutch 374 and clutch 376 are engaged, shafts 326, 328, 330 rotate as a unit. As the open ended packages are successively deposited upon idle rolls 263 by the feed conveyor, they are sequentially pushed onto conveyor 59 with their open ends positioned adjacent slide frame member 11. When the bags reach gathering brushes 364 and 366, the open end is flattened between the brushes and deflected in the direction of arrow 281 (FIGURE 1) where it is directed between guide roller 284 and gathering belt 77. As the open end passes beneath guide roller 284 it trips the actuating arm of a microswitch which actuates the clutch and drive train 325. Actuation of the clutch and drive train 325 causes clutch 374 to couple shaft 326 with drive shaft 326, and after a predetermined time delay to permit the package to reach tying station 97, clutch 376 engages to connect shaft 330 with shaft 328 and initiate the tying operation.

Tying mechanism 131 includes a needle 135 (FIGURE 4), a twister hook 137, an associated wire gripper and cutter 132, and a stripper arm 134. Tying station 97 refers generally to the area between the needle 135 and gripper 132 in their "at rest" position shown in FIGURE 7. As the flattened end of the package reaches tying station 97, gripping belt 77 and gathering feed rollers force the bag end into engagement with the segment 144d of tie wire ribbon between needle 135 and gripper 132 restricting the open end into a gathered neck C illustrated in FIGURE 4. Upon actuation of the tying mechanism 131, needle 135 encircles neck C with the segment 144d of wire 144b; twister hook 137 forces feed rollers 144a and 144b together; and the associated wire gripper and cutter 132 sever the end of strand 144b from the supply and grips the severed end leading to the supply between one of the abutments 155L or 155R. After the twisting operation is completed, stop-ejector 125 is rotated through one step of its cycle to evert the tied package from tying station 97 where it is then carried away by conveyor 59.

SUPPORTING FRAME

With reference primarily to FIGURES 1 through 6 the machine is supported on a frame identified generally by reference numeral 1. Frame 1 includes a base member 2 which may be supported on stacks or rollers, if desired, for moving the machine from place to place. Extending upwardly from base member 2 are a plurality of vertical support members or columns 3, 4, 5, as shown in FIGURE 2 as well as 6 and 7 which are illustrated in FIGURE 3. Supports between columns 3 and 6, and between columns 5 and 7 is a horizontal front beam 8, and between columns 6 and 7 is a horizontal rear beam 9. Beams 8 and 9 support parallel side frame members 11 and 13a. Extending between side frame member 11 and columns 6 and 4, respectively, are horizontal support members or columns 123. Column 123 may be in the form of an enlarged end portion of beam 8 which extends beyond side frame member 11 to column 3. Posts 19 and 21 are mounted on platforms 17 and 15, respectively, for supporting a horizontal deck plate 23. Deck plate 23 is formed with a raised, offset portion 25 and a rear plate 27 which extends between side frame member 11 and offset portion 25 (FIGURE 1). Nuts 29 and 31 are threaded onto the ends of posts 19 and 21, respectively (FIGURE 7) to secure deck plate 23 to the posts.

PACKAGE CONVEYOR AND GATHERING ASSEMBLIES

Mounted on side frame member 11 adjacent the front and rear, respectively, thereof, are bearing plates 33 and 35 which are disposed opposite to bearing plates 43 and 45, respectively, on side frame member 13. Journalled in bearings 33, 43 and in bearings 35, 45, respectively, are the rear and front shafts 47 and 48 of an endless conveyor indicated generally by reference numeral 59. Conveyor 59 is in the form of a plurality of spaced, endless belts 53, each of which is supported between opposite pairs of rear and front pulleys 49 and 51, respectively, which in turn are secured for rotation with their respective shafts 47 and 48.

Extending between side frame members 11 and 13a, intermediate conveyor sections shafts 47 and 48, is a shaft 55 which is journalled in bearings 57 and 61 secured to side frame members 11 and 13a, respectively. Fixed to the end of shaft 47, adjacent side frame member 11, is a gathering pulley 63 and secured to the opposite end of shaft 55, adjacent side frame member 13a, is a sprocket 71. Keyed to the end of front conveyor shaft 48 is a pulley 75. Rotation of shaft 55 is transmitted to front conveyor shaft 48 by an endless gathering belt 77 supported on pulleys 63 and 75. The upper portion of gathering belt 77 is also supported intermediate pulleys 63 and 75 by an idler pulley 79 mounted for free rotation on side frame member 11.

Supported on deck plate 23 is a guide member 81, the upper side of which is formed with a longitudinal groove 83 (FIGURES 7 and 12) for receiving gathering belt 77. Guide member 81 supports the upper portion of gathering belt 77 between pulley 63 and idler pulley 79. A pair of gathering feed rollers 85 and 87 are mounted for free rotation in guide member 81 and extend through slots in guide member 81 to tangentially engage the lower surface of gathering belt 77 providing friction free movement of belt 77 relative to guide member 81. Supported on the tying mechanism, on the opposite side of gathering belt 77, is a driven sprocket 77, which is a slotted guide bar 89 rotatably supporting gathering feed rollers 101, 103 and 105 which tangentially engage the upper surface of gathering belt 77. As the open end of the package which is to be tied approaches the tying mechanism, feed rollers 101, 103 and 105 cooperate with gathering belt 77 to flatten the open end of the package or bag and force it against the tying ribbon or wire to constrict it into a neck configuration in a manner to be described below.

Conveyor 59 is driven continuously in the direction of arrow 95 (FIGURE 1) to transport the package or bag to a tying station indicated generally by reference numeral 97 (FIGURES 1 and 4). When the bag reaches tying station 97, it is lifted off conveyor 59 by a lifting bar 107 mounted on shaft 109 (FIGURES 3 and 10). Shaft 109 is mounted between side frame members 11 and 13a beneath shaft 55 (FIGURE 3) and is selectively rotatable to locate it in operative and inoperative positions through a lever arm 111. Lever arm 111 is illustrated in its inoperative position in FIGURE 3 and is movable to an operative position in which a pin 113 is received in an aperture 115a formed in side frame member 13. Pin 113 is positionable in one of two apertures 115a and 115b. Pin 113 is located at aperture 115b, the position of FIGURE 3, lifting bar 107 is disposed beneath the upper surface of the
3,138,904

PACKAGE EJECTOR ASSEMBLY

Journaled for rotation in bearings 121 and 123 mounted on side frame members 11 and 13a, respectively, is a shaft 118 for a stop-ejector mechanism 125. Stop-ejector 125 consists of a plurality of hub members 127 mounted along the axis of shaft 118 and fixed to the shaft by set screws for rotation therewith. Extending radially from each hub 127 are a plurality of fingers 129; three such fingers being provided in the illustrated embodiment which are angularly spaced approximately 120 degrees apart.

With reference to FIGURE 10, a finger 129a is shown in the stop position in which it projects above the upper surface of any objects carried on conveyor 59 into the path of movement of any objects carried on conveyor 59. As the packages or bags or other objects are carried forward on conveyor 59 toward tying station 97, the forward momentum of the package carries it onto lifting bar 107 to elevate it above the conveyor surface. The forward momentum of the package is stopped momentarily by finger 129a which, upon actuation of the tying mechanism, as will be presently described in detail, immediately rotates out of the path of the package. Actuation of the tying mechanism causes counterclockwise rotation of shaft 118 of the stop-ejector, as viewed in FIGURE 10, to immediately move finger 129a out of the path of the package being tied.

As the tying operation is carried out, shaft 118 rotates through an angle of 120 degrees to move finger 129b into the position formerly held by finger 129a. As finger 129b moves counterclockwise in FIGURE 10, it strikes the package from the rear and ejects it from the tying station coming to rest in the position previously occupied by finger 129a in which it projects above the conveyor just forward of lifting bar 107. Thus, for each tying cycle, the stop-ejector fingers 129 first stop movement of the package, and then rotate 120 degrees to eject the tied package back onto the moving conveyor upon completion of the tying operation. It is apparent that while three fingers 129 are illustrated, more or less than three may be provided to perform the same operation, dependent upon the relative sizes of sprocket 350 and sprocket 348 which drives shaft 110 (FIGURE 6).

TYING ASSEMBLY

With reference particularly to FIGURE 4, the tying mechanism is identified generally by reference numeral 131 and includes a needle 135, a twister hook 137, an associated wire gripper and cutter 132, and a stripper bar 134. Needle 135 is of general arcuate shape and is formed on its outer end with an eyelet 139 in which is mounted a freely rotatable roller or pulley 141. Roller 141 is formed with a groove for guiding the ribbon or tie wire 144h. Needle 135 is fixed to the end of a rotatable shaft 143.

Twister hook 137 is mounted on the lower end of a vertical, rotatable shaft 142b and is operable upon rotation of the shaft to gather the strands 144a and 144b of the segment of ribbon or tie wire 144 between eyelet 139 and end 144c of the ribbon or tie wire held by gripper 132 that has been looped around the constricted neck C of a bag by needle 135.

Projecting from the end of a plate member 147 is a horizontal, triangular ledge 149. Ledge 149 extends from the end of plate 147 over gathering belt 77. Projecting from the rear of ledge 149 over the tying station is a pair of spaced parallel legs 151L and 151R, and projecting inwardly from each of legs 151L and 151R is a knife edge 153L and 153R, respectively. Mounted on top of each of legs 151L and 151R is a resilient member 155L and 155R, respectively. Each of abutments 155L and 155R is formed with an inwardly projecting tongue 157L and 157R, respectively; tongue 157L only being visible in FIGURE 4. Tongues 157L and R each project into the space between legs 151L and R. Head 133 of gripper 132 is formed on each side with a recess 159 for receiving tongues 157 as the gripper oscillates between abutments 155L and 155R. Recess 159 defines an upper gripping edge 163 which cooperates with vertical inner edges of abutments 155 above tongues 157 to grip and hold the end 144c of the ribbon or tie wire. Recess 159 also defines a lower cutting edge 161 which cooperates with knife edges 153 to sever the length of tie wire from the supply that has been wrapped around the neck C of the package or bag.

Supported above deck plate 23 on a wall 176 (FIGURES 2, 7, 8 and 12) is a support plate 174a which is formed with an upwardly curved guide flange 177 at its rear. The space between plates 23 and 174a defines a guideeway 177a for receiving the open end of the bag as it approaches tying station 97.

Mounted on plate 174 is a pair of spaced vertical plates for support brackets 187 and 189 on which are mounted, respectively, bearings 191 and 193 (FIGURE 8). Rotatably supported in bearings 191 and 193 is a shaft 195, on the outer end of which is mounted an actuating sprocket 197. Sprocket 197 is keyed or otherwise fixed to shaft 195 for rotation with the shaft.

Mounted on the bottom side of deck plate 23 is a bearing member 181 (FIGURE 12) in which needle shaft 143 is journaled for rotation. Fixed to the outer end of needle shaft 143 is a needle actuating lever 183.

