METHOD AND APPARATUS FOR OPENING ENVELOPES

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References Cited

UNITED STATES PATENTS
3,238,926 3/1968 Huck .................83/912 X
3,204,503 9/1965 Simjian ............83/912 X

ABSTRACT

To continuously open envelopes of a preselected size, the process of jogging the contents to the bottom of the envelope, cutting off the top edge, slitting both side edges, and then holding the faces of the envelope open to expose the contents thereof for manual removal. Apparatus employing the principles of the process include a feeder station onto which envelopes are initially placed for jogging the contents and for advancing the envelopes toward a pick-up station. The latter station individually grips, with a vacuum arm, an envelope on the feeder station and delivers it to a top edge cutting station where cutting wheels remove a portion of the envelope along the top edge. Next to the cutting station is a drop chute station that delivers the envelope to a V-shaped tray of a conveyor which then moves the envelope to an end slitting station where both side edges of the envelope are split open by cam operated blades, after which the faces of the envelope are held open in the tray by vacuum members. The conveyor then moves the tray into a sorting area where operators remove the contents for sorting.

12 Claims, 18 Drawing Figures
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METHOD AND APPARATUS FOR OPENING ENVELOPES

BACKGROUND OF THE INVENTION

Although the use of mail has greatly increased through the years, the method and tools used for opening envelopes remain virtually unchanged. Herein lies a problem of great magnitude for companies which receive large quantities of mail, and the problem is particularly acute in collection or accounting departments of those companies handling monthly credit transactions.

No doubt the simplest tool used for opening an envelope is the hand letter opener which is quite familiar to most people. Likewise, the process of inserting the blade at one corner of the envelope and then sitting across the top edge of the envelope and then sliding the contents out is familiar. Contents near the top edge will likewise be cut. And if a staple or paper clip happens to be near the top edge, damage to the machine itself is foreseeable. In spite of these shortcomings, however, it is apparent that this automatic device is merely a replacement for the hand letter opener, since the person must still remove the contents from the envelope by hand.

There have been some experimental machines which attempted to improve on these prior concepts. To our knowledge, none have proved satisfactory. One such experimental machine cut and removed a portion of the envelope along three sides and then stacked that envelope with previously cut envelopes. However, damage to the contents was not infrequent, and in this age of "do not bend, fold, or mutilate," such damage simply cannot be tolerated, particularly when the contents of the envelope includes a machine readable data card to be used by the accounting department.

A second type of experimental machine attempted, by the use of a quartz crystal, to burn three edges of the envelope and then dump it onto a conveyor where operators could then pull the faces of the envelope apart and remove the contents. In view of the substantial fire hazard, use of this machine was unquestionably limited from its inception.

And finally, a third experimental machine for opening mail required an envelope which was pre-perforated on three sides. The machine itself had a rotatable friction wheel for engagement with one face of the envelope in order to peel that face away from the other. Here, the theory was to crumple one face of the envelope in order to expose the contents, but unfortunately the contents were also crumpled with great regularity.

Therefore, even for those who receive vast quantities of mail, there are basically only two tools which are commercially available and which may be successfully used for gaining access to the interior of an envelope. These tools are the hand letter opener and the automatic mail opener, as previously described. With these tools, therefore, the way in which to open increased quantities of mail is to hire additional employees to perform the task. However, it is noted by collection or accounting departments of companies having a large amount of credit transactions that the largest quantity of mail is received around the first and then again around the middle of the month. Herein lies a dilemma between being understaffed during the heavy period or overstaffed during the slack period of the month.

In these departments, which normally send the customer a statement and a return envelope in which payment can be mailed, the common practice used in opening mail is to provide each of those assigned this task with a stack of envelopes to be opened. The employee first picks an envelope from the stack and then either removes the top edge with an automatic mail opener or slits the top edge with a hand letter opener. The contents of the envelope are then removed by hand in conventional manner. If the envelope contains no change of address information, it is normally thrown in a waste paper receptacle.

The contents of the envelope are then sorted in various ways so that the transaction can be further processed for accounting purposes. The contents will normally contain a return portion of the monthly statement (which is usually a machine readable data card) and a payment from the customer. If the payment is in the amount of the statement, the contents are placed in one sorting bin. However, if the payment does not agree with the amount of the statement, then the contents are placed in a separate sorting bin. The foregoing is only illustrative of the sorting procedure involved and there are other sorts which may be required, such as sorts according to whether the transaction is paid by check or by currency.

The sorting process is not a source of great problems, primarily because it involves the thinking process. That is, the employee must compare and evaluate that, by the nature of the task itself, require the employee's full attention. On the other hand, the opening process involves only the motor faculties and is a source of many problems. In the first place, the opening operations are very monotonous and, frequently, without intention and as an automatic reflex, the employee will throw away an envelope without removing the contents. When this occurs, the customer relationship is strained to the least. The customer is sure that he paid his bill, but the company has no record of payment. Straightening out the error, therefore, is irritating for the customer and time consuming for the company.

In addition, since this system is boring and monotonous for the employees, it is a great source of inefficiency and many employees tend to loaf unless constantly supervised.

SUMMARY OF THE INVENTION

A primary object of this invention is to fill the long felt need in industry for a mail handling system to continuously open envelopes of a pre-selected size without damage to the contents thereof.

Additionally, an object of the invention is to provide a mail handling system which virtually eliminates the problem of envelope contents being accidentally thrown away. Not only is it a direct money saving benefit
realized, but for companies handling credit transactions, the costly annoyance of throw aways no longer plagues customer relationships.

Another object of the invention is to provide a mail handling system in which the boring and monotonous drudgery of the opening operations is entirely machine implemented, while the sorting operations are carried out more as a group effort to yield improved efficiency and better employee attitudes.

