Dec. 29, 1931. V. E. HEYWOOD 1,839,152

PACKAGING AND BANDING MACHINE

Filed July 24, 1928 9 Sheets-Sheet 1

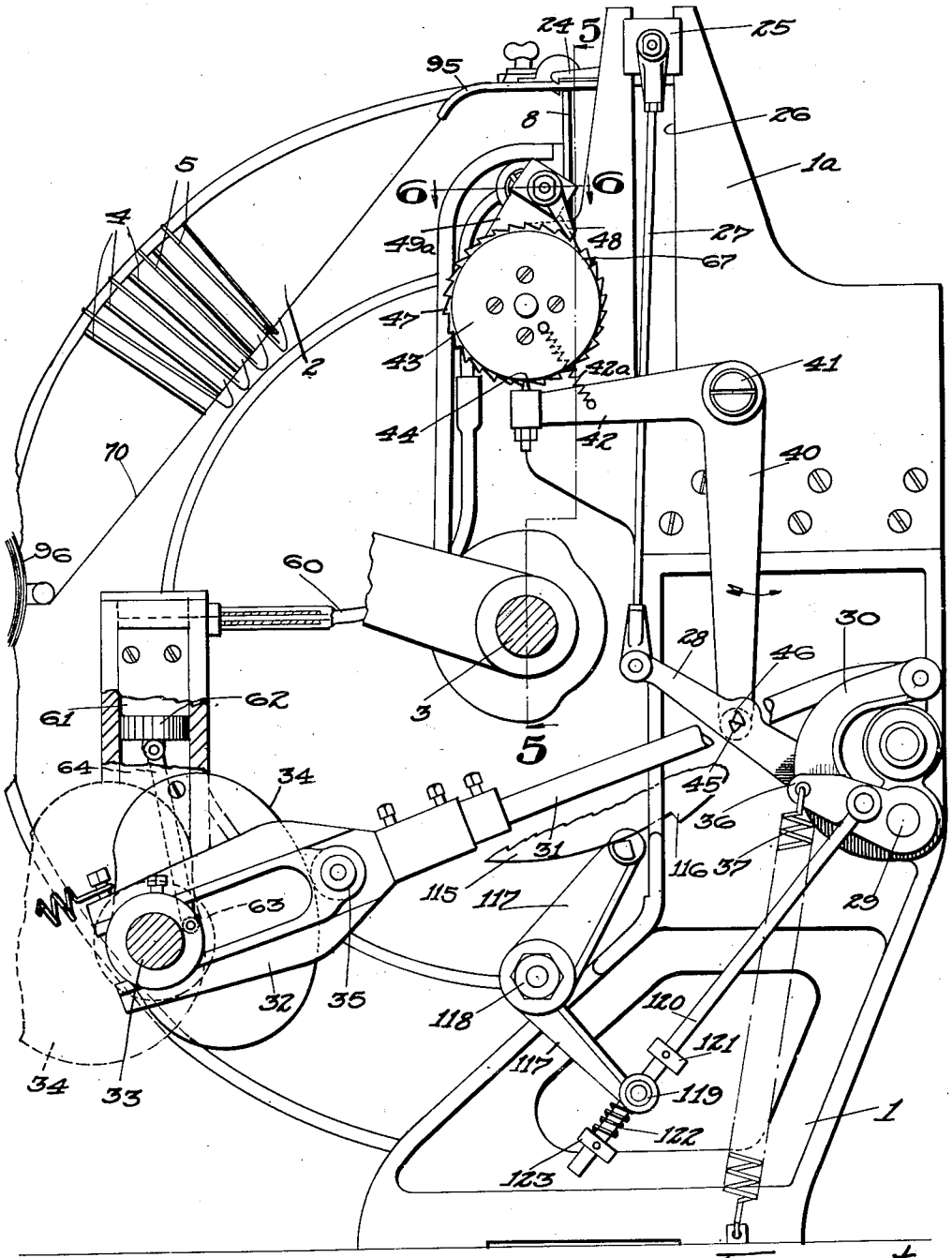

Fig. 1.

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PACKAGING AND BANDING MACHINE

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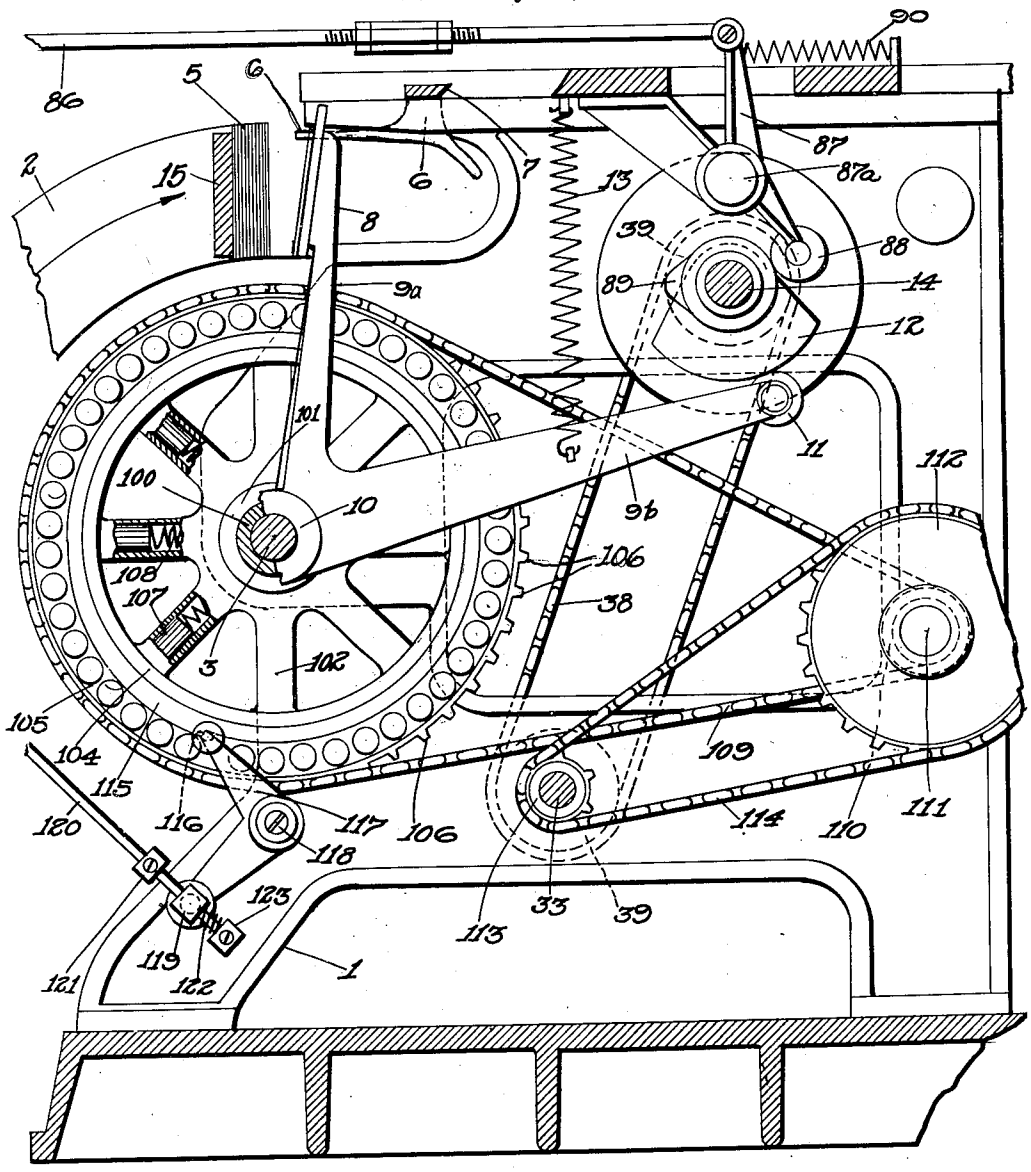

Fig. 2.

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PACKAGING AND BANDING MACHINE

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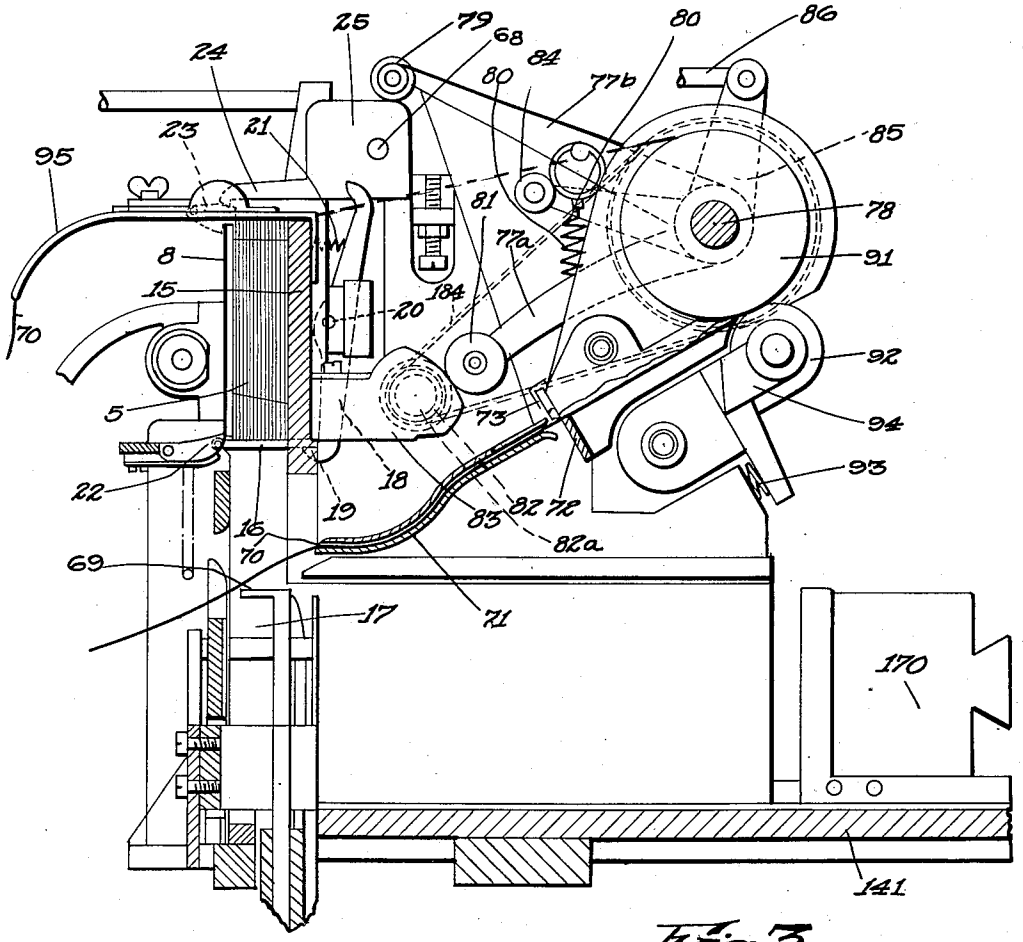

Fig. 3.