Rotation of sprocket 197 is converted into an oscillating movement of needle 135 about the axis of shaft 143 through a connecting link 199. Connecting link 199 has one end pivotally connected to sprocket 197 by a pin 197 near the outer periphery of the sprocket, and its other end pivotally connected to the end of actuating lever 183 by a pin 198. Starting from the position of FIGURE 7, clockwise rotation of sprocket 197 will initially cause lever 183 and needle 135 to rotate in a clockwise direction about shaft 143 until link 199 moves across the axis of shaft 195, whereupon lever 183 and needle 135 will pivot in a counterclockwise direction to return to the at rest position of FIGURE 7.

Mounted on shaft 195 between support brackets 187 and 189 is a mutilated bevel gear 202. Multigated gear 202 is formed with beveled teeth 201 over approximately one-half its circumference. In the opposite face of gear 202 from teeth 201 is formed a recess 203 having a notch 205 formed in the rim or wall thereof (FIGURES 13 and 14). The outer edge of the rim of gear 202 is tapered inwardly at 203e toward the lower wall of slot 205, as shown in FIGURE 13. Adjacent the lower edge of notch 205 and projecting from the inner wall of recess 203 is a tooth or projection 207.

With reference to FIGURES 8, 9 and 14, plate 147 is supported on a pair of rectangular posts 147a and 147b mounted on plate 174a (FIGURE 14). Mounted on the upper side of plate 147 is a bearing member 209 for rotatably supporting a cam shaft 211 (FIGURE 9). A gripper actuating cam 213 is mounted on the forward end of shaft 211. Cam 213 is in the form of a circular disk and a roller 215 is mounted on the outer face of cam 213 eccentrically of the axis of shaft 211. Gripper actuating link 175 is reciprocally supported in an angle bracket 225 mounted on plate 147, the actuating link being slidably supported in a rectangular notch formed in the vertical leg of bracket 225. Cam 213 is a pair of cam blocks 219 and 221 which cooperate to define a vertical slot or groove for receiving cam roller 218. Consequently, upon rotation of cam 213, roller 218 acts against the opposed edges of blocks 219 and 221 in the slot of bracket 225 which in turn causes oscillation of gripper mechanism about an axis 217.

Mounted on the opposite end of shaft 211 from cam 213 is a pair of gripper actuating cams 227 and 229.
which are disposed axially on shaft 211 at substantially right angles to each other. Cam 227 is formed with two oppositely projecting teeth 227a and 227b, and cam 229 is formed with two teeth 229a and 229b. With reference to FIGURE 13 tooth 229a, of cam 229 projects into recess 203 in the path of tooth 207 and the longitudinal axis of cam 227 is disposed parallel to the rim of gear 206. As gear 202 rotates counterclockwise as viewed in FIGURE 13A, tooth 207 moves downwardly in FIGURE 13 and strikes tooth 229a causing shaft 211 to pivot counterclockwise. Tooth 227a of cam 227 follows the downward movement of the tapered or inclined portion 203a of the rim and meshes with notch 205. As gear 202 continues to rotate, the upper wall of notch 205 pivots tooth 227a counterclockwise until it moves out of the notch whereupon cam 227 again assumes its parallel position with the rim; but having rotated 180 degrees from the position of FIGURE 13. That is, in the new position, after notch 205 has passed below shaft 211 in FIGURE 13, tooth 227a will point upwardly and tooth 229b will be received in recess 203. Thus, each time gear 202 completes one revolution, shaft 211 is rotated through an angle of 180 degrees. Consequently, with each revolution of gear 202, cam 227 rotates through an angle of 180 degrees and gripper head 233 (FIGURE 4) will shift from abutment 459R to 155L or vice versa.

Mounted on support bracket 187 by welding or other conventional means is a bearing member 232 for rotatably supporting a shaft 231, at the lower end of which is mounted a beveled pinion gear 233. Mounted on the upper end of shaft 231 (FIGURE 1) is a sprocket 235. Mounted on the upper end of twister shaft 142b, which it rotatably mounted in a cylindrical sleeve bearing 142a, is a sprocket 237 coupled with sprocket 235 by a chain 240a that engages sprockets 235, 237. Gear 233 meshes with teeth 211 of the rim of the gear 202 for approximately one-half of each revolution of gear 202 to cause intermittent rotation of shafts 142 and 231. In the illustrated embodiment, the ratio between gears 202 and 233, and between sprockets 235 and 237 is such that with each revolution of the mutilated gear 202, there will be approximately three revolutions of twister shaft 142b. Obviously, the number of revolutions of twister shaft 142b can be varied as desired by changing the gear and/or sprocket ratios.

STRIPPER ASSEMBLY

With reference particularly to FIGURES 7, 8 and 12, stripper arm 134 is mounted on a shaft 241 rotatably supported between a guide plate 243a and post 147a. Mounted on the opposite end of shaft 241 from stripper arm 134 is a stripper actuating lever 248a which is biased in a counterclockwise direction, as viewed in FIGURE 7, by a spring 250a connected between lever 248 and bracket 225. In the position illustrated in FIGURE 7, stripper arm 134 is in its inoperative position. Stripper actuating lever 248a projects into the path of a stripper actuating pin 252a mounted on the inner face of sprocket 197. Consequently, clockwise rotation of sprocket 197, as viewed in FIGURE 7, causes pin 252a to take the end of lever 248 and rotate stripper arm 134 downwardly in a counterclockwise direction about the axis of shaft 241, as viewed in FIGURE 7, and in a clockwise direction, as viewed in FIGURE 4. Upon actuation of lever 248a by pin 252a, stripper arm 134 pivots downwardly (FIGURE 4) and actuates the bag roller 280 and the tie wire or ribbon ends from twister hook 137.

PACKAGE CLAMPING ASSEMBLY

Pivotedly connected to deck plate 23 by a pin 254 (FIGURE 9) is a presser-foot 256 which is pivoted about the end of the bag against the underside of plate 174a during the tying operation. For actuating presser-foot 256, an aperture 258 is provided in deck plate 33 through which extends a reciprocating presser-foot connecting rod 262 that is pivotally connected by a pin 260 to the underside of presser-foot 256. When the bag reaches tying station 97, presser-foot rod 262 actuates the presser-foot to clamp the end of the package or bag retaining it against the underside of plate 174a during tying operation. Presser-foot 256 is normally employed with packages made from certain types of materials, e.g., those having a relatively low coefficient of friction, or those of extremely lightweight material such as mesh fabric.

PACKAGE GATHERING SYSTEM

Mounted at the receiving end of conveyor 59, between side frame members 11 and 12a, are a plurality (three being illustrated) of idler rolls 263. Idler rolls 263 are mounted between suitable brackets secured to the side frame members. Idler rolls 263 receive the bags of bread or other packaged material from a feed conveyor 261 (FIGURE 2) and serve to momentarily bring the bags to rest as they are received from feed conveyor 261. As the bags are fed from conveyor 261, each bag is pushed along idler rolls 263 by the preceding bag until it is forced onto conveyor 59 and carried to the tying station.

As soon as each bag is picked up from idler rolls 263 by conveyor 59, the open end of the package is flattened between a pair of oppositely rotating gathering brushes 264 and 266 which are driven at a rate approximately four times the speed of the conveyor shafts. With reference to FIGURES 2 and 10, gathering brush 264 has its shaft rotatably supported in a cylindrical bearing member 268 which is secured to a support bracket 270 mounted on top of plate 27. Bracket 270 is secured to plate 27 by welding or other conventional means. Fixed to the opposite end of the shaft of gathering brush 264 is a pulley 272 which is driven by a belt 274 passing around pulley 272 and a double drive pulley 276. Belt 274 is twisted one turn between pulleys 272 and 276 so that clockwise rotation of pulley 276 causes counterclockwise rotation of pulley 272 and brush 264 as viewed in FIGURE 2.

Brush 266 has its shaft rotatably supported in a cylindrical bearing 278 secured to a bracket 280a which in turn is mounted on the underside of plate 27. Gathering brush 266 is driven by a pulley 280 mounted at the opposite end of its shaft which is also coupled with the double pulley 276 by a belt 282. Belt 282 is positioned to drive pulley 290 in the same direction as the double pulley 276. Consequently, clockwise rotation of double pulley 276 as viewed in FIGURE 2, causes counterclockwise rotation of brush 264 and clockwise rotation of brush 266.

As the end of each bag is flattened and drawn between brushes 264 and 266, the brushes deflect the end outwardly from the conveyor toward gathering belt 77 in the direction of arrow 281 shown in FIGURE 1. From the brushes, the flattened end of the bag is carried between gathering belt 77 and the rim 283 of a guide roller 284 (FIGURES 8 and 11). Guide roller 284 is freely rotatable about its shaft 285 which is mounted on a support bracket 286. Bracket 288 in turn is mounted on plate 174. Guide roller 284 is formed with a groove 290 for receiving the actuating arm 296 of a microswitch 292.

Microswitch 292 is mounted on a horizontal flange of support bracket 288 and is actuated by rotation of a shaft 294 on the outer end of which is mounted lever 295. Actuating arm 296 is secured to the end of lever 294 and the weight of actuating arm 296 and lever 295 bias the shaft in a direction to open the contacts of microswitch 292. As the flattened end of the bag passes between rim 283 and gathering belt 77 it strikes the lower end of actuating arm 296 and pivots it counterclockwise, as shown in FIGURE 7, to close the switch contacts and
actuate a clutch and drive mechanism to be described hereinafter. Switch 292 acts as a control device for actuating the stop-ejector 125 and tying mechanism 131.

CLUTCH AND DRIVE MECHANISM

With reference to FIGURES 2, 3, 5 and 6, a conventional 1725 r.p.m. ½ H.P. electric motor 298 is mounted on base 2 for driving the bag-tying apparatus. Mounted on shaft 301 of motor 298 is a pulley 303 which is coupled with the input shaft 307 of an 18:1 gear reduction box 305. Input shaft 307 is driven by motor 298 through a variable pulley 309 which is coupled with motor pulley 303 by means of an endless belt 311. The flanges 309a and 309b of pulley 309 are spring-biased toward each other, and by spreading the flanges apart, the effective diameter of pulley 309 may be selectively decreased. Thus, by adjusting the relative positions of flanges 309a and 309b, the speed of shaft 307 may be varied since the ratio between the diameter of pulley 309 can be adjusted with respect to that of pulley 309. Pulley 309 is of conventional construction and the details thereof being no part of the present invention.

In order to control the axial position of flanges 309a and 309b of pulley 309, motor 298 is adjusably mounted on a support 312a. By rotating a hand wheel 314 (FIGURE 3) on the end of a shaft 316 extending from support 312a, the position of motor 298 may be adjusted along the axis of shaft 316. Adjustment of motor 298 along the axis of shaft 316 controls the tension on belt 311 to increase or decrease the space between flanges 309a and 309b and thereby regulate the speed of input shaft 307.

Mounted on the output shaft 318 of gear reduction box 305 is a 24 tooth sprocket 320 which is coupled through a chain 322 with the 20 tooth input sprocket 324 of a clutch and drive train identified generally by reference numeral 325. Drive train 325 includes an input or drive shaft 326, a time delay shaft 328 and an actuating or output shaft 330. Shafts 326, 328 and 330 are journaled between pairs of plates 332 mounted on base 2 by welding or other conventional means. Input sprocket 324 is mounted on drive shaft 326 and continuously drives shaft 326 when motor 298 is energized.

