DEVICES FOR STORING AND FEEDING FOLDING BOX BLANKS

Fig. 2

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Stacks of flat folding box blanks are stored in blank magazines in which they preferably rest on edge on suitable supporting means, such as bars or rods. This arrangement offers the advantage of leaving the force exerted on the foremost blank of the stack substantially unaffected by the length of the stack, thus facilitating the removal of the blanks, one by one, by a vacuum feeder which attaches itself to the foremost blank and moves it from the magazine to a place of deposit, for example the mouth of a folding die.

The stack of blanks is held in the magazine by retaining elements which marginally overlap the foremost blank and prevent it from falling out of the magazine under the action of gravity. These elements generally have the form of lips or fingers which extend slightly past the edges of the blank, and the vacuum feeder or transport means pulls the foremost blank out of the grip of these fingers.

Many modern blanks are of complex configuration, necessitated by the need for glueless corner locks, hinge covers, cover locks, tear strips to facilitate opening of the box, etc. In addition blanks are of substantial size, yet are desired to be handled at high speed to supply equally fast operating box forming machines. It is generally not practical to grasp a blank at several widely spaced points, but it is preferred practice to grasp a principal panel, such as a box bottom or box cover panel, while letting the remainder of the blank follow along.

Large blank size and complex configuration contribute to difficulties arising from the tendency of blanks to cling together. The larger the blank, the more difficult it is to permit sufficient air to pass between the foremost and the next blank to prevent the next blank from being dragged along. Complex configuration adds to the tendency of blanks to interlock mechanically.

This invention provides mechanism for handling blanks in such a manner that they will not cling together, thus eliminating the principal cause of misfeeding of blanks.

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 this 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:

FIGS. 1 to 4 are perspective views of a feeding and blank separating mechanism incorporating this invention, the mechanism being shown in successive stages of operation;

FIGS. 5 and 6 are perspective views of the operating mechanism;

FIG. 7 is a perspective view of the vacuum control valve mechanism;

FIG. 8 is an elevational front view of the movable valve member of the vacuum control valve mechanism; and

FIGS. 9, 10 and 11 are, respectively, end views of the valve mechanism in three different positions of operation, FIG. 10 incorporating a section taken on line 10—10 of FIG. 8.

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 should be 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.

FIGS. 1 through 4 show the front end of a blank magazine in which a stack of blanks 11 rests upright on edge on supporting rods 12 and 13 extending rearwardly from a magazine gate frame 14. The blanks 11 are maintained in alignment by lateral aligning rods 15 and 16.

The foremost blank of the stack is held in the magazine against dropping out under the action of gravity by means of a plurality of blank retaining lip elements. Relatively wide lip elements 17 and 18 marginally overlap the foremost blank at the top and the bottom edges, considering the blank in its position in the magazine. Smaller lip elements 19 and 20 engage the blank near the bottom corners and further lateral lip elements 21 and 22 extend slightly beyond the side edges of the blank.

At this point the existence of the transverse bar 23 may be disregarded as this bar does not serve a comparable purpose to the lip elements 17 to 22. The bar 23 is slightly forwardly spaced with respect to the stack of blanks so that there is normally an air gap between the rear surface of the bar 23 and the foremost blank. The foremost blank is held in the magazine gate solely by the action of the retaining lip elements until the blank is withdrawn therefrom in a manner later to be described.

Two different sets of vacuum elements are provided, of which the primary function of the first set is to insure separation of the blanks, whereas the primary purpose of the second set is to transport the blank physically from the magazine to a desired point of deposit. This is normally the mouth of a forming die through which a plunger then forces the blank to set it up in box shape in a manner well known in the art. In order not to complicate the illustrations the mouth of the die is shown covered by a piece of sheet material 24 upon which the blanks are being deposited as seen at the lower right hand corner of FIGS. 1 through 4.

