United States Patent

Lenk

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[45] **Aug. 15, 1972**

[54] **RUNNING FEEDBACK ADJUSTMENT OF ENVELOPE MAKING MACHINES**

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[73] Assignee: **Berkley Machine Company,** Kansas City, Mo.

[22] Filed: **May 24, 1971**

[21] Appl. No.: **146,179**

[52] **U.S. Cl.** .....**93/61 AC,** 271/52, 271/59

[51] **Int. Cl.** **B31b 1/00**

[58] **Field of Search** ..93/61, 61 AC, 62, 8 R; 271/52, 271/59, 41

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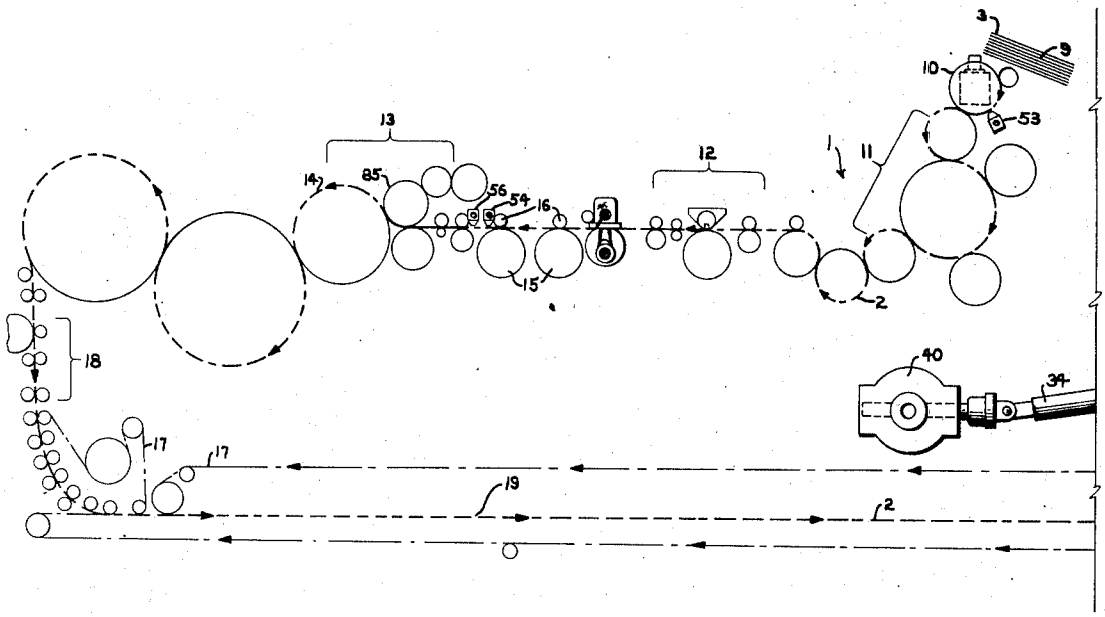
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Primary Examiner—Bernard Stickney
Attorney—Fishburn, Gold and Litman

[57] **ABSTRACT**

The envelope making machine is provided with a multiplicity of envelope blank proximity devices which read the instantaneous position of respective blanks at important locations along the path of travel. Blank position signals are analyzed and, if a discrepancy with desired position appears, adjusting mechanisms located upstream from the sensing devices are actuated to correct succeeding blanks. Among the adjusting mechanisms disclosed are phase shifting differential transmissions connected between the machine drive train and the respective blank advancing members, and correcting drivers which include expandable and steerable driving tires for correcting blank lateral shift, skew and lead errors.

