Oct. 20, 1964 F. F. BORKMANN ETAL 3,153,374

CARTON FORMING MACHINE

Filed July 31, 1962 11 Sheets-Sheet 1

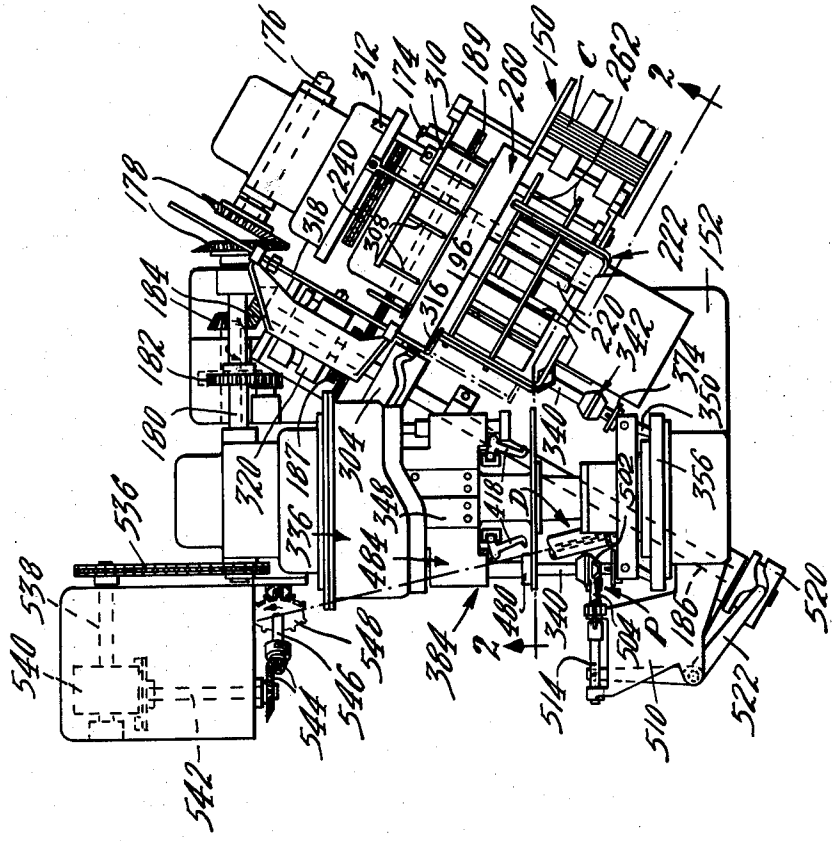


Fig. 1

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CARTON FORMING MACHINE

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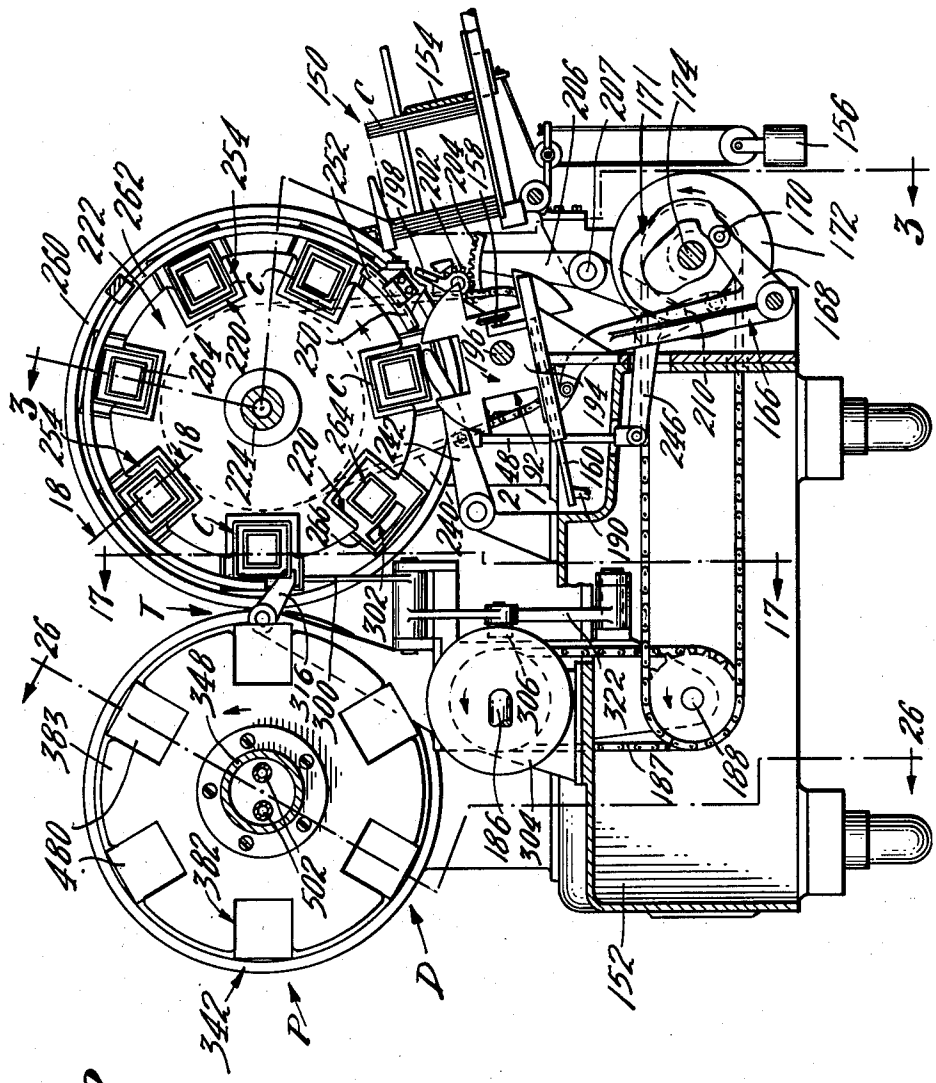


