A score breaking mechanism comprises a vertically reciprocable carriage having a pair of roof panel wings and a pair of gable panel wings mounted thereon. As the carriage is lowered toward a carton having score lines to be broken, two racks slidably mounted in the carriage contact stops, and upon continued downward movement of the carriage the racks rotate a pair of pinion gears attached to the gable panel wings to rotate the wings inwardly toward each other and into folding contact with the gable panels of the carton. When the downward movement of the carriage ceases, the roof panel wings are rotated inwardly toward each other over the enfolded gable panels to complete the score breaking operation. The roof panel wings are then rotated away from the carton before the carriage starts its upward movement, after which the gable panel wings are rotated away from the carton to clear the carton.
SCORE BREAKING MECHANISM FOR GABLE TOP CARTON

The invention relates to mechanisms for breaking score lines in a carton. In a specific aspect it relates to score breaking mechanism for gable top cartons.

In a filling and sealing machine for paperboard gable top cartons, it is frequently desirable to break the score lines forming the gable top structure prior to heating the ridge panels to minimize the mechanical handling of the heated panels. When the score lines are broken before heating, the carton is generally moved to the heating station with the top structure partially open. With hot gas heater heads which enclose the top of the carton, it is important that the score breaking operation be consistent from carton to carton to avoid contact between the carton and the heater head. It is also desirable that the score breaking operation be accomplished at a single work station to minimize the size of the machine.

Accordingly, it is an object of the invention to provide a new and improved score breaking mechanism. Another object is to minimize the work space occupied by a score breaking mechanism. Yet another object of the invention is to provide consistency in the shape to which a scored carton is formed in a score breaking operation. A further object of the invention is to avoid damage to a carton during a score breaking operation.

Other objects, aspects and advantages of the invention will be apparent from a study of the specification, the drawings and the appended claims to the invention.

In the drawings, FIG. 1 is a front elevational view of a carton forming, filling and sealing machine embodying the present invention;

FIG. 2 is a simplified side elevational view, partly in cross section, of the score breaking mechanism of the machine of FIG. 1 in the up or retracted position;

FIG. 3 is a simplified side elevational view, partly in cross section, of the score breaking mechanism of FIG. 2 in an intermediate position;

FIG. 4 is a simplified side elevational view, partly in cross section, of the score breaking mechanism of FIG. 2 in the fully down or carton engaging position;

FIG. 5 is a simplified front elevational view, partly in cross section, taken along line 5—5 in FIG. 4;

FIG. 6 is a simplified plan view, partly in cross section, taken along line 6—6 in FIG. 4;

FIG. 7 is a detail elevational view of the rack and pinion mechanism for the triangular gable wings;

FIG. 8 is a detail elevational view of the mechanism for the roof panel wings;

FIG. 9 is a perspective view of the upper portion of a gable top carton before the score breaking operation; and

FIG. 10 is a perspective view of the carton of FIG. 9 after the score breaking operation.

Referring now to the drawings in detail and to FIG. 1 in particular, the carton forming, filling and sealing machine comprises a forming section 11 and a filling and sealing section 12. The forming section 11 comprises a sidewall blank feeding and heating subsection 13, a bottom blank feeding and heating subsection 14, a forming subsection 15, and a transfer subsection 16.

The filling and sealing section has two parallel endless conveyor systems 17, and each conveyor system comprises a filling subsection 18 occupying five conveyor

stations, a defoaming station 19, a score breaking station 20, a top heating station 21, a folding and sealing station 22, a secondary sealing station 23, a branding station 24, and a transfer station 25.

The sidewall blanks 31 manually placed in the sidewall blank magazine 32 are flat, single sheets of paperboard, rectangular in shape, scored to provide five longitudinal panels, and gable top structure, and coated on both the top and bottom surfaces of each sheet with a thermoplastic material, e.g., polyethylene. The sidewall blanks 31 are successively withdrawn from magazine 32 and intermittently advanced through the sidewall blank heating station 33 to the sidewall blank receiving station 34 for turret 35. At the sidewall blank heating station 33, the side margins to be overlapped and the bottom margin of the sidewall blank are heated to a bonding temperature for the thermoplastic coating.