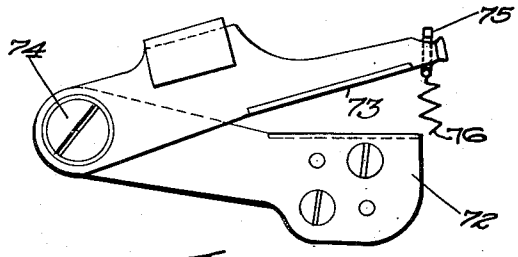

Fig. 17.

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PACKAGING AND BANDING MACHINE

Filed July 24, 1928 9 Sheets-Sheet 4

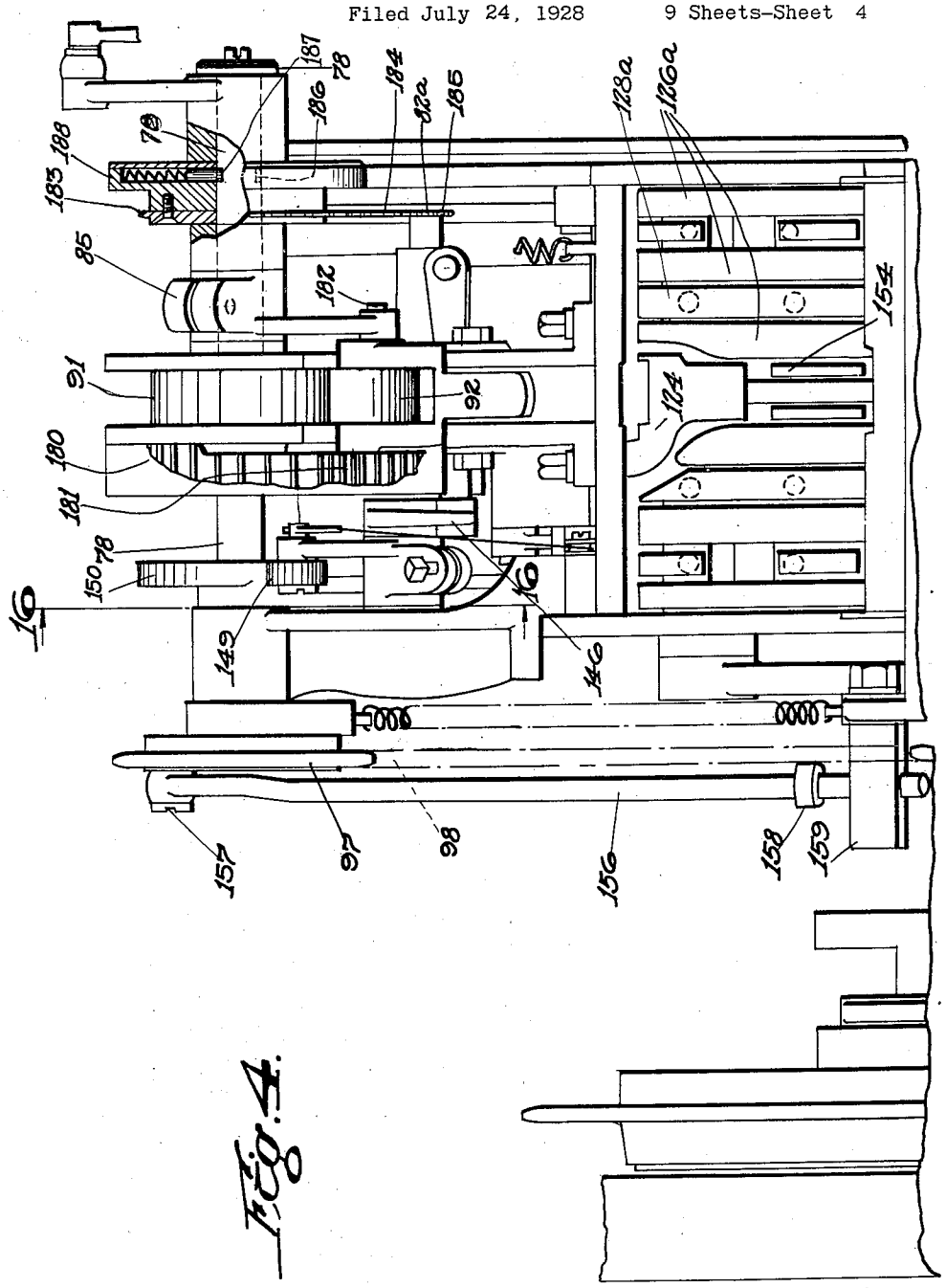

Fig. 4.

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PACKAGING AND BANDING MACHINE

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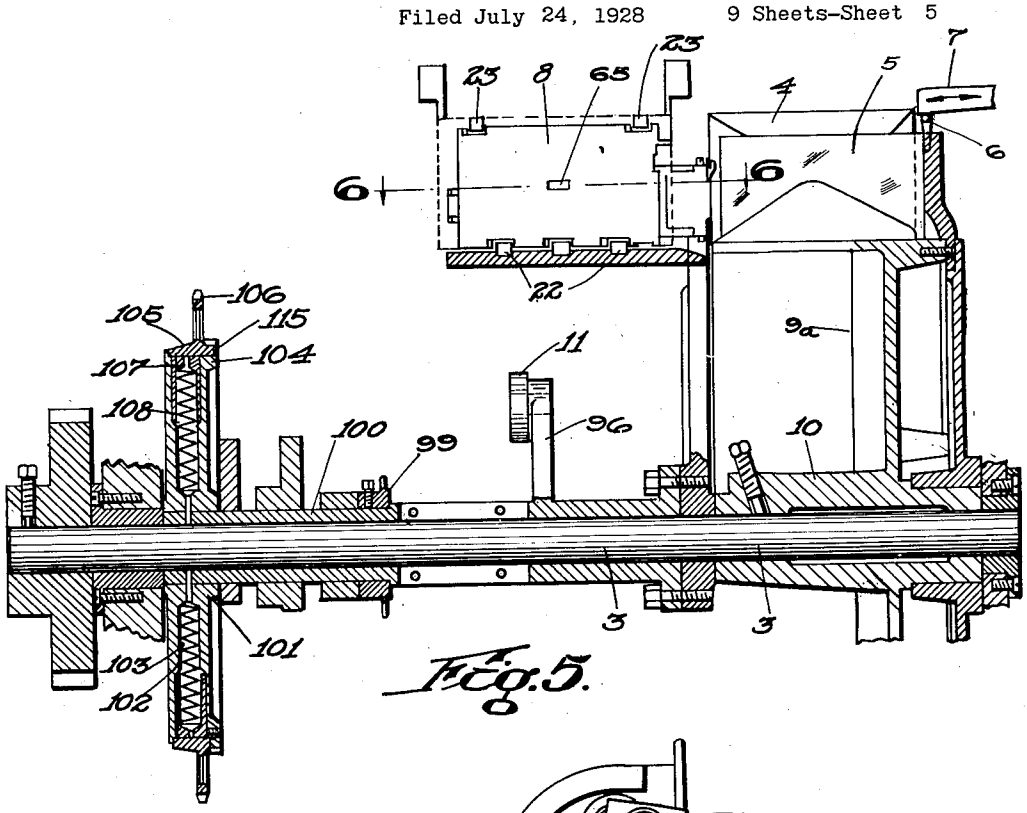

Fig. 5.

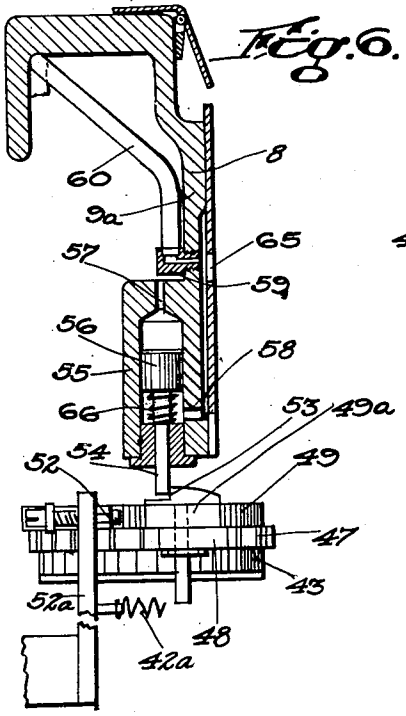

Fig. 6.

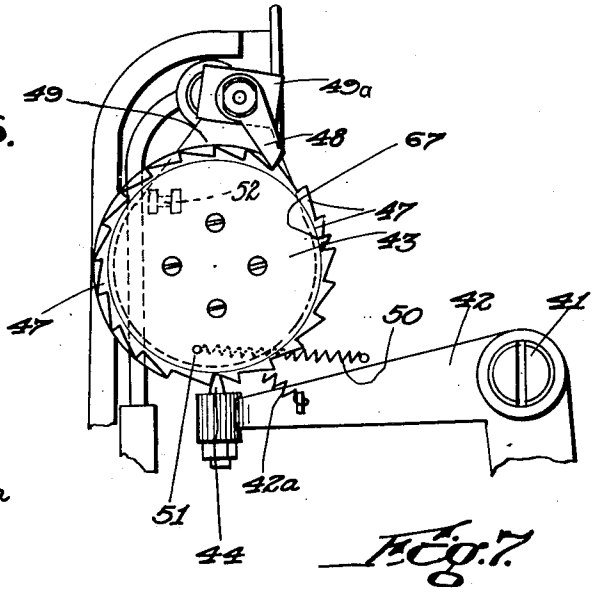

Fig. 7.

