Nov. 14, 1961 C. J. PIERCE, JR 3,008,385

FOLDING BOX BLANK FEEDING AND FOLDING DEVICES

Filed March 21, 1960 5 Sheets-Sheet 1

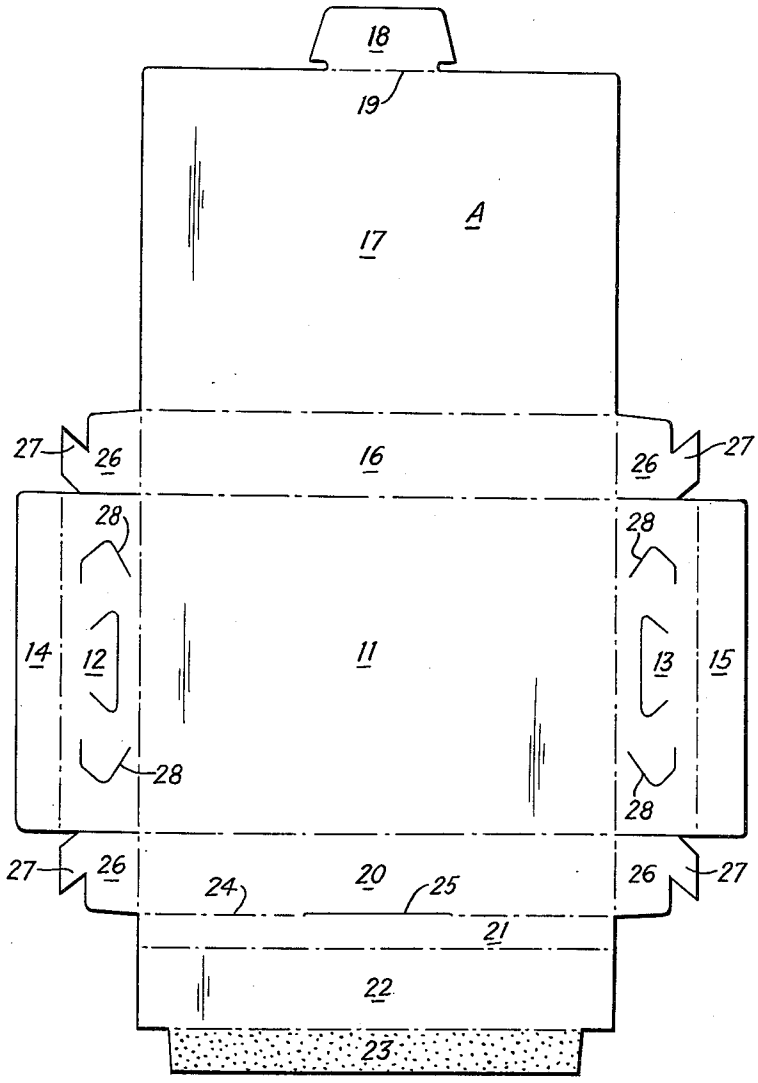


Fig. 1

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Filed March 21, 1960 5 Sheets-Sheet 2

