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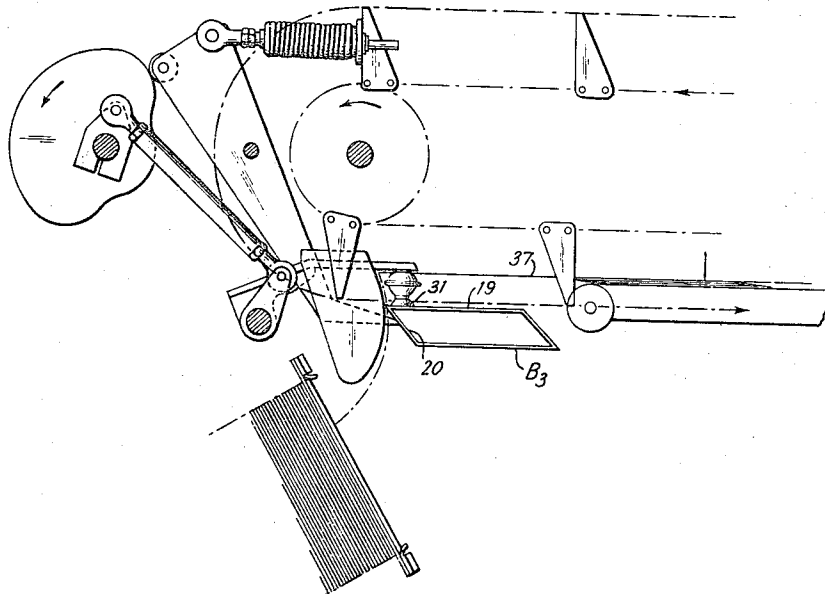
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[54] **DEVICE FOR EXPANDING AND REVERSE-COLLAPSING TUBULAR FOLDING BOX BLANKS**
8 Claims, 7 Drawing Figs.

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 [51] Int. Cl. B31b 1/76
 [50] Field of Search 93/53,
 530(R), 53(PSD)

ABSTRACT: In a device of the type in which a vacuum cup drags a flat collapsed tubular folding box blank over the face of a cam in order to expand the blank prior to deposit of the blank on a conveyor, a finger element engages the side of the expanded blank and reverse-collapses it. The conveyor receives the blank in reverse-collapsed condition. The resistance to folding of all box-edge-forming creases is thus equalized.