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PACKAGING AND BANDING MACHINE

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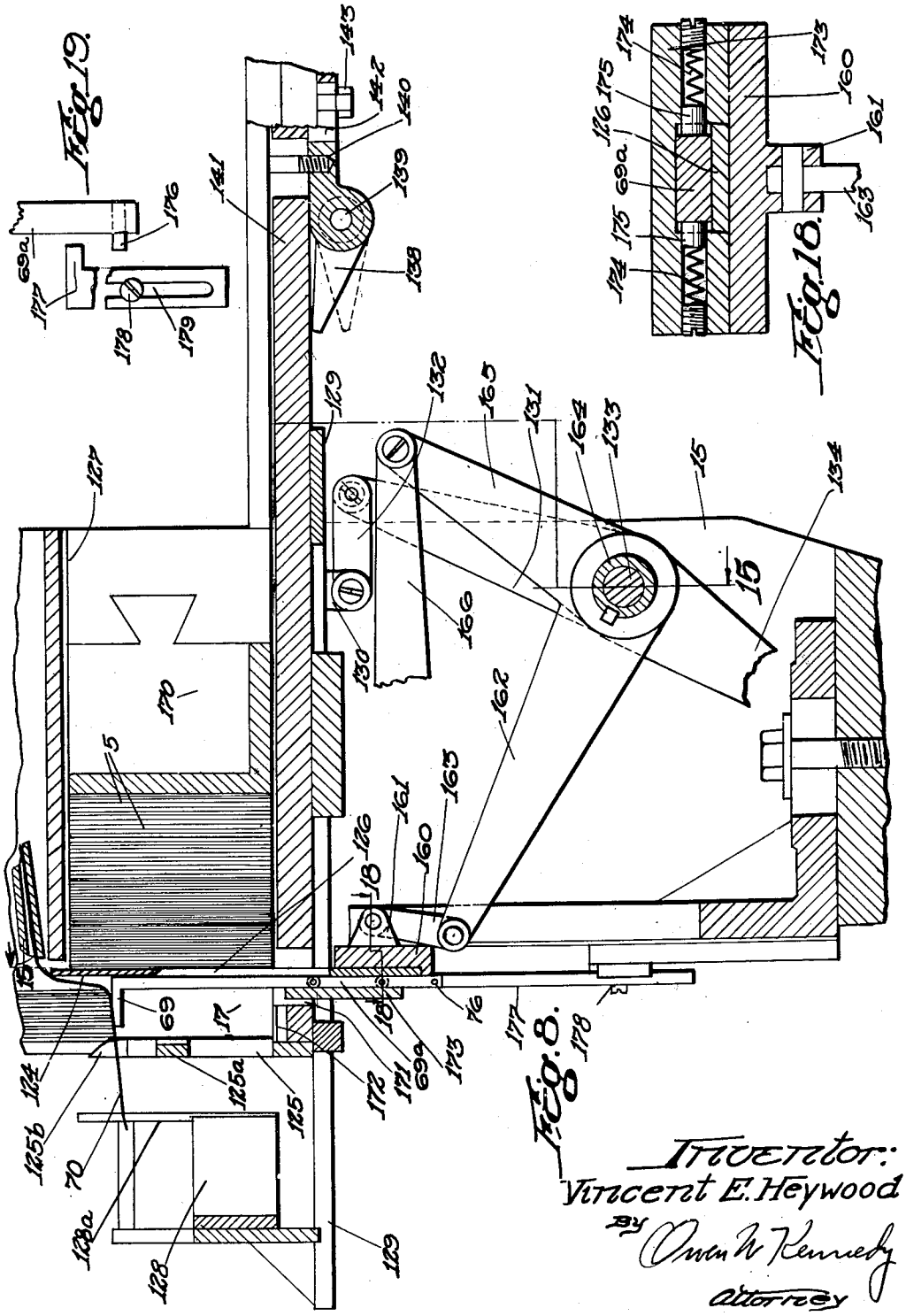

Fig. 8.

Fig. 19.

Fig. 16.

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PACKAGING AND BANDING MACHINE

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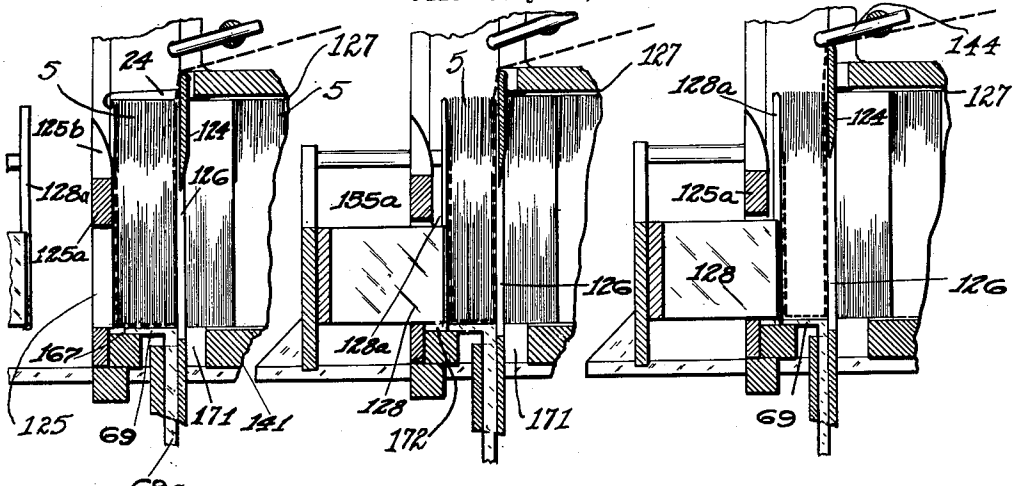

Fig. 9. Fig. 10. Fig. 11.

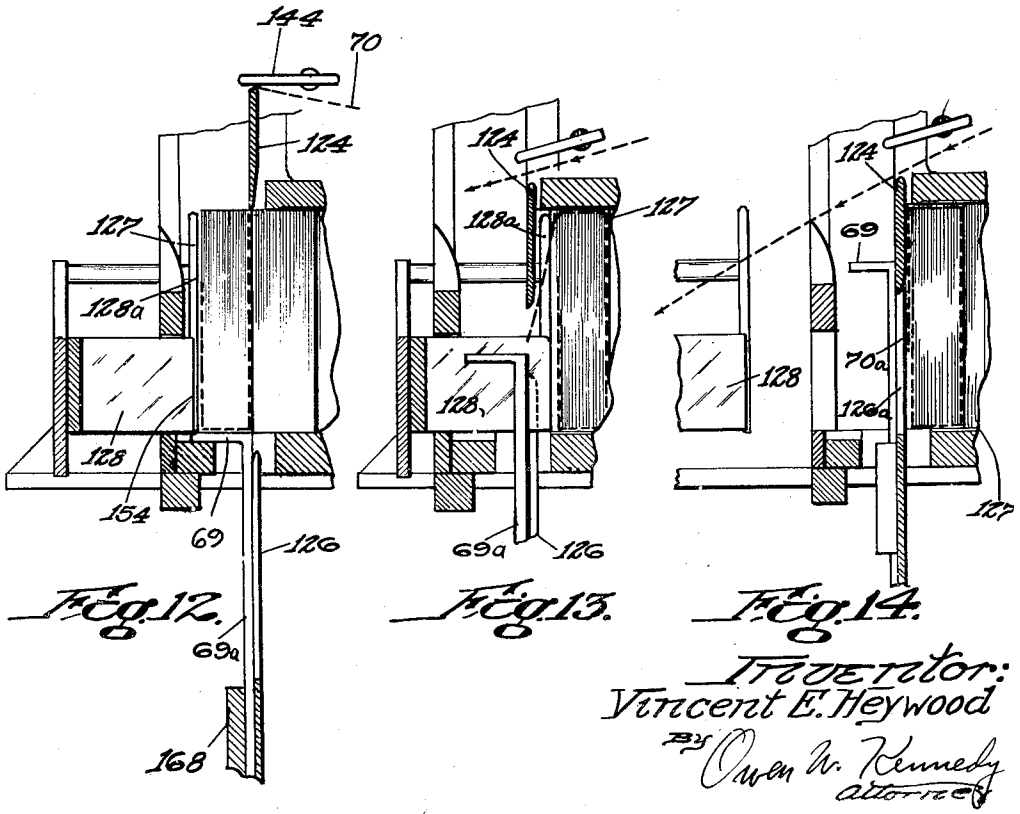

Fig. 12. Fig. 13. Fig. 14.

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PACKAGING AND BANDING MACHINE

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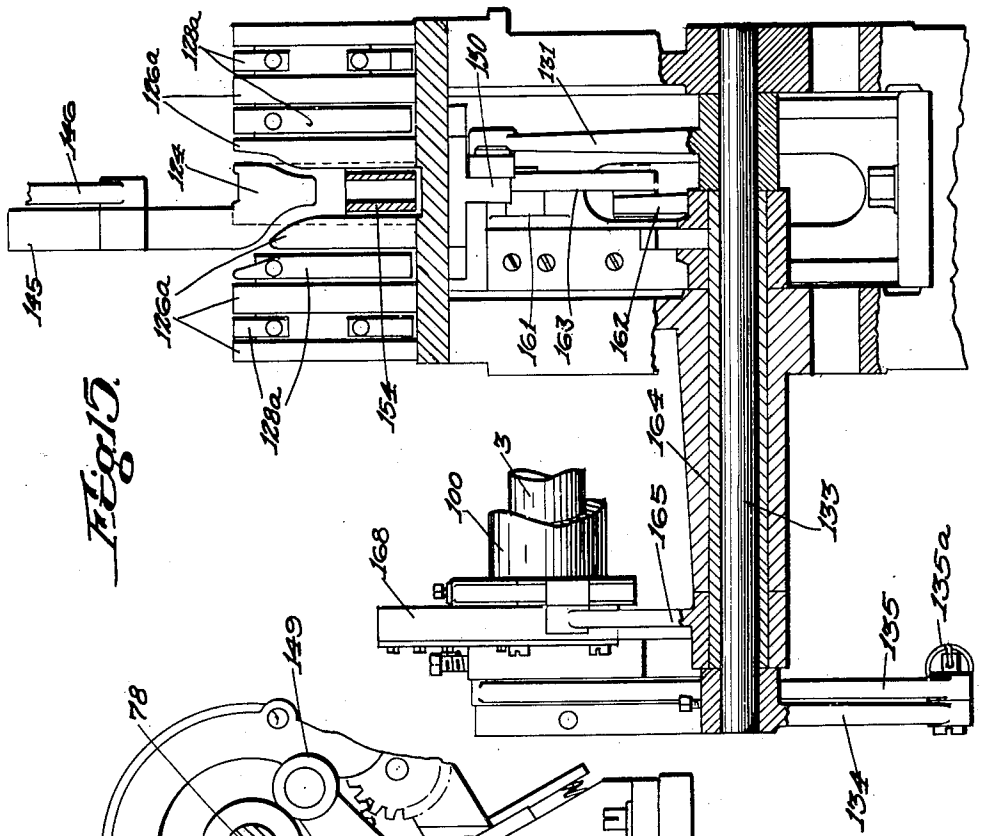

Fig. 15.