13 Claims, 17 Drawing Figures



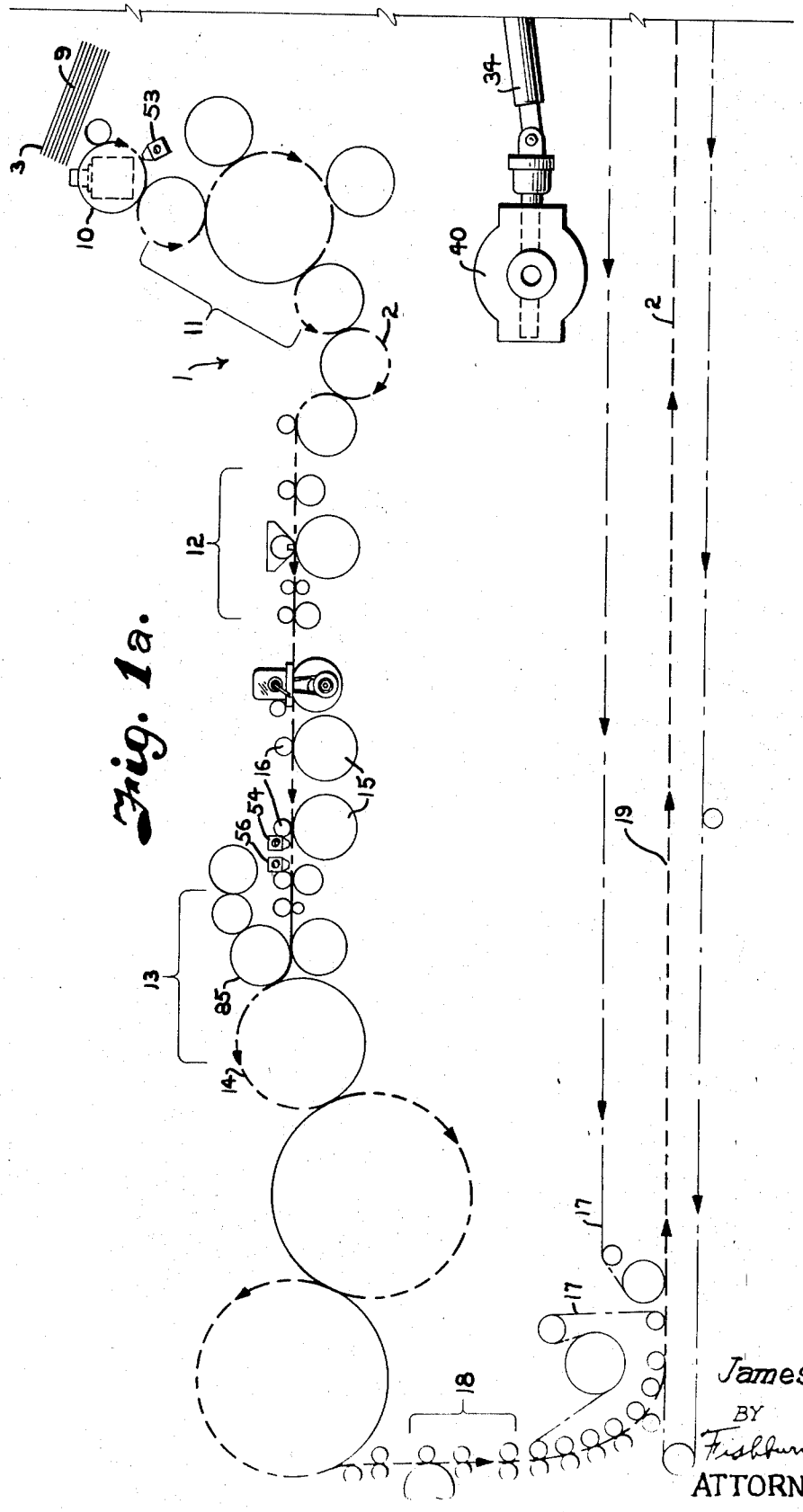
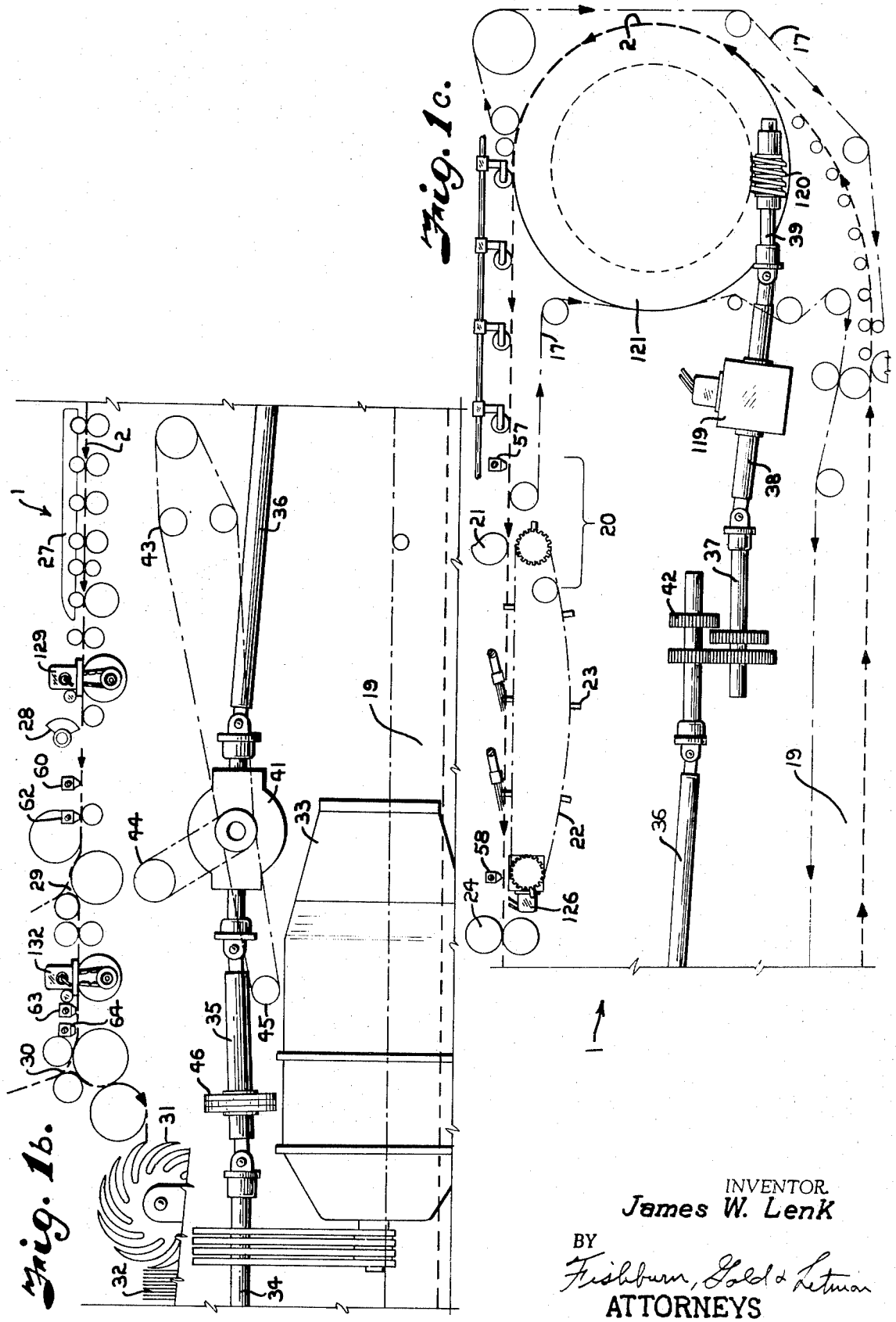


Fig. 1a.

