BAG OPENING APPARATUS

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Filed Aug. 19, 1966, Ser. No. 569,196

Int. Cl. B65b 43/30

U.S. Cl. 53—386

14 Claims

ABSTRACT OF THE DISCLOSURE

The bag opening device includes a turntable rotatable about a vertical axis and which moves intermittently through four angularly spaced stations. At the first station, a bag is removed from a hopper by suction cups on the turntable. At the second station, the bag is opened up by suction cups engaging the outer surface of the bag, and a mandrel enters the bag to open it fully. At the third station the opened bag is discharged onto a conveyor which delivers the opened bag to other equipment for filling and closing the bags.

This invention relates to an improvement in bag opening apparatus and deals particularly with a device for removing flat bags from a hopper, spreading the opposite sides of the bag apart, inserting a means for squaring up the walls and bottom of the bag, and discharging the opened bags from the machine.

Bags of the type are used for the packaging of bulk cookies and the like are often formed with two opposed main panels, the corresponding side edges of which are connected by a pair of gusset panels which are folded into face contact between the edge portions of the main panels. One end of the bag is normally closed by folding the lower edge of the bag body and adhering it to the outer surface of one of the walls. When this type of bag is to be used, the gusset panels are folded into a common plane in right angular relation to the main panel. Simultaneously, the lower end portions of the main panels are folded into a common plane to provide a square end on the bag. This operation is usually done manually. The opened bags are filled with the desired amount of product, and the upper end of the bag is folded and sealed by adhesive or other suitable means.

It is an object of the present invention to provide an apparatus for removing the flat folded bags from a hopper, opening the bags by spreading the main panels of the bags apart, inserting a plunger into the bag, and expanding the bags into rectangular form simultaneously pressing the bottom of the bag against a suitable platform. The bags then opened are discharged from the machine, as for example, by a conveyor leading to the bag filling apparatus.

A feature of the present invention resides in the provision of an apparatus which preferably comprises a turntable which is usually rotatable about a vertical shaft. The table is rotated 90° at a time and remains stationary in each position for a dwell period between the periods of movement. A plurality of bag carriers, normally four in number, are supported by the turntable. A bag hopper is provided adjoining the bag carrier in one of the positions of rotation and means is provided for removing a bag from the hopper during the dwell period of the turntable. As the bag is moved to its next position, means are provided for drawing the sides of the bag apart, inserting a mandrel to square up the bag, and for removing the mandrel from the bag. In a third position, a conveyor or other means is provided for receiving the opened bag.

A feature of the present invention resides in the provision of a device of the type described in which the opposite sides of the bag are pulled apart by suction cups engaging opposite bag panels and pulling them apart. While held in this position, a mandrel is lowered into the open end of the bag, the mandrel having a cooperative platform engageable with the bottom edge of the bag to insure its proper forming.

These and other objects and novel features of the present invention will be more clearly and fully set forth in the following specification and claims.

In the drawings forming a part of the specification, FIGURE 1 is a front elevational view of the bag opening apparatus, showing the general arrangement of parts therein.

FIGURE 2 is a side elevational view of the apparatus illustrated in FIGURE 1.

FIGURE 3 is a side elevational view of a bag of the type illustrated, the thickness of the material being increased for the purpose of illustration.

FIGURE 4 is a top elevational view of the bag while supported by a pair of suction cups.

FIGURE 5 is a diagrammatic view showing in vertical section a portion of the bag hopper and the means for supporting and reciprocating the suction cups for removing a bag from the hopper.

FIGURE 6 is an enlarged sectional view through the slide for reciprocating the suction cups, the position of the section being indicated by the numeral 6—6 of FIGURE 5.

FIGURE 7 is a diagrammatic view showing the drive means including Geneva motion device for rotating the turntable at intervals from a constantly rotating power source.

FIGURE 8 is a vertical sectional view through the apparatus while located at the bag opening position.

FIGURE 9 is a vertical sectional view through a portion of the drive means for the bag holding head and turntable.

FIGURE 10 is a sectional view on the line 10—10 of FIGURE 8.

FIGURE 11 is a view similar to the upper portion of FIGURE 8, showing the position of the parts before the bag is opened.

FIGURE 12 is a sectional view through the slide supporting the suction cups which are engageable with the outer surface of the bag, the position of the section being indicated by the line 12—12 of FIGURE 11.

FIGURE 13 is an elevational view of the support for the suction cups engaging the outer surface of the bag.

FIGURE 14 is a diagrammatic view showing in section the suction cups support and one of the suction cups shown in FIGURE 13; portions of the section being taken in two different planes.