Yet another object of the invention is to provide a mail handling system of the character described for processing large quantities of incoming mail by utilizing a much smaller work force than could heretofore be used. Such is achieved by pacing the sorting operators to a machine speed in order to insure consistent production output. With a reduced work force and increased efficiency, labor costs for handling mail is sizably diminished and the company no longer need be overstaffed simply to be ready for periodic surges in the amount of mail to be processed.

An additional object of the invention is to provide a mail handling system in which envelopes are opened to completely expose the contents thereof for easy, manual removal. This feature is accomplished without damage to the contents which may include folded, as well as flat, items.

A further object of the invention is to provide mail handling apparatus which may be additionally fed, even during operation, with a new supply of envelopes to be opened.

Yet a further object of the invention is to provide mail handling apparatus for feeding envelopes to an automatic mail opener in such a manner as to eliminate damage to the envelope contents, as well as the danger of metal objects coming in contact with the cutting members of the mail opener.

Other and further objects of the invention, together with features of novelty appurtenant thereto, will appear in the course of the following description.

DESCRIPTION OF THE DRAWINGS

In the accompanying drawings, which form a part of the specification and are to be read in conjunction therewith, and in which like reference numerals are used to indicate like parts in the various views:

FIG. 1 is a plan view of a mail opening machine, constructed in accordance with a preferred embodiment of the invention, utilizing the method of opening envelopes as taught herein;

FIG. 2 is an enlarged plan view of an envelope tray, of which a plurality form the conveyor as seen in FIG. 1;

FIG. 3 is a side-sectional view of the envelope tray and underlying support structure as taken along line 3—3 of FIG. 2 in the direction of the arrows;

FIG. 4 is a plan view of the feeder station, with portions thereof broken away to show additional details of construction;

FIG. 5 is a sectional view of the feeder station taken along line 5—5 of FIG. 4 in the direction of the arrows;

FIG. 6 is an end view, partially sectional, taken along line 6—6 of FIG. 5 in the direction of the arrows;

FIG. 7 is a sectional view taken along line 7—7 of FIG. 5 in the direction of the arrows;

FIG. 8 is a plan view of the envelope pick-off station and the top edge cutting station;

FIG. 9 is a side elevational view taken along line 9—9 of FIG. 8 in the direction of the arrows;

FIG. 10 is an enlarged, side elevational view of the pick-off station taken along line 10—10 of FIG. 8 in the direction of the arrows;

FIG. 11 is a side sectional view through the drop chute station, generally taken along line 11—11 of FIG. 8 in the direction of the arrows;

FIG. 12 is a front elevational view taken along line 12—12 of FIG. 11 in the direction of the arrows;

FIG. 13 is a plan view of the end slitting station with an envelope to be opened shown in broken lines;

FIG. 14 is a reduced, side sectional view taken along line 14—14 of FIG. 13 in the direction of the arrows;

FIG. 15 is a rear elevational view, partly sectional, of the mail opening machine, with various portions of the supporting frame and enclosure panels thereof broken away or omitted to better illustrate the details of construction;

FIG. 16 is a plan view of the central drive shaft and camming structure taken along line 16—16 of FIG. 15 in the direction of the arrows;

FIG. 17 is a plan view of the motor and gearing mechanism used to operate the central drive shaft and tray conveyor as taken along line 17—17 of FIG. 15 in the direction of the arrows, with the supporting frame omitted; and

FIG. 18 is a timing diagram illustrating the interrelationship of the various cams with respect to one full revolution of the central drive shaft.

Before presenting a detailed structural description of the apparatus, a brief functional description of the operations performed in order to open an envelope is beneficial. In this respect, moderate reference is made to FIG. 1 where the movement of an envelope by the apparatus is indicated with arrows generally moving from left to right.

Initially, a quantity of envelopes is placed into a feeder station 100 from which they are individually picked off, one at a time, and laid flat onto a pick-off station 200. Once on the pick-off station 200, the envelope is conveyed to a top edge cutting station 300 where a portion of the envelope across the top edge thereof is completely removed. From this station 300, the envelope is advanced to a drop chute station 400 where the envelope is reoriented from its flat position to a vertical position resting in a V-shaped tray 501 of a tray conveyor 500. Operation of the conveyor 500 then advances the tray 501 containing the envelope held in an upright position to an end slitting station 600 at which both end or side edges of the envelope are completely split. At this point, the front and rear faces or walls of the envelope are held together only by the bottom edge.

From the slitting station 600 the envelope is advanced in its individual tray 501 by the conveyor 500 past operators positioned in the sorting area 700. Here, the faces of the envelope are held open to expose the contents which are removed and sorted by the operators. If an envelope is not removed from a tray 501 by an operator, that envelope is dumped into a waste removal container positioned at the end of the conveyor 500.

Because of its somewhat complicated nature, the apparatus has arbitrarily been divided into the previously mentioned stations for the purpose of the discussion to
follow. For each station, a structural description is given, as well as a description of the operations performed on a single envelope at that station. However, it must be remembered that all of the stations are integrally related in order to perform the specified envelope opening function in a continuous manner.

Likewise, for convenience of reference, there is an attempt to follow a numbering system in which the members of the feeder station receive numbers in the 100 series, the pick-off station in the 200 series, the top edge cutting station in the 300 series, the drop chute in the 400 series, the envelope tray and conveyor in the 500 series, the end sitting station in the 600 series, the sorting area in the 700 series, and the main drive train in the 800 series.