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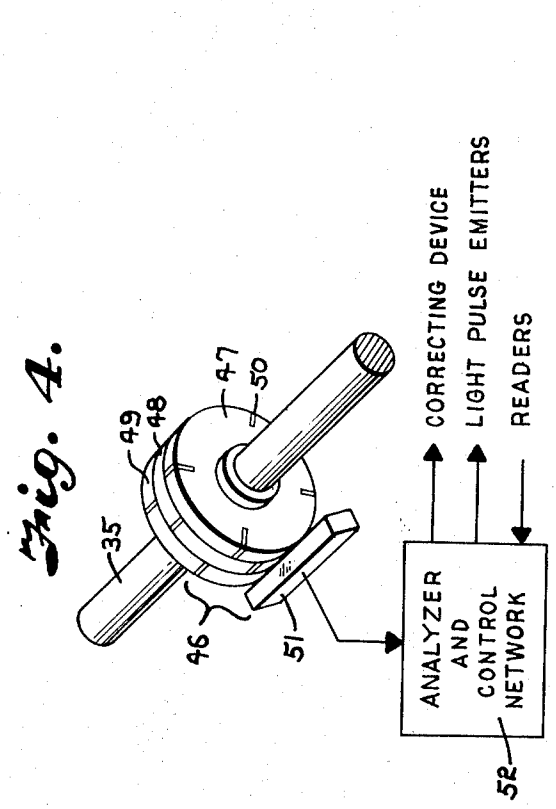


Fig. 4.

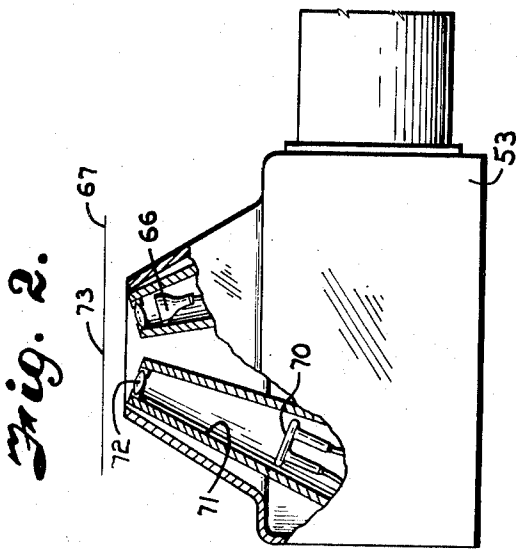


Fig. 2.

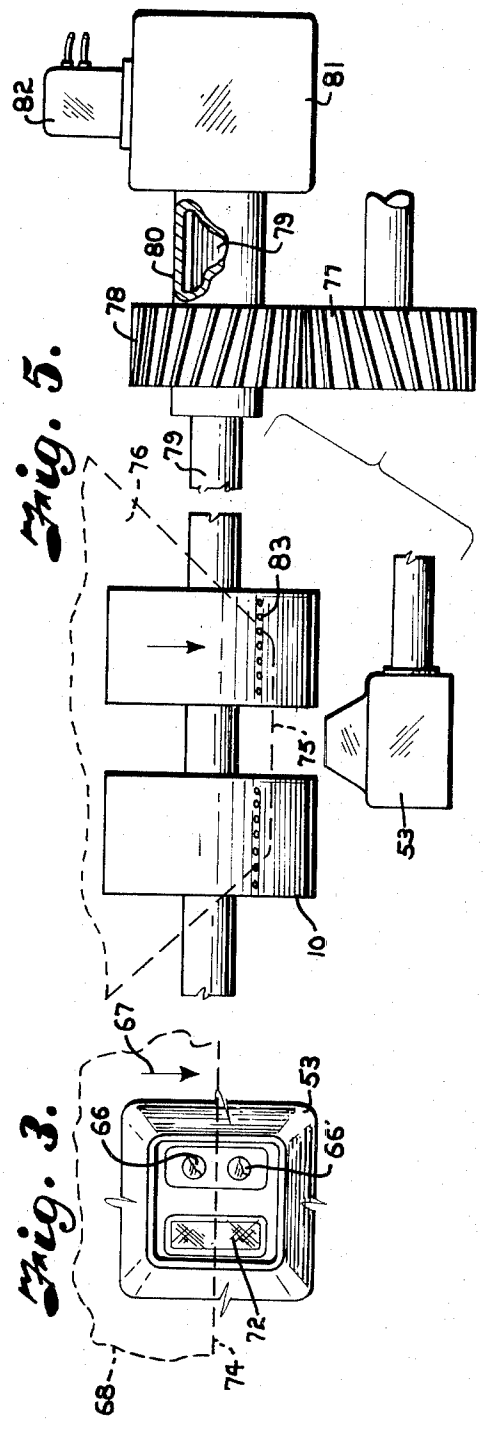


Fig. 5.

Fig. 3.

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Fig. 8.

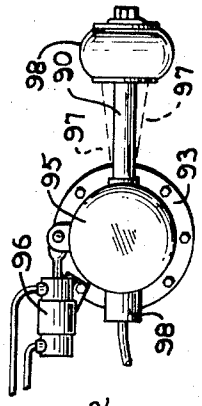


Fig. 11.