FIGURE 15 is a horizontal sectional view through the turntable supporting shaft above the turntable showing the various reciprocable bag carrying means.

FIGURE 16 is a plan view of the double cam used for reciprocating the inner and outer suction cups, the position of the section being indicated by the line 16—16 of FIGURE 8.

FIGURE 17 is an end elevational view of one of the sucker heads.

FIGURE 18 is a diagrammatic elevational view of the expandable and retractable mandrel used for squaring up the bags, showing the mandrel in elevated position.

FIGURE 19 is a view similar to FIGURE 18 showing the mandrel in position within the bag.

FIGURE 20 is a horizontal sectional view through the mandrel support and means for expanding the same, the position of the section being indicated by the line 20—20 of FIGURE 18.

A FIGURE 21 is a horizontal view of the mandrel support with the mandrel in expanded position, the position...
of the section being substantially on the line 21—21 of FIGURE 19.

FIGURE 22 is a horizontal section through the mandrel in expanded form, the position of the section being indicated by the line 22—22 of FIGURE 19. FIGURE 23 is a side elevational view of the mandrel support and mandrel in expanded position. FIGURE 24 is a perspective view of the bag in its opened position.

FIGURE 25 is a diagrammatic view showing the vacuum system for the suction cups.

The bag opening apparatus is indicated in general in FIGURES 1 and 2 of the drawings by the letter A. The machine A is supported by an upright frame which is rectangular and substantially square in horizontal section. The frame includes front and rear panels 10 and 11 and parallel side panels 12 and 13. The various wall panels are apertured in order to provide access to the interior of the frame. Horizontal partition panels 14, 15, and 16 extend across the frame from one side panel 12 to the other side panel 13, the partition panels 14 and 15 extending from the front panel 10 to a point spaced from the rear panel 11, as indicated in FIGURE 2 of the drawings, while the partition panel 16 extends entirely across the frame.

A motor 17 is mounted upon the partition panel 16 and is connected to a gear case 19 through a suitable coupling 20. The gear housing 19 drives a vertical shaft supporting a drive gear 21. The drive gear 21 is in mesh with a relatively large diameter gear 22 mounted upon a vertical drive shaft 23. The various mechanisms forming a part of the apparatus are driven by the vertical drive shaft 23, as will be later described. The drive shaft 23 is supported by suitable bearings 24 and 25 mounted upon the partition panels 16 and 15 respectively.

With reference to FIGURE 8 of the drawings, a parallel vertical shaft 26 is supported by suitable collars 27 and 28 on the partition panels 15 and 16 respectively. The shaft 26 supports a hub 30 mounted upon vertically spaced bearings 31 to permit rotation of the hub about the fixed shaft 26. The female driven member or star wheel member 32 of a geneva motion member is provided at the lower end of the hub 30. A flange 28 is provided at the upper end of the hub 30. The flange 28 is bolted to a turntable which is indicated in general by the numeral 33 by means of bolts 34. The turntable 33 acts as the means of conveying the bags from one position to another, as will be later described.

The drive connecting the drive shaft 23 to the female driven member 32 of the geneva drive is illustrated in FIGURES 7 and 9 of the drawings. A gear 35 is mounted upon the drive shaft 23 and is in engagement with a gear 36 mounted upon a vertical counter shaft 37 mounted in suitable bearings 39 and 40 on the partition panels 14 and 15 respectively. The male drive member or cam wheel member 41 of the geneva drive mechanism is bored or otherwise secured, as indicated at 42, to the gear 36. A roller 43 projects upward from the Geneva drive member 41 near the periphery thereof. The roller 43 is engageable in the radial slots 44 of the female Geneva drive member. As is customary in such devices, the areas of the female Geneva drive member 32 between the slots 44 are concavely arcuate and are engageable with an arcuate wall 46 on the male drive member 41. The engagement of the wall 46 with the arcuate surfaces 45 of the geneva drive member 32 bold the drive member 32 from movement during three-quarters of the rotation of the drive member 41. As a result, the turntable 33 is rotated 90° during one-quarter of the revolution of the drive member 41, and remains stationary during the other three-quarters of each rotation thereof.

THE TURNTABLE

The turntable 33 is constructed as is best illustrated in FIGURE 15 of the drawings. The turntable includes a disk-like center portion 49 having four radially extending arm portions thereupon, these arm portions being indicated by the numerals 50, 51, 52, and 53. These arms are arranged in right angular relation, and are designed to support sacker heads which are movable parallel to the longitudinal axes of the arms.

The sacker heads are indicated in general by the numeral 54, and each includes a vertical plate 55 having a pair of suction cups 56 mounted upon the forward surface thereof. Each sacker head includes, near the lower end of the plate 55, a forwardly projecting lug 57 which projects to the level of the forward faces of the suction cups.