Mounted on the outer end of drive shaft 326 is a 20 tooth output sprocket 334 which drives a timing belt 77, counter 359, and brushes 264 and 266 by means of a main drive chain 336. Chain 336 passes around and meshes with the teeth of sprocket 334 and passes over a tension idler pulley 338 mounted on a bracket 340 secured in turn to vertical support member 7. From idler pulley 338 chain 336 passes around and meshes with the teeth of a sprocket 342 secured to the end of a shaft 344, on the other end of which is fixed the double pulley 276 for driving brushes 264 and 266 at a rate which exceeds the speed of the conveyor. From sprocket 342, chain 336 passes beneath a directional idler pulley 346 mounted for free rotation on the inside of side frame member 13a and around a 30 tooth sprocket 71 secured to the end of shaft 85 of the 8 inch input gathering pulley 63. Gathering belt 77 in turn drives conveyor 59 through a 5 inch pulley 75 at the end of the forward conveyor shaft 48.

Stop-ejector 125 is actuated by rotation of actuating shaft 330 on which is mounted a sprocket 348. Sprocket 348 is coupled with a sprocket 350 fixed to stop-ejector shaft 118 by means of a chain 352. Chain 352 passes around sprockets 348 and 350 and beneath a tension idler pulley 354 mounted for free rotation at the end of a clutch bar 356. As illustrated more clearly in FIGURE 19, stop-ejector 125 is mounted at 358 to a support bracket 360 and is resiliently biased into engagement with chain 352 by a spring 362 connected between bar 356 and base 12. When clutch bar 354 is in the position shown in FIGURES 2 and 19 stop-ejector 125 is in the operative position with one set of fingers 129 projecting above the surface of conveyor 59 between belts 53.

By pivoting clutch bar 356 counterclockwise as shown in FIGURE 19 until spring 362 moves across pivot point 358 to bias roller 354 against the opposite side of chain 352, shaft 118 will be rotated through a counterclockwise angle of approximately 60 degrees as shown in FIGURE 10 so that the fingers 129 will be retracted below the surface of conveyor 59. Manual operation of clutch bar 356 is provided by a hand lever 364. Thus, when it is desired to let some packages pass through the tying apparatus without being tied, hand lever 123 and mounting bar 107 can be withdrawn to permit the packages to pass freely, and it is not necessary to remove the unit from the production line since the conveyor 59 will transport the packages from the feed conveyor 261 directly to the delivery conveyor 267. This arrangement is particularly useful where a portion of the production run requires sealing of both ends of the package other than by tying.

Fixed to the outer end of actuating shaft 330 is a sprocket 366 which is coupled with actuating sprocket 197 of the tying mechanism by means of a chain 368. Chain 368 passes around sprockets 197 and 366 and around a tension idler pulley 370 mounted for free rotation on a bracket arm 372 supported on horizontal support member 17.

With reference to FIGURES 5 and 6, a drive clutch 374 is connected between drive shaft 326 and time delay shaft 328, and a delay clutch 376 is connected between time delay shaft 328 and actuating shaft 330. Actuation of clutch 374 connects drive shaft 326 with time delay shaft 328 causing time delay shaft 328 to rotate with the drive shaft. When time delay shaft 328 is rotating with drive shaft 326, actuation of delay clutch 376 connects time delay shaft 328 with actuating shaft 330 and shafts 326, 328 and 330 rotate as a unit.

With reference to FIGURES 5, 15 and 15A, drive clutch 374 includes an input clutch member 378 which is fixed to the end of drive shaft 326, and an output clutch member 380 which is fixed to the end of time delay shaft 328. Input member 378 is formed with a recess or chamber 382, the walls of which are formed with a plurality of grooves or flutes 384 which serve as ratchet teeth. Input member 378 may be coupled with output member 380 by means of a pawl lever 386 which is pivotedly connected at 388 with output member 380. Pawl lever 386 is biased in a clockwise direction as viewed in FIGURES 15 and 15A by a spiral spring 390 having one end connected with output member 380 and its other end connected with lever 386. A roller 392 is journaled to the lower end of lever 386 while a follower roller 394 is rotatably mounted at the upper end of lever 386.

As shown in FIGURE 15A, lever 386 is biased in a direction to position roller 392 in one of the grooves 384 of input clutch member 378 to couple the input and output members together. Drive clutch 374 is actuated by a pawl release lever 400 which is rigidly connected at one end with an actuating bar 396. When pawl release lever 400 is in the position shown in FIGURE 15, the end thereof engages roller 394 and pivots lever 386 in a counterclockwise direction preventing roller 392 from engaging grooves 384. In this position, input member 378 is free to rotate relative to output member 380, as indicated by arrow 399 in FIGURE 15. By pivoting pawl release lever 400 in a counterclockwise direction as shown in FIGURE 15A, spring 390 causes lever 386 to pivot in a clockwise direction causing roller 392 to engage one of the grooves 384, and output member 380 is connected to rotate as a unit with input member 378 as indicated by arrow 401 in FIGURE 15A.

With reference to FIGURES 3 and 5, actuating bar 396 is journaled in bearings 396 which are mounted on vertical support members 5 and 6. Pawl release lever 400 is connected through a link 402 with the armature 404 of a solenoid 406. Solenoid 406 is mounted on a bracket 408
which in turn is mounted on frame 1. Solenoid 406 is electrically interconnected with microswitch 229 which serves as the control device for actuating the clutch and drive train. Counterclockwise movement of actuating arm 296 of switch 292 closes the switch contacts and energizes solenoid 406 causing armature 404 to move upward to the position shown in FIGURE 15A and rotates pawl release lever 408 and actuating bar 356 in a counterclockwise direction as viewed in FIGURES 15 and 15A.

With reference to FIGURE 17, delay clutch 376 includes an input clutch member 410 and an output clutch member 412. Input member 410 is fixed to the opposite end of an arm 420 and output member 412 is held out of engagement with input member 410 by a pawl release lever 424 which is biased in a counterclockwise direction by a spiral spring in the same manner as pawl lever 366 of clutch 374. Lever 418 is provided with upper and lower rollers 422 and 420 respectively; roller 420 cooperating with the single tooth 416 to couple the input and output members together. Output member 412 is held out of engagement with input member 410 by a pawl release lever 424 also fixed at one end to shaft 396. Release lever 424 engages roller 422 to hold pawl lever 418 in its inoperative position permitting tooth 416 to freely pass roller 420 upon rotation of input member 410. Upon actuation of solenoid 406, but 366 rotates in a counterclockwise direction to lift lever 424 out of engagement with roller 422 to release lever 418. When input member 410 has completed approximately 3/4 of one revolution, tooth 416 will engage roller 420 and couple actuating shaft 328 with time delay shaft 328. The relative positions of roller 420 and tooth 416 at shafts 328 and 329 cause a time delay between actuation of clutch 376 and clutch 374, upon energization of the solenoid.

Mounted on actuating shaft 330 between clutch 376 and sprocket 366 is an actuating cam 426 (FIGURES 5, 6 and 18). Actuating cam 426 is pivoted at the at rest position of the cam, is positioned above shaft 330 to receive a cam follower 430 rotatably mounted on a cam follower lever 432. Cam follower lever 432 is pivoted at 434 to a bracket 436 mounted on base 12. Cam follower 430 is biased into engagement with cam 426 by a spring 438 connected between lever 432 and base 12. Rigidity is maintained at one end with actuating bar 396 is a holding lever 449 having an adjustable contact screw 442 threaded into its fastened end. Contact screw 442 rides against the top of cam follower lever 432, and upon rotation of shaft 330 in a clockwise direction as viewed in FIGURE 18, cam follower 430 follows the surface of cam 426 and initially pivots lever 432 and holding lever 440 in a clockwise direction until cam 426 returns to its at rest position shown in FIGURE 18. Thus, when the open end of a bag trips actuating arm 296 of switch 292 to energize solenoid 406, drive clutch 374 immediately connects drive shaft 328 with time delay shaft 328. However, when the bag passes beneath actuating arm 296, the weight of the actuating arm causes it to return to its normal position to de-energize switch 292 which in turn de-energizes solenoid 406. During this time, however, roller 394 has moved past the end of pawl release lever 408 and before it returns to the position of FIGURE 15, clutch 376 engages to connect time delay shaft 328 with actuating shaft 330 and starts rotation of actuating cam 426. As soon as cam 426 begins to rotate, cam follower 430 rises out of depression 426 and lever 440 takes over from the solenoid 406 to hold actuating bar 396 in the position of FIGURE 15A until the driving cycle is completed. Cam 426 takes over from release lever 408 to permit output clutch member 380 to make a second revolution after engagement of delay clutch 376.

As soon as cam 426 begins to rotate, the bag has reached tying station 97, and presser-foot rod 252, which is pivotally connected at 444 with cam follower lever 432, rises to actuate presser-foot 256. As cam 426 returns to the at rest position, lever 432 follows its movement and releases presser-foot 256.

To assure that actuating shaft 330 will return to the at rest position with tooth 416 of input clutch member 410 and roller 420 in proper orientation, a brake and centering cam 446 is mounted on shaft 330 between actuating cam 426 and sprocket 366 as viewed in FIGURE 5. With reference to FIGURE 17, delay clutch 376 is shown in a substantially circular disc formed with a single groove 448 at its periphery for receiving a roller 452 rotatably mounted on the end of a cam follower lever 450. Lever 450 is pivoted at 454 to a bracket 456 and is biased into engagement with the cam by a spring 458.

When actuating shaft 330 is connected with drive shaft 326 through clutches 374 and 376, cam 446 rotates with shaft 330 and overrides spring 458. However, when release lever 424 returns to the position of FIGURE 17 to disconnect input member 410 from output member 412, roller 452 engages groove 448 to stop further rotation of shaft 330 in the at rest position.

A similar brake and centering cam 460 is mounted on shaft 328 and is provided with a groove 462 (FIGURE 6) for receiving the roller 464 of a cam follower lever 462 (FIGURE 5). Cam follower lever 462 is pivotally connected with a bracket 468 and is biased into engagement with cam 476 by a spring 470 coupled between lever 466 and base 12. Thus, when clutch 374 disengages, cam 460 cooperates with lever 464 to prevent over-travel of time delay shaft 328.

**TENSION CONTROL SYSTEM**

As illustrated in FIGURES 2 and 7, tie wire or ribbon 144J is supplied from a reel 427 rotatably mounted on a shaft 474 extending from a bracket (not shown) mounted on support member 5. A weighted tension bar 476 is pivotally mounted to side frame member 11 at 478 and is formed with a horizontal arm member 480 on its lower end which rests against tie wire 144J to apply tension to the ribbon. As the supply wire decreases, arm 480 gradually swings downward until it comes to rest against the edges of the reel to apply a frictional resistance to rotation of the reel. Tie wire 144K extends from the reel to a tension lever 482 which is pivotally mounted by pin 484 to side frame member 11. Mounted on the free end of lever 482 are a plurality of rollers 486. Lever 482 is biased in a counterclockwise direction as viewed in FIGURE 7 by a spring 488 connected between lever 482 and the frame. Tie wire 144K is threaded in serpentine fashion through the pulleys 486 and extends upwardly around an idler roller 490 mounted on side frame member 11 beneath the tying mechanism. The end of the tie wire is secured between gripping head 153 and one of the abutments 155J or 155K. Tension bar 476 and tension lever 482 apply constant tension to the tie wire throughout the package gathering and tying operation to initially arrest movement of the open end and assist in forming the gathered neck of each package during the tying sequence.