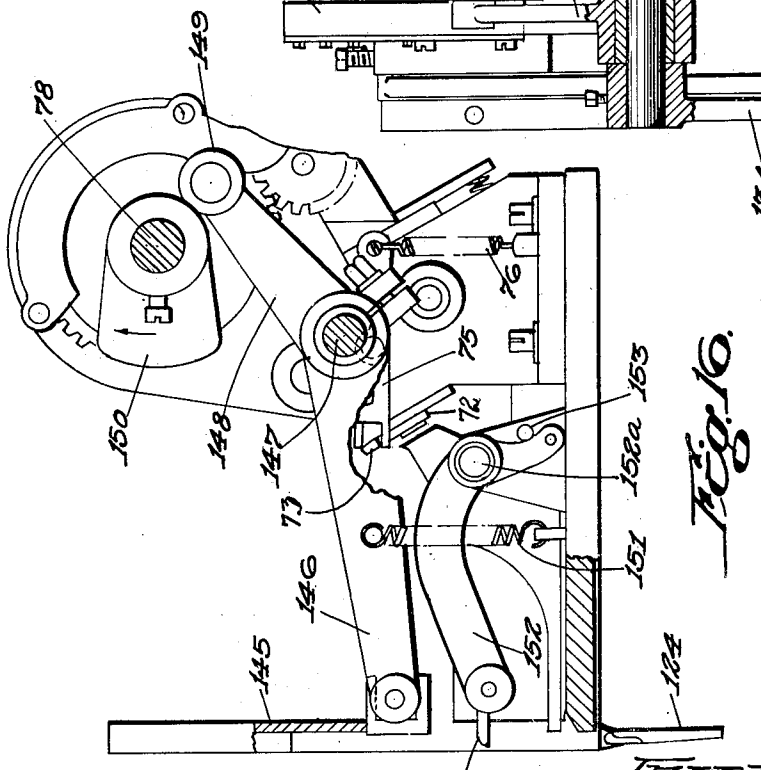

Fig. 16.

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PACKAGING AND BANDING MACHINE

Filed July 24, 1928 9 Sheets-Sheet 9

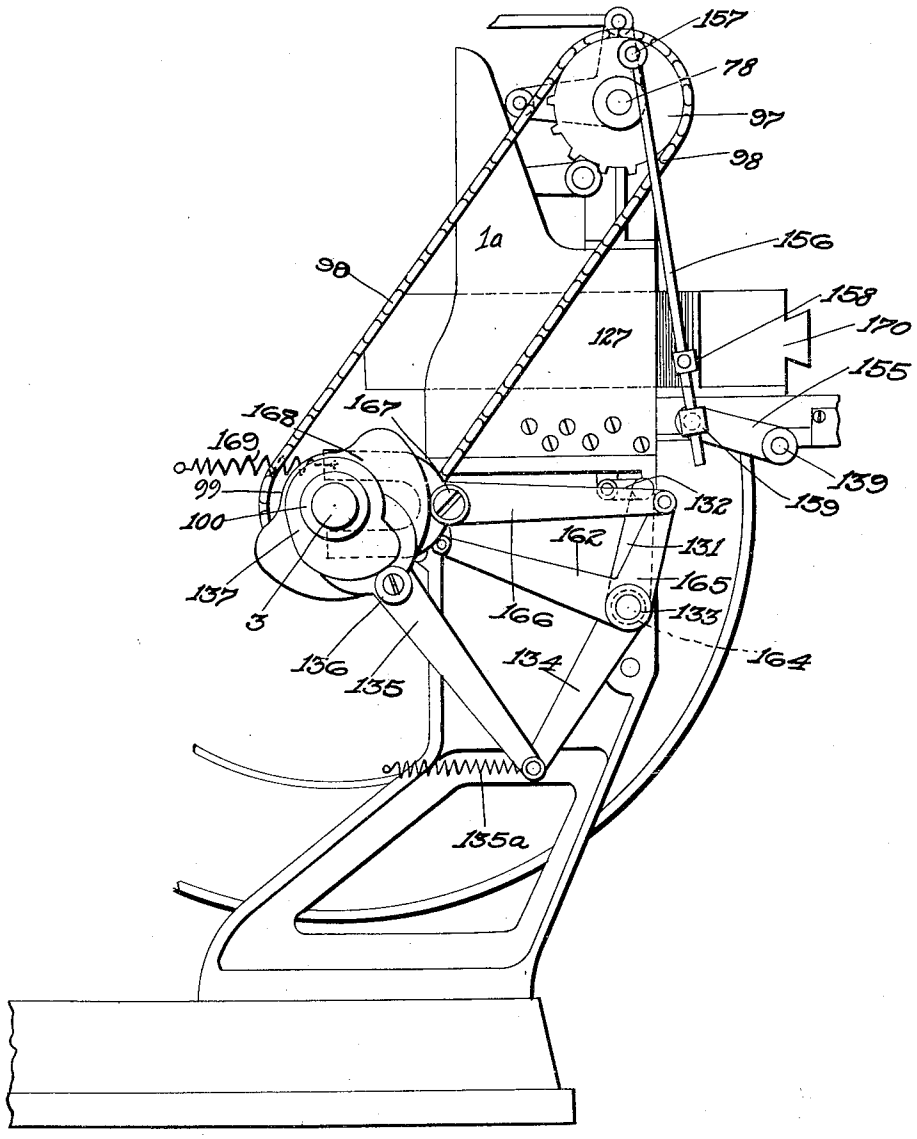

Fig. 20.

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UNITED STATES PATENT OFFICE

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PACKAGING AND BANDING MACHINE

Application filed July 24, 1928. Serial No. 294,956.

My invention relates to a machine for automatically assembling a predetermined number of articles into a package and then applying a band to the package for holding the articles together in package form. My invention is particularly adapted for use in connection with machines for making envelopes, although the principles embodied in the machine may be employed for banding articles other than envelopes.

In the particular embodiment of my invention as illustrated herein my improved packaging and banding mechanism is particularly characterized by the fact that it is adapted to segregate a previously counted package of envelopes and to apply a band to the same without interfering in any way with the normal operation of the machine which produces the envelopes, or other articles as the case may be. My machine is further characterized by the provision of automatic counting means operating so that each package always contains a predetermined number of articles before it is banded. Furthermore, each package is compressed the same amount, before the application of the band, and each band is tightly drawn around its package before being joined together at its ends, thereby insuring the formation of packages of uniform size and appearance. The above and other advantageous features of my invention will hereinafter more fully appear, reference being had to the accompanying drawings in which—

Fig. 1 is a view partially in vertical section and partially in end elevation of a machine embodying my invention.

Fig. 2 is a view similar to Fig. 1 looking in the opposite direction.

Fig. 3 is a vertical sectional view showing on a large scale a portion of the parts of Fig. 1 with one side frame removed.

Fig. 4 is a view in front elevation of the parts shown in Fig. 3 with the delivery chute removed.

Fig. 5 is a fragmentary sectional view along the line 5—5 of Fig. 1, looking in the direction of the arrows.

Fig. 6 is a fragmentary sectional view along the line 6—6 of Fig. 1, on an enlarged scale.

Fig. 7 is a view in end elevation of the parts shown in Fig. 6.

Fig. 8 is a vertical sectional view through the banding well showing the band folding and package compressing mechanism.

Figs. 9 to 14 inclusive are fragmentary views illustrating the several steps in the operation of wrapping a band about a stack of envelopes and moving the same to the delivery chute.

Fig. 15 is a sectional view along the line 15—15 of Fig. 8, looking in the direction of the arrows.

Fig. 16 is a fragmentary sectional view along the line 16—16 of Fig. 4.

Fig. 17 is a detail view showing the construction of the band cutting blades shown in Fig. 3.

Fig. 18 is a fragmentary sectional view along the line 18, 18 of Fig. 8.

Fig. 19 is a fragmentary view of the stop for positioning the stack clamp.

Fig. 20 is a fragmentary view illustrating the operating mechanism for the banding well.

Like reference characters refer to like parts in the different figures.

Referring to the drawings my invention is illustrated in connection with parts of an envelope machine of a well known type, most of the details of which are purposely omitted for the reason that my improved packaging and banding mechanism is adapted for use in connection with other types of envelope machines, as well as other machines for producing flat articles which it is desired to secure in packages. In the illustrative embodiment of my invention the parts of my banding mechanism are shown as co-operating with but a small part of the existing mechanism of an envelope machine and it is believed to be sufficient for the purpose of explaining the present invention to show and describe only those parts of the envelope machine that actually co-operate with the mechanism of the present invention.

Referring to Figs. 1 and 2, the machine comprises a frame 1, at one side of which an

envelope magazine or dryer 2 is mounted on a shaft 3. The dryer 2 is in the form of a drum and provides a large number of separate compartments defined by fins 4 which are adapted to receive and support a large number of envelopes 5 spaced around the periphery of the dryer 2. As the envelope machine operates, completed envelopes 5 are adapted to be successively delivered to the dryer 2, the dryer 2 receiving a rotative movement with the shaft 3 so timed with respect to the envelope folding mechanism that the dryer 2 is moved far enough between the delivery of successive envelopes to receive the envelopes in spaced relation. A machine of this type is shown in Patent No. 466,122 issued December 29, 1891, to Swift et al.

The envelope dryer 2 rotates in the direction of the arrow shown in Fig. 2 and when an envelope 5 therein reaches a position substantially above the axis of the dryer shaft 3, a transfer member 6 carried by a reciprocating bar 7 removes an envelope from the dryer 2 and shifts it laterally into the path of movement of a pusher plate 8, see also Fig. 5. The pusher plate 8 is carried at the end of one arm 9*a* of a bell crank lever, the hub 10 of which is mounted to turn freely on the shaft 3. The other arm 9*b* of this lever carries a roller 11 which is held in engagement with the surface of a cam 12 by means of a spring 13. The cam 12 is mounted on a shaft 14 which is driven from any suitable source of power, not shown, and is adapted to provide power for driving the mechanism of the associated envelope machine, as well as the packaging and banding mechanism as will be hereinafter described. The cam 12 which controls the movement of the pusher plate 8 is so timed that the pusher 8 is maintained in the rearward position shown in Fig. 2 when an envelope 5 is delivered by the transfer member 6 from the dryer cylinder 2. Then the pusher plate 8 moves forwardly to convey the envelope into the stack assembly chamber the front wall of which is defined by a fixed vertical wall portion 15.

