

July 28, 1964

C. J. PIERCE, JR., ETAL
DEVICES FOR SQUARING FLAT COLLAPSED
TUBULAR FOLDING BOX BLANKS

3,142,232

Filed July 26, 1962

8 Sheets-Sheet 1

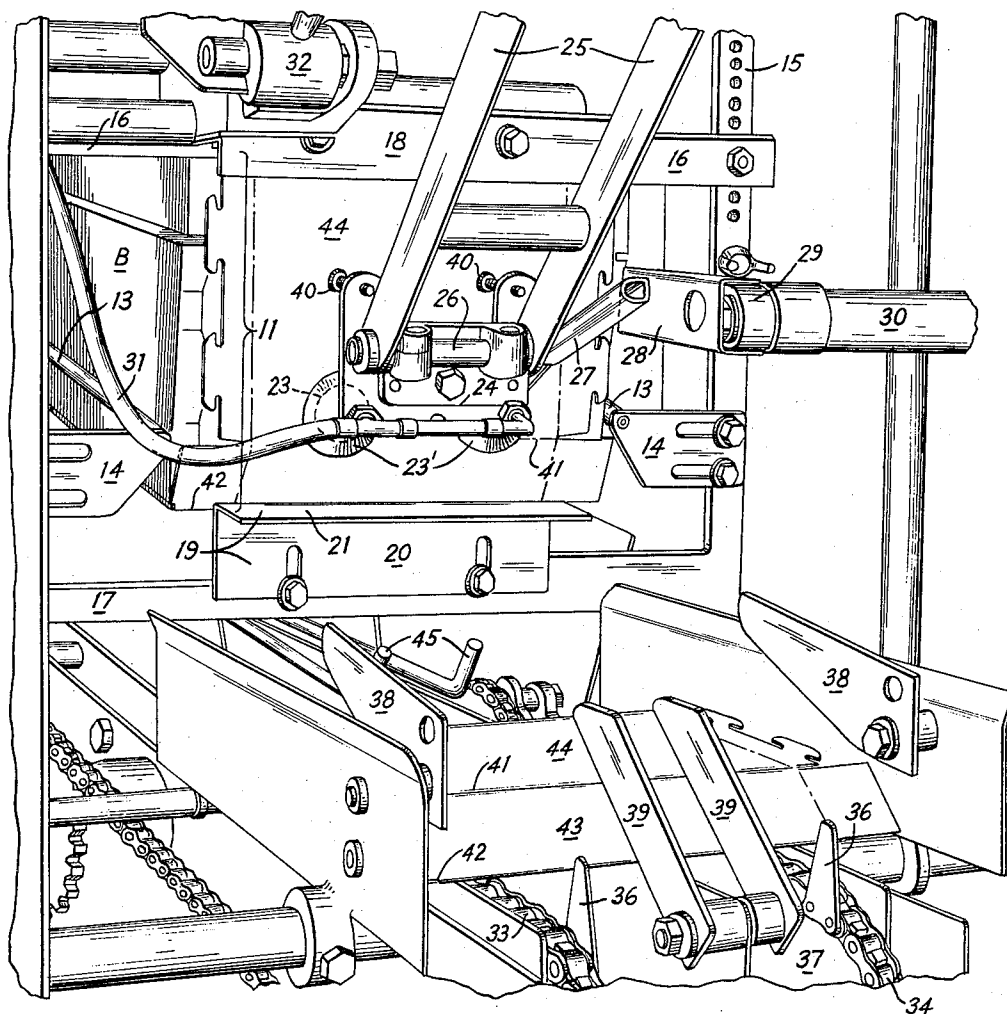


Fig. 1

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8 Sheets-Sheet 3

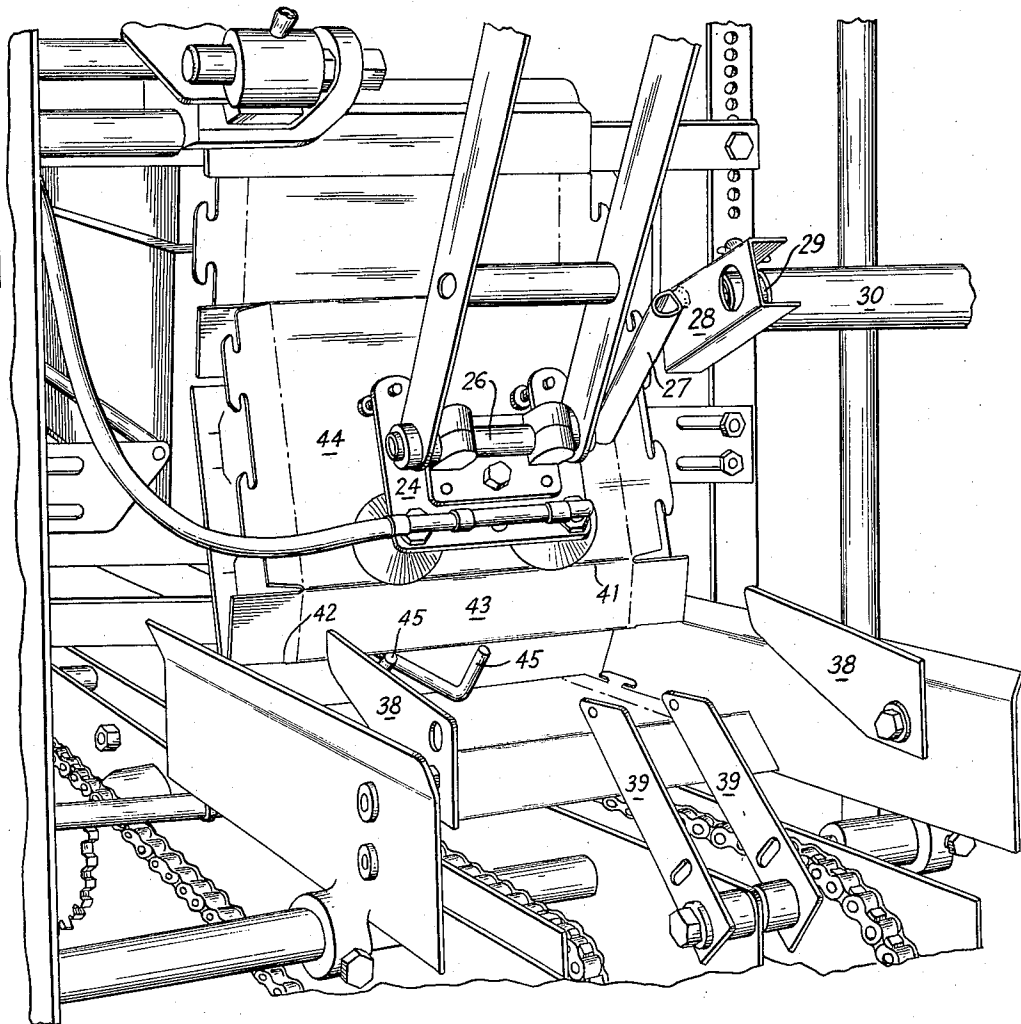


Fig. 3

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8 Sheets-Sheet 4

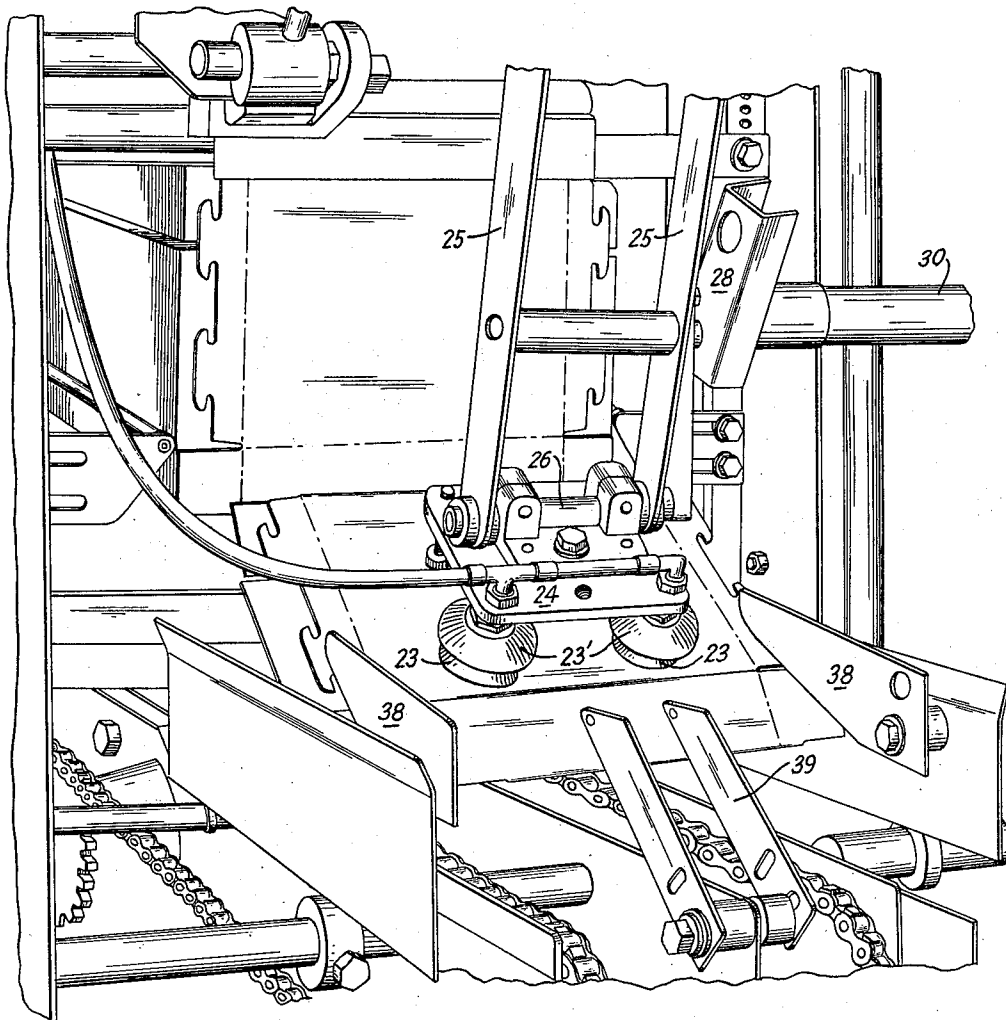


Fig. 4

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8 Sheets-Sheet 5

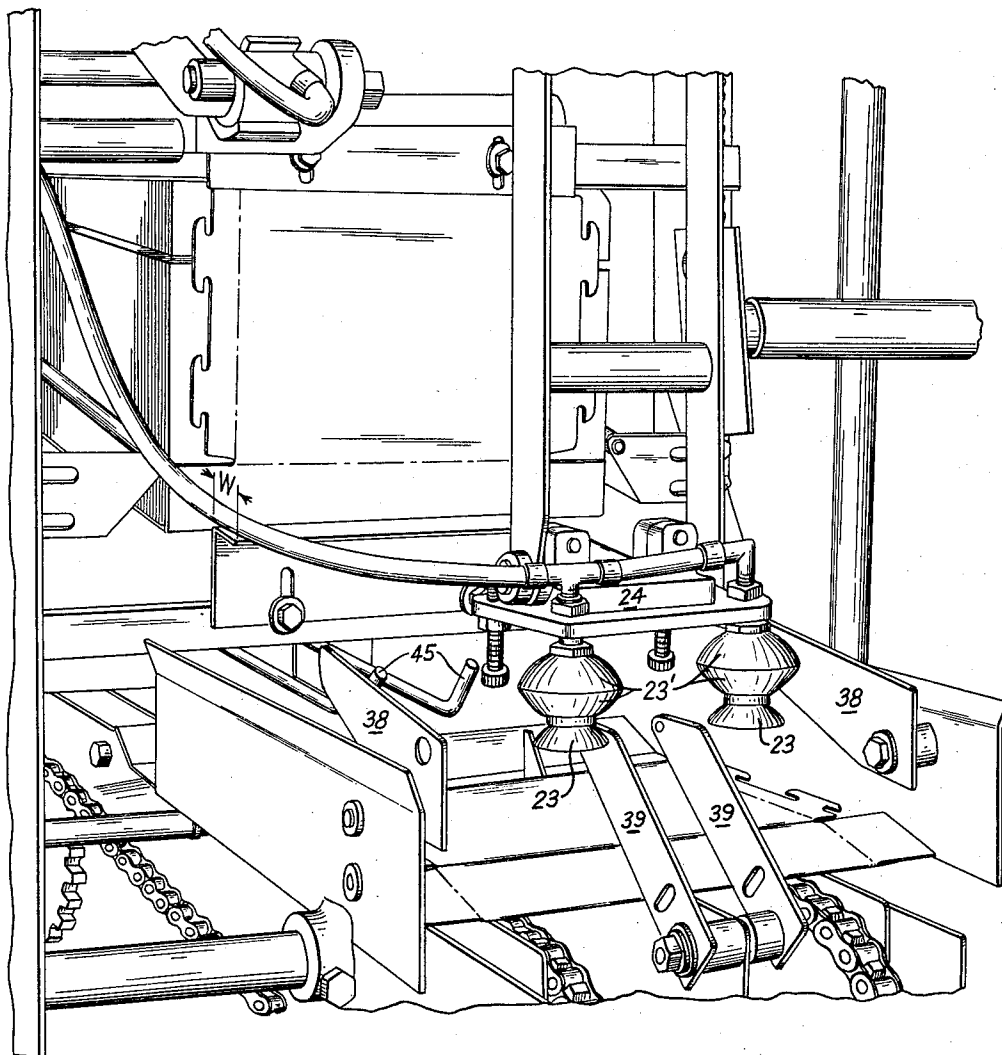


Fig. 5

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8 Sheets-Sheet 6

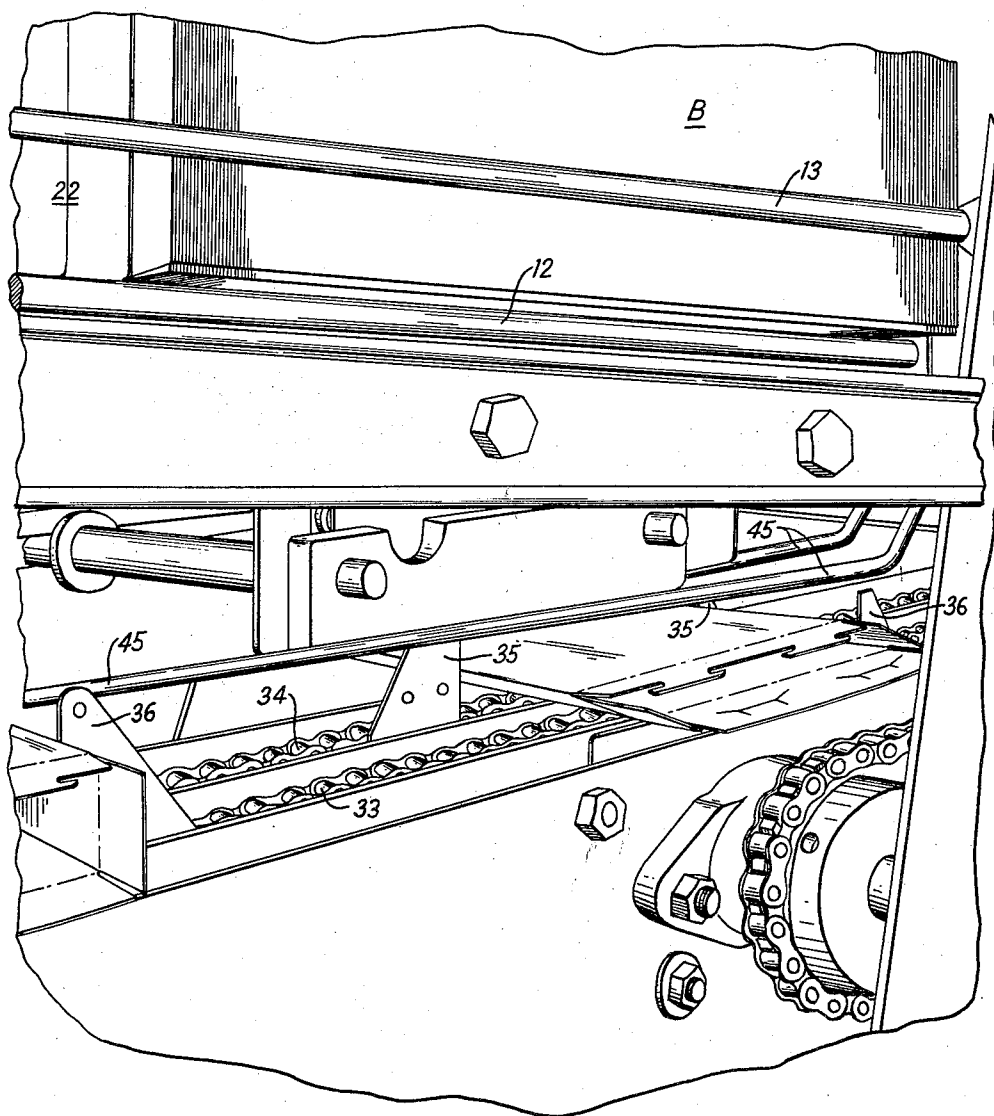


Fig. 6

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8 Sheets-Sheet 7

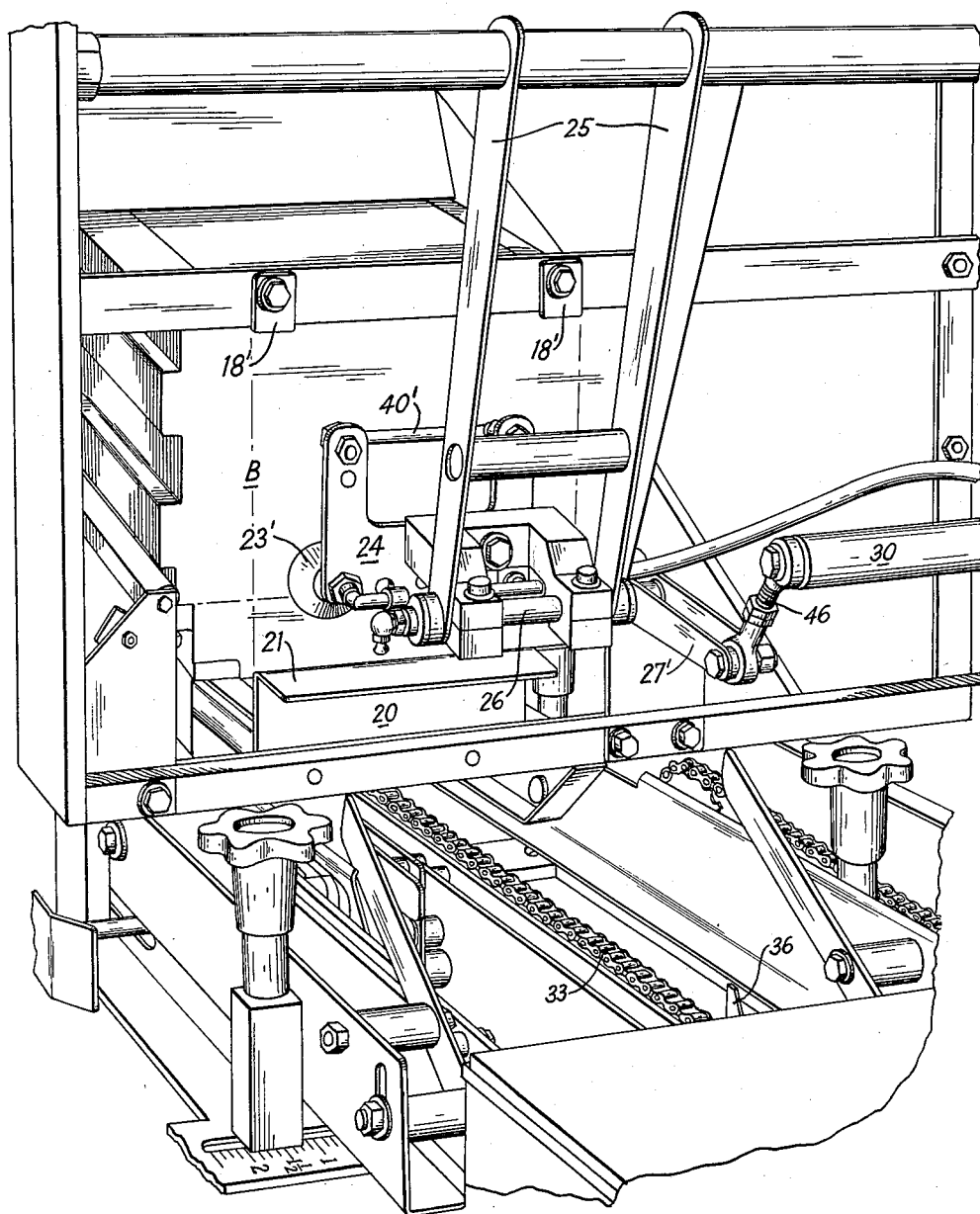


Fig. 7

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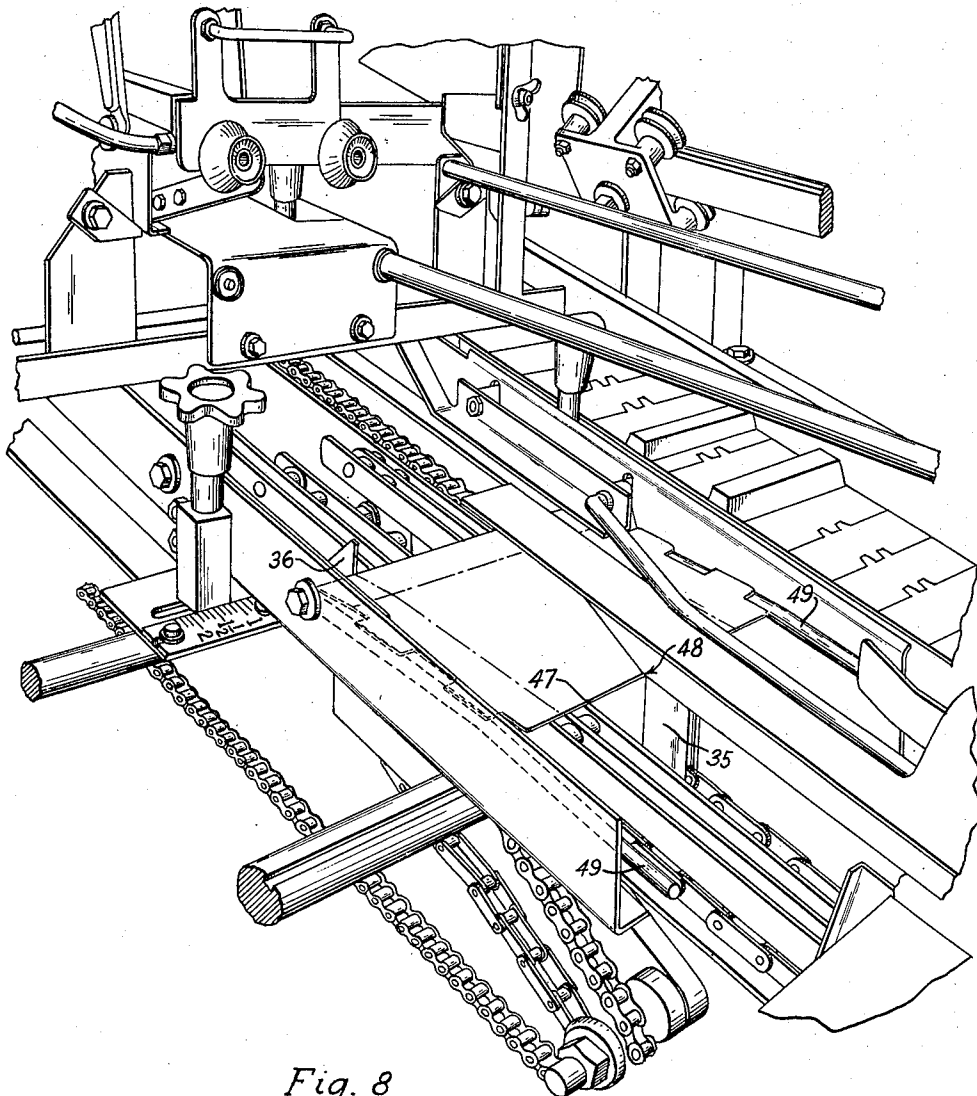


Fig. 8

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3,142,232

DEVICES FOR SQUARING FLAT COLLAPSED TUBULAR FOLDING BOX BLANKS

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Filed July 26, 1962, Ser. No. 212,574