**OVERALL OPERATION**

Referring now to the tying apparatus which forms the subject matter of this invention, the entire unit can be installed in a production line without modification of existing equipment. For example, the unit may be positioned between a feed conveyor 261 and a delivery conveyor 267 in the manner illustrated in FIG. 2. Assuming that the machine is to be employed in a baking plant, feed conveyor 261 will feed loaves of bread or buns from a wrapping machine onto idler rollers 263. In the
wrapping machine, the loaves will be wrapped with cellophane or plastic material and one end of the package will be closed by heat sealing or an adhesive and the opposite end of the wrapper will be left open.

To prepare the machine for operation, a reel of tie wire ribbon is mounted on shaft 474 and the terminal end threaded around rollers 486 and 490 before being fed through needle eylet 139 to tying station 97. The end 144c of the tie wire (FIGURE 4) is then inserted downwardly between gripping head 133 and one of the abutting members 455L or 455R and by manually rotating sprocket 197 through a complete cycle, the wire will be retained by the gripping action exerted by head 133 against an associated abutment. Motor 298 is then turned on and actuating arm 296 of switch 292 is manually tripped causing needle 135 to automatically bring a segment of tie wire into the gripping head where the end of the wire will be supplied between abutment 455L or 455R and edge 163 of gripping head 133.

Variable pulley 309 is adjusted by turning hand wheel 314 to obtain the proper ratio between pulleys 303 and 309 to select the speed of conveyor 59. Conveyor 59 is normally driven at a greater rate of speed than feed conveyor 261 in order to properly space the bags as they are fed into the tying mechanism. The greater speed of conveyor 59 serves to uniformly space the bags as they are fed into the tying mechanism.

Upon energization of motor 298, drive shaft 326 is driven continuously by chain 322 (FIGS. 3 and 6). Brushes 264 and 266, gathering belt 77 and conveyor 59 are driven continuously by main drive chain 336. With actuating arm 296 in its inoperative position, as viewed in FIG. 10, solenoid 406 is deenergized and clutches 374 and 375 are disengaged. Consequently, shafts 328 and 330 are disconnected from drive shaft 326.

The various operations performed on the bag are illustrated schematically in FIGS. 20A through 20E. Reference will be made to these figures in conjunction with a detailed description of the various operations.

With reference to FIGS. 1, 2, 3 and 20A, as bags A are received on conveyor 59, the open end B of the bag extends over the edge of side frame member 11 (FIG. 1). When the bag reaches the brushes, end B is flattened between the counter-rotating brushes to the configuration shown in FIG. 20A. Moreover, the position of the brushes relative to the path of movement, the end is deflected outwardly from conveyor 59 in the direction of arrow 281 shown in FIG. 1 to be received by gathering belt 77.

As the flattened end B of the bag leaves the brushes, it is pulled between rim 283 of roller 284 and gathering belt 77 where it is further flattened, and as illustrated in FIG. 20A, it engages and trips actuating arm 296 of switch 292 to energize solenoid 406. As soon as the end B passes beneath actuating arm 296, the actuating arm is released and falls back to its inoperative position shown in FIG. 1. Deenergizing the solenoid.

The momentary energization of solenoid 406 rotates actuating bar 396 in a counterclockwise direction, as viewed in FIG. 3, raising release levers 400 and 424 as well as holding lever 440. As soon as release lever 400 moves to the position of FIG. 15A, roller 392 of pawl lever 386 engages a groove 384 to couple time delay shaft 328 with drive shaft 356. When actuating arm 296 returns to its inoperative position, solenoid 406 is deenergized and lever 400 is released to fall to the position of FIG. 15. However, the momentary lifting of lever 400 permits roller 394 to pass beneath the lever and output clutch member 380 must complete one revolution before lever 400 can again engage roller 394 to disconnect clutch members 378 and 380.

As soon as clutch member 380 is connected with clutch member 378, time delay shaft 328 rotates with the drive shaft and in turn rotates input clutch member 410 of clutch 376. However, since tooth 416 starts from the at rest position shown in FIG. 17, output clutch member 412 remains stationary until tooth 416 is carried by input clutch member 410 to the position of roller 420. In other words, input clutch member 410 must complete slightly less than one revolution before it will engage with output clutch member 412. The time delay between engagement of clutch 374 and clutch 376 permits the bag to travel from input roller 394 to tying station 97 where gathering belt 77, gathering feed rollers 87, 101, 163, etc., cooperate to force end B of the bag against the segment of the tie wire between eylet 139 and gripping head 133. End B is forced against the tie wire segment intermediate its ends causing end B of the bag to be gathered into a constricted neck C (FIGS. 4 and 20B). As shown in FIG. 4, the end of the bag has been gathered to a neck C between tie wire segment 144a, gathering belt 77 and tongue 89a of guide bar 89 which mutually cooperate to define a neck forming region.

By the time constriction of the bag end has begun, tooth 416 of the bag 4169A is in the relative position shown with roller 420 to connect input clutch member 410 with output clutch member 412 to couple shafts 326, 328 and 330 together as a single unit. Tooth 416 comes into engagement with roller 420 just prior to completion of one revolution by output member 389 of clutch 374.

As soon as clutch 376 engages, actuating cam 426 causes cam follower lever 432 (FIG. 18) to pivot in a counterclockwise direction as cam follower 430 follows the high portion of cam 426. Counterclockwise rotation of lever 432 causes holding lever 439 to pivot actuating bar 396 back to the position shown in FIG. 15A, moving the pawl lever 386 out of the path of roller 394, permitting roller 394 to once again pass the release lever 400. Simultaneously, presser foot rod 262 lifts presser foot 256 into engagement with the bottom of plate 174 to clamp the end of the bag in place at the tying station.

With reference to FIG. 10, as the bag is carried to tying station 97, it rides up onto the end of lifting bar 107 where its forward movement is momentarily halted by fingers 129a. Simultaneously, with the actuation of time delay clutch 376, sprocket 348 rotates with shaft 330 to rotate fingers 129a in a counterclockwise direction about the axis shaft 118 as viewed in FIG. 10 and fingers 129b move upwards to release the bag from the tying station upon completion of the tying operation.

Simultaneously, with rotation of stop-echter 125, chain 368 begins to rotate sprocket 197 (FIG. 7). As pin 198 moves upwardly from the "at rest" position of FIG. 7, due to the counterclockwise rotation of sprocket 197, link 199 acting through lever 183 rotates shaft 143 in a counterclockwise direction.

Rotation of shaft 143 in turn causes counterclockwise rotation of needle 135 about the axis of shaft 134 and eylet 139 carries a loop 144b of tie wire around the constricted neck C as shown in FIGS. 4 and 20B.

While needle 135 moves to the position shown in FIG. 20B, shaft 195 of sprocket 197 rotates milled gear 202 to move teeth 201 toward bevelled pinion gear 233 (FIG. 9). In the "at rest" position of milled gear 202, teeth 201 are approximately 90 degrees from gear 233. Teeth 201 come into engagement with the teeth of gear 233 as needle 135 reaches the approximate positions illustrated in FIGS. 4 and 20B. As soon as teeth 201 come into engagement with gear 233, chain 237 causes twister shaft 142 to rotate in a clockwise direction as viewed in FIG. 1 and twister hook 137 rotates to gather in the looped ends 144c and 144b of the tie wire segment 144.

With reference to FIGS. 4, 13 and 14, twister hook 137 rotates about the axis of shaft 142b through an angle of approximately 270 degrees whereupon tooth 203 of gear 202 engages tooth 229a of cam 229 at the end of shaft
211 of gripper actuating cam 213. Twister hook 137 rotates approximately 270 degrees past its first revolution during the time that shaft 211 completes a cycle of 180 degrees to shift gripper head 133 from abutment 155R into engagement with abutment 155L (FIG. 4). However, just prior to engagement of tooth 223 with tooth 229a, needle 135 engages its full throw position shown in FIG. 20C to position strand 144 between gripper head 133 and abutment 155L. Consequently, cutting edge 161 severs strand 144d of the wire segment 144d from the supply and gripping edge 163 grips the severed end from the supply between gripping edge 163 and the edge portion of abutment 155L above projection 157.

When needle 135 reaches its full throw position with eyelet 139 just above abutments 155L and 155R, pin 198 moves across dead center momentarily stopping the movement of eyelet 139. As link 199 moves across the axis of shaft 195, eyelet 139 remains momentarily idle until pin 198 moves past shaft 195 and starts its downward travel. During the second half of the revolution of sprocket 197, link 199 causes lever 183 and shaft 143 to move in a counterclockwise direction to retract needle 135 (FIG. 20D).

As needle 135 is retracted by the downwind, arcuate movement of pin 198, pin 252 on sprocket 194 moves toward the end of the strip that is transmitting one revolution of the control assembly. During that time that needle 135 is retracting, twister hook 137 starts into its third revolution to continue twisting the severed ends of the loop of the wire. During the last twisting revolution of hook 137, pin 252a engages the end of the strip that is being transmitted. As sprocket 194 completes one revolution, twister hook 137 engages with the strip of sprocket 194 to pivot shaft 241 and strip arm 134 in a clockwise direction, as viewed in FIG. 4.

With reference to FIG. 20E, strip arm 134 is pivoted to the position shown in FIG. 20E to remove end C from beneath twister hook 137 with that of sprocket 144a and 144b of the wire twisted together in the manner shown. Sprocket 197 is returned to the position of FIG. 7 by chain 368 as roller 394 of pawl 356 of the drive clutch comes into engagement with release lever 408. As shaft 330 completes one revolution, cam follower 430 is received into groove 428 of actuating cam 426 permitting this return movement of cam 426 to drop counterclockwise about shaft 396 and pivot release levers 409 and 424 back into their normal positions to engage rollers 394 and 422 respectively. Centering cam 446 and 460 return to the position illustrated in FIG. 16 where rollers 452 and 464 respectively, are forced into grooves 448 and 462, respectively.

As strip arm 134 removes end C from the striping station, fingers 129b of stop-ejector 125 move to the stop position of fingers 129a shown in FIG. 10 and eject the tied bag from lifting arm 187 back onto conveyor 59 where it is discharged and deposited onto delivery conveyor 257.

In summary, with each revolution of actuating shaft 330, the bag has its open end gathered and constricted as well as tied before the bag is ejected from the tying station. Shaft 330 completes one revolution for each tying operation. With each revolution of shaft 330, shaft 195 completes one revolution, twister hook shaft 142b completes three revolutions, shaft 211 of the gripper actuator completes one-half revolution and needle 135 oscillates from the "at rest" position shown in FIG. 9 to the full throw advanced position of FIG. 20C and returns to remote position. The one-half revolution of gripper actuating shaft 214 causes actuating link 175 to reciprocate one-half stroke in bracket 225. Since rotation of shaft 213 of the gripper actuator causes gripper head 133 to oscillate between abutments 155L and 155R, each revolution of shaft 330 causes one-half cycle of oscillation of gripping head 133 about pin 167. The relative diameters of sprockets 348 and 350 illustrated in FIG. 6 are such that with each revolution of shaft 330, shaft 118 of the stop-ejector 125 rotates through an angle of 120 degrees to move the three sets of fingers 129a, 129b and 129c one step. As sprocket 197 completes one revolution, projection 252a slides off the end of stripper actuating lever 248a to permit it to return to its normal position due to the bias of spring 258a.