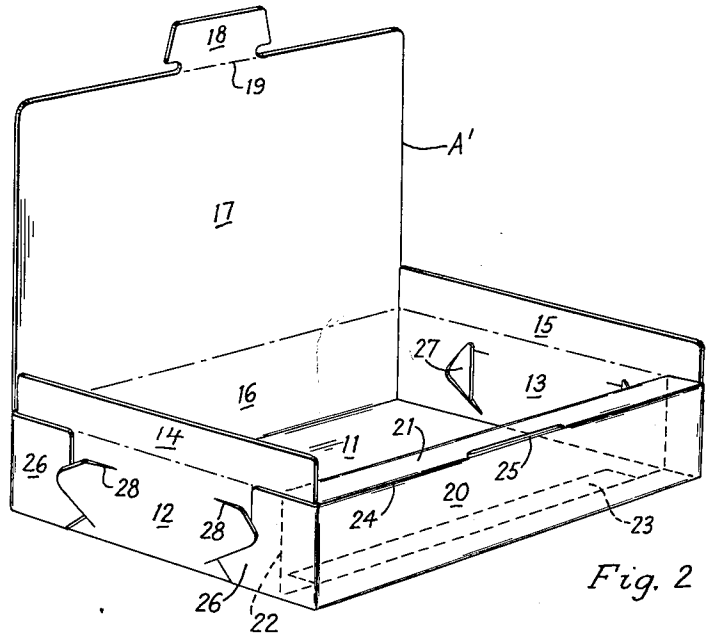


Fig. 2

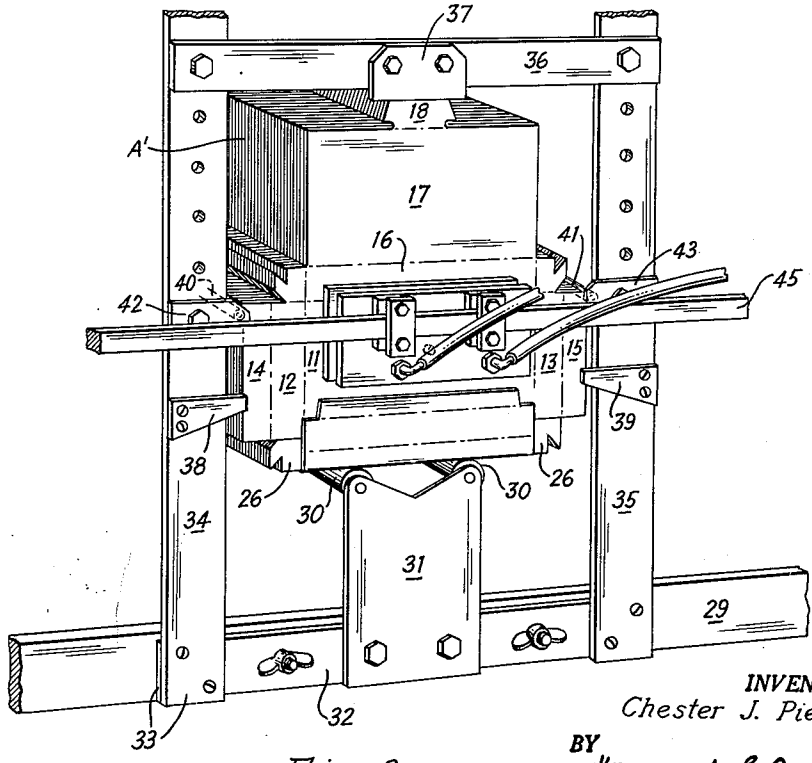


Fig. 3

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FOLDING BOX BLANK FEEDING AND FOLDING DEVICES

Filed March 21, 1960 5 Sheets-Sheet 3

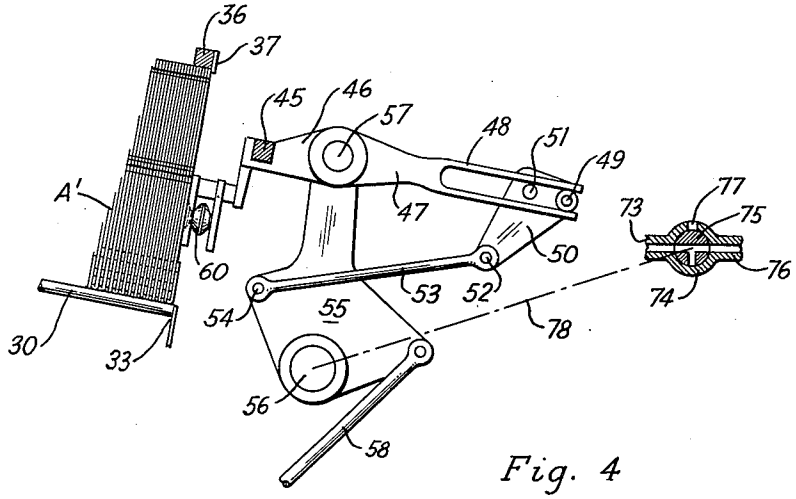


Fig. 4

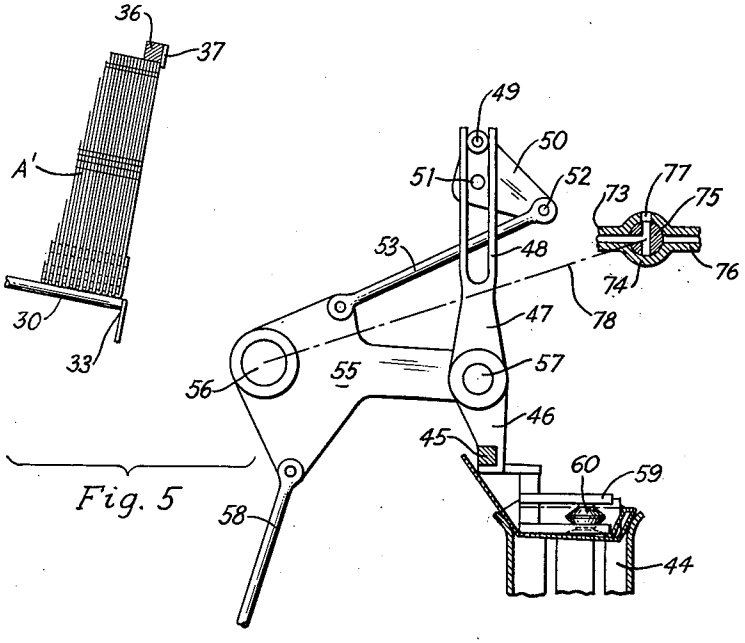


Fig. 5

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FOLDING BOX BLANK FEEDING AND FOLDING DEVICES

Filed March 21, 1960 5 Sheets-Sheet 4

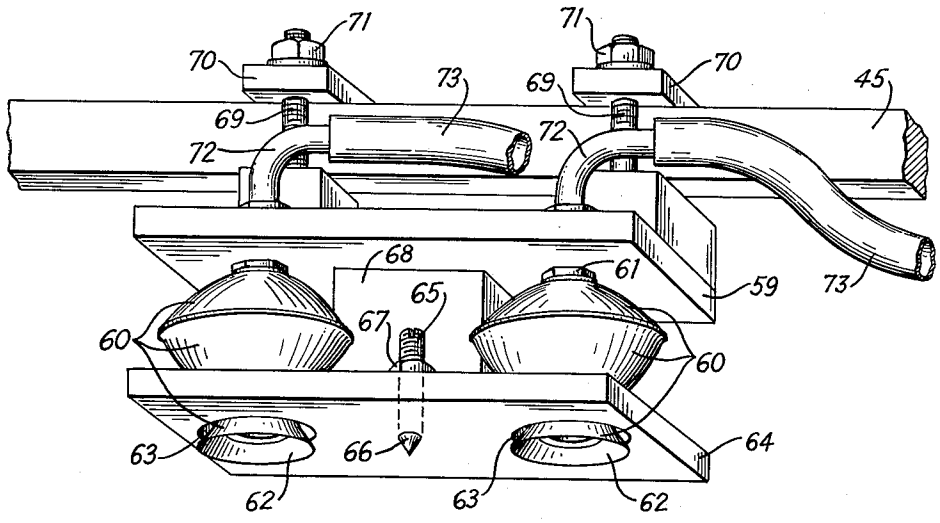


Fig. 7

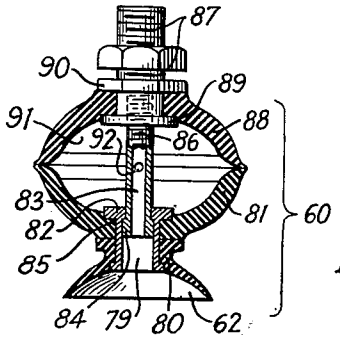


Fig. 6

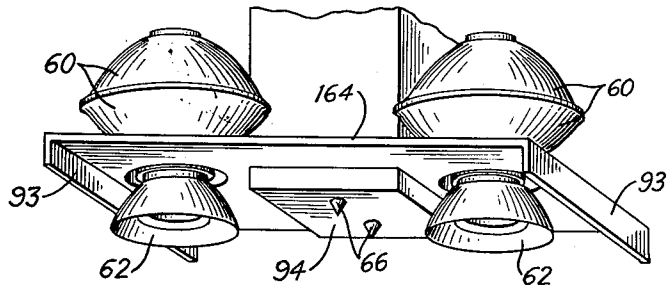


Fig. 8

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FOLDING BOX BLANK FEEDING AND FOLDING DEVICES

Filed March 21, 1960 5 Sheets-Sheet 5

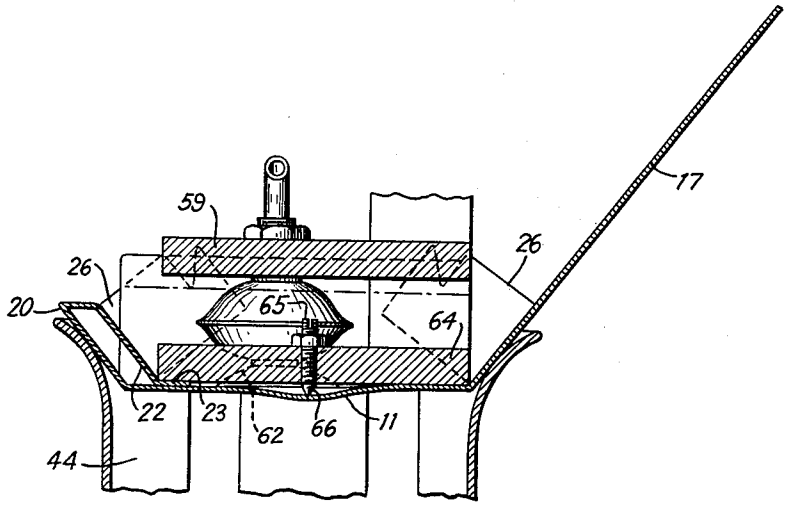


Fig. 9

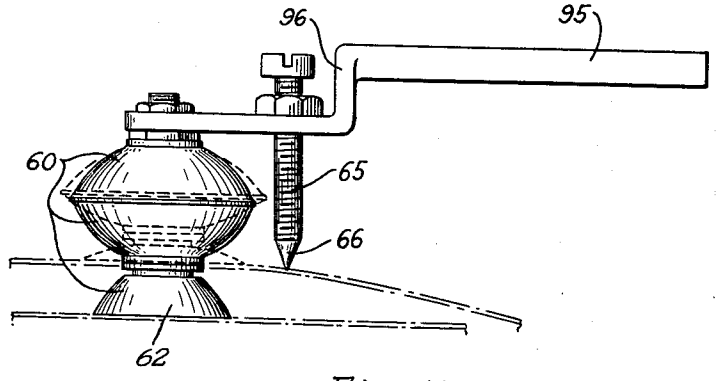


Fig. 10

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Patented Nov. 14, 1961

3,008,385
FOLDING BOX BLANK FEEDING AND FOLDING DEVICES

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Filed Mar. 21, 1960, Ser. No. 16,279
7 Claims. (Cl. 93—51)

This invention relates to improvements in folding box blank feeding devices comprising vacuum cups which remove folding box blanks, one at a time, from a blank magazine and advance the blanks towards the portion of the machine which shapes the box.