As best shown in Fig. 3, the pusher 8 is adapted to move each envelope 5 over the surface of a stacking pawl 16 which supports the envelopes 5 as they are successively delivered by the pusher plate 8 and prevents them from dropping into a banding well 17 immediately below the pawl 16. The pawl 16 is normally held in a horizontal position to support the envelopes 5 by means of one or more latches 18 each providing a notch 19 to receive the edge of the pawl 16. Each latch 18 is pivoted at 20 and is maintained with its notch 19 in a pawl receiving position by means of a spring 21. When the pusher plate 8 returns to its rearward position following the delivery of an envelope 5 over the stacking pawl 16, the envelope is prevented from moving out of the assembly chamber by means of resiliently supported fingers 22 which are depressed each time the plate 8 moves an envelope 5 over them and which are adapted to engage the lower edge of each envelope as it is deposited in the stack. Freely pivoted fingers 23 located above the fingers 22 serve to prevent the upper edges of the stacked envelopes 5 from getting out of position, so that repeated operations of the pusher plate 8 are adapted to build up a compact stack of envelopes 5 above the stacking pawl 16 which envelopes are pressed against the wall 15.

After a predetermined number of envelopes have been stacked on the pawl 16 and counted by mechanism which will be hereinafter described, the stack is adapted to be moved downwardly into the banding well 17 by a pair of hooks 24 which during the stacking of the envelopes are maintained above the envelopes 5. Each hook 24 is carried by a cross head 25 adapted to be moved vertically in a slot 26 provided in a side frame 1*a*. As best shown in Fig. 1 each cross head 25 is connected by means of a link 27 to a lever arm 28 adapted to turn with a shaft 29 extending parallel to the shaft 3. The shaft 29 also carries a curved crank arm 30 which is connected by a rod 31 to a fork 32 embracing a shaft 33 extending parallel to the drive shaft 14. The shaft 33 carries a cam 34 which is adapted to co-operate with a roll 35 carried by the fork 32 to impart an oscillatory movement to the rod 31. The shaft 29 carries a second arm 36 to which is attached a spring 37 which tends to turn the crank 30 in a counterclockwise direction and maintain the roll 35 in engagement with the cam 34.

As shown in Fig. 2, the shaft 33 is adapted to be continuously driven at the same speed and in the same direction of rotation as the power shaft 14 by means of a chain 38 passing over sprocket wheels 39 on the shafts 14 and 33 respectively. When the cam 34 is in the dotted line position of Fig. 1 the spring 37 exerts a force tending to draw the rod 31 towards the cam 34 and so move the cross head 25 downwardly through the action of the link 27 and this tendency of the shaft 29 to be so turned occurs once for each revolution of the main drive shaft 14 at that point in each revolution where the pusher plate 8 has just delivered an envelope to the stack. However, downward movement of the cross head 25 by the shaft 29 is normally prevented while a stack is being assembled by means of a latch lever 40 which is under the control of an envelope counting and registering device which will next be described.

The latch lever 40 is pivoted at 41 and provides an arm 42 extending in the direction of a counting wheel 43, the end of the lever arm 42 providing a pin 44 which is held in engagement with a peripheral portion of the wheel 43 by a spring 42*a*. The lower end of

the lever arm 40 provides a wedge shaped dog 45 which is normally in engagement with a wedge shaped dog 46 provided on the arm 28 which operates the cross head 25. With the dogs 45 and 46 in engagement as shown, the lower dog 45 prevents the cross head arm 28 from moving downward under the action of the spring 37. As best shown in Fig. 7 the counting wheel 43 provides a number of ratchet teeth 47 and these teeth are adapted to be engaged by a pawl 48 carried on a disk 49 freely pivoted on the same axis as the counting wheel 43. A spring 50 secured to a stud 51 on the disk 49 serves to hold the disk 49 against a stop 52, carried by a bracket 52*a* as shown in Fig. 6, with the pawl 48 resting in engagement with one of the teeth 47. The projecting portion 49*a* of the pawl disk 49 which carries the pawl 48 provides a notch 53 within which is received a pin 54 carried by the arm 9*a* on which is mounted the pusher plate 8, the operation of which has been previously described, and normally each forward movement of the pusher plate 8 to deliver an envelope to the stack causes the pin 54 to move the pawl 48 against the pull of the spring 50 and so advance the counting wheel 43 through the space of one tooth.

The above described movement of the counting wheel 43 occurs for each revolution of the main drive shaft 14 so long as the machine is operating normally to cause the delivery of a completed envelope in front of the pusher plate 8 each time the main drive shaft 14 makes one revolution. However in the event that an envelope fails to be delivered in position to be acted upon by the pusher plate 8, my invention contemplates means for automatically preventing the counting wheel 43 from being turned, so that the counting wheel 43 only moves when a completed envelope is actually delivered to the stack above the banding well 17 by the pusher plate 8. To this end, the arm 9*a* which carries the pusher plate also provides a cylinder 55 in which works a plunger 56 carrying the pawl operating pin 54. One end of the cylinder 55 is open to the atmosphere through a port 57 while the other end of the cylinder beyond the piston 56 is connected by a passage 58 to a coupling 59 in which is received a pipe 60 connected to a suitable source of suction. In this case the source of suction is represented by a cylinder 61 having a piston 62 therein operated by a crank disk 63 on the shaft 33 through a piston rod 64, see Fig. 1. The cylinder passage 58 also communicates with an opening 65 provided in the pusher plate 8 but when the presence of an envelope 5 on the pusher plate 8 covers the opening 65, the suction cylinder 61 exhausts the cylinder 55 thus causing atmospheric pressure entering through the vent 57 to force the plunger 56 into the position shown in Fig. 6 wherein the pawl actuating pin 54 is seated in the notch 53. In this position the plunger 56 serves to compress the spring 66 surrounding the pin 54 between the plunger 56 and the end of the cylinder 55.

With the parts in the position shown in Fig. 6, it is obvious that each time the pusher plate 8 with an envelope thereon moves forward to deliver the envelope to the stack above the banding well 17, the suction created in the cylinder 61 will project the pin 54 into the notch 53 and as the arm 9*a* completes its forward movement towards the stack the pawl 48 will turn the counting wheel 43 through the space of one tooth. On the return movement of the pusher arm 9*a* the pin 54 will be withdrawn from the notch 53 by the spring 66 as soon as the envelope is removed from the pusher plate 8 by the fingers 22 and 23, thereby releasing the suction in the cylinder 55. At the same time the spring 50 returns the pawl 48 into a position in engagement with the next ratchet tooth 47. This operation will be repeated each time the pusher plate 8 delivers a completed envelope to the stack so that a step-by-step rotative movement will be imparted to the counting wheel 43.

In the event that the forward movement of the pusher plate 8 does not find a completed envelope in position for delivery to the stack, then the opening 65 will remain uncovered as the plate 8 moves towards the stack and no suction will be applied to the cylinder 55. When this occurs it is obvious that the spring 66 will continue to hold the plunger 56 within the cylinder 55 thereby preventing the pin 54 from being projected into the notch 53 of the pawl carrying disk 49. Therefore, when the empty pusher plate 8 completes its delivery movement there will be no movement imparted to the counting wheel 43 and in fact the counting wheel 43 will remain stationary regardless of the operation of the pusher plate 8 until an envelope is again engaged by the pusher plate 8. This action renders the counting wheel independent of any event which might prevent the transfer of an envelope 5 from the dryer 2 to a position in front of the plate 8, such as removal of defective envelopes from the dryer 2.

Assuming however, that the machine has been operating properly, the continued step-by-step rotative movement of the counting wheel 43 will finally bring a tripping dog 67 into engagement with the pin 44 at the end of the arm 42. The exact moment of the engagement of the pin 44 by the tripping dog 67 is, of course, determined by the number of ratchet teeth 47 on the counting wheel and this is, in turn, dependent upon the number of envelopes which it is desired to have assembled in each stack before the stack is delivered to the banding instrumentalities hereinafter described. In the present em-

bodiment of my invention the counting wheel 43 is shown as providing 25 ratchet teeth 47 so that the tripping dog 67 is adapted to engage the pin 44 after twenty-five envelopes have been properly delivered to the stack by the pusher plate 8.

When the tripping dog 67 engages the pin 44 on the lever arm 42, the arm 42 is moved downwardly in a counterclockwise direction in Fig. 1 thereby imparting angular movement to the arm 40 carrying the dog 45, as indicated by the arrow. When this occurs the lower dog 45 is moved from underneath the dog 46 thereby releasing the lever arm 28 which operates the cross head 25, then at the top of its stroke. As previously pointed out, the cam 12 which operates the pusher plate 8 is so timed that the pusher plate 8 is in its extreme forward position when cam 34 presents its highest point to the roll 35 carried by the rod 31 which operates the cross head actuating lever 28. This relation is shown in Fig. 1 from which it is apparent that when the lever 28 is finally released by operation of the latch lever 40 as just described, the spring 37 is then free to turn the shaft 29 as the roll 35 follows the cam 34 to its low point as shown in dotted lines. This movement of the shaft 29 imparts a rapid downward movement to the cross heads 25 through the links 27, thereby causing the hooks 24 carried by the heads 25 to deliver a stack of counted envelopes 5 to the folding well 17.

The downward movement of the stack is permitted by the stacking pawl 16 being released from its normal engagement with the latches 18. As best shown in Fig. 3, the cross heads 25 carry the pins 68 which when moved downward with the heads 25 engage the upper ends of the latches 18 and turn them about the pivots 20 in a counterclockwise direction to release the stacking pawl 16 from the notches 19 on the latches 18. The release of the stacking pawl 16 occurs coincidently with the initiation of the downward movement of the stack of envelopes by the hooks 24 which carry the stack downwardly into the banding well 17 with their lower edges in engagement with a bottom clamp 69.

As the stack of envelopes is moved downwardly into engagement with the clamp 69, the lower edges of the envelopes engage a length of band 70 which has been previously fed across the upper part of the well 17 before the arrival of a stack of envelopes in this well. The band is projected across the well 17 through a suitable guide 71 extending upwardly from the well 17 and terminating at a point adjacent to a stationary knife blade 72. A movable knife blade 73 pivoted at 74 co-operates with the stationary blade 72 and normally the blade 73 is held away from the blade 72 to permit the passage of the band 70 therebetween by means of the forked end of a lever 75, the other end of which is connected to a spring 76, see Figs. 16 and 17. The movable blade 73 is adapted to be moved toward the fixed blade 72 by means of one arm 77*a* of a bell crank lever pivotally mounted on a shaft 78, the other arm 77*b* of the lever carrying a roll 79 which is held in engagement with the cross head 25 by means of a spring 80. When the cross head 25 moves downwardly to deliver a stack of envelopes to the banding well 17, the roll 79 follows the cross head 25, thereby imparting a downward movement to the lever arm 77*a* which strikes the movable blade 73 and causes the band 70 to be severed as the blades come together.

