

[54] **ROTARY BLADE CARTON RIDDLER**

[72] Inventors: **Warren H. Harlan**, Forest Park; **Albert J. Spaeth**, Greenhills, both of Ohio

[73] Assignee: **The Procter & Gamble Company**, Cincinnati, Ohio

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[58] Field of Search **214/305, 311; 100/176**

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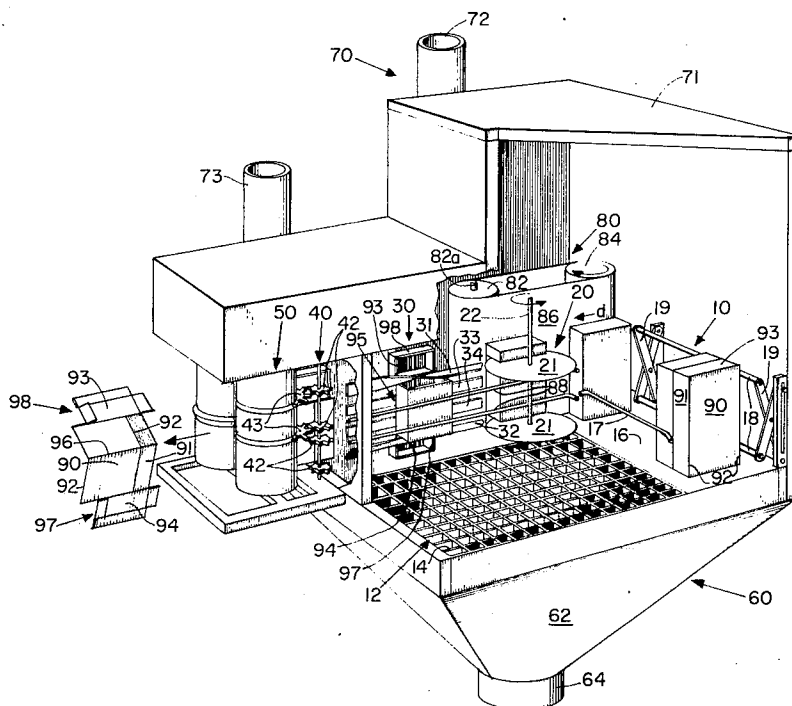
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Primary Examiner—Gerald M. Forlenza
Assistant Examiner—Lawrence J. Oresky
Attorney—John V. Gorman and Richard C. Witte

[57] **ABSTRACT**

A carton riddler is described in which the cartons are cut across three sides, top and bottom, forming articulated end flaps attached to the fourth side. The end flaps are cammed "open" and the product is dumped into a collection hopper. The carton is subsequently flattened and creased in such a way as to maintain the carton in flattened condition.