A. Feeder Station

For a detailed description of the feeder station 100, reference is primarily made to FIGS. 4 through 7. This station 100 includes a horizontal base panel 101 on which is mounted a pair of elongate box-like housings 102 and 103. With a portion of the base panel 101, the interior sides of each housing 102 and 103 define a three-sided envelope magazine 104 in which envelopes to be opened are initially placed and then fed to the pick-off station 200.

One such housing 102 is stationary while the opposite housings 103 is movable for adjustment toward and away from the stationary housing 102 in order to accommodate envelopes of varying width (that is, the dimension corresponding to the flap edge of an ordinary envelope). A pair of multi-toothed tracks 105 which extend beneath the base panel 101, as shown in FIG. 6, are mounted to the movable housing 103 through elongate slots 106. Each track 105 engages a spur gear 107 which is fixed on a rotatable shaft 108 supported beneath the base panel 101 by a plurality of bearing mounts 109. The outer end of the shaft 108 is fitted with a hand wheel 110 for manually rotating the shaft 108 in order to adjustably move the housing 103.

Within each housing 102 and 103 is mounted an endless chain 111 having a plurality of feed dogs 112 affixed thereon. As illustrated in FIG. 4, the feed dogs 112 of the chain 111 in one housing 102 are aligned with the feed dogs 112 of the chain 111 in the opposite housing 103.

Each chain 111 is trained around two sprocket wheels 113 and 114. The first sprocket wheel 113 is carried on a shaft 115 mounted in tension adjustable bearing blocks 116. The other sprocket wheel 114 is carried on a shaft 117 supported in fixed bushings 118. The shaft 117 in each housing 102 and 103 extends through the base panel 101. The shaft 117 in the stationary housing 102 is equipped with a gear which is driven by a DC motor (not shown) and is also equipped with a flexible drive shaft 119 which is coupled to the shaft 117 of the movable housing 103. Such conventional drive linkage is necessary to drive each chain 111 in unison and in the direction as indicated by the arrows in FIG. 4.

The DC motor is controlled by an on-off spring switch 120 which is in turn activated by an envelope advance lever 121. The advance lever 121 is pivotally attached beneath the base panel 101 and projects upwardly into the envelope magazine 104. Attached to the forward and upper ends of each housing 102 and 103, and projecting into the envelope magazine 104, is an envelope stop 122.

Within the envelope magazine 104 and recessed in the base panel 101 is an elongate jogger plate 123 which is pivotally carried on a shaft 124 at the forward end thereof and supported on a ledge 125 at the rearward end thereof to provide a normally level surface with the base panel 101. Mounted beneath the base panel 101, and laterally with respect to the jogger plate 123, is a rotatable shaft 126 driven by a motor 127. An eccentric cam 128 is keyed to the shaft 126 and engages a cross bar 129 attached to the under surface of the jogger plate 123.

In operation, the feeder station 100 is first adjusted, as well as other stations to be described, to accommodate the size envelopes to be opened. The envelopes must be of a uniform width for continuous operation. Such adjustment is accomplished by operating the hand wheel 110 until the distance between the interior sides of the housings 102 and 103 approximately corresponds to the width of the envelopes to be opened. Thereafter, a stack of envelopes sufficient to substantially fill the space between successive feed dogs 112 is placed therebetween, with the bottom edges of the envelopes resting against the base panel 101 and jogger plate 123, and the side edges of the envelopes disposed adjacent the interior sides of the housings 102 and 103.

The motor driving the chains 111 with feed dogs 112 is normally on to advance envelopes to the right in FIG. 4. When the bottom portion of the first envelope in the stack engages the advance lever 121 and pushes it forward (to the right as viewed in FIG. 5), the switch 120 is turned off and the movement of the feed dogs 112 is thus halted. The envelope stops 122 engage the face of the first envelope on its upper side edges and prevent it from falling forward.

As will subsequently be described in greater detail, the first envelope engaging the advance lever 121 and envelope stops 122 is picked off by a vacuum cup arm 203. Successive envelopes in the stack are likewise picked off and eventually, when the envelopes supply less force on the advance lever 121, the lever 121 moves inwardly and turns on the switch 120 to activate the DC motor. This causes the feed dogs 112 again to advance until the envelopes urge against the advance lever 121 to turn off the motor through the switch 120.

The motor 127 controlling the jogger plate 123 is continuously operated, independent of the DC motor controlling the feed dogs 112. Rotation of the shaft 126 and the eccentric cam 128, as indicated by the arrow in FIG. 5, acts to raise and lower the cross bar 129. In response, the rearward end of the jogger plate 123 is pivotally raised, about the shaft 124, above the surface of the base panel 101 and then dropped back onto the ledge 125. This action of raising and then dropping the jogger plate 123 jogs the envelope contents to the bottom edge of the envelope. In this connection, it is desirable that the stack of envelopes between successive feed dogs 112 be somewhat loosely packed in order to achieve the maximum benefit from the jogger plate 123.

With the feeder station 100 constructed as described to advance envelopes in individual stacks between successive sets of feed dogs 112, not only are the problems of jamming and faulty feeding eliminated, but sub-
sequent stacks of envelopes may be inserted between empty feed dogs 112 while the machine is in operation.

B. Pick-Off Station

Referring first to FIG. 4 and to FIGS. 8 through 10, the pick-off station 200 includes a platform base 201 laterally disposed with respect to the end of the envelope magazine 104 of the feeder station 100. The base 201 has a key-hole slot 202 near the envelope advance lever 121 through which may pass a vacuum arm 203 having a vacuum cup 204 mounted on the end thereof. The arm 203 is held by a bracket 205 keyed to a pivotal shaft 206.