Each sacker head 54 is supported by parallel rods, the rods being bolted to and extending rearwardly from the plate 55. Parallel rods 59 are provided for the sacker head adjaunting the end of the turntable arm 50, and are supported by a pair of spaced bearings 60 mounted upon the arm 50 adjoining the outer end thereof. A second pair of bearings 61 extend upwardly from the disk-like center portion 49 to further support the rods 59. The rods are freely movable through the bearings 60 and 61. Each sacker head also includes a rearwardly extending arm 62 which projects from the side of the plate 55 opposite from that in which the suction cups 56 and lug 57 extend. The arm 62 supports a cam roller 63 which is arranged on a vertical axis. The cam roller 63 extends above the level of the body of the sacker head for a purpose which will be later described.

The sacker head 54 which is supported at the end of the arm 52 opposite the arm 50 is supported by a pair of parallel rods 64 which are parallel and are more widely spaced than the rods 59. The parallel rods 64 are supported by a pair of spaced bearings 65 projecting upwardly from the turntable arm 52 near the end extremity thereof. The rods 64 are also supported by a pair of bearings 66 which extend upwardly from the center portion 49 of the turntable. As will be noted, each of the two opposed sacker heads may slide individually of the other.

The sacker head 54 which is supported at the end of the radially extending arm 51 of the turntable is supported by a pair of parallel slide rods 67 which extends through a pair of bearings 69 extending upwardly from the arm 51 near the end extremity thereof. The rods 67 are also supported by a pair of bearings 70 extending upwardly from the center portion 49 of the turntable.

The sacker head 54 which is supported at the end of the fourth radially extending arm 53 is attached to a pair of parallel arms 71 which are spaced more widely apart than the arms 67. The parallel rods 71 are supported by a pair of bearings 72 extending upwardly from the turntable arm 53 near the end extremity thereof. The rods 71 are also supported by a pair of bearings 73 extending upwardly from the central portion 49 of the turntable.

The pairs of rods 67 and 71 are slightly above the level of the pairs of arms 59 and 64, and the arrangement is such that each of the sacker heads may slide inwardly and outwardly relative to the others.

THE FEED MECHANISM

With reference to FIGURE 1 of the drawings, it will be noted that a pair of vertical parallel plates 74 project forwardly from the front panel 10 of the frame of the device slightly below the level of the turntable 33. A pair of spaced shafts 75 are supported by the plates 74, the two shafts 75 being provided with sprockets to accommodate a connecting chain 76. A pair of opposed hopper sides 77 are provided with internally threaded bearings 79. The shafts 75 are provided at one end with the left hand thread and at the other end the right hand thread, and one of the shafts is provided with a crank wheel 80 by means of which the shafts may be rotated in unison so that the hopper sides 77 may be moved together or apart to accommodate bags of various widths.
As indicated in FIGURE 5 of the drawings a bag supporting flange 81 of generally arcuate form extends inwardly from each hopper side wall 77 the arcuate shape of the hopper being designed to compensate for the fact that the lower ends of the bags indicated in general by the letter B is thicker than the upper ends thereof. The arcuate flanges 81 are above the internally threaded bearings 79. A bell-crank lever 82 is pivotally supported at a point 83 which is substantially the center of arcuation of the flanges 81. The lower end 84 of the lever 82 is provided with a pressure plate 85 designed to engage against the base of the other end 86 of the bell-crank lever 82. The bell-crank lever 82 is provided with a weight 87 arranged to apply a force tending to urge the bags toward the forward wall of the apparatus. As will be understood, means such as flanges are provided on the hopper sides 77 which extend in the path of the bags to prevent them from leaving the hopper without being distorted to some extent.

With reference to FIGURE 5 of the drawings, the fixed shaft 26 is anchored in fixed relation to the partition panel 16 to extend downwardly therefrom. The fixed shaft 26 supports an aperture slide guide 90. Above the center of the hopper, a second slide guide 91 is supported by an angular slide guide 91 and bracket 92 also being visible in FIGURE 1 of the drawings. An elongated slide 93 extends through the aligned guides 90 and 91. The slide guide 93 is preferably provided with tapered side edges 94 as indicated in FIGURE 6. The slide 93 is centrally longitudinally slotted as indicated at 95. A pair of shaft supporting blocks 96 project downwardly from the undersurface of the slide 93 in laterally spaced relation on opposite sides of the slot 95. As indicated in FIGURE 5, a bell-crank lever 97 is pivotally supported intermediate its ends to a shaft 99, the ends of which are supported in arm collars 100 on the inner surfaces of the side walls 12 and 13. The lower arm 101 of the bell-crank lever 97 extends through the slot 95 in the slide 93. The lower end of the lower arm 101 is longitudinally slotted as indicated at 102. A pivot pin 103 is supported by the blocks 96 and extends through the slot 102. A roller 104 encircles the pivot pin 103 and sliding in the slot 102 upon oscillation of the bell-crank lever. The slide 93 is also slotted to straddle the fixed shaft 26.