In the illustrated form of device the separation of the blanks is accomplished by a first pair of vacuum cups 25 mounted on arms 26 on a square tilt shaft 27 mounted in end bearings, of which one is visible at 28 in FIGS. 1 through 4, the other end bearing 29 being visible in FIGS. 5 and 6. An operating arm 30 is secured to the tilt shaft by clamping at 31 and is operated by a push rod 32 which moves up and down slightly, thereby imparting an oscillating motion to the tilt shaft 27, and a back-and-forth motion to the vacuum cups 25 in a direction substantially normal to the plane of the blank B.

A second set of vacuum cups 33 is provided whose principal purpose is to transport the blanks, one by one, from the magazine to a deposit station, in the illustrated instance the covering panel 24.

As best seen in FIG. 3, the vacuum cups 33 are mounted on arms 34 which, in turn, are clamped to a transverse feeder bar 35 at 36. The construction of the transporting feeder per se of which the vacuum cups 33
represent the blank gripping element is known. Its construction and the details of the mechanical motions involved are disclosed in the United States Patent No. 2,624,249, dated January 6, 1953.

For the purpose of explanation of the present invention, it is sufficient to state that the ends of the transverse feeder bar 35 are secured to double armed levers 37, one at each end of the bar 35. The double armed lever 37, as best seen in FIG. 5, is pivotally mounted at 38 on the end of an oscillating lever 39, pivotally mounted on the machine frame 40 at 41. The oscillating lever 39 is operated by a push rod 42 leading to the machine drive and linked to the oscillating lever at 43.

Returning to the double armed lever 37, to one end of which the transverse feeder bar 35 is mounted, the other end of the lever 37 is shaped as a track for slideable as well as pivotal engagement with a control pivot 44, best seen in FIG. 5. FIG. 5 shows the opposite end of the transverse feeder bar 35 and the opposite oscillating lever, it being understood that the lever mechanisms on both ends of the feeder bar 35 are identical.

The track on the double armed lever is formed by two plates 45 and 46 bolted to the end 47 of the double armed lever 37 at 48 and 49.

The control pivot 44 is an anti-friction bearing mounted on one arm of an angle lever 50, from the other arm of which a connecting rod 51 extends to a pivot point 52 on the oscillating lever 39. The point 52 is best seen in FIG. 6.

The angle lever 50 is pivotally mounted on the machine frame 40 at 53 and is operated so as to cause the control pivot 44 to oscillate on an arc.

As the oscillating lever 39 is rocked about its pivot axis 41 by the action of the push rod 42, its rocking motion is transmitted to the lever 50 by the connecting rod 51, and the angle lever 50 rocks back and forth. The control pivot 44 moves on an arc about the point 53 modifying the tilt of the double armed lever 37 imparted by its own operating lever 39.

The oscillating lever 39 has a plate 54 secured to it to which the end of the push rod 32 is bolted at 55. An optional hole in the plate 54 for installation of the bolt is seen at 55. The push rod 32 engages the bolt 55 and, as the oscillating lever 39 rocks back and forth, the bolt connection 55 causes the push rod 32 to move up and down thus producing the aforementioned motion of the vacuum cups 25. The extent of the push rod movement can be seen by comparing FIGS. 5 and 6.

It is thus seen that the motion of the upper pair of vacuum cups 25 is coupled with the motion of the transverse feeder bar 35 carrying the lower pair of vacuum cups 33.

Considering the timed relationship of the action of the two pairs of vacuum cups, FIG. 1 shows the position in which the transporing vacuum cups 33 just released a blank B2 which lies on the surface 24. Immediately prior to the illustrated instance of operation the separating vacuum cups 25 made contact with the upper portion of the foremost blank B2 in the magazine above the transverse bar 23. Vacuum is applied to the cups 25 by a control valve mechanism later to be described causing the cups 25 to attach themselves to the blank B2 and further causing the mouths of the cups to retract teleologically towards the observer by collapse of the bellows chambers 12. Since the foremost blank is pulled away from the second blank of the stack. This condition is illustrated in FIG. 1.

The separating cups 25 then continue to move towards the observer by reason of the tilting of the supporting tilt shaft 27, with the result that the foremost blank is pulled out from under the top retaining lip 17.