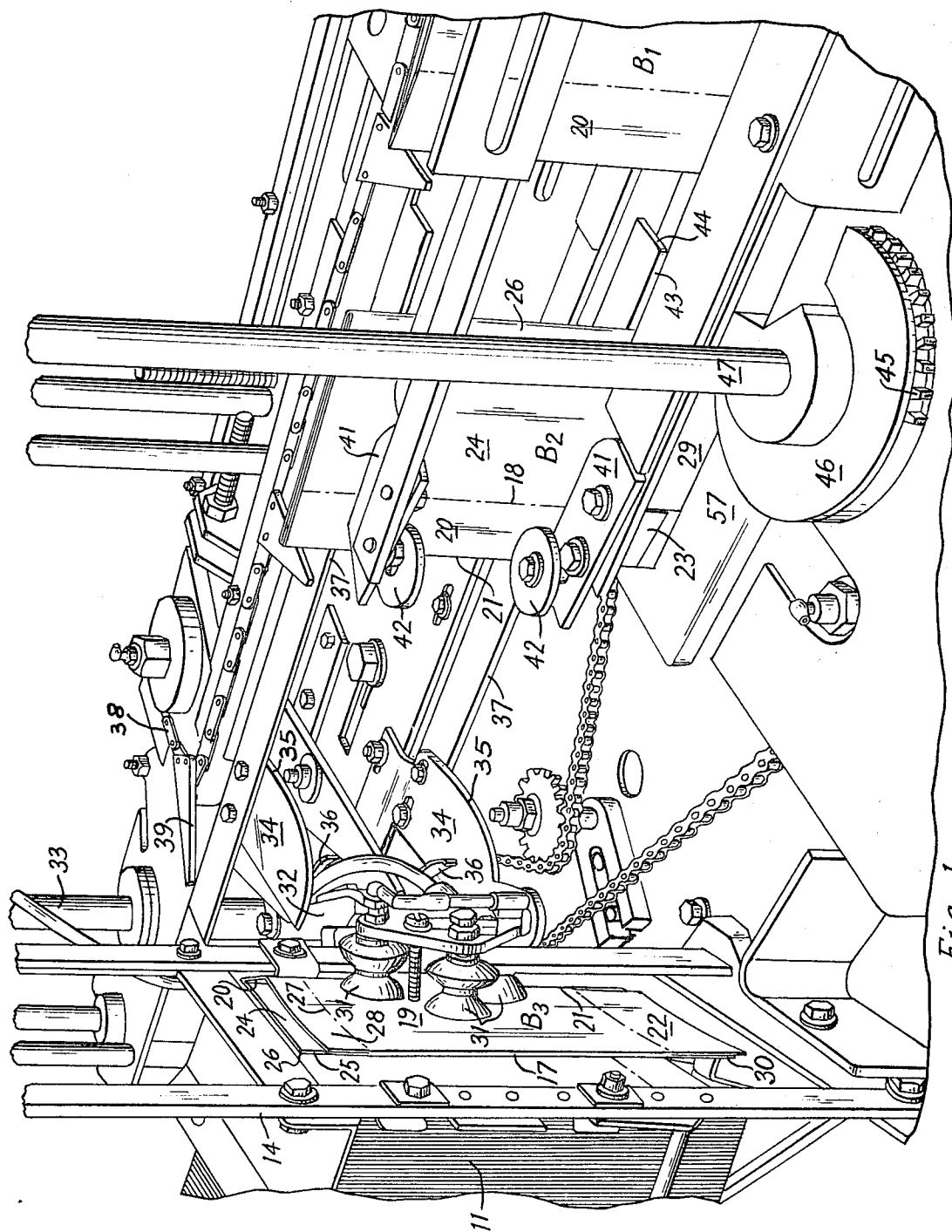


Fig. 1

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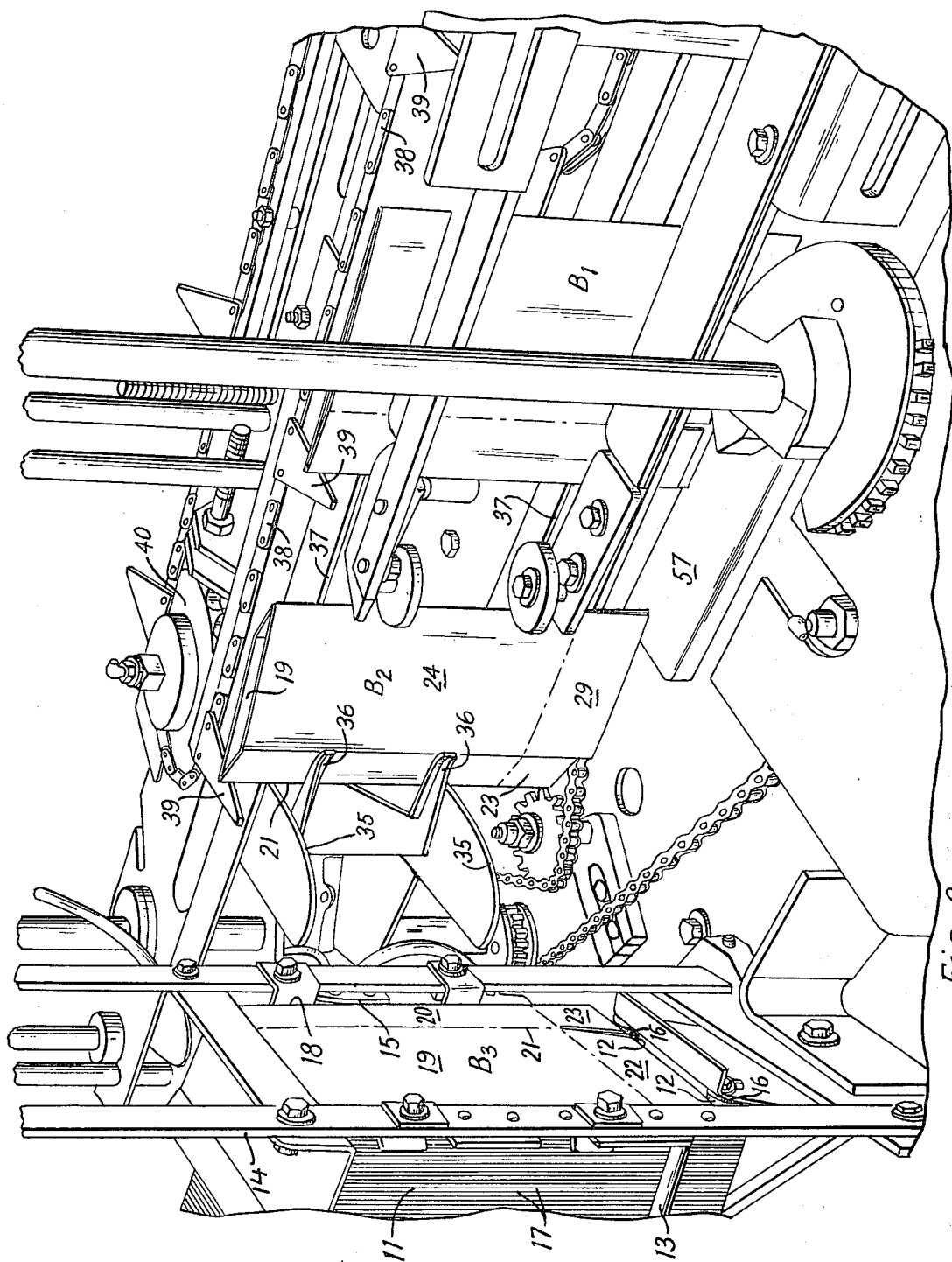