The vacuum arm 203 is fitted with vacuum tubing 207 that leads to a dump or bleed valve 208 that is mounted on the lower supporting frame as shown in FIGS. 15 and 16. Likewise, vacuum tubing 209 leads from the bleed valve 208 and is connected to a high vacuum pressure vacuum pump (not shown). A flexible reed 210, as seen in FIG. 16, rides on an open cam 211 connected to the drive train to control venting of the valve 208.

Also keyed to the pivotal shaft 206 on which the vacuum arm 203 is connected is a lever 212 which, as viewed in FIG. 10, is interconnected to a tie rod 213 by an adjustable extension coupler 214. The tie rod 213 is pivotally mounted intermediate the ends thereof to the supporting frame (FIG. 15) and the lower end of the tie rod 213 is equipped with a cam follower 215 (FIG. 16) that rides in the track of an enclosed cam 216 connected to the drive train.

Under the base 201, a triangular plate 217, as shown in FIG. 9, is supported by a pin 218 from the supporting frame. One leg of the triangular plate 217 is disposed beneath the vacuum arm 203 and the other leg is pinned to a lever 219 pivotally supported intermediate the ends thereof by a pin 220 connected to the supporting frame. Above the pin 220, a spring 221 interconnects the lever 219 and frame to bias the lower end of the lever 219 to the right with respect to FIG. 9. The upper end of the lever 219 is connected to a threaded extension 222 which is received within an oblong hole of a spring-loaded striker block 223 that slidably fits within an elongate slot 224 in the base 201. The striker block 223 is equipped with a thumb depressible plunger 225 for adjusting locking the position of the striker 223 on the threaded extension 222.

In operation, rotation of the feeder cam 216 imparts reciprocal movement to the tie rod 213 which is linked to the vacuum arm 203 as previously indicated. The vacuum arm 203 pivotally moves up through the keyhole slot 202 to centrally strike the first envelope held by the feeder station 100. The high pressure vacuum being drawn through the arm 203 causes the vacuum cup 204 to tightly grip the envelope and, as the cam 216 further rotates, the vacuum arm 203 starts back through the keyhole slot 202.

When the vacuum arm 203 has almost returned to its original position, the vacuum bleed valve 208 is opened by the flexible reed 210 riding on the cam 211. This causes the envelope to be released from the vacuum cup 204 and thus the envelope is laid flat onto the base 201.

When the vacuum arm 203 moves up to pick off an envelope, the spring 221 urges the striker 223 to the left in FIGS. 8 and 9. The striker 223 may be adjusted in the slot 224 to accommodate envelopes of a specified width by depressing the plunger 225, sliding the striker 223 to a new position in the slot 224 and then releasing the plunger 225 to again grip the threaded extension 222.

Upon returning to its original position, the vacuum arm 203 strikes the outer leg of the triangular plate 217 which pivots on the pin 218 and imparts rotation to the lower end of the plate 217. In turn, the lever 219 is moved to pull the striker 223, via the extension 222, to the right with respect to FIG. 9. As the striker 223 thus moves to the right, it strikes the trailing edge of the envelope and knocks the envelope toward the top edge cutting station 300 now to be described.

C. Top Edge Cutting Station

As shown in FIGS. 8 and 9, the top edge cutting station 300 includes a base plate 301 which is in a common plane with the platform base 201 of the previous station 200. At the back edge of the base plate 301 is an upstanding rear wall 302. Recessed in the base plate 301, but raised slightly above the surface thereof, is a first endless conveyor belt 303 mounted on a plurality of pulley wheels 304. Pivotally mounted on a bracket 305 extending from the rear wall 302 are a plurality of weighted rollers 306 which engage the upper portion of the first conveyor belt 303.

Adjacent the end of the first conveyor 303, inwardly toward the rear wall 302, begins a second endless conveyor belt 307 which is likewise supported by a plurality of pulley wheels 308. Engaging the second conveyor 307 is a weighted shoe 309 which is pivotally mounted to L-shaped arms 310 that are pivotally carried on rods 311 projecting from the rear wall 302.

Disposed just outwardly from the rear wall 302 and mounted one above the other, are a pair of knife-edged cutting wheels 312. The cutting wheels 312 are rotatably driven in opposite directions by a motor (not shown). To the right of the cutting wheels 312 is a sliver chute 313. In front of the cutting wheels 312 and recessed within the base plate 301 in like manner as the conveyors 303 and 307 is a motor driven roller 314 which assists the conveyors 303 and 307 in moving the envelope. Toward the forward edge of the base plate 301 and inclined inwardly toward the rear wall 302 is a fence member 315. Optionally, an electrical counting device may be recessed in the plate 301 for counting the number of envelopes processed.

The complete top edge cutting station 300, except for the first conveyor 303 and the fence 315, is commercially available and is manufactured by Pitney-Bowes. More particularly, the Pitney-Bowes Mail Opener Model LA has been successfully employed in this application.

In operation, the first and second conveyors 303 and 307, as well as the cutting wheels 312 and roller 314, are continuously driven by one or more motors. An envelope knocked by the strike 223 from the pick-off station 200 to the cutting station 300 is received between the first conveyor 303 and the plurality of weighted rollers 306 which hold the envelope against the conveyor belt 303 as the envelope moves to the right in FIGS. 8 and 9. The envelope is then picked off by the second conveyor belt 307 and held thereon by the weighted shoe 309. Because both the conveyors 303 and 307 are inclined toward the rear wall 302, by the time the en-
velope reaches the cutting wheels 312, the top edge of the envelope has been butted flush against the rear wall 302. The front fence 315 assists the conveyors 303 and 307 in this function and may be made adjustable to accommodate envelopes of a specified height. The envelope is then moved between the cutting wheels 312 which cut off the upper portion of the envelope (approximately one-sixteenth inch) along the top edge thereof. The sliver of the envelope which is cut off is discharged through the sliver chute 313 and the envelope with its top edge removed is propelled to the drop chute station 400.