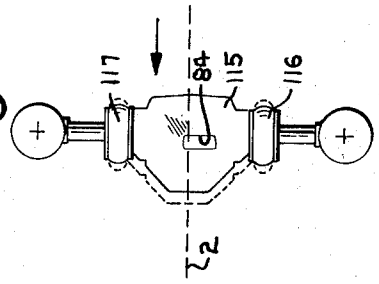


Fig. 7.

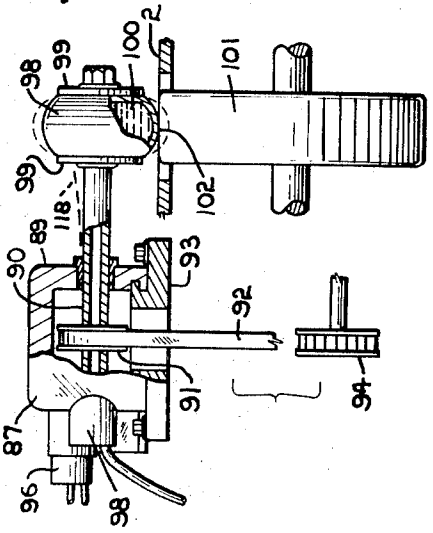


Fig. 10.

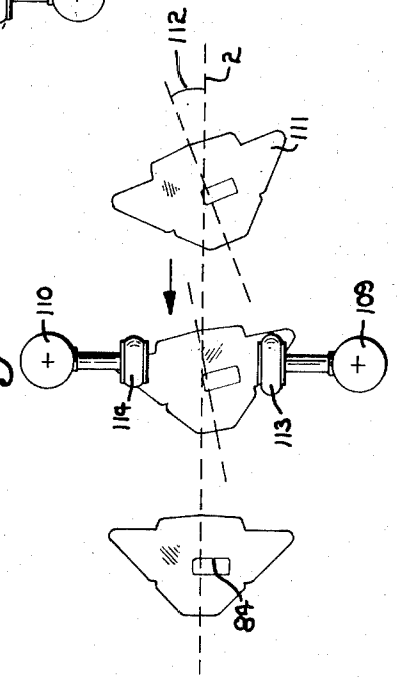


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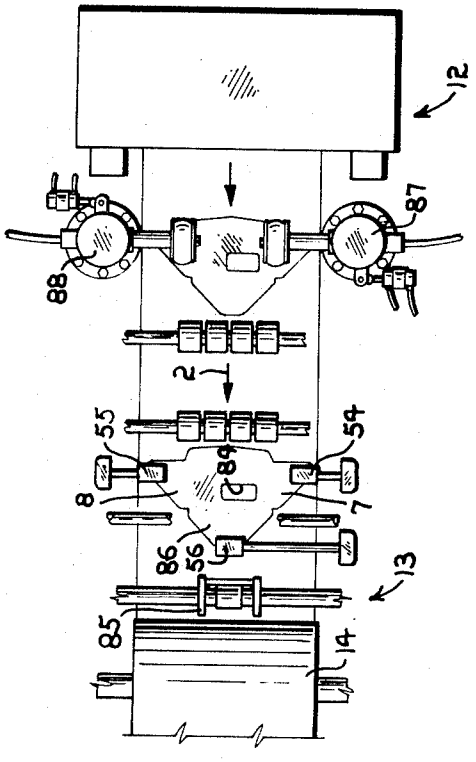
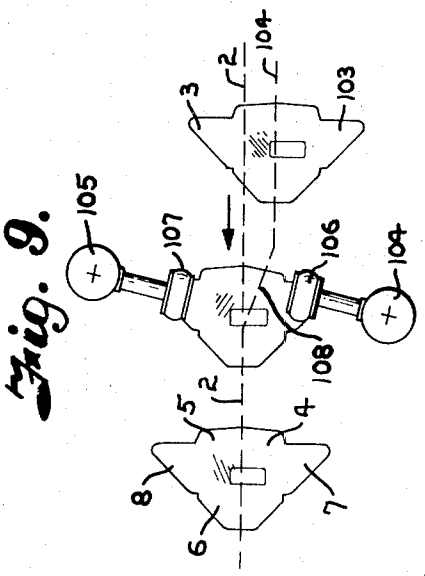


Fig. 9.



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Fig. 15.

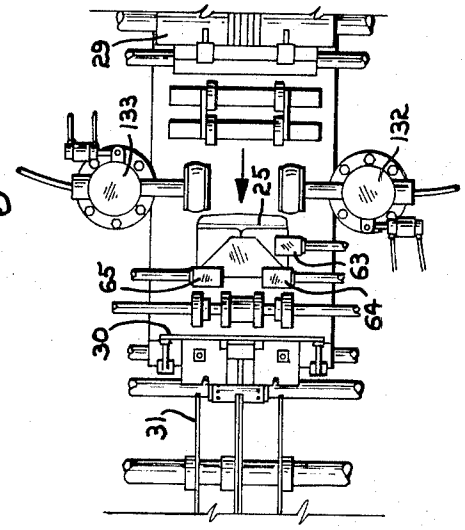


Fig. 13.