Fig. 2

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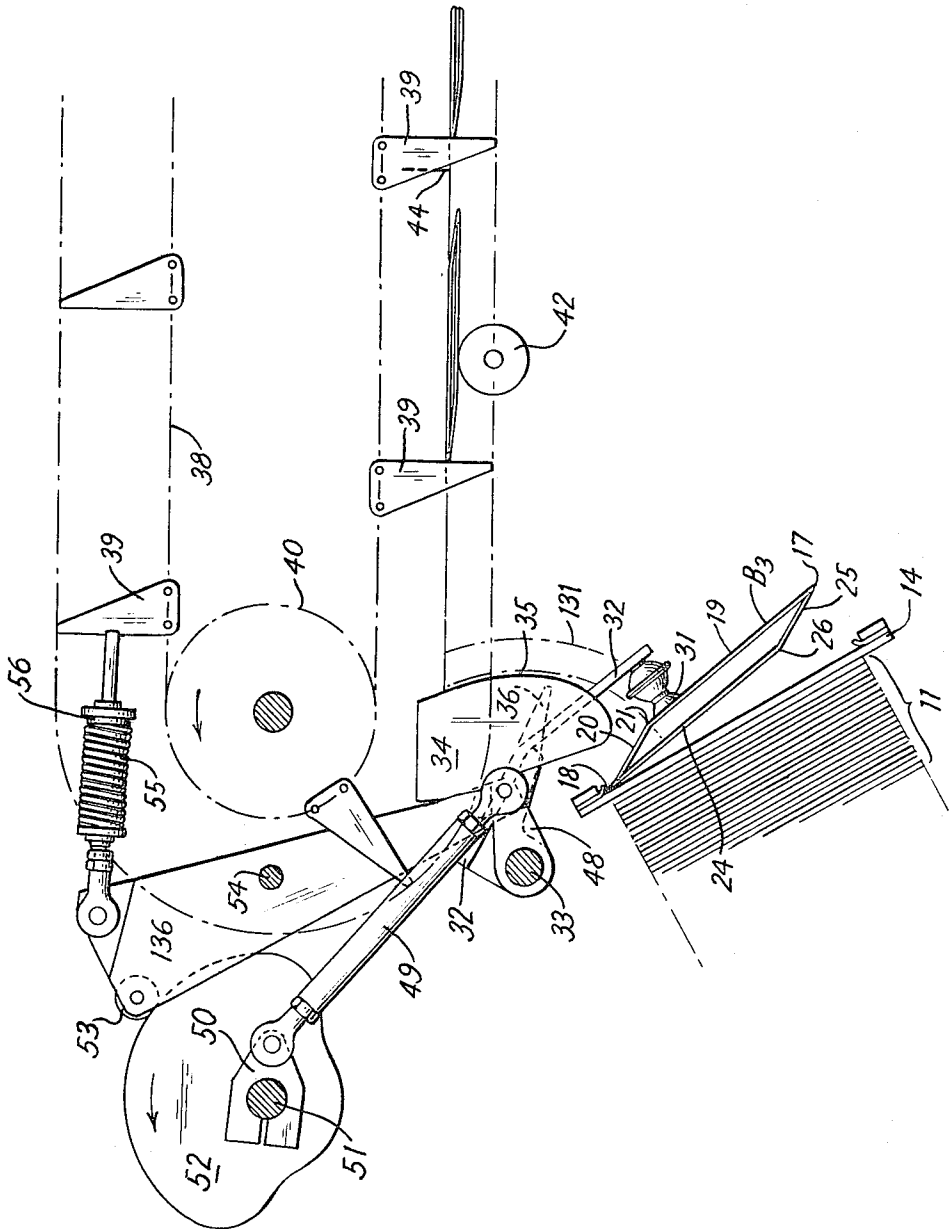
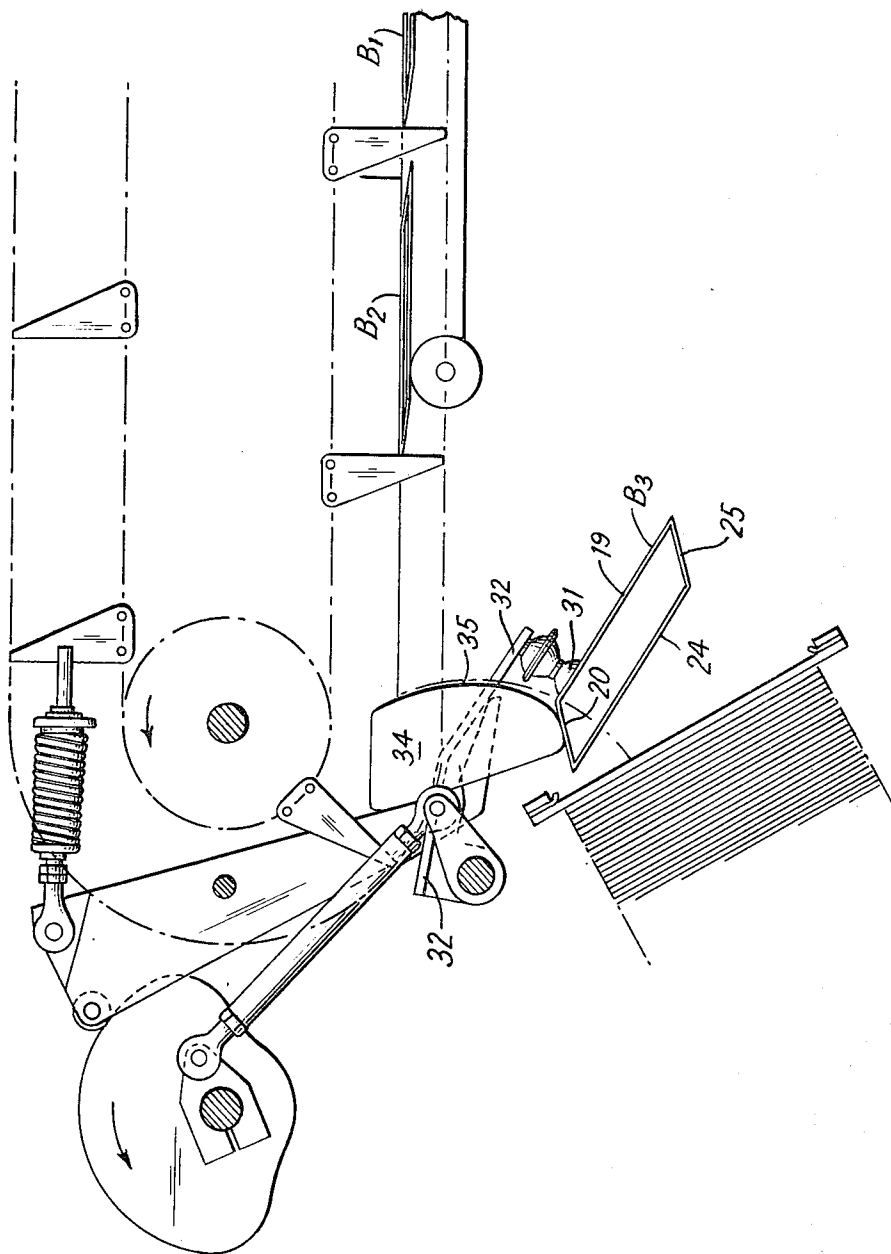