Fig. 2

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CARTON FORMING MACHINE

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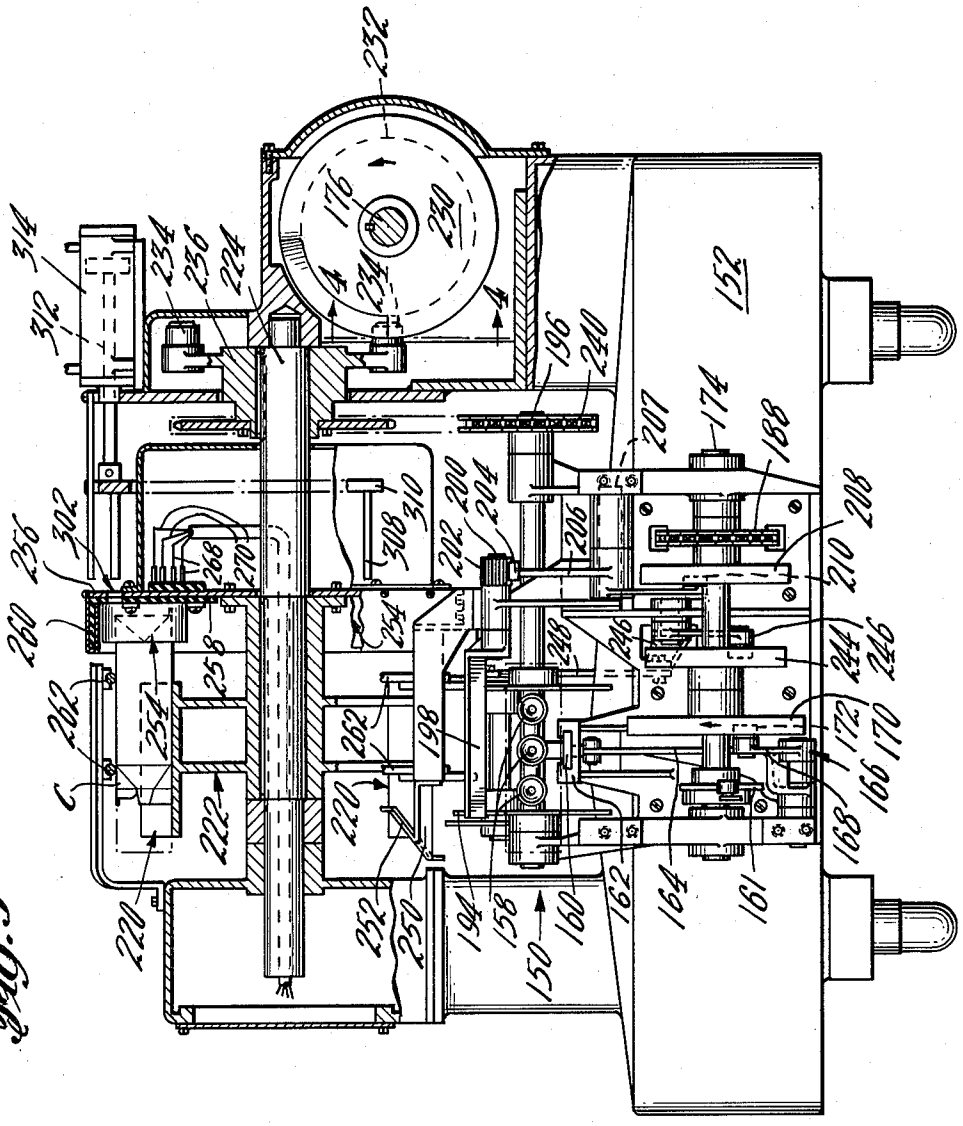