The turret 35 is journalled on a horizontal axis and carries eight circumferentially spaced apart mandrels 36 extending radially from the axis of turret 35. The cross section of each of mandrels 36 in a plane perpendicular to its longitudinal axis is generally rectangular. Suitable drive mechanism is provided for indexing or effecting intermittent rotation of the turret 35 to move each mandrel from the sidewall blank receiving station 34 through a blank folding station 37; a bottom and closure forming, applying and sealing station 38; a secondary bottom sealing station 39, a stripping station 40, and three successive nonoperating stations 41, 42 and 43.

The tubular carton body having a bottom closure sealed thereto is removed from the mandrel 36 at the stripping station 40 and is transferred to a conveyor pocket 45 of one of the two conveyor systems 17. The product to be packaged is introduced into the cut-out tubular carton in the filling subsection 18. If desired, any foam resulting from the filling operation can be removed at defoaming station 19. The scores for the gable top structure can be initially folded in the score breaking station 20, resulting in the conventional six-sided top structure. The gable top ridge panels of the carton are heated in station 21 to a temperature at least as high as the thermal bonding temperature of the thermoplastic coatings on the carton. The heated superstructure is then folded into contact under pressure at the folding and sealing station 22 to effect the bonding of adjacent ridge panels. Secondary sealing station 23 applies pressure to the ridge panels during cooling of the thermoplastic bond. If desired, a date indicia, plant identification or other information can be applied to the bonded ridge panels of the sealed carton at branding station 24. The formed, filled and sealed carton is removed from its conveyor pocket 45 at the transfer station 25 and placed on a delivery conveyor 46.

Referring now to FIGS. 2–8, the score breaking mechanism 20 has a support frame 51 having a base 52 mounted on the frame of the carton filling and sealing machine section 12 above a cam shaft, not shown. Push rod 53 is reciprocated through support 54 by the cam shaft. Push rod 53 is connected to shaft 55 through adjustable linkage 56 for reciprocation of shaft 55 to drive a pair of score breaker mechanisms 20, one on each side of support 51. Only one score breaker mechanism 20 is shown since both are identical. Clevis 57 is mounted on the upper end of shaft 53 and is pivotably connected to crank arm 58 through pin 59. Crank arm 58 is fixedly connected to shaft 60, which is pivotably
mounted in support 51. Also affixed to shaft 60 is lever arm 61, which has at the opposite end thereof clevis 62 which is connected in pivotal relationship to linkage 63 by pin 64. The arcuate movement of lever arm 61 causes linkage 63, connected to clevis 65 by pin 66, to vertically reciprocate the drive push rod for the left score breaker mechanism, not shown. Linkage 67 is connected in pivotal relationship to both lever arm 61 and linkage bar 68. Linkage bar 68 is pivotally about pin 69, supported in frame 51. The opposite end of linkage bar 68 is pivotally connected to U-shaped arm 70 by pin 71. The opposite end of U-shaped bar 70 is connected to clevis 65 of the right score breaker by pin 66 to drive push rod 72. The reciprocation of shaft 55 through the linkage heretofore described will reciprocally drive the push rods 72 of the two score breaker mechanisms in an identical manner.

Carriage 73 is slidable to a limited extent on push rod 72 by virtue of the bias provided by spring 74 against the lower shoulder 75 of clevis 65 and the top of carriage 73, forcing carriage 73 against stop 76 at the lower end of push rod 72. Carriage 73 is supported by plate 77 which guides the movement of carriage 73 by being slidable in the ways 78 of the main frame of the filling and sealing machine section 12 (See FIG. 6).

Support 79 is attached to the front end of carriage 73 and plate 80 is secured to the lower outward edge of support 79. Attached to the inner surface of plate 80 are gable wing supports 81. A rotatable shaft 82 is horizontally mounted in supports 81. A pinion gear 83 and a triangular gable wing 84 are mounted on shaft 82 for rotation therewith. A shaft 85 having a gear rack 86 on the lower end thereof is mounted in one of supports 81 for reciprocating movement in a vertical direction with the gear rack 86 engaging pinion gear 83. A spring 87 is mounted about shaft 85 and extends from a shoulder 88 on the upper end of gear rack 86 to a shoulder 89 of support 81 to bias the rack 86 to the downwardly extended position. Shaft 82 rotates gable wing 84 inwardly toward the carton 50 during the downward movement of the carriage 73 after the rack 86 contacts stationary stop 90 attached to the frame of the machine by element 91, causing the relative movement between rack 86 and carriage 73 to drive pinion gear 83.