D. Drop Chute Station

With respect to the drop chute station 400, reference is primarily made to FIGS. 1, 11 and 12. Beginning in the upper portion of the station 400, a horizontal ledge 401 is provided which is in a common plane continuous with the previously mentioned base plate 301 of the cutting station 300 and the platform base 201 of the pick-off station 200.

Suspended above the ledge 401 on the side closest the cutting station 300 is a pivot rod 402 which is received in a bushing 403 held on an upright bracket 404 attached to the frame. The rod 402 carries a plurality of weighted fingers 405, the bottom tips of which rest against the ledge 401. At the opposite side of the ledge 401 is a side wall 406.

The horizontal ledge 401 is provided with lateral slots 407 therein which receive pushing fingers 408 that are attached to a pivot rod 409 beneath the ledge. Keyed to the pivot rod 409 is a crank 410 which is connected by a tie rod 411 to a rocker arm 412 pivotally mounted on a bracket 413 attached to the lower supporting frame. The rocker arm 412 has a cam follower 414 that rides on an open cam 415 connected to the drive train.

Forwardly of the ledge 401 is a chute structure 416 having an elongate bottom slot 417 through which an envelope may pass. The slot 417 is aligned above the conveyor 500 of envelope trays 501. Oriented between the envelope tray 501 and the bottom slot 417 of the chute 416 are a pair of guide rods 418 which run parallel with the slot 417, but are spaced slightly further apart and which are attached to support rods 419 connected to the frame.

As shown in FIG. 11, the guide rods 418 are so positioned as to hold an envelope 420, shown in broken lines, in an upright or vertical position after the envelope has been dropped through the chute 416. In the event the envelope is taller than the one illustrated and reaches into the chute 416 itself, the forward side wall of the chute 416, as shown in FIG. 12, is provided with a vertical slot 421 to permit the envelope to move to the right in that view.

In operation, an envelope received from the cutting station 300 slides onto the ledge 401 and underneath the fingers 405 which pivot counterclockwise as shown in FIG. 12 to permit the envelope to pass beneath them. When the envelope strikes the side wall 406, it may rebound with some force toward the cutting station 300. However, travel back toward the cutting station 300 is blocked by the fingers 405 resting on the ledge 401. So delivered to the ledge 401, the top edge of the envelope is adjacent the pushing fingers 405 while the bottom edge of the envelope is directed toward the drop chute 416.

At this point, an empty conveyor tray 501 is positioned beneath the chute 416. As the drive train operates, the cam follower 414 is elevated by the lobe on the cam 415. This causes the tie rod 411 to push the crank 410 in a counterclockwise direction (FIG. 11) and results in the fingers 408 moving through the slots 407 in the ledge 401 to push the envelope lying thereon into the drop chute 416. Once in the drop chute 416, the envelope falls by gravity through the bottom slot 417, between the guide rods 418, and into the envelope tray 501. In the tray 501, the envelope is held vertically by the guide rods 418 or the walls of the chute 416.

E. Envelope Conveyor and Tray

With reference to FIGS. 1, 15 and 17, the continuous conveyor 500 includes a plurality of envelope trays 501 which are connected across a pair of endless chains 502 that are trained around a pair of sprocket wheels 503 at each end of the conveyor 500 and are supported between the wheels 503 by angle iron runners 504.

As shown in FIGS. 2 and 3, each tray 501 includes a perforary portion 505 that is centrally drilled to receive screws 506 which mount the tray to plates 507 attached to the chains 502. Each tray 501 also includes inwardly sloped walls 508 which form a V-shaped trough having vertical end walls 509. At each end of the trough, adjacent the end walls 509, is a recess 510. A large central opening 511 is provided in each sloped wall 508 and elongate, longitudinal slots 512 are disposed on each side of the central opening 511.

Extending through the sorting area 700 and into a portion of the end sorting station 600 is a pair of vacuum bars 513 disposed beneath the sloped walls 508 (FIG. 3) and carried on oblique angle irons 514 connected between the supporting frame and the angle iron runners 504. Along the length of the bars 513 are a plurality of holes 515 that are registered with the longitudinal slots 512 of the walls 508. At the forward end of each bar 513, as shown in FIG. 13, is a slot 516 which is likewise registered with the longitudinal slot 512. The vacuum bars 513 are operatively connected to a low pressure, high volume vacuum pump (not shown) for drawing a vacuum at the holes 515 and slots 516.

F. End Slitting Station

With reference to the end slitting station 600, the side from which the envelope is fed to the station 600 is referred to as the input side (to the left in FIG. 13) and the side on which the envelope moves away from the station 600 is referred to as the output side (to the right in FIG. 13).

Referring then first to FIG. 13, a front plate 601 is attached to the supporting frame and extends upwardly alongside and above the envelope conveyor 500. On the front plate 601 are rigidly attached mounting blocks 602 which receive a threaded shaft 603 having left hand threads on one end and right hand threads on the other end. The threaded shaft 603 is equipped with a hand wheel 604 and a spacer block 605 which are disposed between the mounting blocks 602. On the end of the threaded shaft 603 on the output side of the station 600 is threadably received a movable block 606 that pivotally carries one end of an output centering shaft 607. On the end of the threaded shaft 603 on the input side of the station 600 is threadably received a movable block 608 that pivotally carries one end of an input centering shaft 609.
Through the front plate 601 are elongate slots (not shown) which are aligned with the threaded shaft 603 and through which pass locking knobs 610 to engage the movable blocks 606 and 608. The knobs 610 may be tightened to prevent movement of the blocks 606 and 608 on the threaded shaft 603.