ADDITIONAL EMBODIMENTS

A. Framework

With reference to FIGS. 21, 22 and 23, a further embodiment of the invention is disclosed which includes a frame identified generally by reference numeral 10 having a base 10a, vertical support members 12 (FIG. 21), and 12a (FIG. 22), and horizontal support members 12b (FIG. 21) and 12c (FIG. 22) extending between the upper ends of the vertical support members 12 and 12a, respectively. Frame 10 is mounted on casters 13 in order to permit the machine to be freely moved from place to place.

B. Package Conveyor and Guide Assemblies

Mounted between the horizontal frame members 12b and 12c is a stationary conveyor deck 14 of stainless steel, aluminum or other suitable sheet metal that is parallel to the base members between members 12b and 12c at the rear of the frame is a rear conveyor shaft 16 which is journaled for rotation. Mounted between members 12b and 12c at the front of the frame is a forward conveyor shaft 18 also journaled for rotation. Fixed to the ends of shaft 16 in a pair of sprockets 20 and fixed to the ends of shaft 18 is a pair of sprockets 22. Each pair of sprockets 20 and 22 are coupled together by conveyor chains 24 which pass around and mesh with the sprocket teeth so that shafts 16 and 18 will rotate together.

Secured to chains 24 at spaced intervals are the ends 25 of a plurality of drag links 26. As conveyor chains 24 move along deck 14, the drag links carry packages along the conveyor deck toward the tying station identified generally by reference numeral 97.

Mounted on horizontal frame member 12c (FIGS. 22 and 23) is a pair of cylindrical brackets 28 and 30. Brackets 28 and 30 are in the form of cylindrical sleeves and receive rods 34 and 36 on the ends of which are mounted a guide bar 38. Set screws 39 and 41 are threadedly mounted in guide brackets 28 and 30, and by loosening the set screws, rods 34 and 36 can be adjusted in the cylindrical sleeves to thereby adjust the position of guide bar 38 transversely of the conveyor deck in accordance with the size of the packages to be tied.

For special applications, the framework 1 or 10 of the package tying units illustrated in FIGURES 1 and 21 can be mounted to facilitate angular movement for tilting of the conveyor deck 501 in the manner illustrated in FIGURE 48 as well as adjusted to elevate the plane of the conveyor 501 to the level of the production line upon installation of the equipment. Lateral tilting is desirable where the packaged products must be supported adjacent the bottom of the bag so that the contents will not interfere with constriction and tying of the upper open end. As previously noted, an adjustable guide rail 38 can also be utilized to accommodate a variety of package sizes and may be suitably adjusted to assure that the open end of the package will enter the gathering station 503 in proper registry. Accordingly, such a machine is universally adaptable not only as to height and length but also as to the angular disposition of the conveyor deck 501.

In certain applications, particularly in connection with bakery equipment, provision must be made to permit lateral adjustment of the unit relative to the package input conveyor in order to accommodate a variety of package lengths. This is required where the output of the wrapping machine will discharge packages of varying length onto the conveyor 501 of the tying equipment.
In particular, the guiding ledge 505 extending along the tying side of the conveyor must always be aligned in register with the output of the wrapping machine in order to properly introduce the open end of the wrapped package into the gathering station 503.

C. Package Gathering and Constraining Assembly

With reference to FIG. 21, a cam 90 is fixed to the outer end of shaft 16 adjacent frame member 120 for rotation with the shaft. Rigidly connected with cam 90 adjacent its periphery is a pitman 93 which rotates with cam 90 about the axis of shaft 16. Mounted on frame member 120, just forward of shaft 16, is a bracket 99 on which is pivotally mounted by a pin 98a a cam follower lever 98. Mounted on the free end of cam follower lever 98 is a cam follower roller 98a which engages the periphery of cam 90 and follows its movement.

Projecting upwardly from base 10a is a pair of bearing lugs 10b and 10c (FIGS. 21 and 22) which rotatably support the ends of a shaft 94c. One end of an oscillating lever 94 is secured to shaft 94c so as to rotate therewith. Mounted on lever 94 adjacent its lower end is an A-frame 94a. Lever 94 is caused to oscillate about the axis of shaft 94c by a connecting link 96c having one end pivotally connected by a pin 96a to A-frame 94a, and its other end pivotally connected by a pin 96b to the free end of pitman 93. Consequently, rotation of shaft 16 in a clockwise direction from the position of FIG. 21 initially causes lever 94 to rotate in a clockwise direction about the axis of shaft 94c until pin 96b rotates approximately 180 degrees about the axis of shaft 16, whereupon lever 94 will be rotated in a counterclockwise direction about the axis of shaft 94c until pin 96b returns to the approximate position shown in FIG. 21.

Thus, the rotary motion of shaft 16 is converted by cam 90, pitman 93 and link 96c into oscillating motion of lever 94 about the axis of shaft 94c.

Mounted on frame 10 below and slightly to the rear of the tying mechanism 52 is a support plate 102. Pivotally mounted on plate 102 through parallel links 104 and 106 is a guide carriage 91. Links 104 and 106 each have one end pivotally connected with the underside of carriage 91 by pins 108 and 112, respectively, and their other ends pivotally connected with plate 102 by pins 110 and 114, respectively. Pivotally connected with the end of carriage 91 by a pin 100c is a carriage link 93, the other end of which is pivotally connected by a pin 100b with cam follower lever 98. Cam follower lever 98a is biased into engagement with the periphery of cam 90 by a spring 100a connected between carriage link 100 and frame member 120. Thus, during rotation of cam 90, cam follower lever 98 and link 100 follow the surface of cam 90 causing link 100 to reciprocate relative to shaft 16 which in turn causes carriage 91 to swing back and forth about pins 110 and 114 in a reciprocating-oscillating motion. Since links 104 and 106 are the same length, a parallel relationship is maintained between carriage 91 and plate 102 throughout the movement of carriage 91. Carriage 91 is C-shaped in cross-section with its upper and lower horizontal flanges projecting inwardly toward frame member 120 as viewed in FIG. 21.

Slidably mounted in carriage 91 is a gathering plunger 116. Plunger 116 is caused to reciprocate in carriage 91 by a plunger rod 92 pivotally connected by a pin 92a with a free end of oscillating lever 94. As shaft 16 rotates cam 90, plunger 116 is moved upwardly by the oscillating movement of carriage 91 until its longitudinal axis is in line with a guide slot 44 for receiving the package end at the tying station. Oscillation of lever 94 causes the plunger 116 to reciprocate in carriage 91 and move against the open end of the bag and gather it against the tie wire ribbon in a manner to be described in detail below.

As illustrated in FIG. 25, plunger 116 is formed with a pair of parallel plates 117 and 119 each formed with a groove or recess 116a in their forward ends. Recess 116a on plate 117 is slightly larger and offset to the rear of groove 116a formed in plate 119 so that the constriction of the package neck adjacent the contents will be somewhat less in order to relieve the strain on the gathered neck portion.

With reference to FIGS. 21, 29 and 30, a platform 15' is supported between frame member 120 and vertical frame member 12 at the forward end of the machine as viewed in FIG. 21. Posts 19' and 21' are mounted on platform 15' for supporting a horizontal deck plate 23'. Spaced above plate 23' by a wall or ledge 176 is a horizontal plate member 169. Mounted on the upper end of post 19' above the top of plate 69 is a bracket 198 in which is rotatably mounted a gathering brush 46. Fixed to the opposite end of the shaft of brush 46 is pulley 86 which is driven by belt 94 from a drive mechanism which will be subsequently described in detail. Brush 46 is driven in a counterclockwise direction as viewed in FIG. 29 and serves to brush the open end of the bag into position to be received in the gathering slot. Brush 46 is disposed at an angle of approximately 45 degrees relative to the longitudinal axis of conveyor deck 14. Like the counter-rotating brushes of the previously described embodiment of FIGS. 1 through 20, brush 46 is preferably driven at a speed approximating the speed of the conveyor. For bags of heavy material in which the tension of the tie wire may be insufficient to gather and constrain the package neck, a retaining dog 122 may be mounted on frame 12 for rotation about a shaft 124 (FIGS. 41A through D and FIG. 21). Retaining dog 122 is formed with an extension member 126 which serves as a cam follower for a cam 128 mounted on the end of shaft 18. Extension member 126 bears against a bracket member 130 secured to framework 12 of the machine, and upon rotation of shaft 18 and cam 128, the tip end of the latter engages the extreme end of extension member 126. As the cam rotates, retaining dog 122 is urged in a counterclockwise direction about the axis of shaft 124 as shown in FIGS. 41A and 41B until it reaches its full stroke to cooperate with plunger 116 as illustrated in FIG. 41C to constrict the bag between the jaws of dog 122 and plunger 116. The configuration of dog 120 is such that the dog remains in position shown in FIG. 41C until the tying operation is completed.

A modified form of retaining dog is shown in FIGS. 47A and 47B at 360. Retaining dog 300 consists of a stationary upper member 302 which is mounted on frame 10, and a lower member 304 which pivots about an axis 306. Dog 300 has its jaw shaped to receive the open end of the bag in cooperation with plunger head 116. Lower member 304 includes a cam follower 303 which is adapted to ride upon the outer surface of cam 310 mounted on the end of shaft 18. Lower member 304, together with cam follower 303 which is mounted thereon, is suitably weighted so that the jaws will remain open until urged to a closed position by means of cam 310. The jaws remain closed during the following and tying operation as shown in FIGS. 47A and 47B. After the gathered end of the bag 40 has been tied, cam 310 reaches the position shown in FIG. 47D where lower member 304 is raised to return to its normal position in a counterclockwise direction and open the jaws so that the tied bag can be discharged from the tying station.

Due to the tension continuously maintained on wire 62, it is possible to eliminate restraining dogs 122 and 300 without affecting operation of the treating station by utilizing lightweight packaging materials. Since the wire ribbon 62 extends between the gripping member 166 and the wire guide 85 under control tension, the open end of the package 50 can be gathered by the reciprocating plunger head 116 against the downwardly extending wire segment and thereafter restricted to a neck without utili-
zation of the restraining dog mechanism. Although the retaining dog may be eliminated, it is particularly effective for specialized packaging where the open end of the package tends to resist constriction, as for example, where heavy paper material is employed.

D. Package Tying Assembly

With reference to FIGURES 26 and 27, the tying mechanism 52 of the embodiment of FIGURES 21 through 47, like the tying mechanism of the previously described embodiment, includes a needle 253, a twister hook 244, and an associated wire gripper and cutter 166 (FIGURES 26 and 27). Needle 253 is of generally arcuate shape and is formed with an eyelet 210 in which a freely rotatable grooved roller 254 is mounted. Needle 252 is mounted at one end on shaft 250 and oscillates about the axis of shaft 250 in a manner similar to the operation of needle 155 of the previously described embodiment.