The lever arm 77*a* which operates the movable blade 73 also carries a gumming roll 81 which in the position shown in Fig. 3 is in engagement with the periphery of a gum supply roll 82. The gum supply roll 82 is mounted to rotate in a reservoir 83 containing a supply of gum or glue, so that when the gumming roll 81 is moved downwardly by the lever arm 77*a* its gummed periphery is adapted to apply the gum to that portion of the band 70 adjacent to the knife blades 72 and 73. The diameter of the gumming roll 81 is such that the gummed periphery thereof engages the band 70 just as the movable knife blade 73 is operated, so that gum is applied to the end of a band as it is severed. The band guide 71 is provided with a suitable slot through which the gumming roll 81 may engage the band 70. The gum supply roll 82 is adapted to be rotated from the shaft 78 as will be hereinafter described.

It is obvious from a consideration of Fig. 3 that the band 70 will be gummed and severed by the operation of the lever arm 77*a* as the stack enters the upper portion of the banding well 17 and I have provided suitable means for withdrawing the gumming roll 81 from the surface of the severed band 70 before the lower edge of the moving stack clamps the loose band against the top clamp 69 and then draws the band down into the well 17 for folding. The mechanism for obtaining a quick withdrawal of the gumming roll 81 consists of a lifter bar 84 located between the arms 77*a* and 77*b* of the knife operating lever, the bar 84 being carried at the end of one arm of a bell crank lever 85 also mounted on the shaft 78. The upper arm of the lever 85 is connected to one end of a link 86 which as best shown in Fig. 2 is connected at its other end to one arm of a rocking lever 87 pivoted at 87*a* just above the main drive shaft 14. The other arm of the lever 87 carries a roll 88 held in engagement with the periphery of a cam 89 mounted on the shaft 14 by means of a spring 90. The cam 89 is so designed that the high point thereof engages the roll 88 just after the gumming roll 81 has engaged the surface of the band, so that the resulting forward thrust on the link 86 causes the lever 85 to be turned in a clockwise

direction as viewed in Fig. 3, whereupon the lifter bar 84 engages the depressed arm 77b and lifts it to the position shown in Fig. 3 prior to the upward return movement of the cross head 25 following the delivery of a stack of envelopes to the bottom of the banding well 17. Thus there is no tendency for the gumming roll 81 to deposit gum on the band guide 71 for when the severed band 70 is drawn through the guide 71 into the folding well 17 by the descending stack of envelopes 5, the gumming roll 81 has already been withdrawn.

In the foregoing description of the gumming and severing of a band 70 which is to be later wrapped around a stack of envelopes, it has been assumed that a predetermined length of band 70 has been fed through the guide 71 during the formation of a stack, as indicated in Fig. 8 and the instrumentalities for feeding the band 70 as well as for interrupting the feed prior to the downward movement of a stack will now be described. The band 70 is adapted to be fed between the knife blades 72 and 73 by means of a positively driven feed roll 91 mounted on the shaft 78, the roll 91 having a pressure roll 92 yieldingly held in engagement with the periphery thereof by means of a spring 93 acting on the pivoted arm 94 which carries the pressure roll 92. The band 70 after passing between the co-operating rolls 91 and 92 leads around the upper surface of the roll 91 and back over the assembly chamber into a stationary guide 95 secured to the front wall 15 of the assembly chamber. From the guide 95 the band 70 leads downwardly to a supply reel 96 from which the band is drawn. The supply reel 96 is supported in any suitable manner so that the band may be readily unwound therefrom by the operation of the feed roll 91, only a portion of the reel 96 being shown in Fig. 1.

As best shown in Fig. 20, the feed roll shaft 78 is adapted to be rotatably driven by means of a sprocket wheel 97 over which passes a chain 98 from a sprocket 99 on a driving sleeve 100 loosely mounted on the shaft 3 which carries the envelope dryer 2 as previously described. As best shown in Fig. 5 which is a section through the dryer shaft 3 the sleeve 100 also carries a spider 101, the hub of which provides radial arms 102 each having a recess 103. The arms 102 of the spider are joined by a peripheral rim 104 on which is mounted a wheel 105 providing sprocket teeth 106. The sprocket wheel 105 is normally clutched to the spider rim 104 by means of plungers 107 operating in the recesses 102, springs 108 serving to press the ends of the plungers 107 against the inner periphery of the sprocket wheel 105. The springs 108 are normally under such compression that a rotative movement imparted to the sprocket wheel 105 will be transmitted to the spider 101 and the sleeve 100, in the absence of any force operating to positively prevent rotation of the spider 101.

As best shown in Fig. 2, the sprocket 105 is connected by means of a chain 109 to a small sprocket wheel 110 mounted on a shaft 111. The shaft 111 in turn carries a larger sprocket wheel 112 adapted to be driven from a small sprocket wheel 113 on the shaft 33 by means of a chain 114. As previously pointed out the shaft 33 is driven at the same speed and in the same direction of rotation as the main drive shaft 14 and the ratio between the pairs of sprocket wheels 112 and 113, and 110 and 105, respectively, is such that the sprocket wheel 105 is turned through one complete revolution for each twenty-four complete revolutions of the main drive shaft 14. With this arrangement it is apparent then that normally the sleeve 100 is driven in unison with the main drive shaft 14, so that the band feeding roll 91 is adapted to deliver the band 70 beneath the stacking pawl 16 while a stack of envelopes is being assembled on the stacking pawl 16.

However, as previously pointed out, means are provided for stopping the operation of the band feeding rolls prior to the downward movement of a stack into the banding well 17 and this result is obtained by interrupting the rotative movement of the sleeve 100. As best shown in Fig. 2 the spider rim 104 has secured thereto a ring 115 which provides a single tooth 116. This tooth 116 is adapted to be engaged by one end of a bell crank lever 117 mounted on a shaft 118 just below the periphery of the sprocket wheel 105. The other arm of the lever 117 carries a head 119 through which freely passes a rod 120 pivotally connected at its other end to the arm 36 mounted to turn with the shaft 29, see Fig. 1. This shaft 29 is adapted to be turned when the operation of the counting wheel 43 causes the latch lever 40 to release the lever arm 28 mounted on the shaft 29; consequently when the shaft 29 turns the arm 36 in a counter-clockwise direction, a collar 121 on the rod 120 engages the head 119 and turns the lever 117 to disengage the end of the lever from the tooth 116 on the locking ring 115. When this occurs the ring 115 is released so that the springs 108 cause the plungers 107 to immediately clutch the spider 101 to the constantly driven sprocket wheel 105. This rotates the sleeve 100 until the sprocket wheel 105 has completed another revolution whereupon the sleeve 100 is locked again. During this movement of the spider 101, the locking end of the lever 117 is held against the periphery of the ring 115 by means of a spring 122 surrounding the rod 120 between the head 119 and a second stop 123 provided at the end of the rod 120. This spring 122 is effective to tend to hold the lever 117 against the ring 115 by reason of the fact that the rod 120 is returned to the position shown in Fig. 1 when

the shaft 29 returns the cross head 25 to its upper position as soon as a stack of envelopes has been delivered to the folding well 17.

Consequently the sleeve 100 continues to rotate while a new stack is being formed on the stacking pawl 16, during which time the continued rotation of the feed roll 91 causes a predetermined length of band material 70 to be delivered beneath the stacking pawl 16 in the upper portion of the folding well 17. However as the sprocket wheel 105 completes a revolution, the tooth 116 on the ring 115 again engages the end of the lever 117 thereby locking the sleeve 100 against rotation with the constantly driven wheel 105. After the sleeve 100 is locked, the shaft 14 normally makes one more revolution before the operation of the counting device unlocks the mechanism for operating the cross head 25 which immediately makes a rapid downward movement to deliver a counted stack of envelopes to the folding well. As the cross head 25 reaches the lower end of its downward stroke, the turning of the shaft 29 operates through the rod 120 to release the lever 117 from the notch 116 so that the sleeve 100 is again clutched to the sprocket wheel 105 and the feeding of the band 70 is resumed just as the cross head 25 is returned to its upper position by the cam 34 on the counter shaft 33.

The immediate object of the mechanism for interrupting the rotation of the sleeve 100 before a stack has been completely formed on the stacking pawl 16 is to insure that exactly the same amount of band material will be fed by the rolls 91 and 92 each time that the sleeve 100 is rotated. In other words, every time the locking ring 115 and with it the sleeve 100 is released coincidently with the operation of the cross head 25 for delivering a counted stack into the folding well, the next succeeding twenty-four revolutions of the drive shaft 14 will cause the sleeve 100 to drive the band feeding rolls 91 and 92. At the end of the twenty-fourth revolution of the drive shaft 14 the ring 115 and with it the sleeve 100 is again locked by the lever 117 engaging the tooth 116 thereby positively interrupting the feeding of the band 70 entirely irrespective of whether or not twenty-four envelopes have at that time been accumulated in the stack being formed. The band feeding roll 91 is of such diameter that one complete revolution thereof feeds exactly the amount of band required for the stacks being formed and if it were not for the operation of the means for automatically interrupting the operation of the band feeding roll, a considerably longer band than necessary might be fed during the formation of a stack of twenty-five envelopes should more than twenty-five operations of the pusher plate 8 be required to deliver twenty-five envelopes to the stacking chamber.

With the initiation of the band feeding mechanism dependent upon the functioning of the envelope counting device the feeding of bands of equal length is absolutely assured and can not be in any way effected by failure of the envelope forming machine to deliver an envelope for each revolution of the drive shaft 14, nor is the band feeding mechanism in any way effected by the removal of envelopes from the dryer cylinder 2 for inspection purposes.

The net result is that the duration of the dwell in the rotative movement of the sleeve 100 is determined entirely by whether or not an envelope is delivered in position to be acted on by the pusher plate 8 each time the pusher plate is operated from the drive shaft 14. When the machine is functioning normally, the sleeve 100 dwells for only the duration of one revolution of the drive shaft 14 but if for any reason, such as removal of defective envelopes from the dryer 2, it should take twenty-eight operations of the pusher plate 8 to deliver twenty-five envelopes to a stack, then the sleeve 100 would remain stationary for a period equal to the time it takes the drive shaft 14 to make four complete revolutions.

