

April 23, 1968

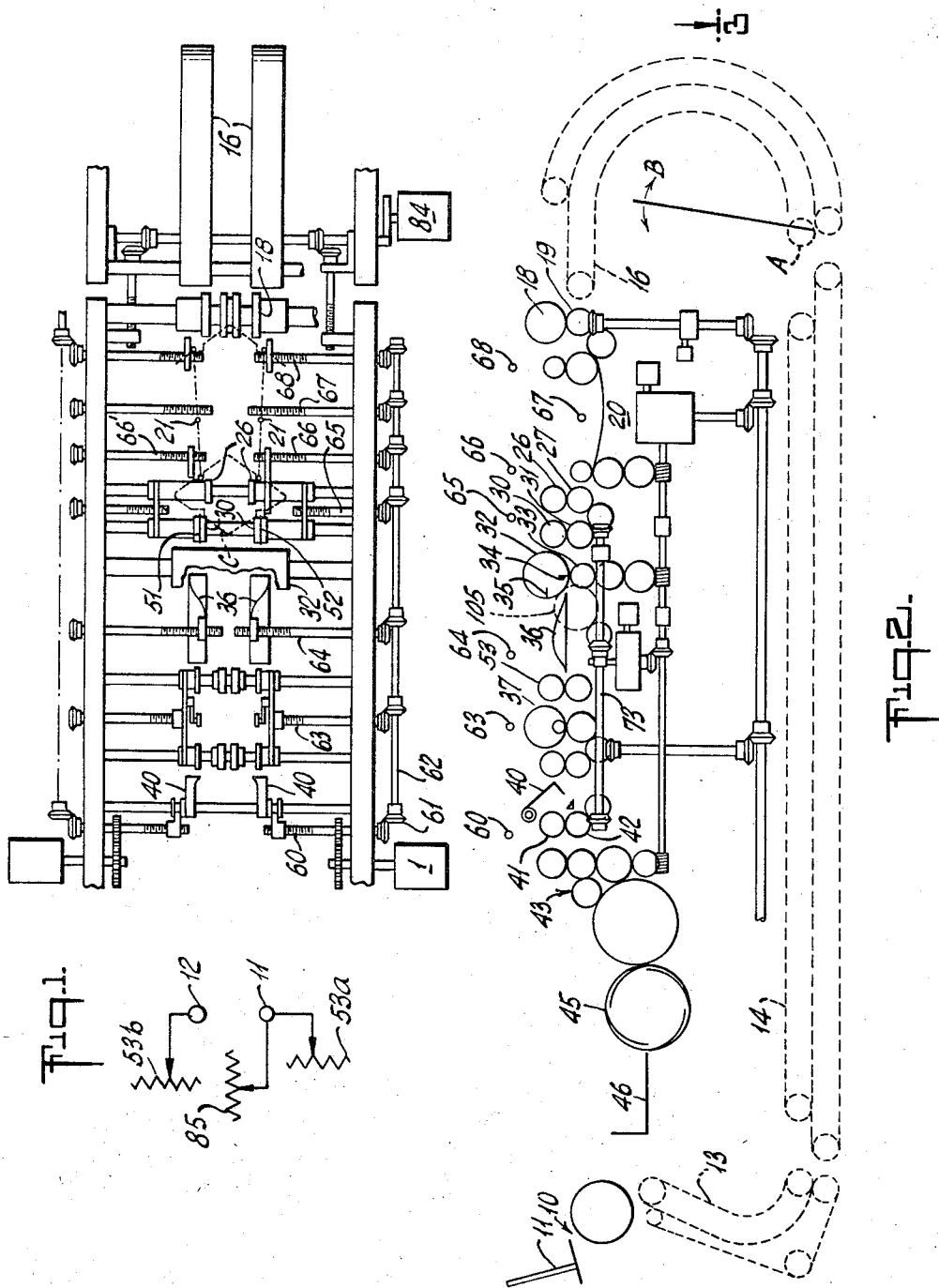
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3,379,103