Fig. 3

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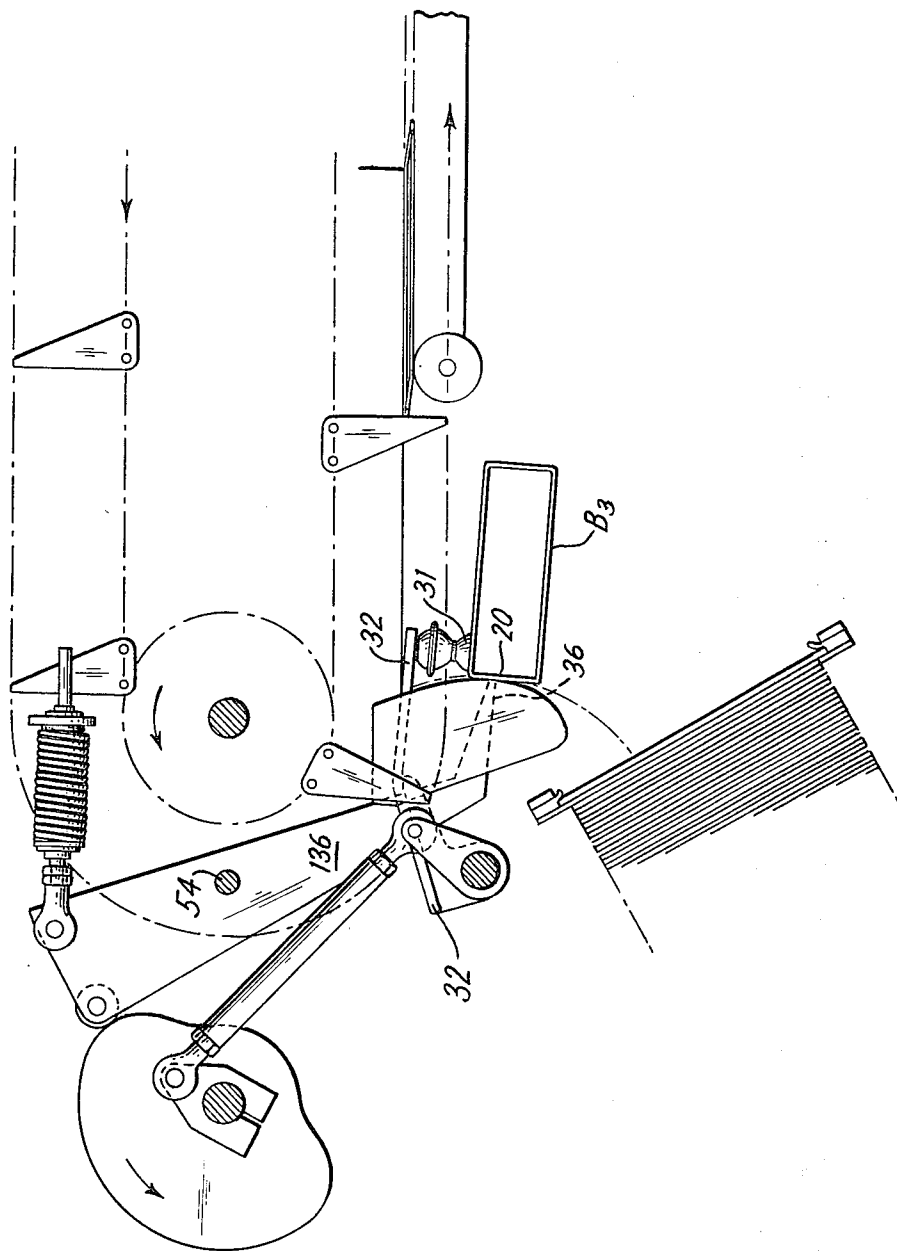