Twister hook 244 is mounted on the lower end of a vertical shaft 240 and rotates about the axis thereof and twists the ends of the tie wire ribbon together as it is carried around the neck 50 of the bag at tying station 57 by the twister hook mechanism. Twister hook 244 is similar to the operation of twister hook 137 of the previously described embodiment of FIGURES 1 through 20.

In this connection, the terminal or leading edge of the twister hooks 137 and 244 is bent upwardly from the base portion where it merges with the related twister shaft in order to pick up the free ends of the wire ribbon near the cutting arm and away from the constricted neck of the package so as to prevent fouling. This assures that the hook will engage the wire at the point where the wire strands are brought together rather than attempting to pick up the ribbon closer to the package as the segments will be clamped to one another adjacent the package neck and could possibly be missed by the hook. Accordingly, by gathering the wire near the cut end, there is less chance for the hook to miss the strands since the free ends are closer together and function to twist about the hook shaft into compression against the constricted package neck.

Shaft 240 of twister hook 244 is rotatably supported in a sleeve type bearing 238 mounted on a bracket which is secured to the top of plate 169. Mounted at the opposite end of shaft 240 from the twister hook is sprocket 242 which is coupled through a chain 243 with a sprocket 236. Sprocket 236 is rotatably supported on a drum 235. The drum 235 is rotatably supported on a drum 234 which is driven through a pinion gear 233 as shown in FIGURE 30. Pinion gear 233 has its shaft rotatably supported in a bearing 230 secured to the end of a bracket 169 which in turn is mounted on plate 169. Beveled gear 234 is driven by a multilobed beveled gear 228 mounted for rotation with a shaft 227. Shaft 227 is journaled in a bearing member 220 on plate 169 and has a sprocket 190 mounted on its outer end.

Shaft 250 of needle 252 is rotatably supported in a bearing mounted on the underside of plate 23, and mounted on the opposite end of shaft 250 from the needle is a lever arm 256 which is engaged with the shear against relative rotation therewith. Needle 252 is actuated by a link 226 pivotally connected with the end of actuating lever 246 by a pin 248 and with sprocket 190 by a pin 245. Mounted on the outer face of sprocket 190 is a single revolution, centering clutch 224 which causes the shaft 222 to return to the "rest" position after each revolution. Sprocket 190 is driven by a chain 80 coupled between sprocket 190 and a sprocket 76 (FIGURE 23A) mounted on the end of an actuating shaft 73b.

Gripper 166 is pivotally connected to a ledge 168 by pin 170 for oscillating movement between a pair of cutting teeth by coupling members 196 similar in construction to the abrasives 155L and 155R of the previously described embodiment. Gripper 166 is actuated by a link 172 which is pivotally connected at 174 with the opposite end of gripping 166 from the associated cutting and gripper head 192. Actuating link 172 is reciprocally mounted in a slotted bracket 178 at the end of a bar 178a which in turn projects from plate 169. Brackets 182 and 184 are adjustable mounted on actuating link 172 by fasteners extending through slots 180 in the actuating link which cooperate to define a slot 185 (FIGURES 28 and 30). Slot 185 receives the cam follower 186 of a disc cam 186a, the shaft of which is rotatably mounted in a bearing 188. On the opposite end of the shaft of cam 186a is an actuating cam which cooperates with mutilated gear 228 in a manner similar to the previously described apparatus in FIGURES 13 and 13A. Upon rotation of sprocket 190, mutilated gear 228 actuates twister hook 240 through pinion gear 230 and causes reciprocation of link 172 for actuating the gripper in a manner similar to the tying mechanism 131 of the previously described embodiment.

E. Clutch and Drive Assembly

With reference to FIGURES 21, 22 and 23A, an electric motor 58 is connected to a clutch and drive assembly 56 through a chain 138 which couples the motor shaft 59 with a sprocket 136 mounted on a drive shaft 73b. On the outer end of the shaft of motor 54 is a pulley 82 which drives a drum 46 through belt 84 that passes around pulley 82 and pulley 86 at the end of a brake 46. The relative diameters of pulley 82 and pulley 86 are such as to give brake 46 a speed of approximately 4 times that of conveyor chains 24.

Clutch and drive train 56 in FIGURE 23A includes a main drive shaft 73a, an actuating shaft 73b for operating the tying mechanism 52, and a conveyor drive shaft 73c, the shafts being journaled in bearings 140 and 142 on base member 10a. Drive shaft 73a may be coupled with actuating shaft 73b through an actuating clutch 146 which is normally coupled with conveyor shaft 73c through an interrupter clutch 146. The input clutch members of clutches 144 and 146 are mounted on the opposite ends of drive shaft 73a, and the output members of the clutches are mounted on the respective ends of shafts 73b and 73c. Mounted on the output member of actuating clutch 144 is a pawl lever 150 which is spring biased in a direction to engage the input and output members to couple shaft 73b with drive shaft 73c. The output member of interrupter clutch 146 is likewise provided with a pawl lever 152 biased in a direction to couple the input and output members of clutch 146.

Journalled for rotation in bearings 154 and 156 is an actuating shaft 152 on which is mounted a cam follower lever 150 and an interrupter lever 158. Cam follower lever 150 is biased into engagement with a cam 148 which is secured to actuating shaft 73b, and interrupter lever 158 is movable, upon rotation of shaft 152, into the path of pawl 162 of clutch 146. Projecting into the path of pawl lever 160 of actuating clutch 144 is the armature 164 of a solenoid 165 which in turn is mounted on frame 12. When solenoid 165 is deenergized, lever 160 engages armature 164 and is held out of engagement with the input clutch 144 and shaft 73b rotates free of shaft 73b. With lever 160 in engagement with armature 164, the position of shaft 73b and cam 148 is such that interrupter lever 158 is positioned out of the path of pawl lever 162 of clutch 146, and shafts 73a and 73c rotate as a unit.

As a package is advanced along conveyor deck 14 by guide links 26, it strikes a microswitch 37 to energize solenoid 165 causing plunger 164 to withdraw from the path of pawl lever 160. Pawl lever 160 immediately engages with the input member of clutch 144 to couple drive shaft 73a with actuating shaft 73b. Cam 146, rotating with shaft 73a, causes lever 150 to rotate in a counterclockwise direction as viewed from the left end of FIGURE 23a, to move the end of interrupter lever 158 into the path of pawl 162 of the interrupter clutch 146.
As soon as pawl 162 comes into engagement with the end of lever 158, interrupter clutch 164 disengages to disconnect shaft 73c from drive shaft 73a and movement of conveyor chains 24 is interrupted.

Simultaneously with the engagement of clutch 144, shaft 222 is actuated through chain 80 to commence the tying operation. While the package is halted at tying station 97, the segment of tie wire around the open end 50 of the package is twisted and severed from the end of the supply by gripper-cutter 166 in the manner previously described with reference to the embodiment of FIGURES 1 through 20. The energization of solenoid 165 is momentary and as soon as lever 160 passes from beneath armature 164, the armature is released by the solenoid and falls back into its normal position in the path of lever 160. Consequently, as soon as the output member of clutch 164 completes one revolution, lever 160 is again engaged by armature 164 to disconnect actuating shaft 73b from drive shaft 73a. When cam 148 completes one revolution, lever 150 rotates shaft 152 to pivot interrupter lever 158 out of the path of pawl 162 permitting clutch 146 to engage and resume operation of the conveyor.

Motor 54 may be turned on and off by a switch box 70 mounted on frame member 12c and connected with a motor through an electrical conductor 69. When motor 54 is turned on, drive shaft 73a is driven continuously and conveyor chains 24 are driven by a chain 74 which passes around the sprocket 72 in the end of conveyor shaft 73c and sprocket 21 at the end of shaft 18 (FIGURE 22). Microswitch 37 is positioned in a recess in conveyor deck 14 (FIGURE 23) near the tying station and is actuated by each bag as it reaches the tying station. Alternatively, microswitch 37 may be retractably located on side frame member 12c so to be actuated by the end of the package or withdrawn in order to permit the conveyor to operate continuously and allow passage of articles that are not to be tied.

P. Tie Wire Tension Control System

Rotatably mounted on a bracket 60 which is secured to base member 10c (FIGS. 21 and 22), is a reel 58 for supplying deformable ribbon or tie wire 62 to the tying mechanism 52. Pivotedly mounted on support members 12 and 12a at 66 is a drag member 64 which rests upon the reel to tension the wire being fed to the tying apparatus. Reel 58 is rotatably mounted by a pin 67 on plate 102 is a tension lever 65. The end of wire 62 is threaded over the pivotally connected end of tension lever 65; along the length of lever 65; through a guide 66 at the free end of lever 65; through eyelet 210 of needle 252; and from eyelet 210 to gripping head 192 of the wire gripper and cutter. The end of wire 62 is held between abutment 196 and gripping head 192 in the manner previously described with reference to the corresponding gripping 132 and abutments 155 of the embodiment of FIGURES 1 through 20. Mounted adjacent tying station 97 is a guide plate 42, similar in construction to guide plate 245a, which cooperates to guide the package along the tying station with the open end of the package projecting in a guide slot 42 between plates 23' and 169. As the bags approach the tying station and are ejected therefrom, the end of the bag adjacent the constricted neck slides against guide plate 44. Guide plate 44 may be polished to reduce friction, or a strip of Teflon or other low-friction material may be adhesively secured to the outer face of guide plate 44 to reduce the frictional contact between the bag and the guide plate.

With reference to FIGURES 21, 22 and 33A, as the bag passes brush 46, the open end 40 of the bag is brushed into the path of slot 44 where it is flattened between the frame and the brush and between the frame and the lower edge of guide plate 42. The timing of cam 90 is such that as the bag passes the brush, plunger 116 is lifted upwardly by carriage 91 and is actuated in a forward direction by the oscillating lever 94 to gather the ends 50 of the bag against the segment of tie wire which is disposed transversely of guide way 44. Carriage 91 is shifted upwardly in a clockwise direction about pivots 110 and 114 (FIGURE 21) to align the tie wire into alignment with slot 44, carriage 91 remaining parallel with the slot due to the parallel linkage 104 and 166. As soon as the plunger gathers the end of the package against the tie wire into the configuration shown in FIGURE 33F, the package will have reached the tying station where it will trip the cam 37 to initiate the tying operation. It is also within the contemplation of this invention that conveyor chains 24 may be operated continuously with the reciprocation of plunger 116 being timed such that the plunger moves forward at a greater rate than the conveyor as each package approaches the tying station, plunger 116 is timed to engage the package end and advance the package to the tying station head of the related flight or drag link.

The movement of the conveyor is such that upon completion of the tying operation, the related flight will have traveled to a position where it again engages the tied package and discharges it from the tying station.