DEVICE FOR ADJUSTING ENVELOPE-MAKING MACHINE

Filed March 15, 1965

2 Sheets-Sheet 1



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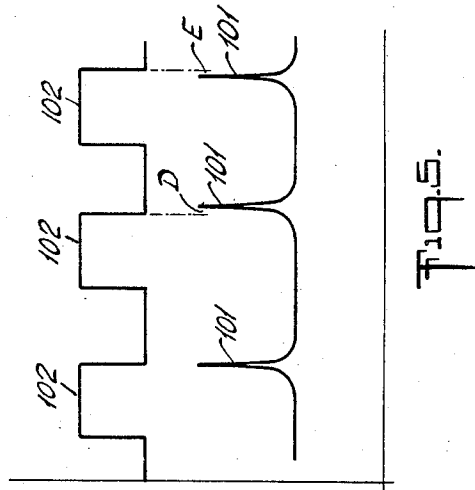
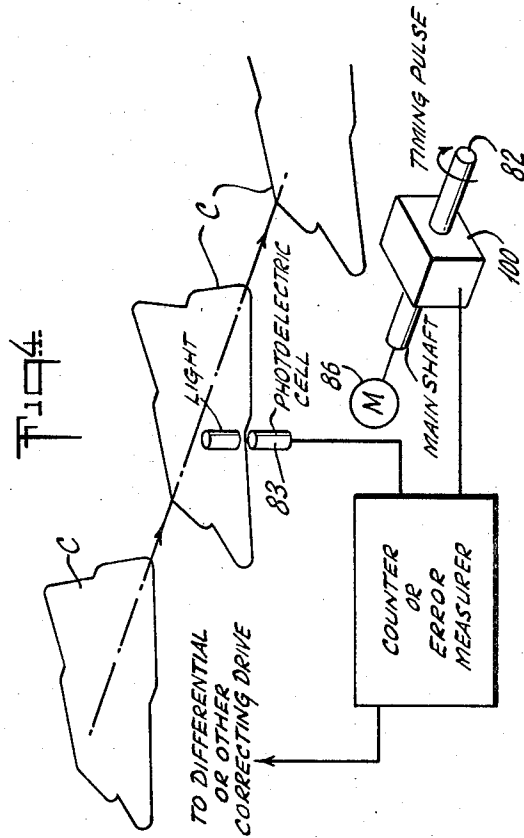
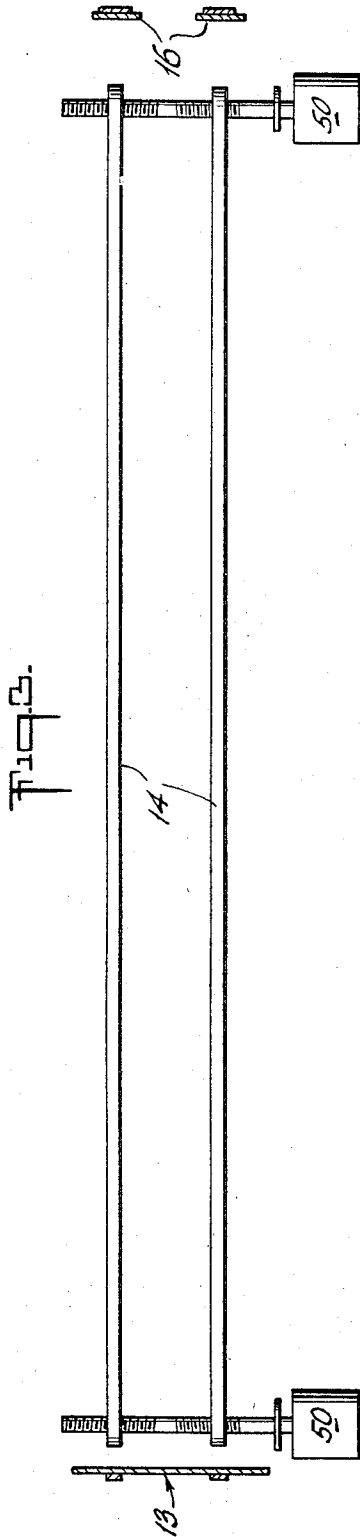
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DEVICE FOR ADJUSTING ENVELOPE-MAKING MACHINE

Filed March 15, 1965

2 Sheets-Sheet 2



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3,379,103

DEVICE FOR ADJUSTING ENVELOPE- MAKING MACHINE

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Filed Mar. 15, 1965, Ser. No. 439,775

21 Claims. (Cl. 93—62)

ABSTRACT OF THE DISCLOSURE

In an envelope-making machine, means are provided for monitoring the movement of blanks therethrough and means are provided for automatically adjusting the position of the mechanisms for creasing, gumming and folding different sizes of envelope blanks. The adjusting means are responsive to electrical signals generated by the monitoring means.