With reference to FIGURE 1 of the drawings, it will be noted that a gear housing 105 is connected to the upper end of the drive shaft 23 through a coupling 106, a vertical power input shaft 107 entering the gear housing. The output shaft 109 of the gear housing is at right angles to the input shaft 107 and is connected by a suitable coupler 110 to a horizontal shaft 111 supported by suitable bearings such as 112 and 113. The shaft 111 supports a cam 114 having an eccentric cam track 115 as indicated in FIGURE 5 of the drawings. The upper arm 116 of the bell-crank lever 97 is provided with a cam roller 17 engaged in the cam track 115.

From this description, it may be seen that rotation of the horizontal shaft 111 in timed relation to the rotation to the turntable 33 will oscillate the bell-crank lever 97 between the position indicated in full lines in FIGURE 5 of the drawings, and the position indicated in dotted lines in this figure. The under surface of the slide 93 carries a block 119 having a transverse groove 120 in its under surface, the groove 120 being designed to accommodate the cam roller 63 of any of the sucker heads. Thus, when a sucker head is swung into position inwardly of, and aligned with, the hopper, the corresponding sucker head 54 will be reciprocated forwardly until the suction cups 56 engage the surface of the innermost bag. The reverse reciprocation of the slide 93 will return the sucker head and the bag supported thereby to its original position indicated in full line in FIGURE 5. Thus, when the turntable is in any of its four rotative positions, the corresponding sucker head which is aligned with the hopper will be moved forwardly and then rearwardly to remove the front bag from the hopper and to maintain it in place upon the sucker head.

THE BAG OPENING MECHANISM

A reciprocable slide 122 is supported for movement at right angles to the direction of movement of the slide 93 by a first slide guide 123 supported by a bracket 124 on the side wall 12 of the frame, and by a second slide guide 125 supported by a bracket 126 on the side wall 13 of the frame. The slide 122 is slotted as indicated at 127 and 129 to straddle the shafts 26 and 23 respectively. The slide 93 is also slotted as indicated at 130 to straddle the shaft 26.

The slide 122 is provided at one end with a pair of spaced downwardly projecting transverse flanges 131 and 132 designed to accommodate the cam roller of a sucker head 54 therebetween. A cam 133 is supported by a flanged collar 134 keyed to the drive shaft 23. The cam 133 is provided with a cam track 135 in its under surface. The slide 122 is connected to an extension arm 136 upon which is supported a cam roller 137 engaged in the cam groove 135. As the cam 133 is rotated, the slide 122 is to be reciprocated from the retracted position shown in FIGURE 8 of the drawings to the projected position indicated in FIGURE 11 of the drawings. Reciprocation of the slide acts to first advance, and then retract, the sucker head controlled by the cam roller 63 of which is disposed between the flanges 131 and 132.

An additional slide 139 is slidably supported by a suitable track 140 mounted on the under surface of the partition panel 16. One end of the slide 139 supports a cam roller 141 engaged in the track 142 in the upper surface of the cam 143 concentric with the cam 133 and bolted thereto to rotate in unison therewith. The other end of the slide 139 supports a bracket 144 which supports a pair of spaced parallel arms 145 extending through the wall 12 of the frame above the position of the bags supported by the sucker heads 54. The spaced rods support a fixed sucker head unit which is indicated in general by the numeral 146. By using the term “fixed” it is not implied that the unit 146 does not reciprocate toward and away from the bag, but rather that it remains at the same station while the other sucker heads 54 rotate with the turntable 33.

As may be seen in FIGURES 13 and 14, the sucker head unit 146 as shown includes a pair of spaced collars 147 which are connected by a connecting plate 149. A vertical plate 150 is bolted to the plate 49 as indicated at 151. A pair of slide arms 152 and 153 project from the vertical plate 150 in a direction parallel to the arms 145 and support a sucker head plate 154 for limited sidable movement toward and away from the vertical supporting plate 150.