10 Claims, 3 Drawing Figures



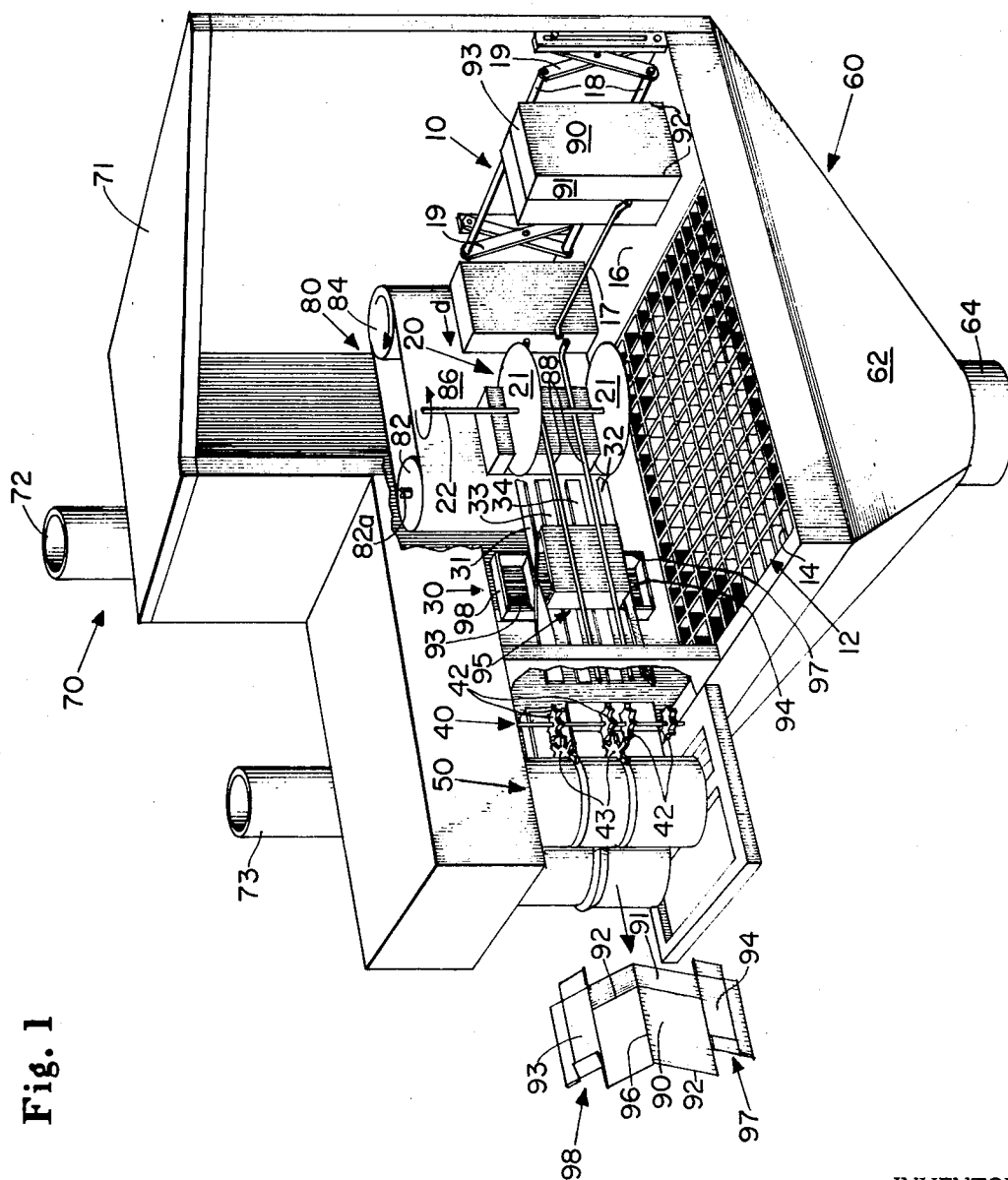
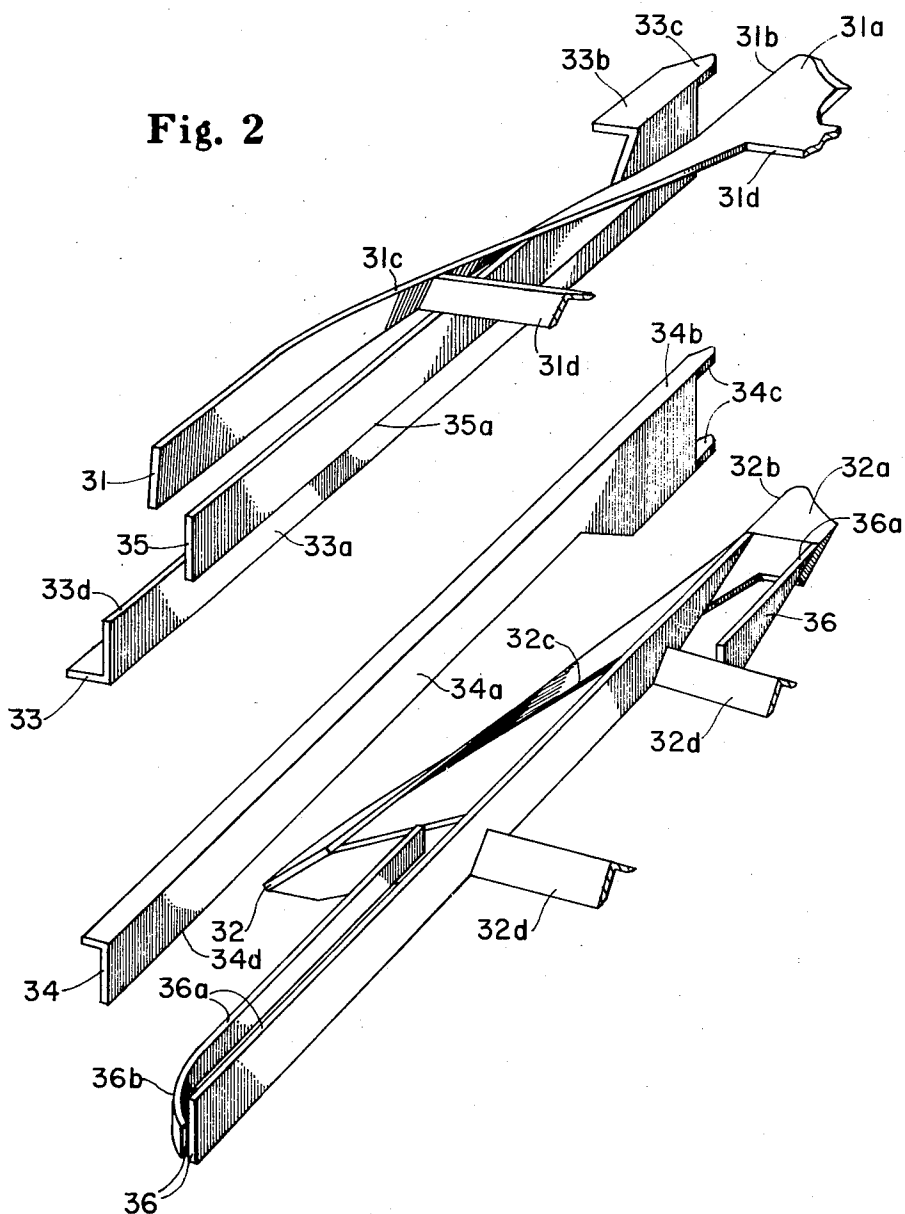