Fig. 5

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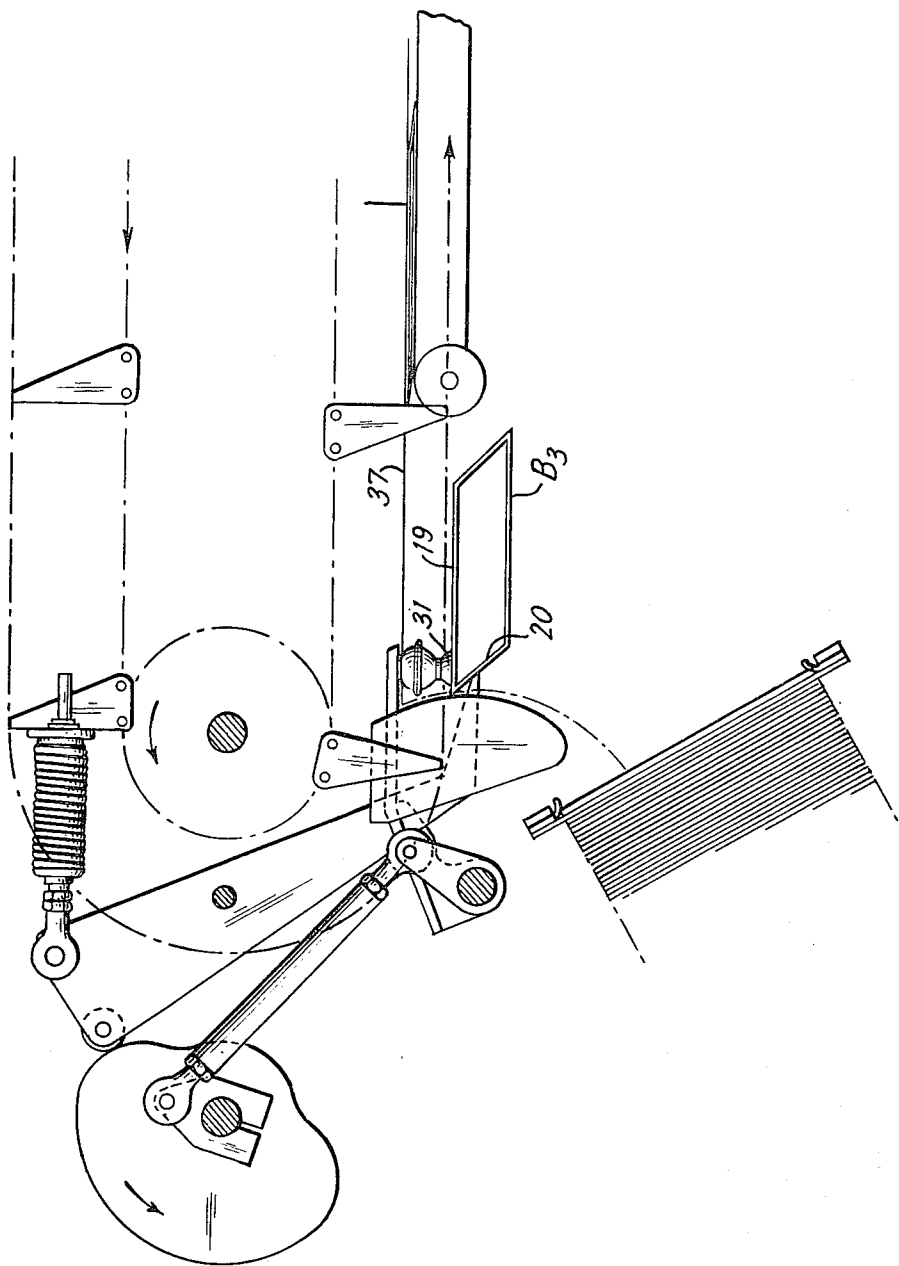


Fig. 6

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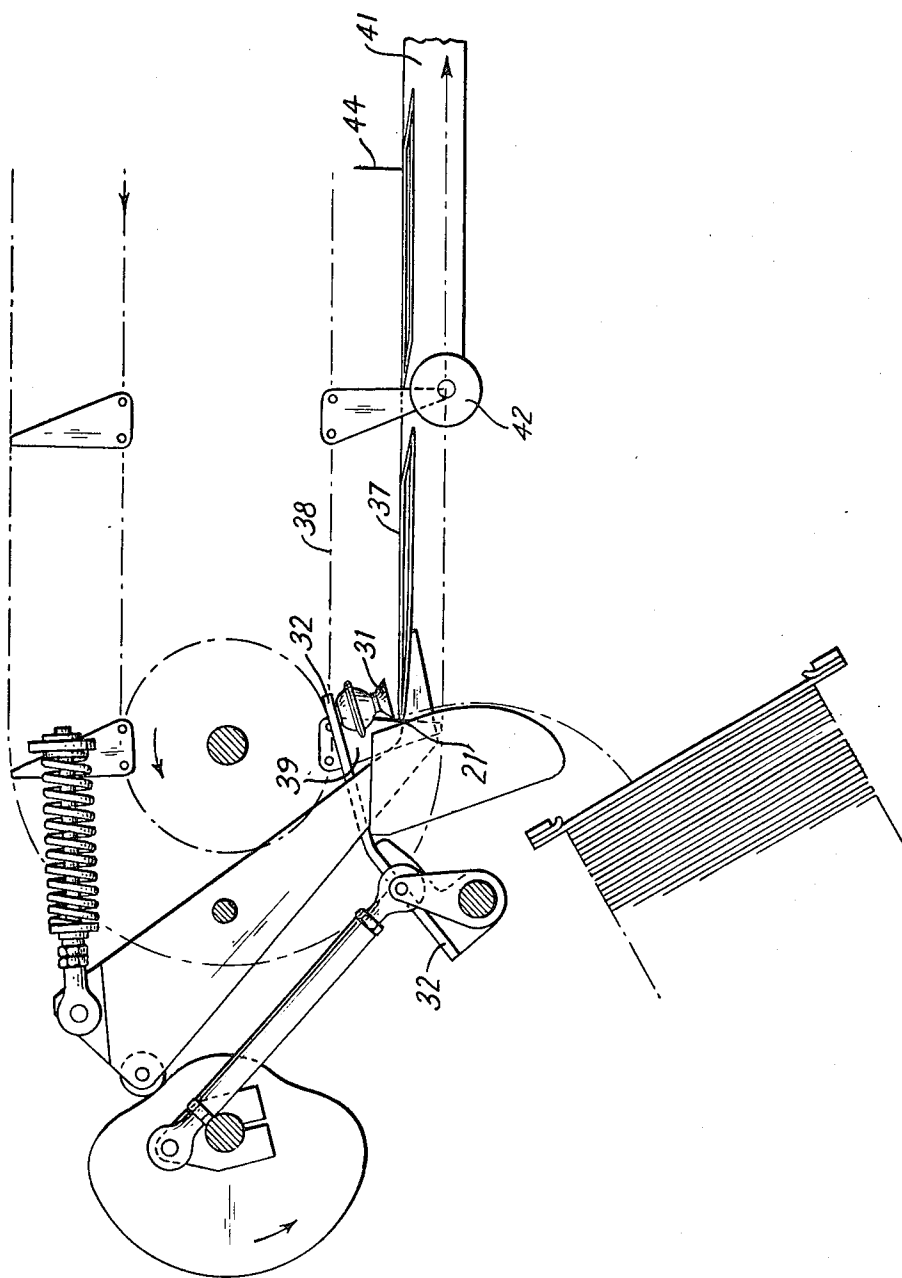