A preferred type of box forming machine is the plunger-and-die type in which a plunger engages the box blank and forces it through a die. During passage of the blank into and through the die the various blank panels are folded into the position they assume in the finished box and are then gluelessly interlocked, adhesively attached, or otherwise secured together, so that a completed box emerges from the die.

Machines of the plunger-and-die type offer the advantage of requiring little floor space in relation to their capacity or output, and the invention may be employed with advantage in machines of this type, although the invention offers similar advantages if applied to machines in which an originally flat blank is delivered to a conveyor in partially folded condition for subsequent completion of the assembly at stations along the conveyor.

A blank feeder of the vacuum cup type offers the advantage of dependably removing blanks, one at a time, from the magazine and is in addition capable of performing certain initial folding operations by forcing the flat blank partially into the die mechanism instead of depositing the blank in flat condition above the mouth of the die. For the performance of such initial folding operations the feeder may be fitted with a blank engaging member or members in the form of rails, edges or surfaces supporting the blank adjacent certain fold lines along which the blank is to be folded when it passes into the mouth of the die mechanism.

It is most important to maintain a high degree of accuracy in the delivery of the blank to the die mechanism, since even small deviations from the correct position may result in a misshapen box, or a box whose glueless interlocks fail to engage properly.

In this connection it must be remembered that the high rate at which boxes are formed does not leave time for re-centering the flat blank at the mouth of the die between centering pins, joggers, or the like. Moreover, recentering of the blank would necessitate loss of the prefolding operations by the feeding mechanism which can ill be spared, if the box is of relatively complex construction and the plunger stroke is to be kept within reasonable limits.

Flat blanks can be stacked and held with great accuracy in the magazine for removal from the magazine gate in a precisely defined position. However, vacuum cups are inherently non-rigid and may also permit the blank to slide slightly at the moments of pick-up and delivery.

The purpose of the invention is to maintain a high degree of accuracy during the phases of withdrawal of the blank from the magazine, transport to the die, and insertion of the blank into the die.