In order to support the sucker head plate 154 in parallel relation to the supporting plate 150, a tube 155 encircles the slide 153 and has a flanged end 156 bolted to the sucker head plate 154 by bolts 157 which extend through the flanged end 156 and the sucker head plate 154, and are threaded into the base of a cap 159. The cap 159 is provided with spaced internal bearings 160 near opposite ends thereof. A spring 161 encircles the tube 155 and tends to urge the sucker head plate 154 away from the supporting plate 150, separation of the plate 154 from the plate 150 is limited by the nut 158 on the slide arm 152.

The sucker head plate 154 supports a sucker suction cups 162 which are actually in opposed aligned relation to the suction cups 56 of the sucker heads 54 when the turntable is in any of its stationary positions.

The relationship between the cam tracks 135 and 142 of the cams 133 and 143 respectively is indicated in FIGURE 16 of the drawings. During the major portion of the time, the cams hold the sucker heads 64 and 146 in the spaced position illustrated in FIGURE 8 of the drawings. However, during the dwell period of the turntable when a bag B has been carried by a sucker head
4 into opposed relation to the sucker head 146, the cam 133 operates to reciprocate the slide 122 outwardly or to the left to the position shown in FIGURE 11 of the drawings. At the same time, the cam 143 acts to slide the slide 122 to the right as viewed in FIGURE 11, this action continuing until the suction cups of the two sucker heads are in engagement with opposite walls of the bag, as indicated in FIGURE 11. Further rotation of the cams 133 and 143 act to return the sucker heads to their original position. This action opens up the walls of the bag to the position indicated in dotted outline in FIGURE 8 of the drawings.

There is a specific purpose in resiliently supporting the sucker head plate 154 on the sucker head 146. As will be understood, the extent of movement of the slides 122 and 139 is determined by the cam tracks in the cams 133 and 143 respectively, and this movement cannot be changed without changing the cams themselves. The bags B which are to be opened may vary to some extent in thickness which is determined by the width of the two gusset panels. If the bag B is somewhat narrower in thickness than the distance between the suction cups 56 and 162 when the suction cups are in their spaced position indicated in FIGURE 8 of the drawings, the bag will be distorted and the opposed panels of the bag will be spread apart a distance greater than they should be in order to properly square up the bag. To obviate this difficulty, the collars 147 of the sucker heads 146 are adjustably supported on the rods 145 so that the distance between the suction cups 56 and 162 may be adjusted to be spaced apart a distance equal to the thickness of the bag. When the two sucker heads are moved together to the position indicated in FIGURE 11 of the drawings, the sucker head 146 is drawn inwards until the bag is clamped between the suction cups 56 and 162. Further inward movement of the sucker head 146 then merely slides the plate 154 towards the supporting plate 150, compressing the spring 161. As a result, the stroke of the suction cups 162 may be varied without changing the shape of the cam tracks in the cam 133 and 143.

THE BAG SQUAREING MECHANISM

Once the bag is opened up into the position shown in dotted outline in FIGURE 8 of the drawings, a mandrel is provided for expanding the bag and squaring it up. This mandrel which is indicated in general by the numeral 164, is supported for vertical reciprocation on the side panel 12 of the frame directly above the opened bag. The location of the mandrel relative to the apparatus as a whole is indicated in FIGURES 1 and 2 of the drawings. The mandrel and its details of construction are best illustrated in FIGURES 18 through 23 of the drawings.

The side panel 12 includes a central vertical plate 165, upon which is supported a pair of spaced parallel bars 166 which include opposed notches 167 which serve as opposed tracks to accommodate a vertical slide 169. Detachable retaining plates 170 are attached to the bars 166 and retain the slide 169 in its tracks. A spacer bar 171 is secured to the slide 169 and projects forwardly therefrom between the plates 170. The spacer bar is secured to a mandrel supporting bar 172 as indicated by the bolts 173. The mandrel supporting bar 172 projects downwardly below the spacer bar 171 as is indicated in FIGURE 23 and acts as a support for the collapsible mandrel 164.

The mandrel 164 is indicated in FIGURES 19, 20, 21 and 22. The mandrel 164 includes a pair of opposed plates 174 and 175 which are connected to the mandrel support 172 by means of lever arms. As indicated in FIGURE 21, an upper pivot 176 extends through the mandrel support 172 and through the ends of a pair of links 177 which are hingedly connected by pivot 179 to bosses 180 on the inner surface of the plate 175. The pivots 176 also extend through the ends of a second pair of links 181 which have their other ends pivotally connected at 182 to bosses 183 on the inner surface of the plate 174. With reference now to FIGURE 22 of the drawings, a lower pivot 184 extends through the mandrel support 172 parallel to the upper pivot 176, the pivot 184 extending through the inner ends of a pair of links 185, the upper ends of which are pivotally connected at 186 to bosses 187 on the inner surface of the plate 174. The pivot 184 also extends through the inner ends of a second pair of links 189, the outer ends of which are pivotally connected at 190 to bosses 191 on the inner surface of the plate 175. As will be noted in FIGURE 19 of the drawings, the links 181 and 185 are at all times parallel so that the plate 174 is at all times substantially vertical. Similarly, the links 177 and 189 are also at all times parallel, so that the plate 175 is at all times vertical.