Fig. 7

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DEVICE FOR EXPANDING AND REVERSE-COLLAPSING TUBULAR FOLDING BOX BLANKS

Tubular folding box blanks are customarily delivered by the blank manufacturer in flat collapsed condition. Two substantially flat layers of paperboard are articulated to each other along parallel collapsing creases. The one layer comprises, beginning at one collapsing crease, a first major wall panel followed by a first minor wall panel terminating at the other collapsing crease. The other layer comprises, beginning at the other collapsing crease, a second major wall panel, followed by a second minor wall panel terminating at the one collapsing crease. An unbroken fold line lies between the respective major and minor panels of each layer. In the box set up from the blank the collapsing creases and the said fold lines form edges of the box.

It is known practice to grasp the collapsed flat tubular blank by a vacuum cup at one of its major panels and to move the cup in such a way that the blank is dragged over the face of a cam engaging the minor panel adjacent the grasped major panel. This causes the minor panel to assume an angular position with respect to the major panel. As the major and minor panels of the blank form a parallelogram in end view, folding of one minor panel causes the other minor panel to assume a corresponding angular position with respect to the second major panel and the blank is thus expanded, or "squared" in box makers' terminology.

The expanded blank is customarily delivered by the vacuum cup to a conveyor which maintains it expanded and moves it past filling and closing stations of a packaging machine. At the latter box end flaps and panels are usually folded into box closing position.

The problem:

If one end of the expanded tubular box blank is first closed prior to filling, the one end of the box is, and remains, accurately squared. The opposite open end of the box, however, will not remain accurately squared, but assumes the form of a parallelogram in end view, none of the parallelogram angles being a right angle. This is the result of the stiffness of the paperboard. The panels bordering a collapsing crease tend to resume a collapsed position and the panels bordering the aforesaid fold lines tend to return to a flat position.

This distortion of the box end leads to difficulties in filling, particularly where the open box end is expected to line up with a square filler spout. Other difficulties are experienced if the box is to be fitted with a squared telescoping cover while the box end is out-of-square.

The solution:

The problem can be met by equalizing the resistance to folding of all the box-edge-forming creases of the blank by a process sometimes referred to as "over-squaring" or "reverse-collapsing" in the box art.

After reverse-collapsing the panels bordering each of the box-edge-forming creases were at one time in flat, and at another time in folded-back position, thus losing their tendency to distort the box end.

A device for expanding tubular flat collapsed box blanks and comprising a vacuum cup mounted for oscillation on an arc about an axis substantially parallel to the collapsing creases of the blank, the arc extending from a pickup station to a delivery station, and a cam in the path of the blank carried by said cup in a position to engage the cup-held blank at an area separated from the area grasped by said cup by a fold line, which fold line is to become an edge of the blank after its expansion, is improved according to this invention by a finger element movable into a position substantially opposite the mouth of the cup, considering the latter in its delivery position, and means timed in relation to the movement of the cup for moving the finger element towards said mouth in a position in which the finger element engages the side of the expanded blank, thereby reverse-collapsing the blank prior to its release by the cup.

Advantageously the finger element lies in its retracted position behind the cam face and extends beyond the cam face when moved into its projected blank-engaging position.

A preferential arrangement is one in which two cams straddle the vacuum cup and two finger elements straddle the two cams.

The axis about which the vacuum cup swings and the blank supporting surface of the conveyor to which the cup delivers the reverse collapsed blank may be vertical. In such an arrangement the closed end of the box may ride on a horizontally extending shelf and the box is in a convenient position for filling from above.

Advantageously the conveyor may be fitted with two oppositely placed elements forming a nip through which the reverse-collapsed blank passes. Downstream with respect to the nip wider spaced guide means permit the flat blank to reopen, whereupon the bottom end of the box may be closed. The open upper end then remains squared by reason of the equalization of the stiffness of the board at all its box-edge-forming creases.

These and various other 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 this 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 this invention which are believed to be novel will be particularly pointed out in the claims appended hereto, the invention itself, 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 the disclosure in which:

FIGS. 1 and 2 are perspective views of a blank feeding and reverse-collapsing mechanism in the initial and final stages, respectively, of its operation; and

FIGS. 3 to 7 are diagrammatic illustrations of major elements of the mechanism in sequential stages of operation.

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 certain specific details of the invention for the purpose of explanation of broader aspects, and it is understood that the details may be modified in various respects without departure from the principles of the invention and that the invention may be embodied in other forms than shown.

Referring to FIG. 2, a horizontal stack 11 of tubular flat collapsed box blanks B of paperboard is stored in a magazine comprising a pair of supporting rods 12 and lateral alignment rods, of which one is visible at 13.