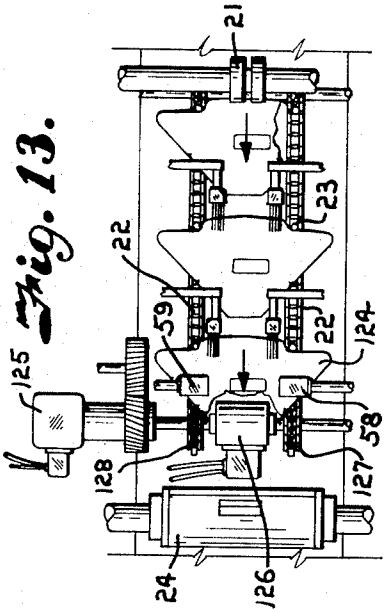


Fig. 14.

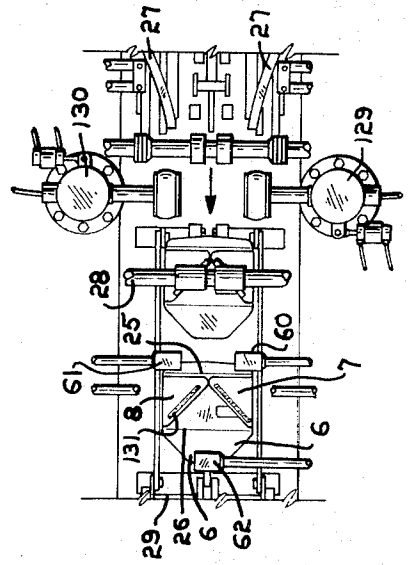
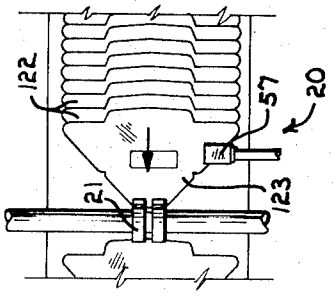


Fig. 12.



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RUNNING FEEDBACK ADJUSTMENT OF ENVELOPE MAKING MACHINES

This invention relates to rotary envelope making machines and more particularly to the adjustment thereof for optimum performance.

In adjusting high speed envelope machines for producing envelopes of different size or style from a previous run, it is necessary to make many adjustments throughout the machine. Basic coarse adjustments must be followed by a much more time consuming fine adjustment procedure during which the machine is "tuned" to perform the necessary operations accurately and repeatedly at high speed over a sustained period. Even though the machine has been finely adjusted, slight variations in envelope blank configuration, environmental temperature and/or humidity conditions, machine wear, the presence of dust, etc. may cause changes in the characteristics of machine driving portions so that the blanks do not follow in the optimum path or in the optimum timed relation intended. Unless corrected, this often results in adverse quality of the finished product, and in certain cases, a complete malfunction of the envelope machine.

In the practice of this invention, the relative positions of individual envelope blanks are monitored during machine operation with respect to both time and aspect at several chosen locations along the operational path of travel and, where excess deviations from an optimum appear, subsequent blanks entering the locations are driven correctively to an extent that proper relative positions are achieved.

The principal objects of the present invention are: to provide envelope making machinery which will produce high quality envelopes with a minimum of attention by skilled mechanics; to provide such apparatus which tends to avoid shutdowns caused by the malpositioning of blanks during machine operation; to provide a system which reduces the necessity for time consuming fine adjustments heretofore necessary in changing envelope size and style; to provide more positive quality control of blanks operated upon within an envelope machine; to provide an automatic adjusting system for envelope machines which is operable for monitoring and adjustment during normal machine runs; and to provide such apparatus adapted for the high speed production of quality envelopes consistently at reduced cost.

Other objects and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawings wherein are set forth by way of illustration and example certain embodiments of this invention.

FIGS. 1*a*, 1*b* and 1*c* taken together show, schematically, the path of travel of envelope blanks through an envelope making machine embodying this invention.

FIG. 2 is a fragmentary plan view showing a typical envelope blank proximity sensing device or reader.

FIG. 3 is a fragmentary front elevational view of the reader with an envelope blank surface, shown in broken lines, in partially covering relation.

FIG. 4 is a fragmentary perspective and schematic representation of a power drive shaft of the envelope machine equipped with a signal pulse producing device which is connected to an analyzer and control network.

FIG. 5 is a fragmentary, schematic view showing the feed cylinder of the envelope machine in association with a phase correcting differential transmission and envelope blank proximity reader.

FIG. 6 is a fragmentary, plan view of the patch gum applying section of the envelope machine incorporating features of this invention.

FIG. 7 is a fragmentary elevational view showing a correcting driver used in pairs for dynamically modifying blank position along the operating path.

FIG. 8 is a plan view showing further details of the correcting driver.

FIG. 9 is a schematic plan view showing a pair of correcting drivers adjusted to correct a lateral shift in the envelope blanks.

FIG. 10 is a schematic plan view showing a pair of correcting drivers adjusted to correct skew in the envelope blanks.

FIG. 11 is a schematic plan view showing a pair of correcting drivers adjusted to alter the relative lead of the envelope blanks.

FIG. 12 is a fragmentary plan view showing the decollating section of the envelope machine with associated proximity reader.

FIG. 13 is a fragmentary plan view showing a scoring section of the envelope machine with proximity readers and phase shifting transmissions.

FIG. 14 is a fragmentary plan view showing the side flap gumming section of the envelope machine with proximity readers and correcting drivers.

FIG. 15 is a fragmentary plan view of the seal flap folding section of the envelope making machine with detectors and correcting drivers.