7 Claims. (Cl. 93—53)

This invention relates to improvements in devices for squaring flat collapsed tubular box blanks.

In order to speed the assembly of folding boxes, it is customary to prefold and preglue box blanks as flat collapsed tubular structures which require a minimum of space for storage in collapsed form and are immediately available for conversion into box form by squaring the tubular structure without the need for a further gluing operation, whereafter the box may be filled and closed in an appropriate manner.

It is known in this connection to place the squared structures in the compartments of a conveyor, for example between successive lugs of an endless chain conveyor, which transports the box structures to the filling and closing stations. In this arrangement the conveyor lugs maintain the box structure squared and prevent recollapsing.

The compartments of an endless conveyor are automatically enlarged at the ends of the conveyor run where the conveyor travels over end rollers and are automatically reduced on the straight run. This characteristic has been utilized in the erection of tubular or sleeve type folding boxes.

According to one known procedure, for example, the flat collapsed tubular blank is placed in an enlarged conveyor compartment which by reason of its enlargement accommodates the flat blank. A pusher mechanism then engages the trailing edge of the blank and, traveling faster than the lineal rate of the conveyor, pushes the blank against the leading lug of the open and enlarged conveyor compartment. This causes the blank structure to open as a squared tube. By this time the trailing lug of the same compartment has advanced sufficiently to maintain the box squared, and the pusher mechanism is withdrawn. The next blank is then placed into the next compartment and the procedure is repeated.

The known arrangement requires considerable spacing of the compartments to permit the pusher to retract and a new blank to be placed in the next compartment and squared before the next compartment is narrowed to the dimension of the box. Wide compartment spacing limits the output rate of the machine.