Fig. 3

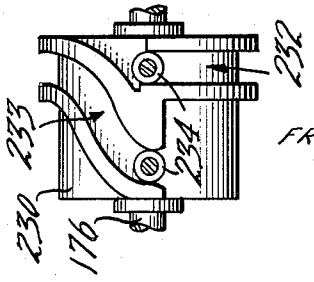


Fig. 4

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CARTON FORMING MACHINE

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Fig. 5

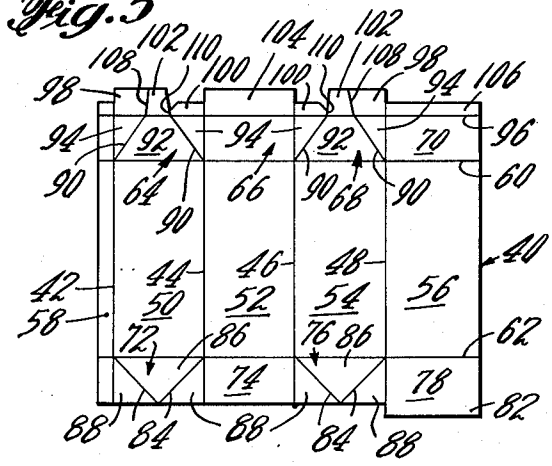


Fig. 6

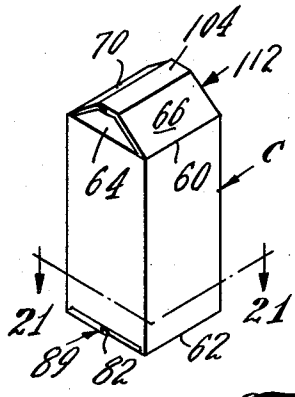


Fig. 7

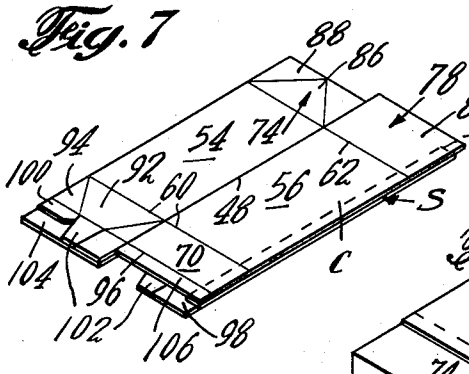


Fig. 8

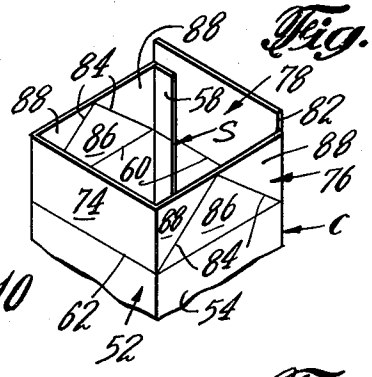


Fig. 10

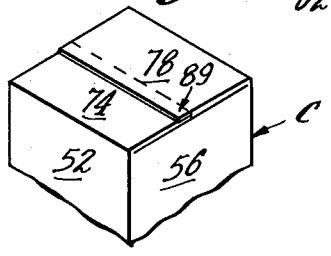