Referring to the drawings in more detail:

The reference number **1**, FIGS. 1*a*, 1*b* and 1*c*, generally designates by way of example a typical continuously repeating cycle rotary envelope making machine, the general type manufactured by Winkler & Dunnebier, Neuwied am Rhein, West Germany, under the designation W& D 127. The illustrations are schematic in nature, showing by representation features of this invention with known components defining a path of travel **2** for envelope blanks **3**. The envelope blanks **3** selected for illustration are typical, having a central panel **4** with connecting top or seal flap **5**, bottom flap **6**, and side flaps **7** and **8** (FIG. 9). The blanks **3** are withdrawn from the bottom of a feed stack **9** by blank advancing means which includes a rotating, split feed cylinder **10**; however, other blank infeed devices, such as the web roll type (not shown) may also be used.

From the feed cylinder **10** (FIG. 1*a*), the blanks **3** travel in spaced, consecutive order through an inside and outside printing section **11**, through a window cutting station **12** and then to a window gum applying section **13**, a window patch or patches being applied at **14**. At many positions throughout the machine the blanks are urged along the path of travel **2** by means of driven rollers, such as those designated **15**, forming a bight with idler rollers such as those designated **16**. Driven belts **17** carry the blanks from the seal flap gumming section **18**, now in overlapping relation, through a drying tunnel **19** to a decollating section **20** (FIG. 1*c*) where they are again separated from each other by means of a decollating roller **21** (FIGS. **12** and **13**). A drive chain **22** (FIGS. 1*a* and **13**) has spaced pins **23** which individually engage the separated blanks, urging them into a scoring roller **24** where top and bot-

tom scores **25** and **26** (FIG. **14**) are applied. From the scoring roller **24**, the blanks are driven against plows **27** (FIG. **14**) where the side flaps **7** and **8** are folded inwardly over the central panel **4** and gum is applied to the folded side flaps by a gummer **28**. The bottom flap **6** is then folded over the gummed side panels at **29** (FIGS. **14** and **15**) and the seal flap is folded at **30** immediately prior to the blanks entering the teeth of a delivery wheel **31** (FIG. **15**) from which they are delivered as finished envelopes **32** (FIG. **1***b*).

The above noted operating mechanisms, rollers and belts are driven in synchronized relationship by means of a drive motor **33** (FIG. **1***b*) which rotates a complex series of interconnected drive members including shafts **34–39**, transmissions **40–42**, chain and sprocket sets **43–45**, and other conventional power train members both shown and deleted for clarity of illustration.

The description to this point is for background information. In the practice of this invention, a suitable signal pulse producing device **46** is associated, for example, with a selected drive shaft **35** of the envelope machine. The device **46** may consist of one or a plurality of discs **47–49** within which are embedded magnetic slugs **50** in a predetermined angularly spaced relation. As the shaft **35** rotates, the respective slugs **50** travel past a suitable detector **51** whereby pulses are created which are respectively associated with certain angular positions of the drive shaft **35** and, due to the positive drive train, known positions of the respective interconnected operating mechanisms of the envelope machine.

The pulses created in the detector **51** are transmitted to a suitable analyzer and control network **52** which may take the form of a typical computer system in which a memory contains coded information regarding the optimum position of a blank at various points along the path of travel with respect to angular positions of the shaft **35**.

Proximity sensing devices or readers **53–65** are spaced along the path of travel **2** in association with respective operating mechanisms as described further below. The readers **53–65**, a typical example of which is shown in FIGS. **2** and **3**, respectively include a pair of closely spaced light sensing elements **66** and **66'** located generally longitudinally of the path of travel **2** illustrated by the arrow **67** and responsive to reflected light by producing a signal indicating the presence or close proximity of a blank surface **68**. The readers **53–65** include an extremely short duration (e.g., 1 micro-second) light pulse source **70** of the type known as a "stroboscope lamp," one supplier being General Radio Company, West Concord, Massachusetts. The source **70**, upon actuation, produces a light pulse which is directed through a tube **71** and lens **72** toward an apparent position **73** which, if occupied by a blank surface **68**, will produce a reflection for detection by the sensing elements **66** and **66'**.

Referring to FIG. **3**, an edge **74** of the blank surface **68** is shown in a location between the sensing elements **66** and **66'** with the surface covering or adjacent to the sensing element **66** only. Thus, a light pulse emitted by the source **70** will be reflected from the blank surface **68** onto the sensing element **66**, but not the element **66'**, thereby producing a response pattern which definitely locates the blank edge **74** at the instant following the generation of the light pulse by the source **70**.

Referring to FIG. **5**, the reader **53** is shown located near the envelope machine feed cylinder **10** in a position for detecting the leading edge **75** of a blank **76**. The feed cylinder **10** is synchronously driven with the machine drive train, beginning with the drive motor **33** and normally ending with a gear **77** which engages a gear **78** normally secured to the shaft **79** which carries the feed cylinder **10**.

In the practice of this invention, however, the gear **78** may not be directly connected to the gear **79** but, rather, in this example, drives a hollow shaft **80** which forms the input to a phase shifting differential transmission **81**, for example, of the type manufactured by Stratos Division of Fairchild-Hiller, Winston-Salem, North Carolina, under the trade designation SPECON. A remotely controlled phase shifting motor **81**, when actuated, slightly varies the usual 1:1 rotational ratio between the shafts **79** and **80**, thereby slightly changing the relative position of the vacuum ports **83** on the feed cylinder **10** with respect to the drive train of the envelope machine. Thus, the presence or absence of reflected light onto the sensing elements **66** and **66'** provides information regarding the instantaneous position of the blank **76** which may be used to actuate the motor **82**, thereby resulting in the relative advancing or retarding of subsequent blanks. Specifically, a reflection onto both of the sensing elements **66** and **66'** will be taken as a signal to retard the relative position of the feed cylinder **10** and the non-reflection to both the sensing elements constitutes a signal that the relative position of the feed cylinder **10** should be advanced.