During the described blank separating action the transporting cups 33 are moving towards the magazine gate in order to grasp the bottom portion of the blank B2 whose top portion was just pulled free of the lip 17 by the separating cups 25.

During the terminal portion of the upward motion of the transporting cups 33 vacuum is applied to the cups 33 through the flexible duct 56. As soon as the cups make contact with the blank B2, the cups attach themselves to the blank and retract slightly by reason of the collapse of their associated bellows chambers 13.

Meanwhile the transverse feeder bar 35 performs a translatory motion towards the observer causing the bottom portion of the blank B2 to be pulled out of the grip of all of the retaining lips below the transverse bar 23. At about this moment atmospheric pressure is restored to the upper vacuum cups 25 which release the blank and move slightly towards the magazine by expansion of their associated bellows chambers 12. Even when extended, however, there is ample clearance between the foremost blank and the mouths 25 of the upper cups so as to permit withdrawal of the blank B2 by the lower transporting cups 33 without interference.

When released the upper portion of the blank B2 moves slightly towards the stack of blanks in the magazine and comes to rest in a position on top of the upper retaining lip 17. This insures maintenance of an ample cushion of air between the upper portion of the blank B2 and the next blank B3 in the stack.

FIG. 7 shows the transporting cups 33 during the initial stage of the feeding motion. More particularly the feeding motion comprises three principal phases as follows:

During a first phase the cups 33 are moved away from the magazine gate towards the observer by a substantially horizontal translatory motion of the feeder bar 35. The first phase is followed by a second phase during which the feeder bar 35 swings approximately on an arc downwardly as is readily seen by comparing FIG. 3 with FIG. 4. This swinging motion ends when the transported blank arrives above the deposit station and is then followed by a third translatory phase during which the feeder bar 35 moves vertically downward to deposit the blank. At the end of the vertical stroke vacuum is cut off and atmospheric pressure is restored in line 56 causing the cups 33 to release the blank.

The characteristics of the feeder motion are described and illustrated in considerable detail in the aforementioned Baker et al. Patent No. 2,624,249.

It is seen that the blank B2 is transported by the feeder cups 33 which attach themselves to one of the principal panels, more particularly the bottom panel of the box to be formed near one end of the blank. This arrangement facilitates the complete separation of the grasped blank from the various retaining lips 18 through 22 for the lower portion of the blank and also insures dependable separation of the grasped blank from the next blank in the stack.

In order to control the motion of the top portion of the blank which trails during the feeding motion, it has been found convenient to provide the transverse bar 23, particularly in the case of long blanks.

The blank B2 is pulled out from under this bar by the action of the feeder cups 33. The bar 23 prevents flutter of the trailing box cover panel portion of the blank and causes even large blanks to move in a way in which a minimum of air resistance is encountered during the rapid downward swing of the blank towards the deposit position.

The flexible duct 56 of the transporting cups leads to a control valve mechanism to which also the separating cups 25 are connected by a separate flexible duct 57. The control valve mechanism is illustrated in FIG. 7 and its action is further illustrated in FIGS. 8 to 11.

The control valve mechanism comprises a movable valve member 58 comprising two portions 59 and 60 cooperating with stationary valve blocks 61 and 62. The movable valve member portions 59 and 60 are mounted on a common shaft 63 and are provided with an actuating vane 64 which lies in the path of two abutment or stops...
The arrangement of the stops 65 and 66 with respect to the vane 64 is such that rocking of the oscillating lever 39 causes the movable valve members 58 to be tilted into one or the other of the two extreme positions shown in FIGS. 9 and 11, respectively.

The valve blocks 61 and 62 have central air passages to which vacuum lines 69 and 70 extend from a suitable source of vacuum, for example a vacuum pump. The tops of the blocks 61 and 62 are provided with cylindrical seats in which the valve member portions 59 and 60 rest.