Likewise, a rear plate 611 is attached to the supporting frame and extends upwardly alongside and above the envelope conveyor 500 in alignment with the front plate 601. On the rear plate 611 are rigidly attached mounting blocks 612 which receive a threaded shaft 613 having left hand threads on one end and right hand threads on the other end. The threaded shaft 613 is equipped with a spacer block 614 disposed between the mounting blocks 612. On each end of the threaded shaft 613 is threadably received a movable block 615 that pivotally carries one end of a slitter shaft 616. The slitter shafts 616 fit into bushings 617 mounted in the ends of the centering shafts 607 and 609 whereby the shafts may be independently rotated.

Fitted to the input end of each threaded shaft 603 and 613 are pulley members 618 and 619, respectively, that receive a drive belt 620 therearound in order that rotation of the front threaded shaft 603 by the hand wheel 604 is imparted to the rear threaded shaft 613. The shafts 603 and 613 are interconnected by brace rods 621 to prevent bending and warping of the shafts.

To the rear of the input centering shaft 609 and projecting inwardly therefrom are a pair of ears 622 on which are pinned a tie rod 623 that extends beneath the conveyor 500 to the drive train below. Attached to the front of the input centering shaft 609 and projecting outwardly therefrom is an L-shaped centering arm 624 on which is mounted, by screws 625, an arcuate set of centering fingers 626 which define an interior V-shaped opening.

Likewise, to the rear of the output centering shaft 607 and projecting inwardly therefrom are a pair of ears 627 on which are pinned a tie rod 628 that extends beneath the conveyor 500 to the drive train below. Attached to the front of the output centering shaft 607 and projecting outwardly therefrom is an L-shaped centering arm 629 on which is mounted, by screws 630, an arcuate set of centering fingers 631 which define an interior V-shaped opening.

With reference now to FIGS. 15 and 16, the tie rod 628 connected to the output centering shaft 607 extends beneath the conveyor 500 and is connected to a rocker arm 632 that is pivotally supported by a bracket 633 attached to the supporting frame. Intermediate the ends of the rocker arm 632 is a cam follower 634 which rides on an open cam 635 connected to the drive train. As the cam follower 634 rides on the open cam 635, the tie rod 632 is raised and lowered, which causes the output centering shaft 607 to rotate inwardly and outwardly.

Likewise, the tie rod 623 connected to the input centering shaft 609 extends beneath the conveyor 500 and is connected to a rocker arm 636 that is pivotally supported by the bracket 633. Intermediate the ends of the rocker arm 636 is a cam follower 637 which rides on an open cam 638 connected to the drive train. As the cam follower 637 rides on the open cam 638, the tie rod 623 is raised and lowered, which causes the input centering shaft 609 to rotate inwardly and outwardly.

Referring again to FIG. 13, to the rear of each slitter shaft 616 and projecting inwardly therefrom are a pair of ears 639 on which are pinned a tie rod 640 that extends beneath the conveyor 500 to the drive train below. Keyed to each slitter shaft 616, toward the forward end thereof, is a mounting block 641 on which is attached, by screws 642, a pie shaped slitter blade 643. The blades 643 cross each other at the center of the station 600, but are spaced apart in order that their inside surfaces do not engage. Each blade 643 is inwardly beveled toward the opposing blade 643.

With reference to FIGS. 15 and 16, the tie rods 640 connected to the slitter shafts 616 extend downwardly past the conveyor 500 and are connected to a common rod 644 which is attached to a rocker arm 645 pivotally supported by a bracket 646 on the opposite side of the frame. The rocker arm 645 includes a cam follower 647 which rides in a track of an enclosed cam 648 connected to the drive train. The cam 648 thus causes the slitter blades 643 to rotate inwardly from a normally up position, shown in broken lines in FIG. 14, to a down position shown in full lines, and then back to the up position.

Beneath the tray conveyor 500 is centrally mounted, on conventional supporting structure, a pair of cooperative vacuum arms 649, each having a vacuum cup head 650. The arms 649 are pivotally mounted on shafts 651 and are linked together by an intermeshing gear 652 such that pivotal movement of one vacuum arm 649 imparts like pivotal movement to the opposite vacuum arm 649. As shown in FIG. 15, one such shaft 651 extends through the supporting structure and is fitted with a crank 653 which is connected to a tie rod 654 that extends downwardly and is connected to a rocker arm 655 pivotally supported by a bracket 656 on the opposite side of the frame. The rocker arm 655 is equipped with a cam follower 657 which rides in the track of an enclosed cam 658 connected to the drive train.

The vacuum arms 649 are equipped with vacuum tubing that is connected through a Y-fitting to a common vacuum line 659 that leads to a bleeder valve 660 which is mounted on the lower supporting frame as shown in FIGS. 15 and 16. Likewise, vacuum tubing 661 leads from the bleeder valve 660 and is connected to a high pressure vacuum pump (not shown). A flexible reed 662, as seen in FIG. 16, rides on an open cam 663 connected to the drive train to control venting of the valve 660.

Before beginning operation, it is first necessary to adjust the station 600 to accommodate envelopes of a preselected width. Such is easily accomplished by loosening the locking knobs 610 and rotating the hand wheel 604 to move the output set of shafts 607 and 616 and the input set of shafts 609 and 616 either toward or away from each other as desired. The locking knobs can then be retightened to prevent unintended disturbance of the adjustment.

For an operational description, it is first assumed that an envelope is just being advanced to the end slitting station 600 (that is, from the left in FIG. 13). In this situation, the centering fingers 626 and 631 and the slitter blades 643 dwell in an up position above the envelope height in the conveyor tray 501. The envelope to be opened is held between the guide rods 418 in a
vertical position as previously mentioned with its opened top edge oriented upwardly.