A rotatable shaft 92 is horizontally mounted in carriage 73 opposite shaft 82 so that shafts 82 and 92 are parallel to each other. A pinion gear, not shown, is mounted on shaft 92 for rotation therewith. A shaft 93 is mounted in carriage 73 for reciprocating movement in a vertical direction. Gear rack 94 is mounted on the lower end of shaft 93 and is engaged by the pinion gear. A spring 95 is mounted about shaft 93 and extends between shoulders 96 and 97 to bias the rack 94 to the downwardly extended position. Triangular gable wing 98 is mounted on shaft 92 for rotation therewith toward the carton 50 during the downward movement of carriage 73 after rack 94 contacts stationary stop 99, attached to frame 51. Thus, the mechanisms for operating gable wings 84 and 98 are essentially identical.

Push rod 72 has a large diameter portion 101 and a small diameter portion 102 separated by shoulder 103. The large diameter portion 101 extends into opening 104 of carriage 73. Fixedly attached against the shoulder 103 of push rod 72 is gear rack 105 (see FIG. 8) which engages pinion gears of 106 and 107. Roof panel wing 108 and pinion gear 106 are fixedly attached to shaft 109 for rotation therewith. Roof panel wing 110 and pinion gear 110 are fixedly attached to shaft 111 for rotation therewith. Shafts 109 and 111 are horizontally mounted in carriage 73 so as to parallel to each other and perpendicular to shaft 82 and 92. Reciprocal movement of the gear rack 105 in a vertical direction causes the arcuate motion of roof panel wings 108 and 110 simultaneously with the shaft 109 and 111, respectively. During the downward movement of push rod 72, carriage 73 and associated components are moved downwardly to engage a carton 50 held in score breaking position by conveyer 17. The racks 86 and 94 first contact the stops 90 and 99, respectively. Additional downward movement of the carriage 73 causes the gable wings 84 and 98 to fold inwardly against the end panels of the carton before the roof panel wings 108 and 110 begin their inward movement. Additional downward movement of the carriage 73 causes the slide plate 77 to contact stop 112 attached to support 51, stopping the movement of carriage 73. Since the push rod 72 is slidable within carriage 73 against the bias spring 74, further movement of the push rod 72 within carriage 73 causes rack 105 to rotate pinion gears 106 and 107, folding roof panel wings 108 and 110 inwardly against the roof panels of the carton to complete the score breaking (see FIGS. 4, 6 and 10).

As the carriage 73 reaches its lower limit of travel before the inward rotation of roof panel wings 108 and 110 begins, the shaft 109 and 111 are stationary, with respect to vertical movement, during the rotation thereof and are located at points outwardly and downwardly of the lower edge of the roof panels 133 and 134, so that roof panel wings 108 and 110 have a large area of contact with roof panels 133 and 134 during the folding of the roof panels 133 and 134 inwardly. This large area of contact, as opposed to a line of contact, provides support for the roof panels 133 and 134 during the folding operation, minimizing the possibility of forming fold lines at location other than the score lines. The subsequent upward movement of push rod 72 caused by the reciprocation of shaft 54 and its associated linkage initially causes the roof panel wings 108 and 110 to fold outwardly and then causes the carriage 73 to begin its upward movement as soon as stop 76 contacts the bottom of carriage 73. The upward motion of carriage 73 permits springs 87 and 95 to move racks 86 and 94 downwardly with respect to carriage 73, thereby rotating shafts 82 and 92 to retraction gable wings 84 and 98 to their vertical position.

Referring now to FIGS. 9 and 10, the carton 50 has vertical score lines 115, 116, 117, and 118 to form the four vertical sides of the carton. A series of horizontal score lines 119, 120, 121, and 122 form the bottom of the gable top structure, while a second series of horizontal score lines 123, 124, 125, and 126 form the bottom of the six ridge panels 127, 128, 129, 130, 131 and 132. Score lines 115, 116, 120 and 124 define one roof panel 133, while score lines 117, 118, 122 and 126 define the opposite roof panel 134. Score line 135 divides ridge panels 127 and 128, while score line 136 divides ridge panels 130 and 131. Score line 137 extends from the intersection of score lines 115 and 119 to the intersection of score lines 135 and 123, while score line 138 extends from the intersection of score lines 118 and 119 to the intersection of score lines 135 and 123, to form the first triangular fold back panel 139, the central triangular panel 140 and the second fold back.
 panel 141. Similarly, score line 142 extends from the intersection of score lines 116 and 121 to the intersection of score lines 125 and 136 while the score line 143 extends from the intersection of score lines 117 and 121 to the intersection of score lines 125 and 136, to form the first triangular fold back panel 144, the central triangular panel 145 and the second fold back panel 146.