Fig. 1

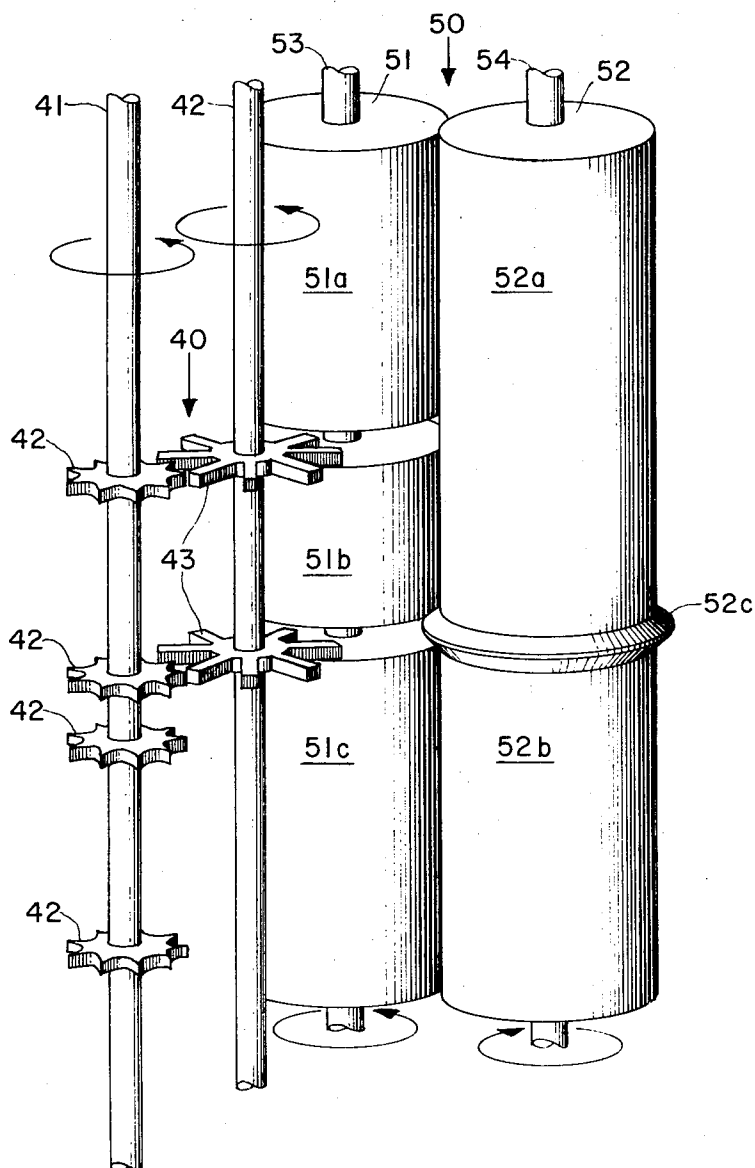
INVENTORS
Warren H. Harlan
Albert J. Spaeth
BY *John V. Gorman*
ATTORNEY

Fig. 2



INVENTORS
 Warren H. Harlan
 Albert J. Spaeth
 BY *John V. Bowman*
 ATTORNEY

Fig. 3



INVENTORS
 Warren H. Harlan
 Albert J. Spaeth
 BY *John V. Spina*
 ATTORNEY

ROTARY BLADE CARTON RIDDLER

FIELD OF THE INVENTION

This invention relates to a carton riddler and, more particularly, to a carton riddler which opens, empties and flattens cartons containing granular products.

A carton riddler is an apparatus for processing product-containing cartons in order to separate the product from the package. This is done for many different reasons; for example, to reclaim the product, to sell the package as scrap, to ease the burden of disposing of the product-containing carton or, possibly, to collect raw materials so-packaged for subsequent manufacturing operations. Generally speaking, however, by far the greatest use of riddlers is for reclaiming product contained in cartons damaged during manufacture or shipment.

To date the commercially available equipment to perform the riddling function has been unsatisfactory in performance. These use rotary knives or band saws to cut the cartons in half and the cut halves are placed in a tumble drum to separate product and carton. The forms of equipment are large, expensive and do not reduce the scrap carton volume.

The patent art discloses apparatus (such as those shown in Pinkham et al., U.S. Pat. No. 3,386,320, issued June 4, 1968; Grahm et al., U.S. Pat. No. 3,263,843, issued Aug. 2, 1966, and Kluytenaar et al., U.S. Pat. No. 3,266,541) which are special purpose devices unsuitable for use in connection with generally free flowing products and/or are subject to some of the problems described above in connection with the commercial equipment.

OBJECTS OF THE INVENTION

It is an object of the present invention to provide a carton riddler which will obviate the above problems.

It is another object of the present invention to provide a small, efficient, high speed carton riddler which opens, empties and flattens cartons.

It is a further object of the present invention to provide a small, efficient, high speed, dust controlled carton riddler which opens, empties and flattens cartons containing powdery or granular products.

It is a still further object of the present invention to provide a carton riddler which flattens the cartons and places them in such a conformation as to resist the inherent tendency of the cartonboard to spring open.

SUMMARY OF THE INVENTION

In accordance with one aspect of the present invention there is provided a riddling apparatus for removal of product from parallelepipedal cartons. The apparatus has a slitting station including means to cut through both side panels and one face panel of the carton adjacent both closures, thus defining end flaps hinged to the uncut face panel. A product dumping station is provided for supporting the cut carton and for rotating the end flaps into open positions permitting egress of the product. The apparatus also includes a carton crushing means for reducing the bulk of the empty carton.

BRIEF DESCRIPTION OF THE DRAWINGS

While the specification concludes with claims particularly pointing out and distinctly claiming the sub-

ject which is regarded as the present invention, it is believed that the invention will be better understood from the following description taken in connection with the accompanying drawings in which:

FIG. 1 is a fragmentary perspective view, partly schematic for simplicity of presentation, of the carton riddling apparatus of the present invention;

FIG. 2 is an enlarged fragmentary perspective view of the flap plow rails and support and back-up rails of the apparatus of FIG. 1; and

FIG. 3 is an enlarged, fragmentary perspective view of the crushing rolls and carton flattening devices of FIG. 1, with the separation of the shafts thereof exaggerated for clarity.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, the apparatus of the present invention generally comprises carton infeed station 10, slitting station 20, product dumping station 30, carton flattening means 40, carton crushing means 50, product collection means 60 and dust collection means 70. FIG. 1 shows the apparatus in simplified form and does not include many of the structural or drive components inasmuch as these do not constitute a part of the present invention and are details of which can be readily provided by designers of ordinary skill in the art. Moreover, although cartons are shown in various stages of the riddling operation some of the cartons which would also be present in the machine have not been shown. These were omitted since the same would have obscured important parts of the equipment.