It will be noted that the lower edges of the links 185 and 189 are at right angles to the plates 174 and 175 in the expanded position thereof, and are substantially flush with the lower ends of these plates. In order to form a bottom on the mandrel, bottom plates 192 and 193 are secured to the under surfaces of the links 185 and 189 respectively. The inner end of the plate 193 is notched or cut away as indicated at 194, and the cut away portion of the plate 193 is partially filled by an extension 195 on the inner end of the plate 192. As a result, the two plates cover a large percentage of the area of the bottom of the mandrel in open position, and yet the links 185 and 189 may swing into angular relation to collapse the mandrel, as indicated in FIGURE 18 of the drawings.

The mandrel 164 thus described will normally collapse into the position shown in FIGURE 18 of the drawings merely by its own weight. Means are provided for expanding the mandrel at a time when the mandrel has virtually reached the lowest point of its stroke. This means is best illustrated in FIGURES 18, 19, and 20 of the drawings.

A pair of brackets 196 are secured to the frame side 12 by bolts 197 or other suitable means. These brackets 196 are located on opposite sides of the path of travel of the mandrel 164. Each bracket supports a forwardly projecting pivot pin 199, the two pivots being parallel. A yoke 200 is pivotally supported on each pivot 199. Each yoke 200 includes a hub 201 including bearings 202 rotatable upon the corresponding pivot 199. A yoke 203 including a pair of spaced arms 204 extends radially from the hub 201. A pin 205 extends through, and bridges the gap between the arms 204. The axes of the pins 205 are parallel, and parallel to the axes of the pivot pins 199. A closely notched bar 206 also spans the gap between the two arms 204 between the pin 205 and the hub 201. A hook shaped projection 207 projects radially from the hub 201 on the side of the hub opposite that from which the yoke 203 extends.

A collar 209 is secured to the pivot pin 199 between each hub 201 and the bracket 196. Each collar 209 supports a pin 210 having a flattened end portion 211 adapted to engage the hook shaped projection 207 on each hub 201. The engagement of the projection 207 with the pin face 211 limits pivotal movement of the hub 201 about its supporting pivot pin 199. The hub 201 is held engaged upon the pivot pin 199 by any suitable means such as the bolt and washer 212.

As indicated in FIGURES 18 and 19 of the drawings, the side wall plate 165 includes a pair of laterally projecting ears 213 having forwardly projecting lug portions of the ears 213 is threaded into each lug 241. Springs 216 are detachably connected at their upper ends to the eye bolts 215 and the lower ends of these springs are engaged in the notches of the notched pins 206 straddling the yoke arms 204. The springs 216 hold the arms 204 in a substantially horizontal position as indicated in FIGURE 18, with the hook shaped projections 207 engaging the flat faces 211 of the pins 210.

Each of the mandrel plates 174 and 175 has secured to its inner surface the lower end of an arm 217. The
upper ends of the arms 217 project above the plates 174 and 175 and diverge outwardly and upwardly was indicated at 219. The arm portions 219 terminate in outwardly extending hooks 220 which may be perhaps best illustrated in FIGURE 18. These hook ends 220 are of proper shape to hook about the pins 265 spanning the yokes of the members 200. Downward movement of the mandrel causes the yoke arms 204 to pivot about their supporting pivots 199, so that the ends of the yoke arms swing farther and farther apart. In the lowermost position of the mandrel 164, the various toggle links connecting the plates 174 and 175 to the mandrel support 173 swing into the notch position indicated in FIGURE 19. This action is caused by the restraining of the downward movement of the plates and the continued downward movement of the mandrel support 172. Thus, the mandrel is expanded to its fullest extent as it reaches the bottom of its stroke and acts to square up the walls of the container.

In order to reciprocate the mandrel 164, a connecting rod 221 is provided with a bearing member 222 at one end thereof encircling a wrist pin 223 extending forwardly from the spacer block 121 of the mandrel supporting slide. The upper end of the connecting rod 221 is provided with a bearing 224 encircling the crank pin 225 of a crank arm 226 having its hub 227 secured to the end of the transverse shaft 111. Thus, once during each rotation of the shaft 211 the mandrel is lowered into a bag expanded position, raised out of the bag and contracted, and moved upwardly out of contact with the bag.