Further, the resulting box is not precisely square after the box ends are glued.

Operational reasons require the conveyor compartments to be slightly larger than the width of the finished box. Were it not so, the box would be gripped as in a vise and the surface of the box would be marred.

In order to avoid this, the conveyor compartment is constructed to fit the box with a certain amount of play. The play may lead to the formation of a box which is slightly off square, the end has the shape of a parallelogram after gluing of the end closure. A contributing cause of the misshape is that box board and paperboard possess resiliency, as a result of which the squared box tends to recollapse and assume an off square shape, if play in the conveyor compartment so permits. The tendency of recollapsing can be overcome by temporary over-squaring, i.e., by moving the vertical walls beyond the 90 degree position with respect to the horizontal walls.

The aforementioned conveyor and pusher arrangement is incapable of performing an over-squaring operation.

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The present invention provides a relatively simple and very compact mechanism for squaring tubular box blanks, over-squaring the blank in the process, if desired, and placing the squared structure into the compartments of a conveyor which may be closely spaced from one another.

The invention may be incorporated in existing machines of the vacuum feeder type by relatively simple adaptation.

These and various other 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, an 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 this invention which are believed to be novel will be particularly pointed out in the claims appended thereto, 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 perspective end view of a device for squaring tubular folding box blanks;

FIGS. 2 to 5 are perspective views of the device in different successive phases of operation;

FIG. 6 is a perspective side view of the conveyor portion of the device;

FIG. 7 is a perspective view of a modified form of control mechanism for the carrier; and

FIG. 8 is a perspective view of another portion of the conveyor.