The product collection means 60 is shown schematically as a hopper 62 adapted to funnel the product removed from cartons to a pipe 64. The pipe 64 can lead to a collection drum, a belt conveyor, an air conveying system, or any other convenient device to collect the product for subsequent use or disposal. If desired, an incline screen can be placed across the interior of the hopper 62, to separate foreign material (such as torn pieces of cartonboard) from the product.

The product collection means 60 is capped by a table 12 comprising a grated section 14 (underlying areas adjacent the product dumping station 30 into which it could be expected that product emanating from cartons being processed could fall) and an infeed slide section 16, shown in FIG. 1 as a smooth "dead plate" formed from polished metal. The grating has a section removed directly underneath the product dumping station 30 so that the lower end flap can be rotated to an "open" position, as described hereinafter. The grated section 14 can be a close mesh type floor grating, many types of which are commercially available. Preferably the grating is made removable in order to permit access to the hopper 62 interior when necessary. Alternatively, the infeed slide section 16 can be made of a multiplicity of polished metal rods laterally spaced from one another and extending in the direction in which the cartons will slide in use. Such construction would prevent the build-up of any product in the infeed station 10 since such product would fall between the rods into the hopper 62 and increases the potential work area if supplemental hand riddling is contemplated.

As described, the infeed station is of the manual type, wherein an operator places the cartons on the in-

feed slide section 16 and pushes them inwardly during operation. It will be apparent, however, that such operations could readily be mechanized by using appropriate conveying and infeed apparatus. The illustrated manually operated carton infeed station comprises, in addition to the infeed slide section 16 of table 12, stationary guide rail 17 and adjustable guide rails 18, each of which extend in the direction in which cartons are fed to the apparatus. The inner end of stationary guide rail 17 is spaced outwardly from the conveying means 80 by a distance greater than the face-to-face dimension of the cartons being riddled by the machine so that upon contacting the conveying means 80, the innermost carton can be fed to the slitting station in a direction transverse the columnar alignment of the cartons at the infeed station 10. The adjustable guide rails 18 are shown mounted on a pair of spaced, similarly constructed scissor-type supports 19 which can be suitably be locked in any preset position desired, so as to place the guide rails 18 in the correct lateral location for helping to lead the cartons into the machine. Thus, the infeed station can be adapted to accept a variety of carton sizes.

The conveying means 80 comprises a drive roll 82 and an idler roll 84 over which an endless conveyor belt 86 is trained, moving in the direction of arrow "d" shown thereon in FIG. 1. If desired, a rigid, adjustable back-up plate can be provided between the rolls 82 and 84 to prevent the outer run of the belt 86 from flexing inwardly when a carton is pressed against it. Although not critical, a belt speed of approximately 50 feet per minute has proven satisfactory. The belt 86 can be provided, on its outer surface, with spaced protuberances or cleats to engage the upstream (right-hand, as shown) side panel of the innermost carton at the infeed station 10. The type shown in FIG. 1, however, is a grip-top type of belt, the outer surface of which is comprised of a material which, in conjunction with cartonboard, has a coefficient of friction sufficiently high to assure the movement of the cartons toward the slitting station 20 in the normal course of operation. One belt which has been found to be well suited for this use is the 3-Ply-Amber Claw Top belt, manufactured and sold by Ton-Tex Corporation of Grand Rapids, Mich. Many other satisfactory belt materials of this type are also available, such as, for example, those which have been in common use in constructing inclined materials handling conveyors.

Spaced outwardly from the conveyor belt 86 by a distance approximately equal to the face-to-face dimension of the cartons are a pair of guide rails 88 which extend from a point in general alignment with stationary rail 17 to the carton flattening means 40. The guide rails 88 are parallel with the outer run of conveyor belt 86 and serve to lead the cartons through the slitting station 20 and product dumping station 30.

The slitting station 20 is equipped with a pair of spaced, circularly shaped, rotating knives 21, similar in many respect to the type of knife used in meat slicing equipment. Although many different satisfactory designs are available, it has been found advantageous to construct these knives 21 from one-eighth inch thick tool steel, having a diameter of about 12 inches. A sharp edge can be produced on one side of each knife by grinding a chamfer at about 8° with the other side.

For best service, the knives can be hardened and chrome plated.

The knives 21 are mounted, with the sides bearing the sharp edges facing one another, on a vertically extending shaft 22. Shaft 22 is preferably driven (by means not shown) at a peripheral speed substantially in excess of the speed of conveyor belt 86 and in a direction such that the outer run of the belt 86 and the portions of the rotating knives 21 adjacent thereto are moving in the same direction, as shown in FIG. 1. If a cleated belt 86 is used the rotation of the knives 21 can be reversed without problems. For example, the knives 21 can be driven at about 333 R.P.M. with completely satisfactory performance. The higher knife 21 speed and the direction of rotation shown assist the conveyor belt 86 in moving the cartons through the slitting station. If versatility is necessary, the vertical position of the upper knife 21 should be made adjustable so that cartons of various sizes can be handled by the riddler. This can be done in many ways, as will be realized by a machine designer, but can be simply accomplished by mounting the upper knife 21 on a hub equipped with a set screw.