Fig. 9

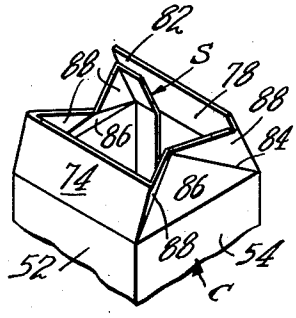


Fig. 11

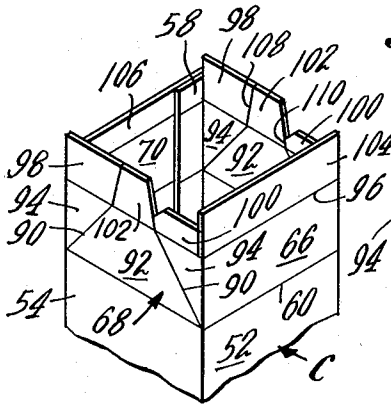
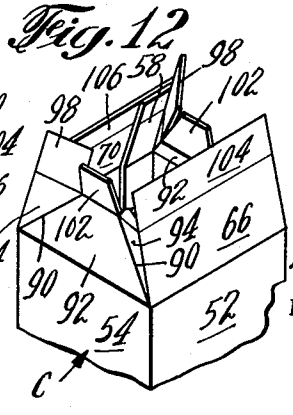


Fig. 12



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CARTON FORMING MACHINE

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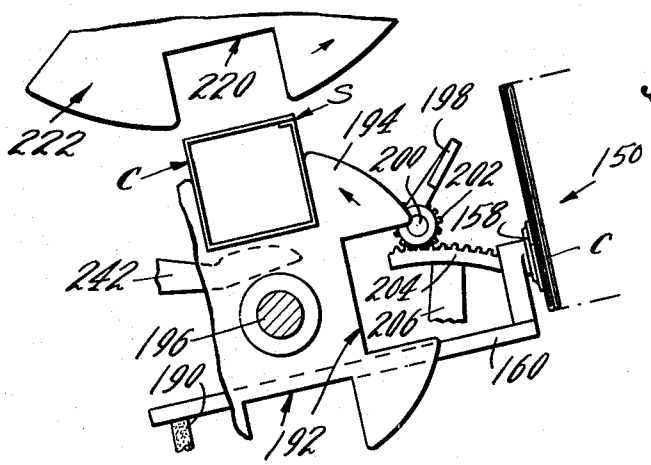


Fig. 13

Fig. 14

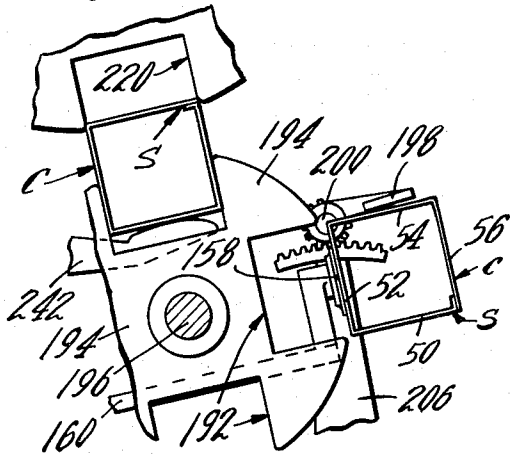
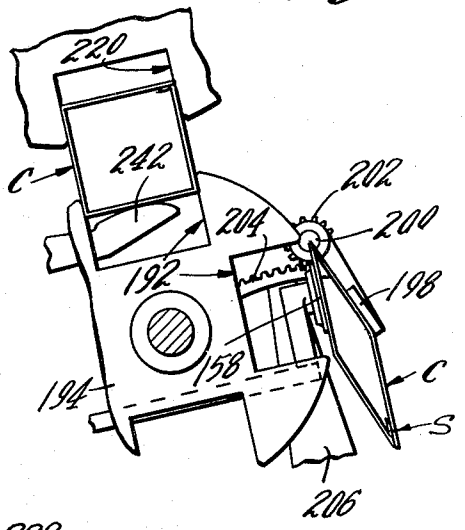