This invention relates to envelope-making machines and has particular reference to modern high speed machines adjustable to crease, gum, and fold different sizes of envelope blanks.

At the present state of the art, it is customary for the operator to set by hand all of the mechanisms which must be set for each envelope size, and, if necessary, change some of the rollers or make adjustments on them. The blanks are then jogged through the machine and further adjustments are made to produce the desired delivered product. The machine is then started and the operator adjusts it to produce the best product it is capable of by further changes in the various settings originally made.

This work requires considerable experience, judgment and skill. One factor which makes the achievement of acceptable quality of envelopes difficult is the variation in the dimensions of the blanks. The blanks are delivered to the machine and are piled on the feeder platform as needed. There is often some variation in the size of the blanks from stack to stack, sufficient to result in unacceptable envelopes. This variation may be very small, but sufficient to make the envelopes unacceptable, and can result from the settings on the blank producing machine, or the moisture content of the paper, or several other factors.

In addition to this, there are adjustments which must be made on the machine as it is running because of variations in the way the blanks travel through the various mechanisms. For example, the refeeder is supposed to deliver blanks in an overlapped array to the pull out mechanism in such a manner that the leading blank is presented as close as possible to a predetermined position, in order that the pull out mechanism may at the right instant grasp it and deliver it to the aligner. However, the feeder and drier deliver the overlapped blanks to the refeeder, and any shifting or unevenness of delivery to the refeeder belts will render the delivery of blanks to the refeeder pull out mechanism inaccurate.

This invention eliminates to a large extent the tedious hand adjustments needed in setting up an envelope machine for a run of a particular size of product. Once the machine is in operation, the machine monitors the blanks passing selected points to make adjustments as required. It is also within the scope of the present invention to provide means whereby the operator can adjust the machine while it is running without disturbing this monitoring function.

It is therefore a primary object of the present invention to provide an envelope-making machine which can

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readily be adjusted for any selected size of product in its range.

It is a further object of the present invention to provide an envelope machine having automatic means for monitoring the blanks as they progress through the machine for making adjustments to relationship of machine parts as required by the product being produced.

It is a further object of the present invention to provide an envelope machine which will adjust itself in accordance with variations in blanks supplied to it, to produce a properly assembled envelope.

Further object and advantages will become apparent as the description proceeds with reference to the drawing form-part of this specification, in which:

FIG. 1 is a largely diagrammatic view looking down upon a preferred embodiment of the present invention;

FIG. 2 is a diagrammatic side view of the machine shown in FIG. 1;

FIG. 3 is a section taking on lines 3—3 of FIG. 2 also largely diagrammatic;

FIG. 4 is a diagrammatic showing of a correcting mechanism; and

FIG. 5 is a diagram illustrating the operation of the device shown in FIG. 4.

In order to describe the present invention intelligibly without too much digression the type of machine taken as an example will now be set forth with its operation.

A platform 10 supports a stack of blanks for utilization by the machine. The platform is supplied with a pair of upstanding posts 11 and 12. These posts are set by the operator to the correct distance apart to engage the corner notches of the selected envelope blank and are also adjusted in the correct position lengthwise of the machine in accordance with the length of the blank in order that the bottom blank be in a correct position relatively to the feeding mechanism. The table is actually composed of a pair of rotating discs of the type shown in U.S. Patent 2,799,497 and the corner posts 11 and 12 form part of the support for the blanks.

Suitable mechanism draws the blanks one by one from the bottom of the stack and arranges them in overlapping array in the feeder belts 13, whence they travel to the drier 14 after having adhesive applied to their seal flaps. It is customary to have the drier chains which convey the envelopes across the drier travel at a slightly higher surface speed than the feeder belts 13, for the purpose of separating the blanks slightly. This separation prevents the blanks from adhering to each other while drying. Such separation decreases the overlap only slightly, leaving the blanks in a deeply overlapped array.