The shaft 22 is offset outwardly from the adjacent outer surface of belt 86 by a distance slightly greater than the radius of the knives 21. Preferably the distance exceeds the radius by an amount in the range of from about one-sixteenth inch to about one-half inch. If closer than about one-sixteenth inch, the end flaps hereinafter described can be easily torn off and cause problems in operating the riddler. On the other hand, if the distance is greater than about one-half inch, then the end flaps of some types of cartons cannot later be satisfactorily cammed out of the way and the riddling will be inefficient. With respect to the relative positions of the shaft 82a of drive roll 82 and the shaft 22 in the direction of the path of travel of the carton being cut, it is preferable that the cuts made by knives 21 be completed prior to the carton being released from the conveyor 86 and so shaft 22 should be upstream of shaft 82a. In connection with cartons having sizes such as are commonly used in packaging granular laundry detergents, a distance between the axes of such shafts of about 4 inches, as measured in the direction of carton movement, has proved satisfactory when 12 inch knives 21 are used.

Referring to FIGS. 1 and 2, it will be seen that the product dumping station 30 comprises upper and lower plow rails 31 and 32, respectively, upper and lower back-up rails 33 and 34, respectively, and upper and lower carton support rails 35 and 36, respectively, none of which support rails are shown in FIG. 1. The upper and lower back-up rails 33 and 34 have outer surfaces 33a, 34a parallel to and in alignment with the outer surface of the outer run of conveyor belt 86, serving to support the innermost face of the cartons as they progress from the slitting station 20 to the carton flattening means 40 and crushing means 50. The upstream ends 33b, 34b are channel-shaped with the portions thereof which are at right angles with faces 33a, 34a having tongues 33c, 34c projecting therefrom which are arcuately shaped at their distal ends to conform to the adjacent portion of the conveyor belt 86 on drive roll 82. This construction permits the use of a cleated belt 86 by merely cutting slots in the cleats at elevations

corresponding with those of the tongues 33c, 34c. The tongues 33c, 34c lead the innermost face of the cartons to the surfaces 33a, 34a. The downstream portions of the back-up rails 33, 34 are reduced in height, shown by edges 33d, 34d, in order to permit subsequent rotation of the carton end flaps, as will be more fully understood from subsequent description. The top of the upstream end 33b of upper back-up rail 33 and the bottom of upstream end 34b of back-up rail 34 can be at any convenient elevation so long as they do not interfere with the initial stages of carton end flap rotation, but the edges 33d, 34d should both be located at elevations intermediate those of the rotating knives 21.

The upper and lower plow rails 31 and 32 are of curviform shape and have horizontally oriented upstream ends 31a, 32a vertically aligned, respectively, with the upper and lower rotating knives 21. Each of the plow rail ends 31a and 32a is sharpened and shaped to conform generally to the periphery of knives 21, being positioned closely adjacent a said knife 21 with the innermost edges 31b and 32b spaced outwardly from the outer run of conveyor belt 86 by a distance preferably greater than the spacing of the rotating knives 21 therefrom. Plow rail 31 is twisted about 80° and extends inwardly and upwardly so that the outer edge 31c becomes uppermost with the downstream end of plow rail 31 approximately vertical and spaced outwardly from the surface 33a of back-up rail 33 by about the same distance as that separating the rotating knives 21 from the conveyor belt 86. The twisting of the plow rail 31 is adapted to cam or rotate the upper end flap of the carton to an approximate vertical position. Plow rail 32 is twisted approximately 135° and extends inwardly and downwardly so that the outer edge 32c becomes lowermost with the downstream end of plow rail 32 at an angle of about 45° with the vertical. The twisting of the plow rail 32 is adapted to rotate the lower end flap of the carton to a point beyond its vertical position in order to assure complete emptying of product from the carton. For this reason, the downstream portion of outer edge 32c projects inwardly beyond the surface 34a of overlying back-up rail 34. It will be noted that lower plow rail 32 is shorter than the other rails comprising the product dumping station so that the lower end flap is released, prior to entry of the carton in the carton crushing means, so that it will return to a generally vertical position. The innermost lower support rail 36b prevents the lower end flap from springing too far back towards its initial position on the carton.

The upper and lower carton support rails 35 and 36 each have horizontal edges 35a and 36a aligned with the upper and lower rotating knives 21, respectively, and these are adapted to vertically support the tubular body of the cut carton as it proceeds through the product dumping station. The carton support rails 35 and 36, in combination with the back-up rails 33 and 34 and with the guide rails 88 maintain the horizontal and vertical attitudes of the carton as it traverses the plow rails 31, 32.

The rails comprising the carton dumping station 30 can be supported in any convenient manner, such as by the supports 31d and 32d shown in FIG. 2. Downstream support 31d is welded to both upper plow rail 31 and upper carton support rail 35 (the upstream end of which is also welded to plow rail 31) and the whole as-

sembly is mounted by means, not shown, to the machine frame. The lower plow rail 31 and lower carton support rails are similarly unitized by welding and are cantilevered from the machine frame by supports 32d. The back-up rails can be appropriately supported from the other, inner, side and thus each of the supports avoids interference with the cartons being processed. If the machine is to be adapted to handle cartons of varying height, then the elevation of the upper plow rail 31, upper back-up rail 33 and upper carton support rail 35 should be adjustable to the same extent as the upper rotating knife 21.

If the product is one which occasionally sticks within the carton and will not flow freely at the product dumping station 30, a "thumping" means can be provided at that location to impact the innermost face panel of the carton as an aid in dislodging the product. The thumping means can comprise a vibrator acting on a back-up rail or, if desired be so simple as a rotating shaft with a pin extending therethrough, the ends of which are arranged to contact the carton as the shaft turns.