Referring now to Fig. 8, there the parts are shown in the position they occupy when the hooks 24 have moved a stack of envelopes partially into the banding well 17 to a point at which the severed band 70 is clamped against the bottom clamp 69 by the lower edges of the envelopes. As the cross head 25 carrying the hooks 24 moves further downwardly into the well, the band 70 is folded around the lower portion of the stack as shown in Fig. 9, the band 70 being drawn over the upper edge of a movable folder 124 and over the edge of a stationary guide bar 125*a* carried by a wall 125 forming one side of the folding well 17. The wall 125 provides wedge shaped prongs 125*b* above the bar 125*a* to prevent the pack from bellying. The other side of the banding well 17 is defined by the folder 124 and a gate 126 which serves to separate the stack of envelopes just delivered to the folding well 17 from other stacks of banded envelopes which have already been delivered into a delivery chute 127 contiguous to the folding well 17.

After a stack of envelopes has been delivered completely in the folding well 17 as shown in Fig. 9, the cam 34 acting through the rod 31 and arm 28 raises the cross head 25 to its upper position thereby withdrawing the hooks 24 from engagement with the top of the stack just delivered. Just after the hooks 24 have been raised, a combined ejector and compressor 128 is moved from the position shown in Fig. 9 to the position shown in Fig. 10 to compress the stack of envelopes

against the gate 126 which as shown in Fig. 15 provides spaced fingers 126*a* between which are received the end of the folder 124 and fingers 128*a* provided by the ejector 128. As best shown in Fig. 8 the ejector 128 is mounted on a longitudinal slide 129 movable along the bottom of the delivery chute 127. The slide 129 is adapted to be moved by means of a lug 130 to which is pivotally connected a lever arm 131 by means of a link 132. The arm 131 is mounted on a shaft 133 extending parallel to and just above the shaft 29 which carries the levers for operating the cross head 25. The shaft 133 carries a second arm 134 which is pivotally connected at its free end with a fork 135 carrying a roll 136 in engagement with a cam 137, see Fig. 20. The cam 137 is carried on the sleeve 100 driven by the sprocket wheel 105, the intermittent movement of which sleeve 100 has been previously described.

The cam 137 is so designed that the slide 129 occupies its extreme left hand position in Fig. 8 when the hooks 24 deliver a stack of envelopes at the bottom of the folding well 17. However when the hooks 24 are lifted as shown in Fig. 10, the shaft 133 is turned in a clockwise direction by a spring 135*a* causing the yoke 135 to follow the cam 137 thereby moving the slide 129 and with it the ejector 128 to engage the stack and compress the same against the gate 126 which at this time is staionary within the folding well 17.

The amount of compression of the stack of envelopes between the ejector 128 and the gate 126 is determined by a stop pawl 138 which arrests the movement of the slide 129 by the lever arm 131. The stop pawl 138 is pivoted on a pin 139 carried by a plate 140 adjustable on a table 141 which forms the bottom of the delivery chute 127. The plate 140 provides a slot 142 for receiving a stud 143 threaded into the table 141, so that the position of the end of the pawl 138 can be adjusted to regulate the degree to which the stack is compressed against the gate 126 by the ejector 128. When the slide 129 engages the stop pawl 138, the roll 136 on the yoke 135 is held away from the cam 137 as the low portion of the cam comes under the roll 136, so that the spring 135*a* acting on the arm 135 is unable to move the slide 129 further. Consequently, when the pawl 138 is turned to release the slide 129, by mechanism which shall be hereinafter described, the ejector 128 is in readiness to be moved quickly to project the partially banded stack into the delivery chute 127.

As the ejector 128 compresses the stack, the folder 124 is moved upwardly in the position shown in Fig. 11, in which position the band extending above the stack is clamped by the folder against the lower surface of a finger 144. As best shown in Figs. 15 and 16, the folder 124 is carried by a slide 145 vertically movable along one side of the wall 15, the slide 145 being connected to an arm 146 mounted on a shaft 147. The shaft 147 also carries a second arm 148 at the end of which is provided a roll 149 bearing on the face of a cam 150 mounted on the shaft 78 which carries the band feed roll 91. A spring 151 maintains the folder slide 145 in its lower position and at the same time holds the roll 149 against the surface of the cam 150, the parts occupying the position shown when a stack is delivered at the bottom of the folding well 17. When the ejector 128 has compressed a stack as shown in Fig. 11, rotation of the band feeding shaft 78 causes the cam 150 to turn the shaft 147 in a clockwise direction thereby raising the slide 145 with its folder 124 to the position shown in Figs. 11 and 12. This upward movement of the folder 124 engages the band 70 between the upper edge of the folder 124 and the finger 144 and so takes up any slack in the band due to compression of the stack. The finger 144 is freely mounted on an arm 152 pivoted at 152*a*, a stop 153 limiting downward movement of the finger 144 so that it remains above the band guide 71. The finger 144 readily yields upwardly when pressed by the folder 124 and as the band 70 is pulled tight, its lower end is clamped against the stack by a corrugated finger 154 forming part of the ejector 128, see Fig. 15.

As the folder 124 reaches its uppermost position in Fig. 12, the gate 126 is lowered from the position shown in Fig. 11 to the position shown in Fig. 12 to permit the ejector 128 to push the stack into the delivery chute 127 as shown in Fig. 13, the roll 136 at this time being held away from the low point on the cam 137 as previously described. The ejector 128 is released when the gate 126 is fully lowered by the pawl 138 being turned downwardly to free the end thereof from the slide 129. As best shown in Figs. 4 and 20, the end of the shaft 139 which carries the pawl 138 also carries a lever 155 adapted to be turned by a rod 156 the upper end of which is connected to a crank pin 157 carried by the sprocket wheel 97 on the shaft 78. The rod 156 carries an adjustable collar 158 which is adapted to engage a head 159 on the lever 155 when the rod 156 moves downwardly. The crank pin 157 is so located that the pawl 138 releases the ejector slide 129 just after the gate 126 is lowered, thereby permitting the spring 135*a* to quickly turn the shaft 133 to move the ejector 128 to its extreme position wherein the partially banded pack is forced inside the delivery chute 127. This movement of the fork 135 causes the roll 136 to engage the low portion of the cam 137 so that the ejector 128 holds the compressed pack within the chute 127 during the final band

folding operation which will now be described.

As the stack is pushed into the delivery chute 127 by the ejector 128, it is obvious that the loose portion of the severed band at that time extended on the folder 124 will be drawn into the chute under the lower edge of the folder 124 as shown in Fig. 13 and as the ejector 128 reaches the end of its stroke to firmly compress the partially banded stack, the folder 124 is moved downwardly to the position shown in Fig. 13 as the roller 149 reaches the low point of the cam 150. This has the effect of folding down the remaining portion of the band, the end of which has had the gum applied thereto as previously described. After the ejector 128 reaches the end of its stroke to completely compress the stack, it remains there while the gate 126 is raised behind the ejector 128 into alinement with the folder 124, see Fig. 15. As shown in Fig. 8, the gate 126 is mounted on a vertically movable slide 160 which provides a lug 161 to which is pivotally connected an arm 162 by means of a link 163. The arm 162 is mounted on a sleeve 164 surrounding the shaft 133, the other end of the sleeve 164 carrying an arm 165 turnable with the arm 162. The free end of the arm 165 carries a yoke 166 embracing the sleeve 100, which yoke carries a roll 167 held against the face of a cam 168 mounted on the sleeve 100 by means of a spring 169. The cam 168 is so designed that the sleeve 164 is turned to lower the gate 126 just before the cam 137 causes the ejector 128 to push the banded stack of envelopes into the delivery chute 127 and to raise the gate 126 just before the ejector 128 moves out of the chute 127.

Consequently as the spaced fingers 128*a* of the ejector 128 are withdrawn through the spaced fingers 126*a* of the raised gate 126, the stack which has just been closely compressed expands as the pressure of the ejector is relieved until the outer envelope of the stack with which the ungummed end of the band is in engagement reaches the then stationary folder 124 and gate 126. This has the effect of bringing the overlapped ends of the band closely together as indicated at 70*a*, Fig. 14, thereby causing the ends of the band to be stuck together. As shown in Fig. 15, the middle fingers 126*a* of the gate 126 overlap the band on either side of the lowered folder 124 to provide a support for the edges of the band at the place where the gummed end of the band overlaps the ungummed end. The gate 126 and the folder 124 remain in the position shown in Fig. 14 while a new stack is being formed above the stacking pawl 16 and is delivered into the lower portion of the folding well 17 as shown in Fig. 9. Therefore, when the gate 126 and folder 124 are withdrawn as shown in Fig. 12, the overlapped ends of the band just joined are engaged by the unbanded stack which has just been delivered and the band ends are tightly pressed together as the new stack is pushed into the chute 127 as shown in Fig. 13. Obviously this pressure on the overlapped ends of a band is maintained as long as the stack remains in the chute 127 thereby allowing plenty of time for the gum on the ends of the band to dry.

As successive stacks of envelopes are delivered into the chute 127, they are held under compression by engagement with the weighted stop member 170 which fits within the chute 127 and offers sufficient frictional resistance to movement therein to hold the envelope stacks under pressure, see Fig. 8. As the machine continues to operate, the accumulated stacks within the chute 127 force the stop 170 beyond the chute, the stop 170 being finally moved to a position indicated in Fig. 20 wherein the banded stacks may be removed by the operator who then pushes back the stop 170 to engage the end of the stack which has just emerged from the chute 126. Obviously the time elapsing between the delivery of a banded stack into the chute 127 by the ejector 128 and the removal of the stack outside the chute is considerable and during this whole period the overlapped ends of the band are subjected to continuous pressure.

When a stack of envelopes is delivered to the bottom of the banding well 17 as shown in Fig. 9, the bottom clamp 69 is moved downwardly through a slot 171 provided in the plate 141 which forms the bottom of the well and also of the chute 127, see Fig. 8. As the clamp 69 reaches the bottom of the well 17 it is prevented from moving any further by the seating of its head in a groove 172 opening into the slot 171. The clamp 69 remains in this lowered position until the gate 126 is moved upwardly into the banding well 17 as shown in Fig. 13. When this occurs, the upward movement of the gate 126 is adapted to be imparted to the clamp 69 by reason of the fact that the shank 69*a* of the clamp 69 is received in a box 173 attached to the gate slide 160. As shown in Fig. 18, the box 173 provides springs 174 bearing on pins 175 on opposite sides of the shank 69*a* so that when the gate 126 moves upwardly after the bottom of the well 17 has been cleared of a stack, the frictional force exerted by the pins 175 serves to lift the bottom clamp 69 to the position shown in Fig. 3 in which the top of the clamp is just below the end of the band guide 71.