A magazine gate is formed by a vertical frame 14 and comprises the customary lug elements 15 and 16 which overlap the foremost blank B₁ marginally and prevent it from falling out of the magazine. Lugs 16 are in the shape of discs on the ends of the rods 12.

The blanks comprise four wall panels arranged in two layers joined along lateral collapsing creases 17 and 18 along which the board is folded by 180 degrees. Each layer comprises a major and a minor panel. The front layer of the foremost blank in the magazine comprises a major panel 19 and a minor panel 20 articulated along a fold line 21. Bottom panels or flaps 22, 23 are articulated to the lower edge of the wall panels.

The panels of the rearward layer are best seen in FIG. 1 and comprise a major wall panel 24 and a minor panel 25 articulated along a fold line 26 to the panel 24.

A cover hinge line 27 extends across the upper portion of the major panel 19 and defines a flap 28 to which sub-

sequently a telescoping hinge cover structure may be attached. The hinge cover is not shown as it is not necessary for an understanding of the invention.

The rearward layer further comprises bottom panels 29, 30 extending from the panels 24 and 25, respectively. The bottom panel 29 is best seen in FIG. 1 near the center of the figure and only the edge of panel 30 is visible at the left of the figure.

Returning to the mechanism and referring to FIG. 1, an assembly of vacuum cups 31 is mounted on an arm 32 which is secured to a vertical oscillating shaft 33. Suffice it at this moment to state that the shaft 33 is oscillated to move the vacuum cups on an arc between a pickup station at which the cups pick up a blank at the magazine gate (in FIG. 1 a blank B₃ has just been withdrawn) and a delivery station at which a blank B₂ is shown as being transferred to a conveyor (See FIG. 2, center).

The vacuum cups 31 are flanked on both sides by a pair of stationary cams 34 whose faces 35 make contact with the minor panel 20 of the blank, as the latter is being carried towards the delivery station. Details of this operation are best seen from the diagrammatic figures later to be described.

The travel of the minor panel 20 over the cam surfaces causes the panel 20 to assume positions of increasing inclination with respect to the major panel 19 grasped by the vacuum cups, leading to squaring of the blank.

Finger elements are provided for engaging the minor panel 20 and fold it back upon the panel 19 along the fold line 21, as is shown of B₂ at the center of FIG. 2.

The finger elements are normally retracted behind the cam faces 35, as can be seen in FIG. 1 where only the tips of the fingers 36 are visible. The finger tips move in a substantially horizontal plane, engage the panel 20 as soon as they move beyond the cam faces and then urge the minor panel 20 towards the major panel 19 or, in other words, towards the mouth of the vacuum cups which are attached to the panel 19 but are not visible in FIG. 2. This involves a finger motion composed of a component substantially normal to the mouth of the cup and a further component parallel to the mouth of the cup.

At the delivery station the blank B₁ is in reverse-collapsed condition and comes to rest against face rails 37 of a conveying mechanism comprising an endless conveyor chain 38 fitted with lugs 39 projecting beyond the rails 37 and moving the reverse-collapsed blank to the right. The chain 38 is trained around a sprocket wheel 40.

FIG. 2 shows the blank B₂ in about the position of delivery and release by the vacuum cups. A conveyor lug 39 is beginning to engage the blank B₂ and will move it out of the grip of the fingers 36, which first pressed it against the vacuum cups and later against the face rails 37 at a moment the vacuum cups are retracted slightly behind the face of the rails, as will later be described with reference to FIG. 7.

In FIG. 1 a blank B₂ which preceded blank B₃ is shown to have been moved into a nip formed by the face rails 37 in the back and by the edge of plates 41 and rollers 42 in the front. The nip forming elements 37, 41, 42 ensure complete flattening out of the reverse-collapsed blank in a position in which the board is now folded back upon itself along fold lines 21 and 26 and is flattened out along the previous collapsing creases 17, 18.

The width of the nip is clearly seen at 43 in FIG. 1 and terminates at 44. Here blank B₁ is permitted to expand to the full width of the minor panel 20. The reexpansion of the blank is accomplished by means of further movable conveyor elements which are not shown. Suffice it to say that such elements may be of known construction.

While caught in the nip the collapsed blank may be moved past the face of type 45 in a coding wheel 46 on a shaft 47.

A horizontal shelf plate 57 limits downward movement of the blank after the blank passes out of the grip of the fingers 36.

The geometry of the mechanism of FIGS. 1 and 2 and its successive phases of operation are best explained by reference to FIGS. 3 to 7.

The shaft 33 is oscillated about its axis by means of an arm 48, connecting rod 49 and crank 50 on a continuously rotating drive shaft 51.

The shaft 51 also carries a cam 52 which is fixed thereon and is engaged by a cam follower 53 on one end of a double armed lever 136 whose other end is fitted with the flat-faced fingers 36 (See FIG. 2). The lever is pivoted intermediate its ends at 54 and is under the action of a compressed helical spring 55 mounted at 56 and urging the follower 53 against the cam 52.

In the position of the elements illustrated in FIG. 3 the blank B₃ has just been withdrawn from the magazine gate 14 by the vacuum cup 31 moving on an arc 131 about the axis of shaft 33.

Shortly thereafter the minor panel 20 is engaged by the face 35 of the cam 34 causing the panel 20 to assume positions of increasing angularity with respect to the panel 19 to which the cup 31 is affixed (FIG. 4). The panels 24, 25 assume corresponding positions of angularity, as the blank represents a parallelogram in end view.