As the conveyor tray 501 moves to the right toward the position as shown in FIG. 13, the output centering fingers 631 begin to rotate downwardly in a counterclockwise direction (with respect to FIG. 14) and the leading edge of the envelope is caught in the V-shaped interior of the fingers 631 before the trailing edge of the envelope passes the outer end of the guide rods 418. Once the envelope has moved far enough to the right, and as the movement of the tray 501 stops, the input centering fingers 626 start downwardly and catch the trailing edge of the envelope in the V-shaped interior of the fingers 626. As the centering fingers 626 and 631 further rotate inwardly, the side edges of the envelope are moved deeper into the V-shaped interiors, and thus the envelope is brought to a more precise vertical or perpendicular position in the tray 501. As the fingers 626 and 631 continue to rotate inwardly, the lower edge of the centering arms 624 and 629 abut the edges of the envelope in order to longitudinally center the envelopes in the tray 501.

At this point, the vacuum arms 649, through which a high pressure vacuum is drawn, move upwardly through the central openings 511 in the sloped walls 508 of the tray 501 and come together so that the vacuum cups 650 tightly grip each face of the envelope. The vacuum arms 649 then retract to hold the faces of the envelope open, such as indicated by the broken lines in FIG. 13. The vacuum arms 649 then dwell in this retracted position while the slitter blades 643 move downwardly into the envelope and rupture the side edges such as shown in FIG. 14. When the blades 643 have passed completely through the side edges of the envelope, the envelope is thus opened on three sides and the faces are held together only by the bottom edge. The slitter blades 643 then rotate upwardly to dwell at their original up position.

After the blades 643 are removed, the vacuum arms 649 again come together at the center in order to again grasp the envelope faces, should such grip have become lost during operation of the slitter blades 643. The vacuum arms 649 then separate, carrying the faces of the envelope along therewith, and move back through the openings 511 in the tray 501 to their original position. As the vacuum arms 649 move through the openings 511, the reed 662 opens the bleed valve 660 to release the vacuum in the arms 649, whereby the faces of the envelope are released by the vacuum cups 650. When the vacuum cups 650 are so released, the faces of the envelope are held against the sloped walls 508 of the tray 501 by the vacuum drawn through the slot 516 in the vacuum bar 513 that registers with the longitudinal slot 512 in the tray 501 toward the output side of the station 600.

As previously mentioned, the slitter blades 643 are spaced apart, which not only prevents binding of the blades, but also prevents damage to the envelope contents. In this same connection, it is preferable that the edge of the blades 643 which actually engages the side edge of the envelope be slightly rounded, rather than have a sharp knife edge. Such a construction prevents damage to folded contents. If the blade 643 engages a folded article in the envelope, such as a check, on the folded edge thereof, the article will be carried along on the blade 643 as it ruptures the side edge of the envelope. The folded article will not be damaged, however, because the blade edge is slightly rounded and the article offers no resistance to movement by the blade 643.

It is further noted that the blades 643 have an inwardly sloped edge to prevent binding against the sloped walls 508 of the tray 501. Adjacent the vertical walls 509 are recesses 510 which also eliminate binding of the blades 643 and ensure that the sides of the envelope will be fully opened.

From the end slitting station 600, the envelope and its content are transported in the tray 501 to the sorting area 700.

G. Sorting Area

Past the end slitting station 600, as shown in FIG. 1, is a sorting area 700 that includes a table like working surface 701 through which the conveyor 500 is disposed. The conveyor 500 and working surface 701 may be of varying length, depending upon the size and speed of the machine, as well as the number of employees available for sorting. Two sorting stations 702 are shown across from each other and each includes a set of sorting bins 703. At the end of the conveyor 500, is a waste paper receptacle 704 or other suitable paper disposing facilities.

In operation, one or more operators are positioned at the sorting stations 702. As the conveyor 500 is intermittently advanced, the envelope in each tray 501 is held open by the vacuum drawn through the holes 515 in the vacuum bar 513. Thus, the contents of each envelope are held in individual trays 501 and may be easily removed by the operators. When more than one operator is available for sorting, it may be beneficial to color code the trays so that each operator will know the specific trays for which he is responsible.

The envelope itself may also be removed by the operators if desired. However, if the envelope is not removed, it travels to the end of the conveyor 500, where the vacuum bar 513 ends, and is dumped to the receptacle 704 as the tray 501 moves around the sprocket wheels 503.

H. Drive Train

From the foregoing description, a skilled mechanic is no doubt aware of several gearing, camming and driving arrangements which could be designed in order to achieve the previously stated functions. However, with respect to FIGS. 15 through 17, an operative drive train is illustrated.

Referring then first to FIG. 17, a variable speed motor 801 has an output shaft 802 fitted with a pulley 803. A drive belt 804 is trained around the pulley 803 and around a pulley 805 mounted on the input shaft 806 of a gear box 807. The output shaft 808 is linked through a flexible coupling 809 to the input shaft 810 of a parallel shaft indexing drive 811. Such a drive 811 is commercially available and is marked with U.S. Pat. No. 2,986,949, by Lancaster et al., issued June 6, 1961, entitled "Indexing Cam Structure."