A danger of shifting of the blank with respect to the feeder exists during the removal of the blank from the magazine. Shifting may be caused when a blank offers greater-than-normal resistance to removal through the magazine gate, or when blanks adhere together in the stack. Shifting is further promoted by slippery, wax sized, or high gloss blank surfaces.

A tendency of the blank to shift is also present when the vacuum cup grasped blank strikes the mouth of the die mechanism, particularly in instances where the die mechanism or the blank, or both, are not symmetrical, tending to displace the blank away from the folding element of the die first struck by the blank.

The invention provides an improved vacuum-cup type blank feeding device in which the position of the blank in relation to the feeder is fixed immediately upon removal of the blank from the magazine gate. At that moment a sharp pointed element is forced into the blank surface to prevent any shifting of the blank relatively to the feeder. This is accomplished by a relative motion of the blank and the pointed element towards each other. In a preferred manner of carrying out the invention the blank is retracted parallel to itself into a position in which the point is forced into the slightly flexed surface of the blank.

In this specification the term "point" is employed in a broad sense comprising both the point of a pin and the point of a chisel, i.e., a sharp edge.

The various objects, features and advantages of this invention will appear more fully from the detailed description which follows accompanied by drawings showing, for the purpose of illustration, a preferred embodiment of the invention. The invention also resides in certain new and original features of construction and combination of elements hereinafter set forth and claimed.

Although the characteristic features of the invention which are believed to be novel will be particularly pointed out in the claims appended hereto, the invention itself, its objects and advantages, and the manner in which it may be carried out may be better understood by referring to the following description taken in connection with the accompanying drawings forming a part of it in which:

FIG. 1 is a typical box blank, the folding of which presents certain difficulties which are successfully overcome by the invention;

FIG. 2 is a perspective view of a box assembled from the blank of FIG. 1;

FIG. 3 is a perspective view of the magazine and die portions of a folding box assembly machine between which the blank feeder incorporating the invention transports the box blanks;

FIG. 4 is a partially diagrammatic illustration of the feeder in the position in which it removes a blank from the blank magazine;

FIG. 5 is a partially diagrammatic illustration of the feeder in the position in which it inserts the blank into the mouth of a folding die;

FIG. 6 is a vertical cross section through a typical suction cup device combined with a pneumatically operated retracting mechanism;

FIG. 7 is a perspective view of the blank carrying portion of the feeder mechanism;

FIG. 8 is a modified form of a portion of the mechanism of FIG. 7;

FIG. 9 is a side view, partially in section, showing the feeder head supporting a blank during the prefolding operation; and

FIG. 10 is a side view of a preferred form of feeder arm.

In the following description and in the claims various details will be identified by specific names for convenience. The names, however, are intended to be generic in their application. Corresponding reference characters refer to corresponding parts in the several figures of the drawings.

The drawings accompanying, and forming part of, this specification disclose specific details of construction for the purpose of explanation of broader aspects of the invention, but it is understood that structural details may

be modified in various respects without departure from the principles of the invention and that the invention may be incorporated in other structural forms than shown.

The form of blank shown in FIG. 1 was selected to illustrate certain difficulties encountered in the feeding and prefolding of folding box blanks, in that the blank is asymmetrical in the sense that greater resistance to folding of the front wall structure is experienced than at the rear wall, as a result of which there is danger of lateral displacement of the blank with respect to the feeder.

The blank A of FIG. 1 consists of suitable foldable sheet material such as paperboard and comprises a bottom panel **11** to which side panels **12** and **13** are articulated. Dust flaps **14** and **15** extend from the side panels. A rear wall panel **16** extends from the bottom panel and has a cover panel **17** articulated thereto, provided with a tuck tab **18** articulated to the cover panel along a tab fold line **19**.

A series of panels constitute a front wall assembly and comprise an outer front wall panel **20** articulated to the bottom panel, a top wall panel **21**, an inner front wall panel **22**, and a glue lap **23**.

The fold line **24** along which the top wall panel **21** is articulated to the outer front wall panel **20** comprises a slit **25** into which the tuck tab **18** may be inserted in order to close the box formed from the blank A.

Lock tabs **26** extend from the ends of the rear and front wall panels **16** and **20** and are provided with hook portions **27** adapted to engage, and interlock with, appropriately shaped locking cuts **28** in the side panels **12** and **13**.

The blank A first undergoes a preliminary folding and gluing operation. Adhesive is applied to the glue lap **23** and the panels **21**, **22**, **23** are then folded back upon panels **20**, **11** to bring the glue lap **23** into adhesive engagement with the bottom panel **11**. It is readily apparent that subsequent folding of the outer front wall panel **20** into upright position with respect to the bottom panel automatically results in the formation of a hollow double walled front wall structure.