The carton flattening means 40 is shown in FIGS. 1 and 3, the latter being a perspective as viewed from an upstream position. The flattening means 40 comprises a pair of driven shafts 41, 42 rotating in the directions illustrated, each carrying elements having projections thereon adapted to contact the outer face panel of the cartons feeding from the product dumping station to the carton crushing means 50. On shaft 41, the rotating elements comprise four standard sprockets 42 affixed by convenient means such as set screws in spaced relation over the flattened height range of cartons adapted to be acted upon by the riddler. The rotating elements affixed on shaft 42 are a pair of pickers 43, each of which has 8 equally spaced, radially extending fingers. The pickers 43 are spaced from one another by several inches in the central portion of the flattened height range of the cartons.

The carton crushing means 50 comprises a pair of driven counter-rotating rolls 51, 52. The roll 51 is constructed of three spaced segments 51a, 51b, 51c mounted on a shaft 53, whereas the roll 52 has two segments 52a, 52b having a spacer 52c of greater diameter therebetween, all of which are mounted on shaft 54. The spacing between segments 51a and 51b aligns with the location of upper picker 43 on shaft 42, and is of a dimension slightly exceeding the thickness of such picker. The spacing between segments 51b and 51c, in effect a groove, similarly aligns with and exceeds the height of lower picker 43 on shaft 42. The spacer 52c also aligns with the spacing between roll segments 51b and 51c and can be constructed from a three-fourth inch thick disc the periphery of which is chamfered at 30° with each side (60° included angle) and the apex rounded to a final diameter exceeding that of the roll segments 52a, 52b by about 1 inch. As shown in its assembled form, the outwardly projecting periphery of the spacer 52c constitutes a projecting rib adapted to be received in the groove between segments 51b and 51c of roll 51. Each of the roll segments 51a, 51b, 51c, 52a and 52b is preferably peripherally covered with a tough, resilient, high friction coating to assist in pulling cartons through the nip therebetween. One satisfactorily performing coating for this service is an epoxy compound ground to a thickness of about three-eighths inch

and having a durometer of shore A-80. This compound is made of 100 parts by weight duPont Adiprene L-420 (the epoxy), 8.8 parts by weight Moca (a hardener) and 10 parts by weight General Electric RTV-630 (a silicone).

For packages having sizes such as used in packaging detergents (i.e. face-to-face dimensions of from about 1 to about 5 inches) rolls 51, 52 having an outside diameter of about 6 inches have proven satisfactory. The shafts 53, 54 are separated by a distance equal to the diameter of the rolls 51, 52 so that the same are approximately in line contact. The shaft 54 of the innermost roll 52 is located inwardly from the plane of back-up rail surfaces 33a, 34a by about one third of the diameter of the rolls 51, 52, thus being offset by about 2 inches when 6 inch rolls are used. Preferably, the shaft 54 is located slightly upstream of shaft 53, in order to assist in flattening the cartons. For example, a line connecting the shaft axes can be at an angle of about 102° with the plane of back-up rail surfaces 33a, 34a. The precise location of the shaft 54 in the direction of the carton's path of travel through the slitting and dumping stations 20 and 30 is not critical so long as the cartons are adequately supported until the carton enters the nip between the rolls 51, 52.

As will be seen in FIG. 3, the pickers 43 enter the spaces between segments 51a, 51b and 51c. The distance between shafts 42 and 53 can be such as to place shaft 42 a small distance, e.g. one-fourth inch, from the periphery of roll 51 and the design of the pickers 43 is such that the distal ends of the picker fingers miss the shaft 53 by approximately one-half inch or so. For example, with a roll 51 diameter of 6 inches, a shaft 53 diameter of 1 inch and a shaft 42 diameter of three-fourths inch, the center-to-center distance between shafts 53 and 42 can be about 3- $\frac{5}{8}$ inches and the outside diameter of the picker 43 can be about 5- $\frac{1}{4}$ inches.

The illustration of FIG. 3 shows the shafts 41 and 42 spaced further apart than they actually are in order to clearly show the rotating elements thereon. Actually, the peripheries of sprockets 42 and pickers 43 overlap to some extent so that, for example, with a shaft 42 and pickers 43 sized as stated above and a shaft 41 of about three-fourths inch diameter, the center-to-center distance between shafts 42 and 41 can be about 3- $\frac{1}{4}$ inches. Using sprockets 42 which are standard for No. 80 chain and having nine teeth, the diameter thereof being about 3- $\frac{1}{2}$ inches, the projections on the pickers 43 and sprockets 42 overlap by about 1 inch. As shown in FIG. 1, the top sprocket 42 overlies top picker 43 and the center sprockets 42 lie to either side of bottom picker 43. Although not critical, a separation of one-fourth inch between adjacent surfaces of these elements has been found satisfactory. Using the dimensional relationship described above, it has been found satisfactory for the rolls 51, 52, the sprockets 42 and the pickers 43 to be rotated at a speed of approximately 111 R.P.M.

The shafts 41 and 42 are mounted in fixed relation on supports (not shown) adapted to be simultaneously adjusted in a horizontal arcuate path centered about the axis of shaft 53, with the axes of shafts 41 and 42 and the axis of rotation of the support lying along a straight line. Thus, if cartons having a large face-to-face

dimension are being processed, the supports would be swung outwardly and locked in an appropriate position to have the sprockets 42 and pickers 43 act on the carton. On the other hand, where thin cartons are being run, the supports would be swung inwardly, closer to the plane of back-up rail surfaces 33a, 34a, and locked in the desired position.