The valve member portions 59 and 60 have ports 71 and 72 from which nipples extend at 73 and 74. Duct 57 is connected to nipple 73 which lies in back of the shaft axis of the valve member 58 and terminates at the port 71. The duct 56 is connected to nipple 74 which lies in front of the shaft axis 63 and terminates at the port 72, as seen in FIG. 7. In the illustrated position the port 72 is open to the atmosphere and, as a result, atmospheric pressure prevails in the flexible duct 56 leading to the transport cups 33. This position is also shown in FIG. 9. Duct 71 is vented to the atmosphere, as a result of which atmospheric pressure is restored in duct 57 leading to the separator cups 25. This position is shown in FIG. 11. If the valve member 58 were moved into a halfway position as shown in FIG. 10, both ports 71 and 72 are closed, both with respect to the atmosphere and also with respect to the vacuum ducts 69, 70 leading to the vacuum pump.

In the position shown in FIG. 9 vacuum is applied to the separator cups 25 by duct 57 whose port 71 is in communication with the vacuum line 69. In the position shown in FIG. 11 the vacuum line 70 supplies vacuum via port 72 to the cups 33 which the duct 56 is connected leading to the transport cups 33.

In the position shown in FIG. 7 the stop 65 has engaged the vane 64 and has just turned the valve member 58 in a clockwise direction, opening port 72. At this moment the stop 66 is in its former position away from the observer. During the return oscillation of the lever 39 the stop 66 engages the vane 64 and turns the valve body 59, 60 back into the position shown in FIG. 11.

Reviewing briefly the phases of operation of the valve mechanism, it is seen that in the position of FIG. 1 vacuum is applied to the separator cups 25 while the transporting cups 33 are vented. This condition still prevails in FIG. 2. In FIG. 3 the separating cups 25 are vented, whereas vacuum is applied to the transporting cups 33. This condition also prevails in FIG. 4 in which the blank B2 approaches the deposit position at which the transport cups 38 then are vented, whereupon vacuum is applied to the separating cups 25 as shown in FIG. 1. This completes the cycle.

What is claimed is:

1. A blank feeder for folding box blanks, the feeder comprising, in combination, a blank magazine comprising bottom support means for supporting a stack of blanks on edge by the bottom of the blanks, lateral aligning means adjacent the lower portion of the blanks, and a gate including upper and lower blank retaining elements marginally overlapping the upper and lower portions, respectively, of the foremost blank in the magazine; a first and a second vacuum element mounted to engage the lower and the upper portions, respectively, of the foremost blank at said gate; first carrier means for moving said first vacuum element on a first path between a pickup position at the gate out of the grip of said lower retaining element to a deposit position remote from said gate; second carrier means for moving said second vacuum element on a second path between a pickup position to a release position at which the upper blank portion is withdrawn from said upper retaining element, the second path being shorter than the first path and so laid out as not to displace the lower blank portion with respect to said aligning means; means for operating said first and said second carrier means in timed sequence; and control means for supplying vacuum to, and relieving vacuum at, said first and said second vacuum elements in sequence such that vacuum is applied to said second vacuum element before vacuum is applied to said first vacuum element for the purpose of grasping the same blank and that, further, vacuum is relieved at said second vacuum element before the first vacuum element under vacuum moves away from the gate to withdraw the blank.

2. A blank feeder for folding box blanks, the feeder comprising, in combination, a blank magazine comprising bottom support means for supporting a stack of blanks on edge by the bottom of the blanks, lateral aligning means adjacent the lower portion of the blanks, and a gate including lower and upper retaining elements marginally overlapping the lower and the upper portion, respectively, of the foremost blank in the magazine; a first and a second vacuum element mounted to engage the lower and the upper portions, respectively, of the foremost blank at said gate and to withdraw the said blank portion from the grip of said lower and upper retaining elements, respectively; means for moving said first vacuum element on a first path between the gate at which said first vacuum element makes contact with the lower portion of the foremost blank and a deposit station remote from said gate; during the first portion of which path the first element withdraws the blank from said lower retaining element; second carrier means for moving said second vacuum element on a second path of a length sufficient to remove the grasped blank portion free from the grip of said upper retaining element, yet short enough as not to displace the lower blank portion with respect to the lower retaining element; means for supplying vacuum to, and relieving vacuum at, said first and said second vacuum elements in such a sequence that one portion of the foremost blank is first withdrawn from the grip of said upper retaining element by said second vacuum elements and that subsequently the blank is withdrawn from the grip of said lower retaining element by said first vacuum element.