After leaving the feed cylinder **10**, the blanks pass through the printing section **11** and window cutting station **12** where, if desired, a window **84** is cut thereinto. Prior to entering beneath the window gum applying cylinder **85**, a blank **86** passes beneath readers **54**, **55** and **56**, which are positioned to monitor the locations of the blank leading edge and selected edges of the respective side flaps **7** and **8**. The reader **56** signals the lead position of the blank along the path of travel **2** (FIG. **6**) and the readers **54** and **55** function to determine skew and/or lateral displacement.

The signal pattern produced by the readers **54**, **55** and **56** is used to control correcting drivers **87** and **88** which are typical of similar devices used along the blank path of travel **2** and comprise an upper housing **89** having a hollow shaft **90** journaled therewithin and projecting into the path of travel **2** (FIG. **7**). A timing pulley **91** is engaged with the shaft **90** and carries a timing belt **92** which is directed axially downwardly through an opening in a housing base **93**. Below the base **93**, the belt **92** engages a drive pulley **94** which is typically operably connected to the drive train of the envelope machine. The upper housing **89** is suitably mounted on the base **93** to permit a degree of rotation about a vertical axis as illustrated in FIG. **7**.

A suitable remotely controlled motion transmitting device, such as an hydraulic cylinder **96** (FIG. **8**), operated by a suitable pump system (not shown) under the direction of the control network **52**, is operably connected between the base **93** and upper housing **89** to produce a steering of the hollow shaft **90** in a horizontal plane as indicated in an exaggerated manner by the broken lines **97** (FIG. **8**). The rear portion of the hollow shaft **90** terminates in a suitable rotating shaft seal **98** operable to permit free rotation of the shaft **90**

while hydraulic fluid or the like may be introduced thereinto without external leakage.

The forward or projecting portion of the shaft **90** terminates in a resilient hollow roller or tire **98** which is restricted against bulging axially of the shaft **90** by rigid plates **99**, but is free to expand and contract radially in external diameter normally of the shaft **90** under variations in internal pressure. Thus, the introduction of hydraulic fluid **100** or the like within the tire **98** through the hollow shaft **90** may be used to control the peripheral velocity of the tire **98** relative to the input speed of the drive train pulley **94** during machine operation.

The correcting driver tires **98** are urged against respective idler rollers **101** producing a bight at **102** for grasping and driving the envelope blanks along the path **2**. By placing correcting drivers **87** and **88** in opposed, facing positions along the path **2** (FIG. **6**) and coordinating the rotation of the respective housings **89** about vertical axes with the diameter of the tires **98** controlled by the hydraulic pressure therein, several types of correction may be simultaneously accomplished.

Referring to FIG. **9**, assuming that the envelope blank **103** is laterally displaced from the desired path **2** along a path **104**, correction is accomplished by moving both correcting drivers **104** and **105** slightly clockwise. While the blank is under the driving influence of the respective tires **106** and **107**, it is shifted along an angular path **108** while the centerline thereof remains parallel to the path of travel. When the conventional driving members take over from the tires **106** and **107**, the blank is advancing in a proper relative position, no longer laterally displaced.

Referring to FIG. **10**, the correcting drivers **109** and **110** are cooperatively operated to correct a blank which is properly centered in the path of travel **2** but skewed at an angle **112**. In this instance, the respective tires **113** and **114** are maintained in axial alignment across the path **2** but the tire **113** is expanded to a size somewhat greater than tire **114**, whereby the portion of the blank **111** which is driven by the tire **113** is accelerated over the opposite portion of the blank, thereby correcting the skew angle as the blank travels past the drivers **109** and **110**.

FIG. **11** illustrates the correction of an error in lead of the blank **115**. In this instance, the tires **116** and **117** are aligned on a common axis extending transversely to the path of travel **2** and are simultaneously equally increased or decreased in diameter depending upon whether an increase or decrease in lead along the path is desired.

It is noted that the shaft **90** of the respective correcting drivers is somewhat flexible, thus permitting the slight bending necessary to accommodate variations in tire diameter against an unyielding idler roller **101**, as noted by the broken lines **118**. It is further noted that multiple corrections in lateral displacement, skew and lead may occur simultaneously through the proper manipulation of the various correcting driver parameters.

Following the sensing and correction occurring between the window cutting station **12** and window gum applying station **13** (FIG. **6**), the blanks, in this example, are not again monitored until they approach the decollating roller **21** (FIGS. **1***c* and **12**). Here, the reader **57** senses only lead of the blanks and the correction for error is accomplished through a phase shifting differential transmission **119** (FIG. **1**c), which is adapted to vary the phase angle between the drive shaft **38** and shaft **39**. The shaft **39** drives, through a worm **120**, a pulley drum **121** about which driven belts **17** are wrapped to deliver the blanks in overlapping condition from the drying tunnel **19** to the decollating roller **21**, as shown as **122** (FIG. **12**). A variation in phase angle between the drive shafts **38** and **39** will vary the position where the decollating roller **121** seizes the leading envelope blank **123**, thus adjusting the position to which the blank is forwarded for proper engagement by the drive chain pins **23** (FIG. **13**).