In operation, a carton 50 carried by conveyor 17 is positioned underneath the score breaker mechanism 20. The carriage 73 is initially in the up or retracted position, as shown in FIG. 2. The initial downward motion of the push rod 53 causes adjustable link 56 and shaft 55 to move downwardly, rotating crank 58 in a counterclockwise direction along with lever arm 61, causing a downward movement of link 67 and a clockwise rotation of lever bar 68. The clockwise rotation of lever bar 68 moves U-shaped bar 70 downwardly, driving push rod 72 downwardly. The downward movement of push rod 72 moves carriage 73 downwardly. As carriage 73 moves downwardly, bringing the gable panel wings 84 and 98 and the roof panel wings 108 and 110 into close proximity to the top of the carton 50, racks 86 and 94 contact the stops 90 and 99, respectively. Additional downward movement of the carriage 73 causes racks 86 and 94 to drive gable panel wings 84 and 98 inwardly against the panels 140 and 145, breaking the score lines 119, 121, 135, 136, 137, 138, 142 and 143. Gable panel wings 84 and 98 have a triangular configuration with the base thereof being attached to the respective shaft. The apex portion of gable panel wings 84 and 98 conforms to and is slightly smaller than triangular panels 140 and 145 so that the apex portion of wings 84 and 98 contact only the respective panel 140 or 145 during the folding operation. During the contact of wings 84 and 98 with panels 140 and 145, the sides of the wings are preferably at least substantially parallel to the respective set of score lines 137, 138 and 142, 143, as well as being in close proximity thereto. When the carriage 73 has reached the lower limit of its travel by contacting stop 112, the push rod 72 continues its downward movement against the bias of spring 74 pushing rack 105 downwardly to drive pinion gears 106 and 107 and the associated roof panel wings 108 and 110 out the roof panels 133 and 134, breaking score lines 120 and 122, and folding the roof panels 133 and 134 inwardly over the already enfolded gable ends. Roof panel wings 108 and 110 are generally rectangular in configuration and are at least substantially coextensive with roof panels 133 and 134 in the lowermost position of the roof panel wings. By having wings 108 and 110 substantially the same size or larger than the roof panels, the roof panels 133 and 134 are supported throughout the extent thereof, thus minimizing the possibility of buckling or folding other than along a score line. At this point all the components have reached the lower limit of their travel (see FIGS. 4 and 6). Further rotation of the cam shaft, not shown, causes an upward travel of the shaft 55, and associated linkage to move push rod 72 upwardly. The initial upward movement of push rod 72 reverses the procedure here-tofore described by permitting rack 105 to move upwardly to drive pinion gears 106 and 107 to move the associated roof panel wings 108 and 110 outwardly. Further upward movement of the push rod 72 causes stop 76 to contact carriage 73, moving carriage 73 upwardly and allowing the racks 86 and 94 to move downwardly due to the bias of springs 87 and 95. As the racks 86 and 94 move away from stops 90 and 99, the gable panel wings 84 and 98 move outwardly away from the carton 50. As the push rod 72 and the carriage 73 continue their upward movement to their upper limit as shown in FIG. 2, the scorebroken carton 50 is cleared for movement to the sealing station by conveyor 17. Another carton moves into position underneath the score breaker, and the cycle is repeated. Thus, the score lines forming the gable top structure are broken in a uniformly reproducible shape without damage to the carton and without the necessity of inserting a mandrel inside the carton to serve as an anvil.

Reasonable variations and modifications are possible within the scope of the foregoing disclosure, the drawings and the appended claims to the invention. That which is claimed is:

1. Apparatus for breaking score lines in the upper portion of an open top tubular carton having first and second opposing roof panels joined by first and second opposing gable panels to form a gable top structure, each of said gable panels comprising a central triangular panel joined to one of said roof panels by a first triangular fold back panel and to the other of said roof panels by a second triangular fold back panel, comprising a carriage; means for effecting reciprocal movement of said carriage between a retracted position and a carton engaging position located over a score breaking station; support means for guiding said carriage during the reciprocal motion of said carriage; first, second, third and fourth shafts mounted in said carriage, with said first and second shafts being parallel to each other, and said third and fourth shafts being parallel to each other and perpendicular to said first and second shafts; first and second triangular gable wings mounted on said first and second shafts, respectively, for arcuate movement about the axis of the respective shaft; first and second roof panel wings mounted on said third and fourth shafts for arcuate movement about the axis of the respective shaft; actuating means responsive to said means for effecting reciprocal movement of said carriage to effect the arcuate movement of said first and second gable wings about the respective axis of the first and second shafts into contact with the first and second opposing gable panels, respectively, of a carton in said score breaking station to fold said first and second opposing gable panels inwardly toward each other other during the movement of said carriage from said retracted position toward said carton engaging position, to subsequently effect the arcuate movement of said first and second roof panel wings about the respective axis of said third and fourth shafts into contact with the first and second opposing roof panels of said carton in said score breaking station to fold said first and second opposing roof panels inwardly toward each other over the enfolded first and second opposing gable panels, to thereby break score lines forming the first and second opposing roof panels and the first and second opposing gable panels, to thereafter effect the arcuate movement of said first and second roof panel wings about the respective axis of said third and fourth shafts away from said first and second opposing roof panels of said carton in said score breaking station, and then during the movement of said carriage from said carton engaging position toward said retracted position to effect the arcuate movement of said first and second gable wings.
about the respective axis of said first and second shafts away from said first and second opposing gable panels of said carton in said score breaking station to clear said carton.

2. Apparatus in accordance with claim 1 wherein said actuating means comprises first and second pinion gears mounted on said first and second shafts, respectively, for rotation therewith, and first and second racks mounted in said carriage for vertical movement with respect thereto in engagement with said first and second pinion gears, respectively, means for biasing said first and second racks in the down position, and stop means for engaging said first and second racks at a point in the downward travel of said carriage to stop the downward movement of said racks while said carriage continues to move downwardly, thereby effecting relative movement between said racks and said carriage to rotate said first and second shafts to move said first and second gable wings into folding contact with said first and second opposing gable panels.

3. Apparatus in accordance with claim 2 wherein said actuating means further comprises a drive shaft mounted in said carriage for vertical movement relative thereto, means biasing said carriage downwardly on said drive shaft, third and fourth racks mounted on said drive shaft for movement therewith, third and fourth pinion gears mounted on said third and fourth shafts, respectively, in engagement with said third and fourth racks, respectively, and second stop means to stop the downward movement of said carriage after said first and second gable wings have been rotated into folding contact with the first and second opposing gable panels of the carton in said score breaking station while permitting the continuation of the downward movement of said drive shaft against said means biasing said carriage, to effect relative movement of said drive shaft and said carriage to rotate said third and fourth shafts to move said first and second roof panel wings into folding contact with the first and second opposing roof panels.

4. Apparatus in accordance with claim 3 wherein said actuating means further comprises shoulder means on the lower portion of said drive shaft for engaging a shoulder on said carriage during the upward travel of said drive shaft to raise said carriage with said drive shaft after an initial period of upward movement of said drive shaft with respect to said carriage.

5. Apparatus in accordance with claim 4 wherein said first, second, third and fourth shafts are located below the bottom of said gable panels and said roof panels of said carton in said score breaking station when said first and second roof panel wings are in contact with said roof panels.

6. Apparatus in accordance with claim 5 wherein each of said first and second roof panel wings has a generally rectangular configuration which is at least substantially the size of the respective one of said roof panels; and wherein each of said first and second triangular gable wings is shaped and positioned to contact only the central triangular panel of the respective gable panel.

7. Apparatus in accordance with claim 1 wherein said actuating means comprises a drive shaft mounted in said carriage for vertical movement relative thereto, means biasing said carriage downwardly on said drive shaft, first and second racks mounted on said drive shaft for movement therewith, first and second pinion gears mounted on said third and fourth shafts, respectively, in engagement with said first and second racks, respectively, and stop means to stop the downward movement of said carriage after said first and second gable wings have been rotated into folding contact with the first and second opposing gable panels of the carton in said score breaking station while permitting the continuation of the downward movement of said drive shaft against said means biasing said carriage, to effect relative movement of said drive shaft and said carriage to rotate said third and fourth shafts to move said first and second roof panel wings into folding contact with the first and second opposing roof panels.

8. Apparatus in accordance with claim 7 wherein said actuating means further comprises shoulder means on the lower portion of said drive shaft for engaging a shoulder on said carriage during the upward travel of said drive shaft to raise said carriage with said drive shaft after an initial period of upward movement of said drive shaft with respect to said carriage.