The drier delivers the envelopes to a refeeder 16. The refeeder is essentially a set of belts which deliver the overlapped array of envelopes to the top of machine. A pair of pull out rollers 18, 19 grasps the foremost blank in the array and accelerates it to place it on the aligner 20. The aligner mechanism has travelling pins which engage the corner notches of the blanks and accurately position them with respect to the machine.

As was pointed out above, the blank should arrive at the rollers 18, 19 when the rollers have a certain angular position, that is, at a definite stage in the operational cycle of the machine, a cycle being one revolution of the various mechanisms which operate on the envelope blank.

In order to assure this mode of operation for production involving blanks of different sizes, the entire refeeder 16 is mounted to pivot about the axis A and is movable in the direction of the arrows B to present blanks at the proper instant to the rollers 18, 19.

The aligner 20 has travelling pins or the like 21 engaged by the corner notches of the blanks, and these pins accurately position the blanks both widthwise and lengthwise for passage through the rest of the machine, which takes

the blanks one by one and performs all of the remaining operations thereon. A pair of rollers **26, 27** withdraws the blanks one by one from the aligner for further operation. Inasmuch as the blanks have been accurately positioned in the aligner they are accurately presented to the pull out rollers **26, 27** whence they are fed to the parts of the machine which score, fold, complete and deliver the envelope. Rollers **30, 31** perform the side scoring operation. That is, they produce the creases necessary in order that the side flaps may be folded inwardly. The rollers **32** and **33** perform the top and bottom score. For envelopes of different nominal sizes, the angular relationship between the seal flap score blade **34** and the bottom flap score blade **35** is adjusted by the operator before starting up. The blank is passed over a folding mechanism which folds in the side flap. This folding mechanism has been illustrated as the common plowshare type well known in the art. The blanks are then passed between a series of rollers to a gummer mechanism which applies adhesive to the outside of the side flaps for securing the bottom flap thereto. Any suitable mechanism may be utilized to fold and adhere the bottom flap to the side flaps. In the shown form it is in the form of a lifter and tucker mechanism. The arms **40** reciprocate in such a fashion as to crease the bottom flap and pass it between the two rolls **41** and **42** causing the bottom flap to adhere to the adhesive on the side flaps. The only operation now required is the folding over of the seal flap which is done by a series of rollers generally illustrated at **43** whence the blanks are delivered to a plurality of co-axial rotating discs **45** having spiral notches therein which engage each envelope as it approaches the disc and delivers it to a receiving table **46**.

From the above description, it can be seen that from a purely geometrical point of view, a change from one envelope size to another requires in general adjustments in the machine depending on the width of the product, and other adjustments depending on the length thereof. At the same time, the corner posts must be set to properly support the pile of blanks in the proper position to be removed one by one and delivered in overlapped array to the drier.

In FIG. 1 there are shown somewhat schematically some of the adjustments which are required when changing from one size envelope to another. The width of the envelope, that is, its dimension from side to side (the seal flap being considered at the top of the envelope), requires the side scorer and pull out segments be adjusted. The die portions **51, 52**, on the side scorer **30** are set distance apart determining the width between the score lines. Similarly it is necessary to move the plowshares **36** together and apart for the purpose of correctly folding the now scored blank. Likewise the parts involved in the gumming require widthwise adjustment in order to properly place adhesive on the side flaps the adhesive being applied by the element **53**. The tuckers **40** also require widthwise adjustment in order to properly engage the blank for insertion between the rollers **41** and **42**. The aligner chains also are required to be accurately positioned in order that the envelope be presented properly to the machine. The refeeder belts and also the drier chains are required to be placed in a proper position for envelopes of different widths in order that they properly support the envelope and leave the necessary area for the application of adhesive to the seal flap.

The setting of the feeder belts, refeeder belts and the drier chains is ordinarily not too critical and it is usually not necessary to do more than set them for the nominal width of envelopes being produced. Accordingly, the feeder belt mechanism, drier chain mechanism, and refeeder belt mechanism are provided with widthwise adjustments in the form of left and right handed lead screws, and suitable driving means, illustrated for the drier chains in FIG. 3 as a pair of motors **50** for rotating the lead screws to alter the spacing of the belts and chains. Potentiometers **53a** and **53b** or some such devices as variable transformers is actuated by sideways movement of the posts **11** and **12**

as the posts are set to fit the corner notches in the envelope. By means of any convenient electrical circuitry, the position of the belts and chains is made to correspond with the position of posts **11** and **12**.