FIG. 2 shows the assembled carton A′ after assembly, but prior to filling and closing. Formation of the box involves folding of the wall panels into upright position with respect to the bottom panel and insertion of the hook portions **27** of the lock tabs into the locking cuts in order to interlock the four box corners. It is also readily seen that erection of the hollow front wall assembly involves folding of the stock at four fold lines, whereas folding of the rear wall panel **16** into upright position involves folding of the board along only one fold line. If the folding is accomplished by insertion of the blank between appropriately shaped curved folding elements of the forming die, there is danger of displacing the blank towards the back, as a consequence of which malformation of the box may result, or the corner locks may fail to engage.

FIG. 3 illustrates certain portions of a box forming machine of the plunger and die type which are essential for an understanding of this invention. At the upper portion of the figure a blank magazine is shown, mounted on a transversely extending structural member **29** of the box forming machine. A stack of blanks A′ rests edgewise on a pair of supporting rods **30** supported by a bracket **31** secured to a horizontal bottom rail **32** of the magazine gate **33**. Two lateral gate rails **34** and **35** extend outwardly from the bottom rail **32** and are joined by a horizontal top rail **36** carrying a stack retaining plate or lip **37** slightly overlapping the tuck tab **18** of the frontmost blank so as to prevent the blank from falling out of the gates. Similar stack retaining plates or lips **38** and **39** are secured to the lateral rails **34** and **35** and overlap the dust flaps **14** and **15** slightly. Lateral blank aligning rods **40** and **41** are supported on the magazine gate by brackets **42** and **43**.

The magazine gate **33** is normally slightly inclined with respect to the vertical in the sense that its top rail **36** is slightly forward of the bottom rail **32**, as is also indicated in FIGS. 4 and 5. The rods **30**, **40** and **41** locate the blanks accurately with respect to the magazine gate and to the remainder of the machine, so that a positively acting feeding mechanism with respect to which the blank is not permitted to shift will eliminate the need for subsequent realignment of a blank with respect to the box forming mechanisms, more particularly the die **44** shown in the lower portion of FIG. 3.

In accordance with accepted practice, the blanks are withdrawn one at a time from the magazine gate, advanced to the die **44** and then forced through the die by an appropriately constructed plunger which causes the box corners to interlock in a manner well known in the art.

Inasmuch as the construction and the operation of the plunger are not essential to an understanding of the invention, the plunger is not shown in any of the drawings.

The feeding mechanism comprises a transverse feeder bar **45** moved by an appropriately constructed mechanism to travel back and forth between the magazine gate and the die along a somewhat complex motion having essentially three phases.

During a first phase a blank is withdrawn from the stack by a motion substantially parallel to itself. During this phase the danger of sliding of the blank relatively to the cups exists, particularly if increased resistance to withdrawal through the magazine gate is experienced. Such resistance may exist at one or several of the blank retaining lips of the magazine gate, or as a result of slight interlocking of the blanks in the stack at tabs, cuts, etc., or by reason of wax coated blanks adhering to one another. Sliding may also result from great smoothness of a highly finished, for example, glossy blank surface.

During the second phase of the motion the blank is moved along an arcuate path so as to bring it from the substantially vertical position it occupied in the magazine into a substantially horizontal position above the die.

A third and final motion moves the blank parallel to itself into the mouth of the die where it is released by the feeder which then returns to the magazine gate to pick up the next blank.

During the return motion of the feeder the plunger moves the blank through the die and causes the corners of the box to be interlocked, whereafter the box is then ejected from the bottom of the die.

The geometry of the feeder mechanism is best explained by referring to FIGS. 4 and 5. The feeder bar **45** is secured to one arm **46** of a double armed lever **47** whose other arm **48** is forked to provide for sliding as well as pivoting engagement with a roller **49**. The roller **49** is mounted on a bell crank **50** pivotally mounted on the machine about a pivot **51**. The bell crank further carries a link pin **52** from which a connecting rod **53** extends to a link pin **54** of a main lever **55**. The main lever is pivotally mounted on the machine about a pivot **56** and supports the double armed lever **47** about a supporting pivot **57**. An actuating rod **58** leading to an oscillating arm, or a crank, of the machine mechanism (not shown) swings the main lever through an arc of approximately 90 degrees from the position shown in FIG. 4 into the position shown in FIG. 5.