3. A blank feeder for folding box blanks, the feeder comprising, in combination, a blank magazine comprising bottom support means for supporting a stack of blanks on edge by the blank bottoms, lateral aligning means adjacent the lower portion of the blanks, and a gate including lower and upper retaining elements marginally overlapping the upper and the lower portion, respectively, of the foremost blank in the magazine; a first and a second vacuum element mounted to engage the lower and the upper portions, respectively, of the foremost blank at said gate and to withdraw the said blank portions from the grip of said lower and upper retaining elements, respectively; first carrier means for moving said first vacuum element on a first path between a pickup position at said gate and a deposit station remote from said gate; second carrier means for moving said second vacuum element on a second path, shorter than said first path, and of a length sufficient to remove the grasped blank portion from the grip of said upper retaining element, yet short enough as not to displace the lower blank portion from the grip of said upper retaining element; means for operating said first carrier means and said control means in timed sequence such that the second vacuum element grasps and moves the upper blank portion from the grip of said upper retaining element before the first vacuum element removes the blank from the grip of said lower retaining element and moves the blank to the deposit station.
4. A device for storing and feeding folding box blanks comprising, in combination, a magazine comprising supporting rods for supporting and aligning a stack of upright blanks on edge and further comprising a pair of lower blank retaining lip elements and at least one upper lip element for marginally overlapping the lower and the upper portion, respectively, of the foremost blank of the stack to hold the blank in the magazine against the action of gravity; a first vacuum element; first short-stroke reciprocating motion means for moving said first vacuum element into contact with the upper portion of the foremost blank in the magazine, the stroke length being sufficient to withdraw the blank from said upper lip element, yet so short as not to displace the lower portion of the blank with respect to said rods; first valve means for applying vacuum to, and relieving vacuum at, said first vacuum element; a second vacuum element; second motion means for moving said second vacuum element into contact with a portion of the foremost blank below said upper portion; the stroke of said second motion means being longer than the stroke of said first motion means and sufficient to withdraw the blank from said lower lip elements and to remove the blank entirely from said magazine and said rods to a point of deposit; second valve means for applying vacuum to, and relieving vacuum at, said second vacuum element; and joint operating means for operating said first and said second motion means and said first and said second valve means in timed sequence such that the withdrawal of such blank from said upper lip element by said first vacuum element is completed before withdrawal of the blank from said lower lip elements by said second vacuum element.

5. A device for storing and feeding folding box blanks comprising, in combination, supporting means for supporting a stack of upright blanks on edge; a substantially upright magazine gate comprising a transverse bar extending across and being spaced from, the foremost blank of a stack of blanks resting on said supporting means and an upper and a plurality of lower lip elements marginally overlapping the foremost blank above, and below, said bar, respectively; a first vacuum element; first short-stroke reciprocating motion means for moving said first vacuum element into contact with the upper portion of said foremost blank above said bar and withdraw it from said lower lip elements, the stroke of said first motion means being predominantly normal to the plane of the foremost blank, considering the blank as held by said lip elements, and sufficiently short as not to displace the lower blank portion below said bar of the blank with respect to said supporting means; a second vacuum element; second long-stroke motion means for moving said second vacuum element into contact with the lower portion of said foremost blank below said bar and withdraw it from said lower lip element, the stroke of said second motion means having a downward component substantially parallel to the plane of the foremost blank for withdrawal of said blank from under said bar; second valve means for applying vacuum to, and relieving vacuum at, said second vacuum element; and joint operating means for operating said first and said second motion means and said first and said second valve means in timed sequence such that the withdrawal of each blank from said upper lip element by said first vacuum element is completed before withdrawal of the blank from the lower lip elements by said second vacuum element.

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