Due to uneven wear of the drive chains **22** and minor progressive variations between blanks, the pins **23** sometimes do not present the leading blank **124** (FIG. **13**) correctly to the scoring roller **24**. To avoid this, readers **58** and **59** are utilized to sense improper lead and skew of the blanks, lateral shift correction not being particularly important at this point since top and bottom score lines have considerable transverse latitude. Correction for lead and skew is accomplished by using phase shifting differential transmissions **125** and **126** in tandem, that is, transmission **125** is utilized in the manner described in connection with the feed cylinder **10** (FIG. **5**) and the transmission **126** is used to correct the phase as between the driven chain sprockets **127** and **128**.

After passing beneath the scoring roller **24**, the envelope side flaps **7** and **8** are folded inwardly by the plows **27** (FIG. **14**) and pass beneath correcting drivers **129** and **130** under the control of readers **60**, **61** and **62**, which monitor for lateral shift, skew and lead. The readers **60**, **61** and **62** function immediately following the application of gum **131** to the side flaps **7** and **8** by the gummer **28** and immediately prior to the blank bottom flap **6** being folded thereover at **29** (FIGS. **14** and **15**). By this arrangement, succeeding envelopes are corrected in position just prior to side flap gum application and bottom flap folding.

After bottom flap folding, the blanks pass beneath correcting drivers **132** and **133** (FIG. **15**), which are controlled through readers **63**, **64** and **65** positioned immediately upstream from the top or seal flap folding mechanisms at **30**. Here lead and skew are sensed and corrected since slight lateral shift is relatively unimportant. Following seal flap folding, the blanks are directed into the delivery wheel **31** from which they exit as finished envelopes **32** (FIG. **1**b).

In the practice of this invention the downstream sensing and repeated use of feedback for upstream correcting permits a continuous monitoring of blanks and entering of effective correcting adjustments during actual production operation. Suitable signal pulses which are synchronized with the overall operation of the envelope machine are produced by the device **46** (FIG. **4**) to control the reading timing as needed at the various sensing stations along the path of travel **2**. It is not necessary that each blank be sensed at each station, experience dictating which stations require a frequent check and which, for example, require a check only every 1,000 blanks.

It is to be understood that the particular stations for sensing and correcting chosen herein are by way of example only and a greater or fewer number and different positions may be utilized without departing from the scope of this invention. It is to be further understood that while certain specific examples have been illustrated and described herein, this invention is not to be limited except insofar as such limitations are included in the following claims.

What I claim and desire to secure by Letters Patent is:

1. A repeating cycle envelope making machine for continuously producing envelopes from blanks, said machine having blank advancing members defining a path of travel for said blanks and operating mechanisms spaced along said path for successively operating on said blanks and driving means for driving said advancing members and operating mechanisms in synchronized relation, means for adjusting said machine comprising:
   a. signal pulse producing means associated with a portion of said driving means and creating signal pulses related to rotary positions of said driving means,
   b. a plurality of position sensing readers spaced along said path and operably connected to said pulse producing means, said readers being operable upon actuation in response to said signal pulses to produce signals indicating the presence and absence of a blank surface adjacent thereto, and
   c. adjusting means operably associated with said readers and spaced along said path upstream from respective readers and adapted to modify the position thereon of respective blanks in response to predetermined signals from said readers.

2. The envelope making machine as set forth in claim 1 wherein:
   a. said adjusting means includes a remotely controlled phase shifting differential transmission operably connected between said driving means and an operating mechanism.

3. The envelope making machine as set forth in claim 1 wherein:
   a. said adjusting means includes a remotely controlled phase shifting differential transmission operably connected between said driving means and an advancing member.

4. The envelope making machine as set forth in claim 1 wherein:
   a. said adjusting means includes a pair of opposed remotely operable steering devices respectively having a rotating driving member urged against said blanks.

5. The envelope making machine as set forth in claim 4 wherein:
   a. said rotary driving members include tires adapted to expand and contract in peripheral diameter under remote control.

6. The envelope making machine as set forth in claim 1 wherein:
   a. said position sensing readers comprise a pair of spaced apart sensing elements located generally longitudinally of said path.

7. The envelope making machine as set forth in claim 1 wherein:
   a. said position sensing readers comprise a short duration light source directed toward the apparent instantaneous position of a blank surface in said path.

8. The envelope making machine as set forth in claim 1 wherein:
   a. one of said blank advancing members is a rotary feed cylinder, and
   b. at least one of said position sensing readers is located in association with said feed cylinder.

9. The envelope making machine as set forth in claim 1 wherein:
   a. one of said operating mechanisms is a window gum applying member, and
   b. at least one of said position sensing readers is located closely upstream in said path of travel to said window gum applying member.

10. The envelope making machine as set forth in claim 1 wherein:
   a. one of said operating mechanisms is a blank decollating member, and
   b. at least one of said position sensing readers is located closely upstream in said path of travel to said blank decollating member.

11. The envelope making machine as set forth in claim 1 wherein:
   a. one of said operating mechanisms is a flap scoring member, and
   b. at least one of said position sensing readers is located closely upstream in said path of travel to said flap scoring member.

12. The envelope making machine as set forth in claim 1 wherein:
   a. one of said operating mechanisms is a bottom flap folding member, and
   b. at least one of said position sensing readers is located closely upstream in said path of travel to said bottom flap folding member.

13. The envelope making machine as set forth in claim 1 wherein:
   a. one of said operating mechanisms is a top flap folding member, and
   b. at least one of said position sensing readers is located closely upstream in said path of travel to said top flap folding member.

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