OPERATION

The loaf of bread or other product to be packaged is inserted within the package 40 by hand or by some other suitable process whereupon it is placed on the conveyor deck 14 at the left hand end as viewed in FIGURES 21 and 23 between the drag links 26. The guide 38 is adjusted as heretofore explained according to the length of the package which extends laterally across the conveyor deck, the open end of the package located opposite the guide 38 protruding on and above the tying edge of the mask 25. The bag or package 40 is moved along the surface of the conveyor deck by means of the drag links 26. As the bags move across the conveyor deck, the open end of each bag is inserted within the slot 44 beneath the lower edge of the vertically disposed plate 42. The rotating brush 46 is employed to gather and guide the flared open end of the package into the gathering slot. The brush is offset from the direction of belt travel whereby it tends to pull and roll the flared end thereof into a flattened condition so that it can be collected and gathered for movement through the guideway prior to engagement with the compression bag. Branch 46 places the open end of the package into the path of the plunger. In this connection, a lever could be used to collapse the ends of the bag, if desired, to align the flared bag end with the guideway. As a further aid in introducing the open end of the package into the gathering slot, the peripheral speed of the brush is substantially greater than that of the longitudinal speed of the drag links along the conveyor deck.

Immediately upon insertion of the open end of the package within the slot 44, the cam 90 mounted on the shaft 16, rotating in a clockwise manner as viewed in FIGURE 1, drives the plunger 116 via pitman 93 and linkage 92, 94, 96 to the right. Simultaneously, carriage 91 is moved upwardly in an arcuate manner about pins 110 and 114 by means of cam follower 98a and link 100 raising the plunger head 116 to elevated position 115 in alignment with guiding slot 44. As viewed in FIGURE 1, the plunger engages the left hand portion of the package end passing through the slot 44.

The plunger assembly moves forward in a raised position during the feeding stroke and is then lowered while being withdrawn so as to avoid interference during the feeding operation of the next package. Once elevated, the plunger remains in engagement with the end of the bag as shown in FIGURE 21C until the tying operation is completed.

As plunger 116 moves forward it gathers the end of the wrapper against the segment of tie wire between needle eyelet 210 and gripper 166.
The end 59 is completely enclosed between plunger 116 and the tie wire, or by means of the cooperating plunger and dog members, as shown in FIGURE 13F, and the package has advanced to a position on the conveyor deck where it actuates microswitch 37 to terminate movement of drag links 26 and initiate the tying and cutting cycle.

With particular reference to FIGURE 23A, actuation of microswitch 37 energizes solenoid 165 to momentarily retract plunger 164 moving it out of engagement with pawl 160 of clutch 144 to couple shaft 73a to shaft 73b. After pawl 160 rotates through a sufficient arc, solenoid is de-energized causing circuit breaker relay which after a momentary delay, will interrupt the circuit until microswitch 37 is released, allowing plunger 164 to drop into its original position in the path of pawl 160. Cam 148 on shaft 73b causes follower lever 158 to rotate in a clockwise direction about the axis of shaft 152, as viewed from the left hand side of FIGURE 3A, to move lever 158 into position to engage pawl 162 of clutch 146. Thereafter, shafts 73a and 73c are uncoupled to interrupt movement of drag links 26 along conveyor deck 14.

Upon engagement of actuating clutch 144, sprocket 76 is actuated to initiate the tying operation.

At this point the bag rests upon the conveyor deck 14 with its gathered end extending through guideway 44 transversely of the axis thereof. The end of the bag is held in closed position by the plunger head and retaining dog to receive the tie wire as shown in FIGURE 17. Wire 62 passes downwardly through the forward end of the gathered end of bag 40 across the end of needle 210, then rearwardly about the end of the tension member 65, and downwardly to the reel 58.

Rotation of the sprocket 190 through chain 80 drives needle shaft 250 as well as needle 210 in a clockwise direction as viewed in FIGURES 29, 30, 31, and 37 to draw the wire 62 around the periphery of the gathered end 50 of bag 40 until the needle assumes its full stroke position indicated in FIGURES 26 and 37D.

Concurrently, wire gripper and cutter 166, 196 operates to hold the looped segment of wire 62 in position (see FIGURES 27, 42A and 43A) to be severed from the reel. Sprocket 190 drives mutilated gear 228 through shaft 222, which in turn actuates cam 186. Actuation of cam 186 causes a reciprocating movement of the bar 172 and oscillation of wire gripping member 166. FIGURES 42A through 43D, and 44A through 44G correspond generally with the various stages of the operation illustrated in FIGURES 37A through 37F. While the bag is held in the position shown in FIGURE 37A, the wire 62 is gripped by gripper 166 and abutment plate 196 between the cooperating elements 194 and the tongue 200 respectively as seen in FIGURE 42A. As cam 186 rotates and gripping finger 166 oscillates, the wire is fed into the opening between the plates 196 and gripping member 166 by means of the needle 210 (see FIGURE 43), being partially guided by guide member 252 fixed to the vertical plate 42 (see FIGURES 31 and 32).

Gripping finger 166 then moves toward the right hand portion of the abutment plate 196 as sequentially shown in FIGURES 42 and 43 release the end of the wire indicated at 204 in FIGURE 42C and moves into gripping relation with the wire at 206. The wire is then severed at 206 by the interaction of cutting edges 214 and 216 located on abutment plate 196 and finger 166 respectively. Finger 166 holds the lower end of the wire as shown in FIGURES 42D while the lower free end is cut and released. Finger 166 then remains in the position shown in FIGURES 42E and 43E until the next package or bag moves into tying position, during which subsequent operation finger 166 holds and cuts according to the sequence indicated in FIGURES 42E through 42H and 43E through 43G.

At the instant end 206 of the wire is severed, twister hook 244 is actuated by mutilated gear 228 and pinion 234 to rotate through at least a sufficient number of revolutions as shown in FIGURES 45A through 43G to complete the tying operation. The area of twisting is shown generally at 312 in FIGURE 45, and the final twisted form of the wire about the gathered end 302 is shown generally at 314 of FIGURE 46.

With the gathering and tying operation thus completed, needle 210 is withdrawn and returns to its original position as shown in FIGURE 37F with the wire positioned to receive the next package, as shown in FIGURE 28. Simultaneously, shaft 73b has completed its rotational evolution, pawl 160 once again engages plunger 164 to disengage shaft 73b from shaft 73a. Thereafter, lever 158 comes into engagement with pawl 162 of clutch 146 to resume operation of conveyor chains 24.

Actuation of the conveyor is transmitted by shaft 18 to cam 128 which, upon rotation, disengages cam follower 126 and allows retaining dog 122 to retract downwardly, as shown in FIGURES 41C and 41D to permit the tied end of the package to pass without obstruction. In the modified embodiment illustrated in FIGURE 47, lower member 304 is released and allowed to move downwardly upon rotation of cam 128. In the retracted position, the lower member 304 is disposed below the level of the guideway 44 in order to permit the tied end of the package to be discharged without obstruction. Since the upper member 302 is positioned above the passage way 44, it will not interfere with the movement of the package upon completion of the tying operation.

Simultaneously, cam 90, rotating in a clockwise direction, continues to advance plunger 116 in order to completely free the tied package 40 from the tying unit. This ejection cycle is accomplished by stopping rotation of the cam 90 and plunger 93 upon actuation of solenoid 165 at a point slightly retarded from dead center so that when clutch 146 is reactivated, further rotation of the plunger advances the plunger forward to eject the tied package. After the package is ejected, further rotation of the cam 90 urges the plunger 116 back to its original retracted position.

**CHAIN DRIVEN GATHERING HOOK**

With reference to FIGURE 49, an endless chain 500 and associated gathering head 502 may be employed for transporting the open end of a package to the tying station 97. The timed sequence of chain 500 can be controlled through an intermittently operated transmission gear drive, generally designated by the numeral 504, whereby the free end of the package is gathered by hook 502 in its passage along the longitudinally extending guideway 44 and gathered against a tying ribbon 144 which is maintained under controlled tension in the tying station 97 whereupon movement of the chain is interrupted during the previously described tying cycle. Thereafter, movement of the gathering chain 509 is resumed causing the gathering hook 502 to strip the tied package from the tying station 97 upon completion of the tying operation.

In order to allow for intermittent feeding of successive packages to the tying station, an intermediate conveying section 506 may be utilized which extends transversely across the conveyor deck separating a primary feed conveyor 508 from a secondary discharge conveyor 510. The intermediate conveying section 506 is driven independently relative to the primary and secondary conveyors 508 and 510 so that its operation may be controlled either in timed interrupted sequence with the gathering chain 509 or at a reduced rate of travel as compared with the main feed conveyor 508. If the intermediate conveyor 506 is operated in timed relationship with the gathering chain 500, its movement will be interrupted during the tying cycle and thereafter restarted to discharge the tied package onto the secondary conveyor 510.

Gathering chain 500 is intermittently driven through a 75 sprocket 512 disposed adjacent discharge conveyor 510.
and is interconnected with idler sprocket 514 positioned adjacent the main input feed conveyor 508 in order to pass through the previously described gathering station containing the counter-rotating brushes and upper guide roll (not shown) to the tying station 97 and thereafter returning completion of a cycle. It should be noted that the main feed conveyor also serves to drive the upper guide roll at approximately the same rate during passage of the package through the gathering station.

As shown, three gathering hooks 502 have been fixed to the chain 500 at equally spaced intervals in order to maintain an established timed relationship for the introduction of successive packages. Each gathering hook 502 is similar in outline to the inner plunger head 119 (FIGURE 31), being laterally displaced from the inner edge of guideway 44. As in all other units, a side deflector rail may be employed to laterally guide the wire into registry with the twister hook, the details of which have been previously described, thereby defining a tying region wherein the wire is twisted between a deflector bar, similar to bar 252 located on the vertical guide plate 44, and the gathering hook. During each tying cycle, the gear drive 504 will advance the chain 500 one-third of its entire length when three gathering hooks are employed. Of course, this ratio can be varied to maintain a similar relationship regardless of the number of gathering hooks fixed to the chain.

The interrupted gear drive 504 is timed to drive the gathering chain 500 in such a manner that its movement during each gathering cycle is sequentially interrupted in order to permit the tying operation and thereafter to restart to complete the cycle during which the chain 500 has advanced one-third of its length. During the dwell time of the gathering chain, the tying unit is actuated and the tying sprocket 516 driven one revolution to complete the tying cycle in the manner previously described.

**IDLER CONVEYOR SECTION**

If desired, a series of idler rolls may be employed to interrupt the movement of a package during the tying cycle. With reference to FIGURE 50, an input or primary feed conveyor 518 and a secondary discharge conveyor 520 are separated by three idler rollers 522 which are suitably journaled at each end to oppose sides of the conveyor deck to permit independent free rotation. In order to provide for continuous operation of the main feed conveyor 518 without interrupting transmission, the open package is moved by the conveyor flight 524 onto the three idler rollers 522 where it will come to rest adjacent tying station 97. Upon completion of the tying operation, the preceding package will have been advanced by conveyor 518 through the gathering station to a position where it will be placed the tied package resting on idler rollers 522 onto the discharge conveyor 520. The three idler rollers 522 used to achieve the desired delay are so positioned that they will support the entire package during the tying operation. Thus, by the foregoing arrangement it is possible to introduce successive packages to the tying station without interrupting the operation of the main flighted conveyor through the utilization of an idler deck section whereby each successive package will serve to displace the previously tied package from the tying station in such a manner that the interval during which each package comes to rest on the idler section will afford a sufficient interval of time in which to tie the open end of the package before being displaced by the next package. It should be understood that such an idler conveyor system can be employed in the apparatus illustrated in FIGURES 1 through 20 as well as with the equipment illustrated in FIGURES 21 and 49, if desired.