In order to assist in supporting up the bottom of the bag, a bag bottom forming mechanism which is best illustrated by the numeral 230 is provided. A slide guide 231 is attached to the forward side of the frame side 12 beneath the position of the mandrel 164. A slide 232 is vertically reciprocable in the slide 231. The slide 232 supports a forwardly projecting gusset plate 233 which may be best seen in FIGURE 1 of the drawings. A base table 234 is supported at the upper end of the gusset plate 233. An adjustable table 235 overflies the base table 234 and is adjustably supported by threaded elements 238 so that the elevation of the upper surface of the upper table 235 may be regulated.

With reference to FIGURE 1 of the drawings a gear box 236 is supported upon the partition platform 14 and is connected through a suitable coupler 237 to the lower end of the drive shaft 23. The output shaft of the gear box 236 is horizontal as indicated at 238 and is connected by a suitable coupler 249 to an aligned horizontal shaft 241 supported by suitable bearings such as 242 and 243. The shaft 241 supports a cam 244 which is engageable with the under surface of a cam roller 245 on the lower end of the slide 232. As the mandrel 164 is lowered into the bag, the table 235 engages the lower end of the bag providing a surface against which the bag may be pressed by the mandrel to insure the proper flattening of the bag bottom and a flexible tubular connection 257 to a corresponding sucker head 54 mounted upon the turntable 33. As is indicated at the right of FIGURE 8, each sucker head is provided with internal passages 259 which lead to the interior of the suction cups 56 on the sucker head 54. As is indicated in FIGURE 10 of the drawings, the upper surface of the ring 251 is provided with an arcuate slot 260 concentric with the shaft 26. The slot 260 is substantially semi-circular and is connected to a source of vacuum. The ring 251 is also provided with a pair of relatively short, diametrically opposed slots 261 and 262 which overlap slightly in their longitudinal ends on the slot 260.

As indicated in FIGURE 1 of the drawings, the horizontal shaft 241 supports three spaced cams 263, 264, and 265. These cams are designed to control switches which in turn control solenoid valves which control the vacuum to the sucker heads. The vacuum system is diagrammatically illustrated in FIGURE 25 of the drawings.

As indicated diagrammatically in FIGURE 25, the cam 263 operates a switch 266. The blade 267 of the switch 266 normally breaks the circuit between a power line L-1 and a contact 269 connected to one terminal of a valve solenoid 270. The other terminal of the solenoid 270 is connected to the line wire L-2. Actuation of the valve solenoid 270 opens the valve 271 connected by a conduit 272 to a vacuum source 273. When opened, vacuum is drawn through the conduit 274 from the slot 262. It will be noted that the slot 260 is constantly subjected to vacuum through the conduit 275 which is also connected to the vacuum source 273.

The cam 264 controls the vacuum to the slot 261. The cam 264 operates a switch 276, the blade 277 of which is connected to L-1 and is normally spaced from the fixed contact 279. The contact 279 is connected to one terminal of a valve solenoid 280, the other terminal of which is connected to L-2. When actuated, the solenoid 280 opens a valve 281. When a valve 281 is opened, a vacuum is drawn through the conduit 282 leading to the slot 261. The conduit 272 leading to the vacuum source 273 is common to all of the valves.

The cam 265 operates a switch 283, the blade 284 of which is connected to L-1, the blade being normally spaced from the fixed contact 285. The contact 285 is connected to one terminal of a valve solenoid 286, the other terminal of which is connected to L-2. The solenoid 286 controls a valve 287 connected to the flexible conducting tube 289 to the suction cups 162 of the sucker head 146. The solenoid and the solenoid operated valves are omitted from FIGURE 1 of the drawings, as they are mounted forwardly of the cams 263, 264, and 265, and the position of these cams would be hidden if the various operating valves were shown in this figure.

In the operation of the system, when the turntable 33 is rotated into a position with a sucker head 54 in opposition relation to the hopper, the cam 264 acts to open the valve 281, subjecting the arcuate slot 261 to partial vacuum. This vacuum is drawn through the passage 256 in the flange 250 of the turntable, and through the flexible conduit 257 to the sucker head 54 which is opposed to the hopper. The sucker head 54 is moved outwardly until the suction cups engage the inner surface of bag B. A return reciprocation of the sucker head draws the bag from the hopper.