The folder mechanisms which must be adjusted for a particular size of envelope can be adjusted in a similar fashion. However, because of the dual function of the width adjustments in the folder, as will appear, it is preferred to utilize separate adjustments for these mechanisms, one on each side. Thus, the potentiometer **52** controls a motor **2**, and potentiometer **52a** controls motor **1**, shown in FIG. 1.

Motor **1** upon rotation changes the widthwise relationship of one of the tucker arms **40** by rotating lead screw **60**. By means of a pair of bevel gears **61** a shaft **62** provided with similar bevel gears along the length of the machine adjust the widthwise adjustments of the machine by means of lead screws **63, 64, 65, 66, 67** and **68**. Motor **1**, therefore, will properly position the parts to receive an envelope blank in proper relationship for side operations which are dependent upon sidewise positioning of the parts.

It was mentioned before that the refeeder carriage must be properly positioned with relation to the pull out rollers **18, 19**. The positioning of the carriage is indirectly controlled by the position of post **11** along the axis of the machine, and will be reverted to later.

It is contemplated to utilize electromagnetic means to determine the position of envelope blanks in various parts of the folding section, and also the dimensions of the blank, to automatically adjust the machine to give a proper product.

For this purpose, the device schematically indicated in FIG. 4 is utilized. If blanks **C** are travelling through the machine at any preselected point, their position can be determined very accurately by means of a photocell or other device actuated by the blank passing over it. If an electric pulse is generated by the machine once for every rotation of its main drive, the coincidence or non-coincidence of the obscuration and the pulse is a measure of the accuracy of position of the blank relative to the machine. Thus, the pulse generator **100** produces pulses **101**, and the passing blanks obscuring the photocell produce the wide pulses **102**. In the figure, the first envelope is correctly positioned, the second arrived too late, and the third too soon. Thus, the space **D** in the diagram indicates a correction should be made in one direction, and the space **E** a correction in the opposite direction.

There are available electrical devices which measure the spaces **D** and **E**, in effect, and operate a servo mechanism to apply the necessary correction. However, it is preferred to utilize an electrical circuit which merely delivers a signal which indicates whether the envelope is ahead of or behind its assigned position. By suitable circuitry, the signals can be counted, and, when the count to one side of correct positioning exceeds a certain value, the counter in turn sends a signal out to a correcting mechanism adjusting the part of the machine being monitored. A suitable device of this kind is a capacitive staircase network, adding voltages or subtracting them according to whether the condition at **D** or **E** exists. It is necessary to limit the response to relatively few pulses, in other words, that the counter have a "short memory," which can easily be done by bleeding down the voltage through a resistor or the like. This type of electrical circuitry is known in the art.

From what has been said, it can be seen that it is not contemplated that the adjusting means actuated by the counter adjust itself for every single blank, but only as the envelope blanks tend one way or the other from the assigned position with relation to the machine.

Reverting now to the refeeder and the corner posts, a pulse generator **100** is provided on the shaft **82** which drives the refeeder pull out rollers **18, 19**. A photo-electric cell at **83** and the pulse generator **100** give a pair of

signals to the counter as shown in FIG. 5. This indicates whether the blanks are arriving at 18, 19 at the proper instant to be delivered by the rollers 18, 19 in proper relation to the aligner. A motor 84 by means of lead screws moves the carriage in response to impulses from the counter.

When the corner post 11 is moved lengthwise of the machine, the potentiometer 85 causes operation of motor 86, which in effect rotates the casing of the pulse generator 100 to the proper position in accordance with the length of the blank (as indicated by the position of the corner post). Then, blanks passing the cell 83 will actuate the motor 84 to move the carriage to the proper position to deliver envelopes to the rollers 18, 19.

After initial set up as in setting-up the machine for a new size of envelope, the potentiometers on the corner posts are deactivated. It might be mentioned at this point that cell 83 is adjusted widthwise by means of a lead screw in order that it be in a proper position to sense the corner notch in the blank.