**PRODUCTION OUTPUT**

In normal operation, the package tying units illustrated in FIGURES 1 and 21 can be continuously operated at output rates up to approximately 100 packages per minute by adjusting the variable speed drive unit. In the usual production line, current production requirements normally average around 50 packages per minute, which is well within the output range of this equipment. In view of the extreme versatility afforded by the disclosed apparatus, it is possible to install the complete unit in existing production lines without modification or alteration of the production system. It is to be understood that, although several preferred embodiments of the invention have been shown in the drawings and described with considerable particularity in the foregoing specification, the invention is not limited to the specific details of construction, shown and described, but includes all modifications coming within the scope of the appended claims and their equivalents.

I claim:

1. A method of closing and tying the open end of a flexible bag comprising:

   feeding the bag on a continuously moving conveyor to a tying station,

   lifting the bag from the conveyor when it reaches the tying station to momentarily bring it to rest,

   encircling a length of wire about the open end of the bag,

   engaging the ends of the length of tie wire with a hook to gather the ends of the tie wire within the hook,

   and rotating the hook to twist the ends of the tie wire.

2. A method of closing and tying the open end of a bag as defined in claim 1 further including:

   stripping the twisted wire ends from the hook,

   and engaging the tied bag from the tying station onto the conveyor.

3. A method of gathering and tying the open end of a flexible package with a tie severed from a length of tie material characterized by positioning the tie to transversely engage the open end, applying tension to the tie, forcing the open end against the taut tie to form a gathered neck, encircling the gathered neck with the tie while simultaneously feeding a succeeding length of tie material in position to subsequently engage the open end of a succeeding package, severing the encircling tie from the succeeding length of tie material, and twisting the ends of the severed tie together.

4. A method of separately gathering and tying the open end of a succession of flexible packages with a tie severed from a continuous length of wire characterized by advancing each package in succession along a path, sequentially positioning the tie across the path to transversely engage the open end of each package in succession, applying tension to the tie, forcing the open end of the package being tied against the taut tie to form a gathered neck, encircling the gathered neck with the tie while simultaneously feeding a succeeding length of wire across the path in position to transversely engage the open end of a succeeding package, severing the encircling tie from the succeeding length of wire, and twisting the free ends of the severed tie together to detachably secure the encircling portion about the gathered neck of the package being tied.

5. A method of tying the open end of a flexible package characterized by advancing the package on a continuously moving conveyor to a tying station, lifting the package from the conveyor when it reaches the tying station to momentarily bring it to rest, encircling a tie about the open end of the package, securing the encircling tie to the open end of the package, and thereafter ejecting the package from the tying station onto the moving conveyor.

6. Apparatus for gathering and tying the open end of a flexible package with a tie comprising:

   means for advancing the package along a path,

   means for positioning the tie across the path to transversely engage the open end,

   means for applying sufficient tension to the tie to initially arrest the advancement of the open end along the path and assist in gathering the package,

   means for forcing the open end against the taut tie to form a gathered neck,

   means for encircling the tie about the
gathered neck, and twisting means for securing the en-
circling tie to the gathered neck.
7. Apparatus as defined in claim 6 further including:
means operable to momentarily lift the package from
the conveyor as the open end of the package en-
counters said tie,
and means operable to eject the tied package from
the lifting means onto the conveyor when the ends
of the tie are twisted.
8. Apparatus as defined in claim 6 in which said gather-
ing means includes reciprocating means for forcing said
open end into engagement with said tie.
9. Apparatus as defined in claim 6 in which said gather-
ing means includes a continuously moving gathering bolt
for forcing said open end into engagement with the tie.
10. Apparatus as defined in claim 6 in which said
stirring means includes a chain carried gathering
plunger,
and means for intermittently actuating the gathering
plunger for each tying operation.
11. Packaging apparatus comprising:
a conveyor,
a tying mechanism for successively closing the end of
each package fed thereto by the conveyor,
a drive shaft coupled to the conveyor for continuously
driving the conveyor,
an actuating shaft coupled with the tying mechanism
and rotatable to actuate the tying mechanism,
a time delay shaft,
a control device positioned to be successively actuated
by the packages as they approach the package clos-
ing mechanism,
a drive clutch responsive to actuation of said control
device to couple the time delay shaft with the drive
shaft,
and a delay clutch operable in response to rotation of
the time delay shaft by said drive shaft through a
predetermined angle to couple the actuating shaft
with the time delay shaft,
said predetermined angle of rotation of the time
delay shaft permitting the package to move from
the control device to the package closing mecha-
nism.
12. Apparatus as defined in claim 11 further including:
holding means connected with said actuating shaft for
maintaining said drive and delay clutches in their
coupled relationship until the actuating shaft has
rotated through a selected angle.
13. Apparatus as defined in claim 11 further includ-
ing:
a lifting bar operable to sequentially lift each package
from the conveyor when it reaches the package clos-
ing mechanism.
14. Apparatus as defined in claim 13 further includ-
ing:
stop-ejector means positioned in the path of move-
ment of the packages operable to momentarily bring
each package to rest upon the lifting means,
and means coupling the stop-ejector means with said
actuating shaft for actuating the stop-ejector means
to eject the closed package from the lifting means
upon completion of the closing operation.
15. Apparatus as defined in claim 14 further includ-
ing:
a presser-foot coupled with said actuating shaft and
operable upon rotation thereof to clamp and hold
the open end of the package during the closing
operation.
16. Packaging apparatus comprising:
movable conveyor flights for transporting open pack-
ages across a stationary conveyor deck,
a control device having an actuating means disposed
in the path of the packages,
means operable to close the open packages when the
packages are advanced across the stationary con-
voyer deck to a closing station,
a continuously rotating drive shaft,
a conveyor shaft normally driven by the drive shaft
and coupled to advance the conveyor flights,
an actuating shaft coupled with the package closing
means
and clutch means operable in response to actuation of
the control device to sequentially (1) connect the
actuating shaft with the drive shaft and (2) dis-
connect the conveyor shaft from the drive shaft
until the actuating shaft rotates through a predeter-
mined angle.
17. Packaging tying apparatus comprising:
a tying station,
conveyor means for successively transporting open
ended packages to the tying station,
a guideway for receiving the open end of each package
as it approaches the tying station,
means for positioning a length of tie wire from a con-
tinuous supply across the guide-way at the tying sta-
tion in the path of the open end, means for apply-
ing sufficient tension to the tie wire to initially arrest
the movement of the open end along the path and
assist in gathering the package, means for gathering
the open end against the taut tie wire,
means operable to encircle the gathered end with a
selected length of the tie wire,
and means operable to simultaneously cut said selected
length of tie wire from the supply and twist the ends
thereof.
18. Apparatus as defined in claim 17 including control
means actuated by the moving packages for interrupting
movement of the conveyor means at least until the
gathered end has been encircled with the tie wire.
19. Apparatus as defined in claim 17 including a pair of
oppositely rotating brushes for introducing the open
end into the guideway.
20. Package tying apparatus as defined in claim 18
further including means for resuming operation of the
conveyor means a predetermined time interval subsequent
to actuation of said control means.
21. Package tying apparatus comprising:
a tying station,
a stationary conveyor deck,
conveyor means for moving open ended packages suc-
cessively along the conveyor deck to the tying sta-
tion,
a guideway for receiving the open end of the packages
as they approach the tying station,
a length of tie wire extending across the guideway
under tension,
means for gathering the open end against the length
of tie wire,
clutch means responsive to movement of each package
to the tying station to disengage and interrupt move-
ment of the conveyor means,
means for encircling the gathered end with the length
of tie wire upon interrupting movement of the con-
voyer means,
and means for twisting the ends of the tie wire to
secure the end of the package in a constricted neck
configuration.
22. Apparatus as defined in claim 21 further including
means for simultaneously engaging the clutch to resume
operation of the conveyor means and ejecting the tied
end of the package from the tying station subsequent to
the twisting operation.
23. The construction set forth in claim 22 including
rotating brush means for successively flattening and in-
troducing the open end of each package into said guide-
way.
24. Apparatus as set forth in claim 21 in which said
stirring means includes a reciprocating gathering plun-
ger operable upon resumption of operation of the con-

3,133,904

31. Packaging apparatus comprising, a continuously moving conveyor for transporting packages, a lifting bar projecting above the surface of the conveyor, a stop-ejector means projecting above the surface of the conveyor ahead of the lifting bar in the path of the packages for momentarily bringing each package to rest as it is forced upon the lifting bar off the conveyor surface, and means for actuating the stop-ejector to eject the package from the lifting bar onto the conveyor downstream from the lifting bar.

32. The construction defined in claim 31 further including means for selectively deactivating the lifting bar and stop-ejector to permit continuous, uninterrupted movement of the packages.

33. Apparatus for separately gathering and tying the open end of a succession of flexible packages with a tie severed from a continuous length of wire comprising: means for advancing each package in succession along a path, means for sequentially positioning the tie across the path to transversely engage the open end of each package in succession, means for applying sufficient tension to the tie to initially arrest the advancement of the open end along the path and assist in gathering each package, means for forcing the open end of the package being tied against the taut tie to form a gathered neck, means for encircling the gathered neck with the tie while simultaneously feeding a succeeding length of wire across the path to transversely engage the open end of the succeeding package, means for severing the encircling tie from the succeeding length of wire, and means for twisting the free ends of the severed tie together to detachably secure the encircling portion about the gathered neck of the package being tied.

34. Apparatus for tying the open end of a flexible package comprising: means for advancing the package on a continuously moving conveyor to a tying station, means for lifting the package from the conveyor when it reaches the tying station to bring it to rest, means for encircling a wire about the open end of the package, twisting means for securing the encircling tie to the open end, and means for ejecting the package from the tying station.

35. Apparatus for gathering and tying the open end of a flexible package with a tie severed from a continuous length of wire-like material comprising: feeding means arranged to encircle the tie about the open end of said package, cutting means for severing the encircling tie from the continuous length of wire-like material, retaining means associated with said cutting means for gripping the continuous length of wire-like material upon severance of the encircling tie, means for maintaining the tie under tension while being fed to the associated cutting and retaining means by said feeding means to assist in gathering the open end of said package, and tying means for securing the encircling tie to the gathered end of said package.

36. Apparatus for gathering and tying the open end of a flexible package as defined in claim 35 wherein said associated cutting and retaining means include a pair of fixed abutments arranged in spaced relation, a movable gripping finger mounted for alternate cooperation with each abutment to grip the continuous length of wire-like material, a cutting member mounted on each abutment arranged to cooperate with said fingers to sever the encircling tie from said continuous length of wire-like material, said feeding means being arranged to encircle the tie about the gathered end of said package and introduce the continuous length of wire-like material between said abutments on the opposite side of the finger cooperating with one of said abutments, and actuating means for moving said finger into contact with the introduced length of wire-like material to grip the same against the other abutment and sever the encircling tie with said cutting member after releasing the previously gripped end of the tie.
37. Apparatus for gathering and tying the open end of a flexible package as defined in claim 36 including drive means for intermittently moving said gripping finger in timed sequence with the movement of said feeding means to sever the encircling tie from said continuous length of wire-like material, and means for intermittently operating said tying means in timed sequence with said gripping finger to secure the severed ends of the encircling tie together.

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