After a dwell interval, the turntable 33 rotates through an angle of 90°. The passage 256 which has been in communication with the slot 261 moves into engagement with the slot 260 which slightly overlaps the slot 261 so that the vacuum supplied is continued. The vacuum in the sucker head suction cups 256 is thus maintained, and the bag B is carried 90° with the turntable. The bag then advances into opposition relation with the outer sucker head 146. Upon arrival to this position, the cam 265 acts through the solenoid 286 to open the valve 287 which draws vacuum through the vacuum line 289 to the outer
sucker head 146. The sucker head 146 is reciprocated inwardly, and the sucker head 56 is reciprocated outwardly, carrying the bag into position between the inner and outer sucker heads. The return reciprocation of the inner and outer sucker heads opens the bag into the position indicated in dotted outline and FIGURE 8 of the drawings. The vacuum in both the sucker heads continues while the expandable mandrel 164 is lowered into the bag, and the table 235 raises and engages the bottom of the bag. When the bag has been squared up by the mandrel, the mandrel is moved upwardly and the table is lowered. At this point of the operation, the cam 265 acts to close the vacuum valve 287 to release the outer wall of the bag from the sucker head 146. The vacuum to the inner sucker head 54 continues through the groove 260.

Rotation of the turntable 33 through the next 90° causes the passage 256 in the flange 250 of the turntable to move out of contact with the groove 260 but simultaneously brings this passage 256 into communication with the groove 262. Just prior to the communication of the passage 256 with the groove 262, the cam 263 has opened the valve 271 so that the vacuum to the sucker head 54 continues. After the passage 256 communicates with the slot or groove 262, it moves out of communication with the slot or groove 260. While the turntable is in this position, the cam 263 closes the vacuum valve 271, and the bag B is released.

As is diagrammatically illustrated in FIGURE 1 of the drawings, a conveyor belt 290 is supported by a pair of rollers 291 and supported by a suitable frame 292. In actual practice, the conveyor belt 290 is driven by a chain connected to a sprocket 293 on the shaft 241. However, as the manner in which the conveyor is driven is not of particular importance, the details of the drive are not illustrated. The conveyor belt 290 conveys the bags B in opened squared relation to a filling machine or to a filling station where the bags are filled.

THE BAG

The bag B may be of various styles, but is preferably of the type commercially known as Holweg style bags. As indicated in FIGURES 3, 4 and 24, bags of this type include main front and rear panels 294 and 295, with gusset panels 296 and 297 foldably connected together and to the edges of the front and rear panels along fold lines 299 and 300 respectively. The bottom of the bag is transversely folded to provide a seam 301 which is adhered to the main panel 295 forming a closed bag bottom.

From a mechanical standpoint, the turntable 33 could be rotated a greater angular distance between dwell periods. For example, the turntable could support a single set of slides and rotate 180° between a feed position and a bag opening position, releasing the bag intermediate these stations during travel after the bags are opened. A single pair of opposed slides and sucker heads could similarly be used. Three sets of radially extending slides could similarly be provided and the turntable rotated 120° between three stations. However, from a structural standpoint, the four sets of slides and sucker heads appear more practical.

In accordance with the patent statutes, we have described the principles of construction and operation of our improvement in Bag Opening Apparatus; while we have endeavored to have it understood that obvious changes may be made within the scope of the following claims without departing from the spirit of our invention.

We claim:

1. A bag opening apparatus including:
   a supporting frame,
   a turntable rotatably supported on said frame on a substantially vertical axis,
   means on said frame for intermittently rotating said turntable an angle of ninety degrees and providing a dwell period between rotations,
a hopper on said frame for supporting open ended flat bags in a generally upright position, a turntable supported on said frame for rotation about a vertical axis forwardly of said hopper, means for rotating said turntable intermittently through a predetermined angular distance, means on said turntable engageable with a wall of a bag in said hopper for removing a bag therefrom and supporting the bag for movement with said turntable, means in opposed relation to said bag supporting means after rotation of said turntable said predetermined distance for engaging the opposite wall of said bag and spreading said bag walls apart, mandrel means reciprocally supported for movement into and out of the open end of said bag while supported between said bag wall engaging means, means for releasing said bag from said opposed means before further rotation of said turntable, means for releasing said means on said turntable before movement of said turntable to its original position, said means on said turntable including suction cup means reciprocally supported by said turntable for movement radially thereof and including means for reciprocating said suction cup means.

12. The structure of claim 11 and in which said means for reciprocating said suction cups includes cam means rotatably supported on said frame.

13. In a bag opening apparatus: a frame, two pairs of suction cups, means supporting said pairs of suction cups in opposed relation for movement toward and away from one another and to engage opposite sides of a flat open ended bag therebetween and to open the bag upon separation, a mandrel, means on said frame supporting said mandrel for movement between said pairs of suction cups and to enter an opened bag supported thereby,