As was pointed out before there may be variation in the envelope blanks supplied to the machine, for instance the width may vary slightly from the nominal width. It is contemplated in the present invention to provide means which will take care of such variation by making adjustments, for example, by causing rotation of motor 1 or motor 2 or both. Sensors such as photo electric cells or the like are supported on lead screws 66 and 66'. If the sensors are so arranged as to be activated when an envelope blank is in the position shown as in the dot and dash line in FIG. 1 it is possible by the response of the sensors to determine whether or not the blank has the right width and whether or not it is properly centered with respect to the sensors. In order to perform such a function it will be necessary to actuate the sensors at the precise moment when the envelope blanks reach the position shown. Referring to FIG. 2 it will be noted that the rolls 26 and 27 are driven by a shaft 73 by means which will be described later. The envelope approaches rollers 26 and 27 in such position that it is correctly grasped by the rollers and forwarded to the scoring rollers 30, 31. It can thus be seen that all that is necessary in order to make the sensors indicate whether or not the envelope has the correct width and position is to activate these sensors at the precise time in which rollers 26 and 27 should have delivered blank to the position shown. This is done by providing a timing pulse generating means driven by the shaft 73.

It is not contemplated in the present invention to supply a width sensor means which will immediately correct for random widths of the envelope blanks. What is rather desired is a device which will detect deviation of several envelopes before a correction impulse is applied to readjust the machine for such deviation. A common example of a situation in which this would be desirable is one in which the supplying of a new pile of blanks on the feeder table which vary slightly from the blanks already thereon. This may be caused by any number of factors. Accordingly impulses from the sensor supported on shafts 66 and 66' are fed into a counting mechanism but do not activate any correcting rotation of the motors 1 or 2 unless a series of blanks or blanks of above a certain number passes the sensor with an error in one direction.

It will be appreciated that there are certain mechanisms in the folding part of the machine which may require slight adjustment relative to each other in spite of the control of the sensors supported on shafts 66 and 66'. For instance, it may be found desirable in the event of folding heavy stock to have the plowshares in a slightly different position with respect to the scoring rollers than would be desirable in the case of running lighter stock. It is contemplated that this adjustment and similar adjustments are to be accomplished by the operator by means which enable him to adjust the position of the various lead screws independently of the position taken

by the lead screws in response to the rotation of the shaft 62. This can be done with devices such as tangent screws in the shafts including the lead screws or, by any other suitable mechanism the most elaborate of which would probably be a differential in each of the lead screw shafts which can be adjusted by the operator by hand.

The mechanisms so far described relate to the width of the blank, except for the refedder carriage position control. For envelopes of different lengths, the various operations on the envelope relating to the top and bottom flaps must be correctly related. In addition, the blanks must reach the various mechanisms at the proper instant. Briefly, the way this is done in the present machine is by employing a sensor which detects the position of the blank when it is in the position over the sensor 83 shown in FIG. 4, and correcting the operation of the end folders, etc., to assure correct operation. In addition, the length of the blank is measured, and those operations dependent on the length of the envelope are adjusted with respect to each other, by the use of sensors, timing pulse generators, counters and differential gearing responsive to the output of the counters.

Another sensor is provided, properly placed widthwise by lead screw 68 to be activated by the trailing corner notch of the blank as it enters the aligner. A timing pulse generator on the shaft which drives the seal flap scorer 34, the seal flap folder 43 and the delivery mechanism cooperates with the widthwise adjustable sensor to operate a counter, the output of which controls a motor, which drives a differential. A shaft is driven by the main drive of the machine, and, accordingly, the shaft that drives the seal flap scorer is angularly displaced from the main drive shaft in accordance with errors or variations of the blank at the station affecting the widthwise adjustable sensor, assuring that the blank is properly folded. Actually, the most direct effect the differential has is that it makes the aligner chains take the proper position with respect to the widthwise adjustable sensor, but the described result follows as a consequence of the fact that the shaft that drives the seal flap scorer also drives the other mechanisms mentioned.