It will be recognized, of course, that the elevation of the carton flattening means 40 and the carton crushing means 50, along with the structural framework of the equipment in line with the movement of the cartons therethrough, must be such as to permit the carton unobstructed passage with the lower flap (hereinafter described) cammed into open position. These are aspects which can be readily accounted for in designing the machine of the present invention for a specific application and therefore are not described in detail herein.

The dust collection means 70, as shown in FIG. 1, comprises a dust hood 71 which encloses the back, top and sides of the apparatus and ducts 72, 73 which communicate with the interior of dust hood 71 through appropriate fittings on its back wall. Ducts 72, 73 are connected to any desirable fan-dust collection system, the cubic feet of air per minute capacity of which should be sufficient to have air flowing through the front opening of the hood at a velocity of at least about 100 feet per minute. For example, if such opening has an area of about 20 square feet, the capacity of the system should be at least about 2,000 cubic feet per minute. The dust collection means 70 improves the working conditions for operators tending the machine and reduces the clean-up work following use of the riddler.

The riddler of this invention is adapted to handle cartons of many different types, but is particularly well suited for riddling adhesively secured seal-end cartons. Such cartons can be generally described as being of parallelepipedal shape, having a tubular carton body with opposed, alternating pairs of face and side panels, 90 and 91, respectively, as seen in FIG. 1. The face and side panels 90, 91 are attached along lengthwise-extending scores 92 and each is provided with an upper closure 93 and a lower closure 94.

In setting-up to run a particular size of carton, the adjustable guide rails 18 at the carton infeed station 10 are adjusted to assist in columnarly aligning the cartons with adjacent face panels 90 of sequential cartons bearing against one another (face-to-face contact), the column extending inwardly toward the conveyor belt 86. Next, the elevation of upper rotating knife 21 is adjusted so as to make the upper cut in the carton at a distance of from about one-eighth inch about 2 inches, preferably about one-half inch to about 1 inch, below the upper surface of closure 93. The lower rotating knife 21 can remain fixed at a like elevation above the surface of the infeed slide section 16. Then the guide rails 88 are adjusted so as to be spaced from the outer surface of the outer run of conveyor belt 86 and from the plane of back-up rail surfaces 33a, 34a by a distance corresponding to the width of side panels 91. The elevation of upper plow rail 31, upper back-up rail 33 and upper carton support rail 35 should also be adjusted, this being done in conformity with the elevation of upper rotating knife 21, according to the relationships previously described. Then the angular position

of the supports carrying the carton flattening means 40 is adjusted so that the projections on the rotating elements thereof are adapted to contact and move the outer, cut, face panel 90 of the carton toward and in advance of the inner, uncut, face panel, flattening the tubular carton body 95 (FIG. 1) in parallelogram fashion with a lengthwise-extending edge of the cut face panel 90 constituting the leading edge of the carton. This adjustment is best done by trial and error.

Finally, the space between roll segments 51b and 51c is adjusted so that the adjacent end portions thereof, acting in cooperation with the projecting rib on the roll 52, serve to crease the flattened carton (i.e. that passing through the nip of rolls 51, 52) transversely, across the carton body, as shown at fold 96 in FIG. 1. Once creased in this manner the resulting carton remains substantially flat, whereas it would otherwise have the tendency to spring open again.

Tracing the movement of a carton through the machine, it will be realized that the carton is placed on the outer end of the column at the infeed station 10 and moved inwardly in a step-by-step manner as the preceding cartons are removed from the inner end of the column and processed. When the carton reaches the conveying means 80, the frictional force developed between the inner face 90 of the carton and the conveyor belt 86 moves the carton through the slitting station 20 wherein two spaced cuts are made in the carton. One cut is adjacent the lower closure 94 of the carton and extends substantially through the width of both side panels 91 and across the outer face panel 90, thus defining a lower end flap 97. The other cut is adjacent the upper closure 93 and similarly extends substantially through the width of both side panels 91 and across the outer face panel 90, defining an upper end flap 98.

The conveyor belt 86 moves the carton into the product dumping station where the tubular carton body 95 is supported in back by upper and lower back-up rails 33, 34, in front by guide rails 88 and on top and bottom by upper and lower carton support rails 35 and 36. As the carton proceeds into the product dumping station, upper plow rail 31 enters the carton at the upper cut and cams the upper end flap 98 upwardly, about a line of articulation extending across the upper portion of the inner face panel 90 along a transverse line aligned with the portion of the cut extending through the side panels. Any uncut material of the side panels 91 which lies intermediate the upper cut and the line of articulation described, tears during the camming operation. Simultaneously, lower plow rail 32 enters the carton at the lower cut and cams the lower end flap 97 downwardly about a line of articulation extending across the lower portion of the inner face panel 90 along a transverse line aligned with the portion of the cut extending through the side panels. Here, too, any uncut material of the side panels 91 which lies intermediate the lower cut and the line of articulation of the lower end flap 97, tears during the camming operation. The rotation of the upper and lower end flaps 97, 98 to open position permits the product to flow from the carton, principally through the open portion of grated section 14 of table 12, into the hopper 62 and thence into pipe 64. If some product sticks to the carton interior the thumping means acting on the inner face 90 of the carton dislodges it.

Once having been released from the conveyor 86 in the product dumping station 30, the carton remains stationary until the next carton is similarly delivered, the leading side panel thereof pushing the carton downstream. This process continues with succeeding units pushing the carton until it moves into contact with the teeth of revolving sprockets 42. The sprocket teeth engage with the downstream edge 92 of the outer face panel 90 and cause the said panel to move toward and in advance of the inner (uncut) face panel 90, so that the lengthwise-extending edge is the leading edge of the carton.