In the position of FIG. 5 the blank is substantially squared and the panel 20 is about to be engaged by the fingers 36 which now fold the panel 20 back upon panel 19 and towards the plane of the mouth of the cup 31 (FIG. 6). In the position of FIG. 6 the blank has not yet reached the edge of the face rail 37 beyond which the cup 31 swings (FIG. 7) after detaching itself from the panel 19 by an appropriate relief of the vacuum.

The blank is now pressed against the face rail 37 and the lug 39 of the conveyor chain 38 approaches to engage the edge 21 of the blank to move the reverse-collapsed blank into the nip between roller 42 and plate 41 on the reverse side and the edge 37 on the far side.

The drive mechanism for turning the drive shaft 51 and operating the conveyor is designed to operate the several elements as shown in the sequence of FIGS. 3 to 7.

I claim:

1. A device for expanding and reverse-collapsing a tubular folding box blank comprising two substantially flat layers articulated to each other along parallel collapsing creases, the first layer comprising, beginning at one collapsing crease, a first major panel and a first minor panel, the second layer comprising, beginning at the other collapsing crease, a second major panel and a second minor panel, there being an unbroken folding score between the respective major and minor panel of each layer along which score the blank is to be recollapsed, the device comprising, in combination:

a vacuum cup including means for mounting said cup for oscillating movement about an axis on an arc extending from a pickup station to a deposit station, said cup being adapted to grasp said blank by its first major panel such that the first minor panel lies between said cup and said axis and that the collapsing creases are parallel to said axis;

a cam means between said axis and the path of said cup in a position to engage said first minor panel and fold it into angular position to said first major panel as the cup moves the blank on an arcuate path, thereby squaring the blank;

a finger element movable back and forth in a direction whose major component is substantially parallel to the mouth of said cup, considering the cup in the position in which the blank is squared, and whose minor component is towards and away from the said mouth, said finger element being actuated in timed relationship to the cup movement and mounted in a position to engage said first minor panel and fold it back upon said first major panel to reverse-collapse the blank; and

transport means for moving said reverse-collapsed blank from between said mouth and said finger element in a direction substantially of the plane of the reverse-collapsed blank and away from said axis.

2. A device as defined in claim 1 in which the transport means comprises two oppositely placed elements forming a nip between which elements the reverse-collapsed blank is compressed during transport.

3. A device as defined in claim 1 in which the finger element in its retracted position lies behind the panel engaging face of said cam means and in its projected blank-engaging position extends beyond the face of said cam means.

4. A device as defined in claim 1 in which the axis about which said cup moves is substantially vertical and in which said transport means comprises a substantially horizontal shelf limiting downward movement of the blank carried by said transport means.

5. A device as defined in claim 1 in which the transport means comprises two oppositely placed elements forming a nip through which the reverse-collapsed blank passes and in which, downstream with respect to the nip, diverging guide means are provided for said major panels, the spacing between said guide means being sufficient to accommodate the reexpanded squared blank.

6. A device for equalizing the resistance to folding of paper-board of tubular box blanks at four parallel box-edge-forming creases, along two of which the blank is collapsed flat, the remaining two creases being yet unbroken, the device comprising:

a magazine in which a stack of said collapsed blanks is stored;

a vacuum cup mounted for oscillation on an arc about an axis substantially parallel to the collapsing creases of the blanks in the stack, the arc extending from a pickup station at the end of said stack to a delivery station;

a cam in the path of a blank carried by said cup, the cam being in a position to engage the blank at an area separated from the cup-grasped area by one of said remaining creases;

the device being characterized by a finger element movable into a position substantially opposite the mouth of said cup, considering the cup in its delivery position; and means timed in relation to the movement of said cup for moving said finger element towards said mouth in a position to engage the side of the expanded blank to reverse-collapse the blank along said remaining creases.

7. A device for equalizing the resistance to folding of paper-board of tubular box blanks at four parallel box-edge-forming creases, along two of which the blank is collapsed flat, the

remaining two creases being yet unbroken, the device comprising:

a magazine in which a stack of said collapsed blanks is stored;

a vacuum cup mounted for oscillation on an arc about an axis substantially parallel to the collapsing creases of the blanks in the stack, the arc extending from a pickup station at the end of said stack to a delivery station;

a cam in the path of a blank carried by said cup, the cam being in a position to engage the blank at an area separated from the cup-grasped area by one of said remaining creases;

the device being characterized by a finger element movable into a position substantially opposite the mouth of said cup, considering the cup in its delivery position at the conveyor hereinafter recited;

means timed in relation to the movement of said cup for moving said finger element toward said mouth in a position to engage the side of the expanded blank to reverse-collapse the blank along said remaining creases; and

a conveyor on which said cup deposits said blank, said conveyor comprising a blank supporting surface beyond which the mouth of the cup moves at the delivery end of its movement, said finger being movable towards, but not beyond, said plane at the end of its reverse-collapsing movement.

8. A device for reverse-collapsing, one by one, tubular box blanks stored in flat collapsed condition as a stack in a magazine, the device comprising a vacuum cup mounted for oscillation on an arc about an axis substantially parallel to the collapsing creases of the blanks in the stack, the arc extending from a pickup station at the end of the stack to a delivery station at the conveyor hereinafter recited; a cam in the path of a blank carried by said cup in a position to engage the cup-held blank at an area separated from the blank area grasped by said cup by a fold line which is to become an edge of the blank after its expansion to squared condition, and a conveyor on which said cup deposits the blank, the device being characterized by a finger element movable into a position substantially opposite the mouth of said cup, considering the latter in its delivery position, and means timed in relation to the movement of said cup for moving the finger element towards said mouth in a position in which said element engages the side of the expanded blank to reverse-collapse the blank prior to delivery of the blank to said conveyor.

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