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 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 blank magazine generally designated 11 comprises a pair of blank supporting rods 12 (visible in FIG. 6) on which a stack of blanks B rest on edge in a substantially vertical position and lateral blank aligning rods 13 mounted in forward brackets 14 of a magazine gate frame structure. The frame structure comprises vertical elements 15 between which a top bar 16 and a bottom bar 17 extend. A plate 18 is attached to the top bar 16 in a position slightly overlapping the foremost blank. The plate 18 forms a blank retaining lip at the top, and a similar blank retaining lip prevents blanks from accidentally slipping out of the magazine at the bottom. The bottom lip may be formed by a similar plate, but preferably has the shape of an L-bracket 19 whose vertical portion 20 performs the blank retaining function by marginally overlapping the foremost blank as shown. The bracket 19 further comprises a substantially horizontal portion or surface 21 whose purpose will be explained later.

The stack of blanks is urged towards the gate by a suitable pusher 22 (FIG. 6) which is under gravitational or spring force, as is conventional. It is readily seen that all blanks are retained in the magazine by the retaining elements 18 and 19, and that blanks may be with-

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drawn, one by one, through the gate by an appropriate feeding device grasping the foremost blank.

In the illustrated machine the feeding device comprises a pair of suction cups 23 on a carrier 24 tiltably mounted on the lower end of an oscillating drive arm 25 at 26. The oscillating drive arm itself is pendulously supported about a horizontal axis parallel to the tilt axis 26 beyond the limits of the illustration, and is shown in FIG. 1 in a position at the far end of its swing or oscillation. In FIG. 5 it is shown in its opposite extreme position.

The tilt of the carrier 26 is controlled by an arm 27 fixed to the carrier and comprising a channel shaped bearing portion 28 slidably engaging a fixed pivot in the form of a roller bearing 29 on a stud 30.

It is seen from FIGS. 1 through 5 that the tilt arm 27 of the carrier 24 causes the carrier to assume a substantially vertical position at one end of its stroke or swing (FIG. 1) and a substantially horizontal position at the other end of its stroke or swing (FIG. 5).

The tilt axis 26 of the carrier moves on an arcuate path, and the path of a blank held by the suction cups 23 is a modified arc, modified by the tilt of the carrier, the distance of the mouth of the cups from the tilt axis 26, and the geometry of the tilting mechanism, the latter being mainly determined by the location of the pivot 29 in relation to the axis about which the drive arm 25 swings.

Vacuum is applied to the suction cups 23 through a flexible duct 31 leading to a vacuum pump (not shown) via a control 32. The control valve is a two position valve. In one position (FIG. 1) vacuum is applied to the cups 23 so that the cups will pick up and hold a blank. In the other position the portion of the vacuum line to the pump is closed and the portion of the duct 31 leading to the cup is vented to the atmosphere so that the cups drop the blank (FIG. 5). This form of control is conventional and is disclosed, for example, in the patent to Baker et al. No. 2,624,249 dated January 6, 1953.

A chain conveyor extends beneath the magazine. It comprises a pair of endless chains 33 and 34 fitted with leading lugs 35 and trailing lugs 36 to form individual conveyor compartments therebetween. The compartments are dimensioned to fit a squared blank snugly within the straight portions of the run, as shown at the extreme end of FIG. 6 and are enlarged at the end of the conveyor where the chains run over terminal sprocket gears 37.

Considering, briefly, the feeding operation of blanks, the carrier 24 approaches the foremost blank in the magazine stack and the suction cups attach themselves to the blank, as the valve 32 is in the position in which the vacuum pump applies vacuum through the duct 31.

The carrier then moves away from the gate, withdraws the foremost blank past the retaining elements on lips 18 and 20 and moves the blank forward toward the observer. Lateral guides 38 on the conveyor bed and terminal guides 39 assist in directing the blank into the deposit position (see FIG. 4) until the vacuum is cut off, the cups are vented and the blank drops into an enlarged compartment of the conveyor (FIG. 5).

During its travel from the magazine to the deposit station the blank encounters an obstacle while being moved by the carrier. The obstacle strikes the blank and causes flexing or deformation of the blank in such a way as to prefold the blank along the score lines at which the blank is later folded into expanded or squared tubular shape.

In the illustrated embodiment of the invention the obstacle has the form of a shelf or surface 21 along which the bottom edge of the collapsed blank slides as the carrier 24 moves away from the magazine on a forward and downward arc. The beginning of this phase of motion is shown in FIG. 1.

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FIG. 2 shows an advanced phase at which the blank is substantially squared. The carrier 24 has moved forward and downward, as a result of which the bottom edge of the blank is displaced upward with respect to the suction cups. During this phase of the operation the top panel 44 of the box about to be formed is securely grasped by the suction cups and is further stabilized by stabilizing pins on studs 40 which prevent tilting of the grasped blank panel 44 out of the vertical position.

From a comparison of FIGS. 1, 2 and 3 it is seen that the arrangement is such that a blank fold line 41 which extends generally transverse to the direction of blank movement lies between the obstacle engaged blank portion and the cup engaged portion. The obstacle engaged portion is the bottom edge of the blank as resting in the magazine. This bottom edge is a fold line 42 along which the tubular blank is originally collapsed by folding of the blank by 180 degrees. The panel 43 lying between the fold lines 41 and 42 becomes a side panel of the box after squaring and assumes a 90 degree position with respect to the top panel 44 grasped by the cups.