In order to regulate the upper position of the clamp 69, the lower end of the shank 69*a* carries a pin 176 which is adapted to engage a stop 177 as the gate 126 nearly reaches its uppermost position. As shown in Fig. 19, the stop 177 is secured to the frame by means of a set screw 178 received in a slot 179 pro-

vided in the stop 177 so that the stop 177 may be adjusted vertically with respect to the frame. This adjustment of the degree of upward movement of the clamp 69 is desirable so that the clamp 69 may be set accurately with respect to the band guide 71. As shown in Fig. 3, the clamp 69 should come to rest in its upper position so that the band will feed out from the guide 71 over the clamp 69 while a stack is being formed above, without the band tending to sag appreciably from the end of the guide 71.

Referring now to Fig. 4, it will be seen that the shaft 78 which carries the feed roll 91 also carries a gear 180 adjacent to the feed roll 91, which gear 180 is in mesh with a gear 181 carried on the same shaft 182 as the pressure roll 92, thus the feed rolls 91 and 92 are adapted to be driven in unison when the sleeve 100 is rotatably driven. The shaft 78 also carries a second sprocket wheel 183 connected by a chain 184 to a sprocket wheel 185 on the shaft 82*a* which supports the gum supply roll 82 within the reservoir 83, as indicated in dotted lines in Fig. 3. Consequently the roll 82 is also driven in unison with the feeding rolls 91 and 92 to insure that a freshly gummed surface will be presented to the band gumming roll 81 as the latter is moved downwardly to apply gum to the band after it has been fed between the rollers 91 and 92.

Means are also provided for turning the gum supply roll 82 independently of the shaft 78 should the machine remain idle for such a length of time that the gum would tend to dry on the surface of the supply roll 82. This means consists of ratchet teeth 186 cut on the shaft 78, which are adapted to be engaged by a spring pressed pawl 187 slidable in a slot 188*a* provided in a ring 188 connected to the sprocket wheel 183 which carries the driving chain 184 for the gum supply roll 82. When the pawl 187 is engaged in a tooth 186, the rotative movement of the shaft 78 is imparted to the ring 188 and wheel 183 by the pawl 187, but when the shaft 78 is stationary, the ring 188 can be turned by hand to slip the pawl 187 around the teeth 186 on the shaft 78 independently of the shaft 78. With this arrangement, it is an easy matter for the machine operator to turn the ring 188 by hand and with it the gum supply roll 82 just before starting the machine in operation after an interruption, thus insuring that the band gumming roll 81 will be freshly gummed and ready to apply gum to the band even though the roll 84 should be moved downwardly to engage the band immediately after operation of the machine is resumed.

From the foregoing then it is apparent that by my invention I have provided an improved machine for automatically assembling envelopes into stacks or packages each containing a predetermined number of envelopes, and then moving a completed stack from the stacking position to wrap a band around the same while another stack is being assembled. My machine is particularly characterized by the fact that the instrumentalities for moving a stack from the assembly chamber to the banding chamber can not possibly come into operation until the desired number of envelopes have been actually delivered to the stack by the pusher plate. Thus the machine adapted to deliver stacks which always contain exactly the same number of envelopes, regardless of the fact that the envelope forming machine with which my invention is associated may fail to produce a perfect envelope for each revolution of the driving shaft. Furthermore the removal of completed envelopes from the rotating drier for purposes of inspection, or because of imperfections apparent to the operator, in no way affects the continued formation of stacks each containing the same number of envelopes.

It is also obvious from the foregoing that the mechanism for feeding the bands is automatically controlled so that only a predetermined length of band is fed during the formation of each stack entirely irrespective of the fact it may take longer to form one stack than another, due to the causes previously mentioned. The same holds true of the mechanism for folding a band around a stack and delivering the banded stack to the delivery chute, the mechanism for accomplishing this result being set in operation as soon as a stack is delivered to a banding well after which this mechanism automatically comes to rest and remains in an inoperative position until another stack of counted envelopes is actually delivered in proper position for wrapping a band around the same.

It is to be particularly noted that during the operation of my improved mechanism, the cutting, gumming and application of a band to a stack of envelopes occurs during the very brief interval between the delivery of the last envelope of a counted stack at the assembly station and the arrival of the completed stack at the bottom of the banding well, as well as before the arrival of the first envelope of a new stack at the assembly station. This rapid actuation of the band gumming means insures that the gum will still be moist when the ends of the bands are finally brought together just before the banded stack is pushed into the delivery chute. As arranged, the gumming of the band can occur only after the downward movement of a completed stack has been initiated following the automatic registration of the desired number of envelopes by the counting mechanism.

I claim:

1. In an automatic envelope pack banding machine, the combination with a dryer for supporting a plurality of envelopes, a pack

assembly station, means for removing envelopes one at a time from said dryer and delivering them to said assembly station, and a well located below said assembly station for banding a pack of envelopes, of means for moving a pack of envelopes downwardly from the assembly station into the band wrapping well and further means operating in synchronism with said pack moving means for cutting and gumming a band and applying the severed band to the bottom of the pack while the latter is in transit from the assembly station to the band wrapping well.

2. In an automatic envelope pack banding machine, the combination with a dryer for supporting a plurality of completed envelopes, an envelope pack assembly station, a member for delivering envelopes to said assembly station, and means for transferring envelopes from said dryer into the path of movement of said delivery member, of a counting device for automatically registering the actual delivery of each envelope to the assembly station by said delivery member.

3. In an automatic envelope pack banding machine, the combination with a dryer for supporting a plurality of completed envelopes, an envelope pack assembly station, a member for delivering envelopes to said assembly station, and means for transferring envelopes from said dryer into the path of movement of said delivery member, of an automatic counting device operating independently of said transfer means for registering the actual delivery of each envelope to the assembly station by said delivery member.

4. In an automatic envelope pack banding machine, the combination with a dryer for supporting a plurality of completed envelopes, an envelope pack assembly station, a member for delivering envelopes to said assembly station, and means for transferring envelopes from said dryer into the path of movement of said delivery member, of an automatic counting device actuated by movement of said envelope delivery member, said counting device registering only when an envelope is actually delivered by said delivery member to the assembly station.

5. In an automatic envelope pack banding machine, the combination with a dryer for supporting a plurality of completed envelopes, an envelope pack assembly station, a member for delivering envelopes to said assembly station, and means for transferring envelopes from said dryer into the path of movement of said delivery member, of means for removing a pack of envelopes from said assembly station and a counting device adapted to register each time an envelope is delivered to said assembly station, for automatically controlling the operation of said stack removing means.

6. In an automatic pack banding machine, the combination with a dryer for supporting a plurality of completed envelopes, an envelope pack assembly station, a member for delivering envelopes to said assembly station, and means for transferring envelopes from said dryer into the path of movement of said delivery member, of means for removing a pack of envelopes from said assembly station and a counting device adapted to register each time an envelope is delivered to said assembly station by said delivery member, for automatically causing the operation of said pack moving means when a predetermined number of envelopes has been delivered to said pack.

7. In a machine of the class described, the combination with means for delivering finished envelopes to pack assembly station, of means for automatically removing a pack of envelopes from the assembly station when a predetermined number of envelopes have been accumulated there, means for feeding strip material beneath the envelopes as they accumulate at the assembly station and means for automatically interrupting the feeding of said strip material before a completed pack is removed from the assembly station.

8. In a machine of the class described, the combination with means for delivering finished envelopes to a pack assembly station and means for feeding flexible banding material beneath the envelopes as they are assembled, of means for removing a pack of envelopes from the assembly station when a predetermined number of envelopes have been received in the pack, means for interrupting the feeding of the band prior to the movement of a pack from the assembly station and means operating simultaneously with the movement of a completed pack for gumming and severing the band and applying a severed length to the moving pack.

9. In a machine of the class described, the combination with means for delivering finished envelopes to a pack assembly station, means for feeding flexible banding material beneath the envelopes being assembled and a band folding well located below the assembly station, of means for moving a pack of envelopes from the assembly station to the folding well and means for severing a length of band at the beginning of the movement of a pack whereby the severed band is applied to the pack and carried into the folding well.

10. In a machine of the class described, the combination with means for delivering finished envelopes to a pack assembly station, means for feeding flexible banding material beneath the envelopes being assembled and a band folding well located below the assembly station, of means for moving a pack of envelopes from the assembly station into the folding well, means for simultaneously sev-

ering a length of band whereby the severed band is carried into said folding well by said pack of envelopes and means for compressing the pack of envelopes within the folding well with a band partially wrapped thereabout.

11. In an envelope banding machine, an assembly station, a banding well, a transfer mechanism for transporting a predetermined number of envelopes from the assembly station to the banding well, means for feeding a band of predetermined length, means for wrapping the band about three sides of a pack of envelopes, means for wrapping one end of the band over the fourth side of the pack, then forcing it down and against the first side of the pack for the second time and sticking both ends of the band together, ejector means for clearing the banding well and means for maintaining the initial band sticking pressure while the envelopes are being ejected from the well.

12. In an envelope bander, a band feeding mechanism for feeding a band of constant length, and an adjustable package compressing mechanism for determining the thickness of the banded package, whereby the amount of band overlap is determined by the thickness of the pack.

13. In an envelope pack bander, means for compressing a pack of envelopes partially surrounded by a gummed and registered band and means for removing the slack in the band due to said compression before completing the wrapping and sticking of said band.

14. In an envelope pack banding machine, an assembly station for collecting a predetermined number of envelopes in a semi-compact pack, a vertically disposed chute, means for moving an assembled pack of envelopes down said chute, a horizontally disposed chute having a movable gate located in the intersection between said chutes, means for compressing the envelope pack against said gate, and means for projecting the compressed pack into the horizontal chute against a yielding resistance upon the lowering of said gate.

15. In an envelope pack banding machine, an assembly station for collecting a predetermined number of envelopes in a semi-compact pack, a vertically disposed chute, means for moving an assembled pack of envelopes downwardly in said chute, a horizontally disposed chute intersecting the vertical chute, a vertically movable gate in said horizontal chute, means for compressing a pack of envelopes against said gate in its raised position, means for lowering said gate, means for projecting the compressed pack into said horizontal chute, and means for raising said gate after the reception of a pack into the horizontal chute to maintain the envelope pack in compressed condition against packs of envelopes already in said horizontal chute.

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