The bottom score and fold mechanisms are intended to be automatically adjustable. Accordingly, if a single set of rolls is used for both top and bottom fold, as is shown in the drawings, the angular relation between score blades 34 and 35 must be changed for different sized envelopes, as must the bottom flap folding mechanism. This is accomplished by the utilization of a sensor for cooperation with a blank leaving the aligner. Although this sensor is shown as cooperating with a notch at the same time as are the sensors supported on shafts 66 and 66', this, of course, can be true for only the size of blank illustrated. A timing pulse generator is intended to send a pulse when the leading notch reaches the aligner sensor, regardless of the position of the trailing notches.

The pulse generated by the generator, and the signal from the sensor are fed to a counter, as above described, and the output thereof activates a motor, driving a differential. This results in alteration of the position of a shaft relative to the shaft that drives the seal flap scorer, causing the aligner pull out rollers 26, 27 to take a proper relationship with the leading edge of the blanks coming from the aligner, and also the bottom flap folding mechanism 40 is then timed to properly receive the blank. The bottom flap score blade 35 may be driven by the shaft positioned by the differential in any convenient fashion, indicated by the dotted circle 105 as connected by gearing to the shaft. It is quite possible to provide means for adjusting the angular relationship between the score blades by a motor independent of the shaft positioned by the differential.

The above description should make clear the function of the machine shown. It is to be understood that all of the adjustments, or a least some of them, should be capable of manual change by an adjuster, not because the automatic devices are inaccurate or only approximate,

but because in actual manufacture of a wide variety of sizes and substances of envelopes, the relationship between the parts must be varied slightly from what appears to be theoretically correct, as was pointed out in connection with the widthwise adjustments.

I claim:

1. In an envelope-making machine, a platform for supporting a stack of notched envelope blanks, and an adjustable post for engaging corner notches of the stacked blanks, driven means for adjusting the mechanisms in the machine for different widths of envelopes, and means responsive to the position of the posts operating said drive means to adjust the mechanisms in accordance with the position of the posts.

2. In an envelope-making machine, a platform for supporting a stack of notched envelope blanks and an adjustable post for engaging the corner notches of the stacked blanks, adjustable mechanisms for operating on the envelope to score and fold the side flaps of the envelope, and means responsive to the position of the post operative to adjust said mechanisms to a position corresponding to the position of the post.

3. In an envelope-making machine having a platform for supporting a stack of notched envelope blanks and an adjustable post for engaging the corner notches of the stacked blanks, a plurality of feed means for engaging the blanks as they pass through the machine engageable with part only of the widthwise dimension of the blanks, means for moving said feed means to adjust the machine for envelopes of different widths and means responsive to the position of the corner post causing operation of said feed moving means to position said feed means in accordance with the position of the post.

4. The device of claim 3 in which the feed moving means is a lead screw rotated in response to motion of the post.

5. In an envelope-making machine, a platform for supporting the envelope blanks, an adjustable corner post for engaging the notches in the stacked blanks movable lengthwise with respect to the machine to accommodate blanks for envelopes of different lengths, a refeeder for delivering envelopes in overlapped array for removal one by one by a pull out mechanism, means for moving said refeeder to and away from said pull out mechanism, and means responsive to the lengthwise position of the post operative to locate the refeeder in a corresponding position.

6. In an envelope-making machine, a refeeder delivering envelopes to a pair of pull out rollers, said refeeder being movable toward and away from said rollers, a timing signal generator operatively connected to said rollers to generate a signal on each rotation thereof, means for detecting the position of an envelope blank leaving said rollers, at said signal, and means responsive to the detected position of said refeeder in a direction to cause following blanks to be fed in a predetermined position relative to said rollers.

7. In an envelope-making machine, a table for supporting a stack of notched blanks, a post for engaging the corner notches of said blanks, said post being movable in a direction lengthwise of the blanks to accommodate different size blanks, a refeeder for delivering blanks to a pair of cooperating pull out rollers, means for moving said refeeder toward and away from said rollers, a timing signal generator operatively connected to said rollers to generate a signal on each rotation thereof, means for detecting the position of an envelope blank leaving said rollers at said signal, means responsive to the detected position of said blank moving said refeeder in a direction to cause following blanks to be fed in a predetermined position relative to said rollers, and means responsive to the position of the post cooperating with the signal generating means to alter the time of occurrence of the signal as the post is adjusted for different sized blanks.

8. In an envelope-making machine for operating on

notched blanks, means detecting the widthwise position of said notches, a plurality of mechanisms for operating on said blanks adjustable in accordance with the widthwise position of the notches and means responsive to the detecting means operative to adjust said mechanisms into a predetermined widthwise relation to said notches.