As the blank feeder moves the blank beyond the position shown in FIG. 2, the fold line 42 (which lies hidden behind the duct) is further displaced upwardly relatively to the suction cups, whereby the blank is momentarily over-squared, i.e., the panel 43 is moved into an inclination of less than 90 degrees with respect to the top panel 44. This operation reduces the tendency of the blank to recollapse by "taking the fight out of the board" at the fold lines, to use box makers' terminology.

The prefolded blank then slides off the surface 21, moves within the reach of the guides 38 and 39 (FIG. 4), and is finally dropped into the grasp of the conveyor (FIG. 5).

The blank is finally squared, as the trailing conveyor lugs 36 come up behind it and gradually narrow the space between the leading lugs 35 and the trailing lugs 36 (FIG. 6). Guide rails 45 above the conveyor prevent the blank from jumping out of the gradually narrowing conveyor compartments.

At the extreme left of FIG. 6 a blank is shown completely squared and ready for filling and closing. The illustrated form of blank is designed to be closed by glueless means, but it is obvious that the box ends may also be sealed by adhesive.

In the illustrated embodiment of the invention the blank presquaring or prefolding obstacle is combined with the lower blank retaining lip at the gate. This results in a particularly simple construction.

The degree of prefolding is readily controlled by either the inclination of the surface 21 (a downward inclination producing a lesser degree of prefolding) or the width w (FIG. 5) or both.

The obstacle may obviously be installed at a point farther along the path of the blank so that the blank meets it at a later movement. Such details and modifications are within the skill of the box machine mechanic and are readily determined on the basis of shape and size of blank, machine layout and other details.

As seen from FIG. 5, the suction cups proper 23 are mounted on collapsing bellows 23' causing the cups to be drawn towards the carrier 24 immediately upon contact of the mouth of the cup 23 with the foremost blank in the magazine. This action causes limited opening of the blank as shown in FIG. 1 and prevents the front and back panels of the blank from adhering by permitting air to pass therebetween before the blank strikes the obstacle 21.

The swinging drive arms 25 are power-operated and their motion is timed with respect to the conveyor chains 33, 34.

FIG. 7 illustrates a modified tilt control mechanism for the carrier 24. Its control arm 27' is linked to the stud by a drag link 46.

The drag link permits the carrier 24 initially to move

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away from the magazine and withdraw the blank B from the upper retaining lips 18' without tilting. Shortly after escaping the grip of the lips 18', but while the blank is still in engagement with the horizontal portion 21 of the obstacle 19, the tilt control arm 27' and the drag link 46 cause the blank to tilt until the blank assumes a substantially horizontal position above the conveyor 33 at the deposit station. The deposit station may be defined as the point at which the pivot axis 26 reaches the end of its arcuate path. The blank then drops onto the conveyor 33.

In place of the two individual stabilizing pins 40 shown in FIG. 1, the carrier shown in FIG. 7 is fitted with a U shaped bar 40' which provides an enlarged area of engagement with the blank.

The prefolded blank then moves along the conveyor path propelled by the trailing lug 36 and approaches the leading lug 35 which moves at a slightly slower linear rate. As a result, the length of the conveyor compartment in which the blank rests is reduced, thereby re-squaring the blank between lugs 35 and 36.

Means are provided for raising the leading portion of the blank, more particularly its edge 47 so as to engage the lug 35 at an elevated point 48 high enough to provide clearance for the leading box panel which moves into an upright position.

In the illustrated embodiment the leading portion of the blank is raised by ramp structures 49 alongside the conveyor. Raising of the leading edge eliminates the need for the point of engagement 48 to slide or shift upwardly while the blank is being re-squared. Some types of board engage the conveyor lugs with a considerable degree of friction, and misshapen boxes are likely to result, particularly during high speed operation, if the clearance below point 48 is insufficient. The blank raising devices eliminate this danger.

What is claimed is:

1. In a folding box machine comprising a magazine for storing flat collapsed tubular blanks and a compartmented endless conveyor into whose compartments the blanks are placed and in which the blanks are then squared, a blank presquaring device comprising: a blank carrier including suction cup means for grasping a blank; means for moving said carrier on an arc from a first position at the magazine at which the mouth of said cup means is in a first upright plane to a second position at a blank deposit station adjacent said conveyor at which the mouth of said cup means is in a second substantially horizontal plane, said two planes being disposed substantially at a right angle to each other; and an obstacle in the path of the blank carried by said carrier, said obstacle being mounted adjacent said first plane and at a distance from the apex of said right angle less than the distance of said cup from the apex to flex the obstacle engaged blank portion relatively to the cup engaged portion, the arrangement being such that a blank fold line disposed generally transverse to the direction of blank movement lies between the obstacle engaged blank portion and the cup engaged portion.

2. In a folding box machine for squaring tubular box blanks normally stored in flat collapsed condition in a magazine and subsequently squared in a contractible compartment of a conveyor, a blank presquaring device comprising: a blank carrier including a suction cup for grasping a blank; means for moving said carrier along a 90 degree arc from a first position at the magazine at which the mouth of said cup is in a substantially vertical plane to a second position adjacent said conveyor at which the mouth of said cup is in a substantially horizontal plane, said two planes defining a right angle between them; and an obstacle fixed in relation to said magazine and mounted adjacent said vertical plane at a distance from the apex of said right angle less than the distance of said cup from the apex, the arrangement being such that the

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cup engaged blank portion lies on one side of a blank fold line disposed substantially transverse to the direction of the carrier movement and that the obstacle engaged blank portion lies on the other side of said fold line, so as to cause folding of the blank at said fold line.