As the downstream movement of the carton continues, the teeth of the revolving sprockets move across the outer face panel 90 and the projections of picker 43 start similarly acting on the leading edge of the carton. In this manner the carton is substantially flattened, with the leading edge of the carton led into the nip between crushing rolls 51, 52. The crushing rolls pull the carton through their nip, simultaneously creasing the same transversely, across the carton body, resulting in a fold 96 which prevents subsequent springing open of the carton. As the carton moves through the nip, it will be seen from FIG. 1 that both upper and lower end flaps 98, 97 are also flattened.

While the carton flattening means 40 has been found effective in adapting the machine to handle a variety of different size cartons, it is possible to eliminate the need for the same by sizing and orienting the rolls 51, 52 in such a manner a manner as to invariably properly lead a specific size of carton into the nip therebetween. It should be noted, however, that regardless of how the carton is introduced to the nip, the edge of the cut face panel should be the leading edge. If it is not, i.e. if the downstream edge of the uncut face panel 90 was the leading edge, the flat sides of the upper and lower end flaps 98, 97 could conceivably prevent entry into the nip.

Many modifications of the above invention may be used and it is not intended to hereby limit it to the particular embodiments shown or described. The terms used in describing the invention are used in their descriptive sense and not as terms of limitation.

What is claimed is:

1. Riddling apparatus for removal of product from parallelepipedal cartons, said cartons having a tubular carton body with opposed, alternating, pairs of face and side panels attached along lengthwise-extending scores and an upper and a lower closure, said apparatus comprising:

A. A slitting station including slitting means comprising a pair of vertically spaced, circularly shaped knives rotating in a substantially horizontal plane and adapted to make a cut through both side panels and one face panel of the carton adjacent both upper and lower closures, thereby defining a pair of end flaps articulated to opposite ends of the uncut face panel along transverse lines aligned with the cuts on said side panels;

B. A product dumping station comprising means for supporting said cut carton and for outwardly rotating said end flaps about their lines of articulation to open positions permitting egress of said product whereby said carton is emptied through its lower opening;

- C. Carton crushing means for reducing the bulk of said empty carton, said means comprising a pair of counter-rotating rolls have a nip therebetween for receiving said empty carton; and
- D. Conveying means for moving the carton through said slitting station and said dumping station and into said crushing means.
2. The riddling apparatus of claim 1 including a creaser adapted to fold the flattened carton transversely, across the carton body.
3. The riddling apparatus of claim 2 including carton flattening means to collapse said tubular carton body subsequent to egress of said product therefrom and before entry of said carton into the nip of said crushing means, said carton flattening means being adapted to cause said face panels to approximate, with a lengthwise-extending edge of the cut face panel projecting outwardly beyond the balance of said carton body and thereby constituting a leading edge.
4. The riddling apparatus of claim 3 in which said creaser comprises an outwardly projecting rib on one roll and an aligned, cooperating groove on the other roll.
5. The riddling apparatus of claim 4 in which said carton flattening means comprises rotating elements having projections thereon adapted to contact and move the cut face panel of the tubular carton body toward and in advance of the uncut face panel.
6. The riddling apparatus of claim 5 in which the conveying means is a belt adapted to contact the uncut face panel of said carton.
7. The riddling apparatus of claim 6 in which the conveying belt is of the grip-top type and in which the adjacent portions of the rotating knives are moving in the same general direction as said belt.
8. The riddling apparatus of claim 3 in which thumping means is provided at said product dumping station, said thumping means being adapted to impact the uncut face panel of said carton to dislodge product within said carton.
9. Riddling apparatus for removal of product from closed parallelepipedal cartons, said cartons having a tubular carton body with opposed, alternating pairs of face and side panels attached along lengthwise-extending scores and an upper and a lower closure, said apparatus comprising:

- A. A carton infeed station for aligning a column of cartons in face-to-face contact;
- B. A conveyor belt moving transversely of said column and adapted to contact a first face panel of the innermost carton of said column and move said carton through a slitting station;
- C. said slitting station comprising a pair of spaced, rotating knives each of which is adapted to cut said carton along a line adjacent the corresponding carton closure, said cuts each extending through both side panels and through the second face panel of said carton, defining a pair of end flaps articulated to opposite ends of said first face panel along transverse lines aligned with the cuts on said side panels;
- D. Upper and lower flap plow rails having their upstream ends in alignment with said knives and being of a curviform shape adapted to oppositely rotate said end flaps about their lines of articulation to open positions as said cut carton is moved from the upstream to the downstream ends of said plows;
- E. Guide rails for maintaining the vertical and horizontal attitudes of said carton as it traverses said plow rails;
- F. Product collection means for recovery of product flowing from said carton as it traverses said plows;
- G. Rotating elements adapted to collapse said tubular carton body subsequent to egress of said product, said elements having projections thereon adapted to contact and move said second face panel of the tubular carton body toward and in advance of the said first face panel whereby a lengthwise-extending edge of said second face panel is the leading edge of the carton; and
- H. A pair of counter-rotating crushing rolls having a nip therebetween adapted to receive the collapsed carton, one roll having an outwardly projecting rib on its periphery and the other roll having an aligned groove, said rib and said groove being adapted to cooperatively crease the carton transversely, across the carton body.
10. The riddling apparatus of claim 9 in which a dust control hood and system is provided in which the velocity of air flow through open areas thereof is at least about 100 feet per minute.

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