9. In an envelope-making machine for operating on notched blanks, means detecting the widthwise position of said notches, a plurality of mechanisms for operating on said blanks adjustable in accordance with the widthwise position of the notches, means generating a signal when a blank is at a predetermined position lengthwise of the machine, and means responsive to the detecting means and the signal to adjust said mechanisms into a predetermined widthwise relation to said notches.

10. In an envelope-making machine operating on notched blanks and having an aligner, leaving the aligner mechanisms for operating on the blanks adjustable in accordance with the widthwise position of the notches, means detecting the widthwise position of said notches as the blank leaves the aligner, and means responsive to the detecting means to adjust said mechanisms into a predetermined widthwise relation to said notches.

11. The device of claim 10 in which the detecting means are activated by radiant energy.

12. The device of claim 10 in which the detecting means is moved by the adjusting means simultaneously with said mechanisms into a predetermined widthwise relation with said notches.

13. In an envelope-making machine for operating on notched blanks having an aligner and a shaft operatively connected thereto and a plurality of mechanisms adapted for widthwise adjustment with respect to said notches, a means on said shaft generating a signal on rotation of said shaft, means detecting the widthwise position of the notches upon generation of the signal, and means responsive to said detecting means and said signal means moving said mechanisms into a predetermined widthwise relation to the notches.

14. In an envelope-making machine for operating on notched blanks, a mechanism for operating on an end flap in a predetermined lengthwise relation to the notches, notch detecting means operative to determine the lengthwise position of the notches relative to the mechanisms, and means responsive to the position of a notch as detected by the detecting means adjusting said mechanism into a predetermined lengthwise relation to said notch.

15. In an envelope-making machine for operating on notched blanks, a mechanism for operating on an end flap in a predetermined lengthwise relation to the notches, notch detecting means operative to determine the position of the notches relative to the mechanism, signal generating means operatively connected to the mechanism, and means responsive to the signal and the detecting means adjusting the mechanism into a predetermined lengthwise relation with the notches.

16. The machine of claim 15 in which a differential operatively connected to the mechanism effects such adjustment.

17. The device of claim 16 in which the differential is between the signal generating means and the mechanism.

18. An envelope-making machine for operating on blanks having lengthwise spaced notched mechanisms for operating on the blank in predetermined relations to the lengthwise position of the notches, means detecting the position of the leading notches, means responsive to the position of the leading notches adjusting the mechanism operating thereon into predetermined lengthwise relation thereto, means detecting the position of the trailing notches, and means responsive to the position of the trailing notches adjusting the mechanism operating thereon into predetermined lengthwise relation thereto.

19. In an envelope-making machine, mechanism for operating on an envelope blank having notches, a shaft rotating once per operation of the mechanism, a second

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shaft rotating once per operation of the mechanism, a differential between said shafts, a generator operatively connected to the second shaft for generating a signal once per revolution of said shaft, means detecting the position of a notch in the blank at the generation of the signal, and means responsive to the signal and detecting means operating the differential to thereby alter the angular relation of said shafts to bring the mechanism into a predetermined relation to the blank.

20. In an envelope-making machine for operating on notched blanks, a detecting means responsive to the notches on blanks passing the detecting means to deliver a different quantity of electrical energy when a notch passes from that delivered when the body passes, a timing means producing a timing signal once for each operation of the machine, means differentiating between the quantities at the occurrence of the signal, means adding or subtracting units of a quantity in accordance with said differentiation, and means responsive to the deviation of the second quantity a predetermined amount from a predetermined value operating an adjusting means in a direction to lessen said deviation.

21. In an envelope-making machine for operating on

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blanks having notches and requiring that the notches be in a predetermined position at a predetermined occurrence in the operation of the machine, a generator creating a signal at that occurrence, a detector means generating a signal upon the presence of a notch on one side of the predetermined position and a different signal upon the presence of the notch at the other side of the predetermined position, a counter mechanism adding quantities upon the occurrence signal if the notch is to one side and subtracting them if it is on the other, means responsive to the deviation of the added and subtracted values from zero by a predetermined amount in a predetermined number of prior occurrences.

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