The described feeder mechanism and particulars of the path traversed by the feeder bar is described in considerable detail in the prior patent of Lefief, No. 2,805,060, dated September 3, 1957.

The portion of the feeder which grasps the box blank is shown in greater detail in FIG. 7. The feeder head is mounted on the feeder bar **45** and comprises a mounting plate **59** to which two projectible and retractable vacuum cup devices **60** are secured at **61**. The mouths **62** of the devices **60** extend through holes **53** in a plate **64** which, in the illustrated form of feeder head, constitutes a box

blank supporting member adapted to guide the folding of the blank along certain fold lines.

A screw 65 provided with a sharp point 66 extends through the plate 64 and is held by a lock nut 67 in its properly adjusted position in which the point 66 projects below the bottom surface of the plate 64. The bottom plate 64 is spaced from the mounting plate 59 by a block 68. The feeder head assembly is secured to the transverse bar by bolts 69, clamping plates 70 and nuts 71.

L-fittings 72 and vacuum lines 73 lead to a control valve 74 (FIGS. 4 and 5) whose valve member 75 in the position shown in FIG. 4 establishes communication with a vacuum line 76 leading to a pump (not shown) and in the position shown in FIG. 5 vents the line 73 to the atmosphere through a vent port 77. The dash dot line 78 indicates connection of the valve member with an element oscillating through an arc of 90 degrees during operation of the machine. In the position shown in FIG. 4 the valve 74 applies vacuum to the cups in order to pick up a blank, and in the position shown in FIG. 5 the cups are vented to release the blank.

The vacuum cups 62 proper are provided with servo-means for projecting and retracting them. A particularly simple and preferred form of servo mechanism is shown in FIG. 6.

The vacuum cup 62 is mounted on a metal bushing 79 having a bottom flange 80. A second cup 81 is mounted on the bushing 79 and faces in the opposite direction. The cup 81 is held in place by a top flange 82 of the bushing 79. The bushing 79 is slidable on a hollow central stem 83 having an enlarged head 84 bearing against an internal shoulder 85 on the head 84, thereby limiting the forward movement of the cup 62.

The threaded end 86 of the stem 83 is screwed into a hollow nipple 87 on which a further cup 88 is seated between flanges 89 and 90 and lies face to face with the rim of the cup 81. A chamber 91 is thus formed by cups 81 and 88 communicating with the interior of the nipple 87 through a hole 92 in the nipple 87, the nipple being in communication with the L 72 and the vacuum line 73.

When a blank attaches itself to the cup 62, the pressure inside the cup chamber 91 drops and the cups 81, 88 collapse to a certain degree thereby retracting the blank grasping cup 62. The movement of the cup 62 is guided by the bushing 79 sliding on the stem 83. The retracting motion continues until the top flange 82 of the bushing 79 strikes the flange 89 of the nipple.

The cups 62, 81 and 88 may be made of natural or synthetic rubber. The resiliency of the cup material causes the cups to return to the normal extended position, when the pressure inside the chamber 91 is made equal to the surrounding atmospheric pressure by venting the line 73 at the valve 74.

FIG. 9 shows the feeder head at the moment of entry of the blank into the folding die 44. The vacuum cups 62 draw the blank flat against the bottom of the plate 64 except at the point 66 of the pin 65 where the blank bulges out slightly. The point 66 digging into the surface of the blank prevents shifting of the blank parallel to itself when the blank enters the die. It is readily seen that a tendency to shift to the right exists, due to the greater resistance of the blank to folding at the left where four fold lines are involved than at the right where the blank is only folded at one fold line.

The bottom edges of the plate 64 control the folding by supporting the blank up to the crease lines along which the blank is to fold.

In FIG. 8 a modified form of feeder head is shown in which the blank supporting plate 164 is fitted with folding rules on edges 93 and a central supporting surface 94 through which points 66 project.

FIG. 10 shows a preferred form of feeder arm adapted to be mounted on the transverse feeder bar. The arm 95 is offset at 96 and carries the retractable vacuum cup assembly 60, 62. A screw 65 pointed at 66 extends through the offset and is readily adjustable in length with respect to the cup assembly. The point 66 digs into the blank surface and prevents not only shifting but also turning of the blank with respect to the vacuum cup 62 in the event only one cup is used, as may be desirable in handling small blanks.