The drive 811 has two output shafts 812 and 813, of which one shaft 812 is continuously rotated and the other shaft 813 is cam operated to intermittently rotate. This latter output shaft 813 is linked through a flexible coupling 814 to a shaft 815 on which a pair of the conveyor sprocket wheels 503 are mounted and
provides the intermittent on-off operation of the conveyor 500. The continuously rotated output shaft 812 is equipped with a sprocket wheel 816 around which is positioned a drive chain 817. The drive chain 817, as shown in FIGS. 15 and 16 is trained around a sprocket wheel 818 connected to the input shaft 819 of a gear housing 820 having two output shafts 821 and 822, both of which rotate in a one-to-one correspondence with the input shaft 819. On the first output shaft 821 is mounted the cam 216 that controls the pick-off arm 203. The second output shaft 822 of the gear housing 820 is linked through a flexible coupling 823 to a central drive shaft 824 on which are mounted the previously described cams 211, 663, 658, 648, 638 and 635. The end of the drive shaft 824 is supported on a bushing 825 connected to the supporting frame.

In operation, rotation of the output shaft 802 of the variable speed motor 801 is imparted through a gear box 807 and drive 811 to both the continuously rotated output shaft 812 and the cam indexing shaft 813 that intermittently rotes the sprocket wheels 503 of the conveyor 500. Rotation of the continuously rotated shaft 812 is imparted through the chain 817 to the input shaft 819 of the gear housing 820 which, in turn, causes its output shafts 821 and 822 to rotate in a one-to-one correspondence and thereby rotate the variable speed motor 801.

Although the operation upon a single envelope has been discussed with respect to each station, it must be understood that the entire apparatus is continuously operated.

In this connection, FIG. 18 depicts the interrelationship of the various cam actuated operations. Each situation illustrated is referenced to one complete revolution of the drive shaft. The solid lines indicate the action performed by the cam. When the solid line corresponds with the broken reference line, a dwell position is indicated. When the solid line moves above the reference line, however, then the previously described action is indicated.

For example, referring to the slitting station 600, it is seen that the action of the opener cups 650 at the first peak (approximately 50° on the scale) illustrates the cups 650 coming together to engage the envelope. The cups 650 then retract slightly and dwell at a retracted position from 80° to 160°. Now, with reference to the slitter 643, it is seen that this action is completed (that is, complete opening of the side edges of the envelope) at approximately 120° on the scale or in the middle of the dwell position of the cups 650 in their semi-retracted position. The opener cups 650 then go back together to again grab the envelope should such grip have become lost during the slitting action, after which the cups 650 return to a fully retracted position at 240° where they dwell through the remaining revolution of the drive shaft.

Therefore, FIG. 18 not only teaches the construction of the cam which operates each member, but also teaches the relationship to the other cams in which that cam must be oriented on the drive shaft in order to achieve a preferred operating system.

From the foregoing, it will be understood that this invention is one well adapted to attain all the ends and objects hereinafter set forth, together with other advantages which are obvious and which are inherent to the invention.

It will be understood that certain features and sub-combinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

Having thus described our invention, we claim:

1. Apparatus for opening an envelope made up of two panels of generally rectangular configuration, means for advancing said envelope from a first station to a second station, means at said first station for forming an aperture along one edge of said envelope, means at said second station for supporting said envelope along its edge opposite to said one edge, means at said second station for separating said panels along said one edge, and breaker means at said second station for entering said envelope through said aperture and for engaging the interior of said envelope adjacent to its other edges to exert oppositely directed breaking forces thereon to separate said panels along three edges of said envelope.

2. Apparatus as in claim 1 in which said advancing means advances said envelope from said second station to a third station and means at said third station for spreading said panels apart fully to expose the contents of the envelope.

3. Apparatus as in claim 1 in which said supporting means supports said envelope in a generally vertical orientation.

4. Apparatus as in claim 1 in which said panel separating means comprises pneumatic means for engaging said panels.

5. Apparatus as in claim 1 in which said breaker means comprises a pair of breaker blades, means mounting said breaker blades for pivotal movement around axes generally perpendicular to said supporting means and means for rotating said breaker blades in opposite directions.

6. Apparatus as in claim 5 in which said breaker blades have dull breaker edges.

7. Apparatus as in claim 1 including means at said second station for centering an envelope at the station.

8. Apparatus as in claim 1 in which said supporting means supports said envelope in a generally vertical position, in which said panel separating means comprises pneumatic means for engaging the outer surfaces of said panels and in which said breaker means comprises a pair of breaker blades, means mounting said breaker blades at said second station for pivotal movement between first positions clear of said envelope and second positions at which said blades enter said envelope and break the envelope at said other edges.

9. Apparatus for facilitating removal of the contents from envelopes each made up of two panels of generally rectangular configuration including in combination, means for supporting a plurality of envelopes in upright position and for conveying said envelopes from an input station to a pick-off station, means for feeding envelopes from said pick-off station through a cutting station to a transfer station, means at said pick-off station for removing envelopes from said supporting means and for delivering said envelopes to said feeding
means, means at said cutting station for forming an aperture along one edge of an envelope passing through said cutting station, intermittently actuated means providing a dwell for carrying envelopes in an erect position from adjacent to said cutting station through a breaker station to a contents removal station, means for transferring envelopes from said cutting station to said carrying means, means at said breaker station adapted to be actuated to separate the panels of an envelope along its aperture, breaker means at said breaker station adapted to be actuated to enter an envelope through its aperture and to engage the interior of said envelope adjacent to its other edges to exert a breaking force thereon to separate the panels of an envelope at said breaker station along three edges of the envelope, and means for actuating said separating means and said breaker means during said dwell.

10. Apparatus as in claim 9 including means at said contents removal station for holding the panels of an envelope at said station apart fully to expose the contents of the envelope.

11. Apparatus as in claim 9 in which said breaker means comprises a pair of breaker blades, means mounting said breaker blades at said breaker station for movement between first positions clear of an envelope at said station and second positions at which said other edges of the envelope are broken by the respective blades.

12. Apparatus as in claim 11 in which said blades have dull edges for engaging the material of an envelope.

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