3. A device for squaring flat collapsed tubular box blanks comprising, in combination, a magazine for storing said flat collapsed blanks, said magazine comprising a withdrawal gate through which individual blanks may be withdrawn; a blank carrier including suction cup means for grasping a blank; means for moving said carrier along an arcuate path from said gate at which the mouth of said cup means lies in a first plane to a blank deposit station at which the mouth of said cup lies in a second plane, said two planes being disposed substantially at a right angle to each other; and an obstacle mounted along the path of said carrier at a distance from the apex of said right angle less than the distance of said cup means from the apex in a position to engage a portion of a blank carried by said carrier and displace said portion relatively to the cup-held portion of the blank, the arrangement being such that a certain box body fold line parallel to the fold lines along which the blank is originally collapsed and which are disposed transverse to the direction of movement of the blank with said carrier lies between said cup-held portion of the blank and the obstacle engaged portion of the blank, said blank being substantially flat at said certain fold line and being folded by engagement with said obstacle.

4. A device for squaring flat collapsed tubular box blanks comprising, in combination, a magazine for storing said flat collapsed blanks in a position in which the collapsing lines are substantially horizontal, said magazine including an upright withdrawal gate through which individual blanks may be withdrawn; blank retaining means at said gate including a top element marginally overlapping the top portion of the foremost blank, and a bottom element marginally overlapping the bottom portion of the foremost blank, the top and bottom portions of the blank being defined by collapsing fold lines along which the blank is folded 180 degrees, said bottom element comprising an obstacle portion extending at an angle to the plane of the foremost blank; a blank carrier including suction cup means for grasping the foremost blank; and means for moving said carrier on an arcuate path from said gate at which the mouth of said cup means lies in a first plane to a blank deposit station at which the mouth of said cup means lies in a second plane, said two planes being disposed substantially at a right angle to each other, said obstacle portion being at a shorter distance from the apex of the right angle than the cup means, the path being such that motion of the cup-held blank causes the bottom portion of the blank to slide along said obstacle portion to displace the collapsing fold line at the bottom relatively to the cup-held blank portion, said blank comprising a further fold line between said last named collapsing fold line and said cup-held portion, along which further fold line the blank was originally flat while in the magazine and is folded into angular position by engagement with said obstacle portion.

5. A device for squaring flat collapsed tubular box blanks comprising, in combination, a magazine for storing said flat collapsed blanks on edge in a substantially vertical position with the collapsing lines of the blanks substantially horizontal, said magazine including an upright withdrawal gate through which the foremost blank may be withdrawn; blank retaining means at said gate including a top element marginally overlapping the top portion of the foremost blank, and a bottom element marginally overlapping the bottom portion of the foremost blank, the top and bottom portions of the blank being defined by collapsing fold lines along which the blank is folded 180 degrees; a blank carrier including suction cup means for grasping the foremost blank; means for supporting

said carrier for movement on an arc from a first position at said gate at which the mouth of said suction cup means lies in an upright plane to a second position at which the blank is deposited and the mouth of said suction cup means lies in a substantially vertical plane forming an angle with said upright plane; an obstacle element extending at a slant to the said upright plane adjacent the bottom of the magazine gate for intercepting and deflecting a portion of a blank moved by said carrier on its arcuate path relatively to the portion of the blank grasped by said cup means, said obstacle element being at a shorter distance from the apex of said angle than the path of said suction cup means; and a stabilizing element on said carrier at a greater distance from said apex than said cup means for engaging and stabilizing the cup-held portion of the blank against tilting at the suction cup when the blank moves past said obstacle element.

6. In a folding box machine comprising a magazine for storing flat collapsed tubular blanks and a compartmented endless conveyor into whose compartments the blanks are placed and in which the blanks are then squared by contraction of the compartments, a blank pre-squaring device comprising: a blank carrier including suction cup means for grasping a blank; a drive arm for oscillating said carrier on an arcuate path about a first axis substantially parallel to the plane of the blanks in the magazine, said arcuate path extending between the magazine at which the mouth of the cup means lies in a first plane to a blank deposit station adjacent said conveyor at which the mouth of the cup means lies in a second plane disposed at an angle to said first plane; means for tiltably supporting said carrier on said drive arm about a tilt axis substantially parallel to, and spaced from, said tilt axis; tilt control means for controlling the tilt of said carrier about said tilt axis while the carrier transverses said path, said tilt control means comprising, a control arm on said carrier, a pivot, and a drag link between said control arm and said pivot; and an obstacle mounted at a shorter distance from the apex of said angle than any portion of the path traversed by said cup means, said obstacle being in a position to engage a portion of a blank carried from

the magazine to the blank deposit station and to flex the obstacle engaged blank portion relatively to the cup engaged portion, the arrangement being such that a blank fold line disposed generally transverse to the direction of blank movement lies between the obstacle engaged blank portion and the cup engaged portion.

7. In a folding box machine for squaring tubular box blanks normally stored in flat collapsed condition in a magazine and subsequently squared in a contractible compartment of a conveyor, a blank presquaring device comprising: a blank carrier including suction cup means for grasping a blank; means for moving said carrier along an arcuate path between said magazine at which the mouth of said cup means lies in a first plane and said conveyor at which the mouth of said cup means lies in a second plane, said two planes defining an angle between them; means for tilting said carrier relatively to the horizontal plane during traverse by the said carrier of its arcuate path, said tilting means comprising a control arm fixed on said carrier, a pivot, and a drag link between said control arm and said pivot; and an obstacle fixed in relation to said magazine and mounted at a distance from the apex of said angle less than the distance of said cup means from said apex, said obstacle being in a position to engage a portion of a blank on said carrier moving from said magazine to said conveyor and to flex the engaged blank portion in relation to the cup engaged portion, the arrangement being such that the cup engaged blank portion lies on one side of a blank fold line disposed substantially transverse to the direction of the carrier movement and that the obstacle engaged blank portion lies on the other side of said fold line, so as to cause folding of the blank at said fold line.

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