What is claimed is:

1. A folding box blank handling device comprising, in combination, a magazine; a folding die means; a carrier; means for moving the carrier back and forth to pick up a blank at said magazine and deposit said blank at said folding die means; a suction cup mounted on said carrier, said cup having a blank grasping mouth and being retractible upon application of vacuum thereto; means for periodically applying vacuum to said cup; and a sharp pointed blank engaging element mounted on said carrier in a position in which the sharp point lies behind the plane of the mouth of the extended cup, but in front of the plane of the mouth of the retracted cup, so as to force the point into the surface of the blank held by the retracted cup and fix the blank against lateral displacement.

2. A pneumatic feeder head for box blanks comprising, a supporting member adapted to engage and support the box blank adjacent predetermined fold lines preparatory to folding of the blank at said fold lines by forcible insertion of the blank into a die device; a suction cup having a blank grasping mouth and being mounted in a position in which the mouth is in advance of the said member; means for retracting the cup into a position in which the mouth is retracted at least to a position flush with said member; and a sharp pointed blank engaging element mounted in a position in which its point lies behind the plane of the mouth of the extended cup, but in front of the plane of the retracted cup, so as to force the point into the surface of the blank held by the retracted cup to fix the blank against lateral displacement.

3. A pneumatic feeder head for box blanks comprising, a supporting member adapted to engage and back up the box blank adjacent certain fold lines preparatory to folding the blank at said fold lines by forcible insertion of the blank into a die device; a pair of suction cups, each cup having a blank grasping mouth and being mounted in a position in which the mouth is in advance of said member; means for retracting said cups into a position in which the mouth is retracted at least to a position flush with said member; and a sharp pointed blank engaging element mounted between said cups in a position in which its point lies behind the plane of the mouth of the extended cups but in front of the plane of the mouth of the retracted cups, so as to force the point into the surface of the blank held by the retracted cups to fix the blank against lateral displacement.

4. In a folding box blank shaping assembly comprising a die device, the combination of a blank supporting member adapted to engage and back up the box blank adjacent certain fold lines preparatory to folding the blank at said fold lines by forcible insertion of the blank into a die device by said head; a suction cup having a blank grasping mouth, said cup being mounted on said member in a position in which the mouth lies in advance of said member; means for applying vacuum to said cup; a sharp pointed blank engaging element mounted in a position in which its point lies behind the plane of the mouth; and means responsive to the presence of vacuum at said cup for retracting said cup mouth into a position behind said point, whereby the point is forced into the surface of the blank held by the mouth to prevent shifting of the blank relatively to said member.

5. A mechanism for feeding and prefolding box blanks, the mechanism comprising a die device; a blank supporting member adapted to engage and back up a box blank overlying the member adjacent certain fold lines preparatory to folding the blank at said fold lines by forcible insertion of the blank by said member into the die device; a pair of suction cups, each cup having a blank grasping

mouth and being mounted in a position in which the mouth lies in advance of said member; means for periodically applying vacuum to said cups; a sharp pointed blank-engaging element mounted in a position in which the point lies behind the plane of the mouth, but in advance of the blank engaging plane of said member; means responsive to the presence of vacuum at said cups for retracting said cups into a position in which their mouths lie behind said point to force the point into the surface of a blank held by said cups; and means for periodically reciprocating said member with respect to said die device.

6. A folding box blank feeding device comprising, in combination, a carrier; means for moving the carrier back and forth between a first blank pick-up station and a second blank deposit station; a pair of suction cups mounted on said carrier, each cup having a blank grasping mouth and being contractible upon application of vacuum thereto; means timed with said back and forth motion for periodically applying vacuum to said cups; and a sharp pointed blank engaging element mounted on said carrier in a position in which the sharp point lies behind the plane of the mouths of the extended but in front of the plane of the mouths of the contracted cups, so as to force the point into the surface of the blank upon application of vacuum.

7. A folding box blank feeding device comprising, in combination, a carrier; means for moving the carrier back and forth between a first blank pick-up station and a second blank deposit station; a suction cup element mounted on said carrier and having a blank grasping mouth; means for periodically applying vacuum to said cup element; a sharp pointed blank engaging element mounted on said carrier; and means for periodically adjusting the relative position of said elements from one position in which the mouth lies in advance of said point into a second position in which the mouth lies behind said point in which second position the point is forced into engagement with the surface of a cup-held blank.

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2,406,766	Harrold	Sept. 3, 1946
2,805,060	Lefief	Sept. 3, 1957