Fig. 15



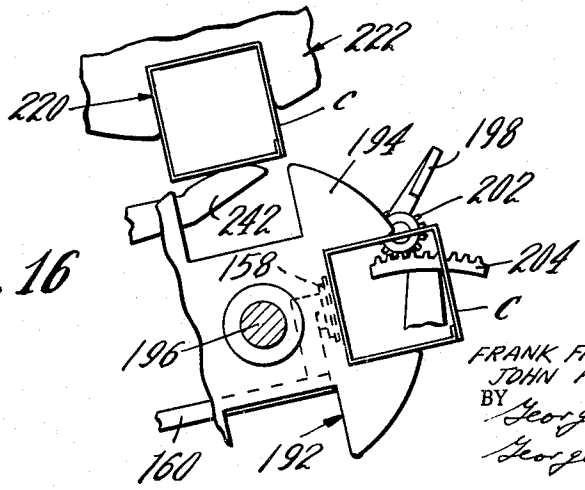


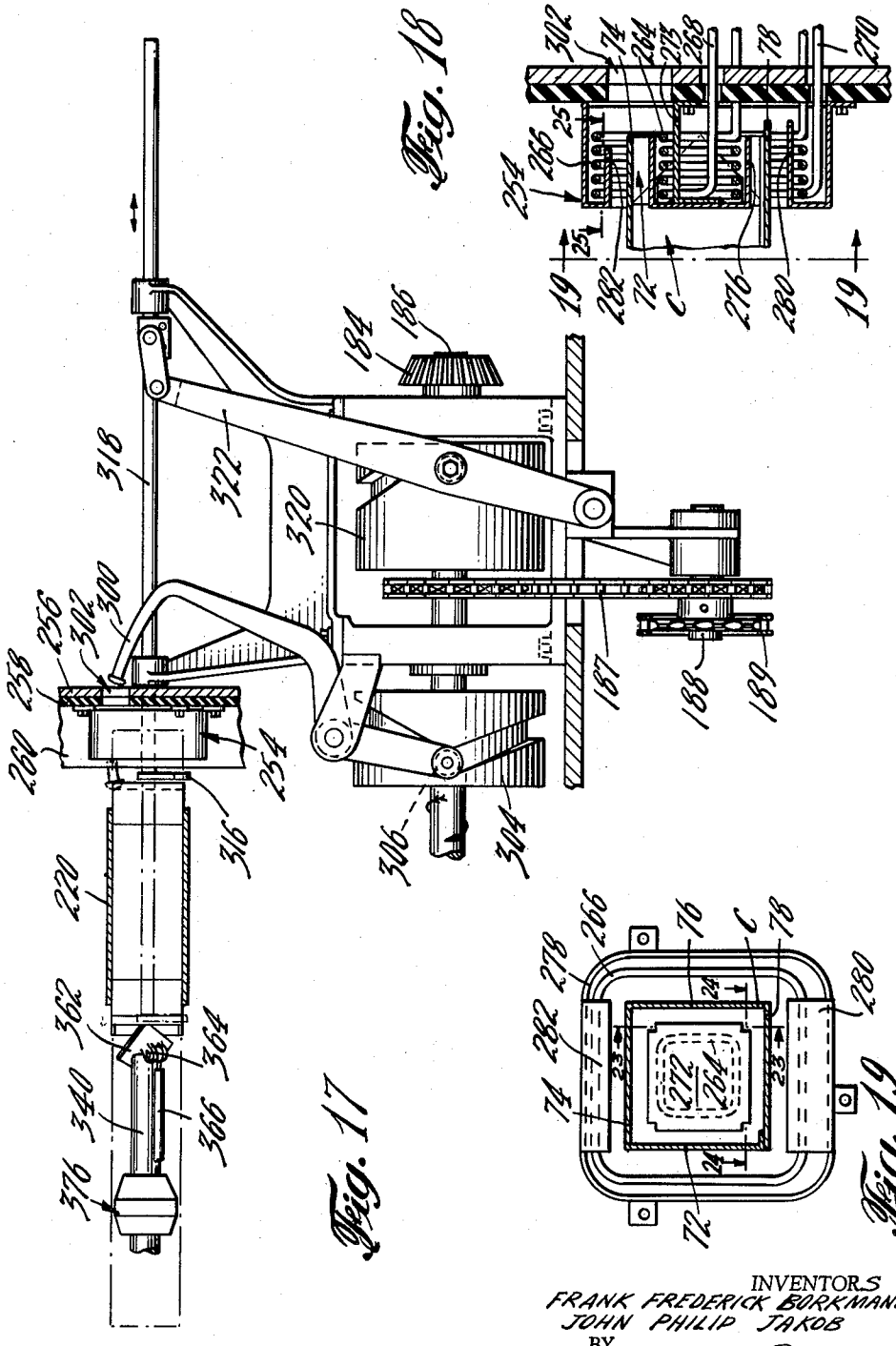
Fig. 16

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CARTON FORMING MACHINE

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CARTON FORMING MACHINE

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Fig. 20

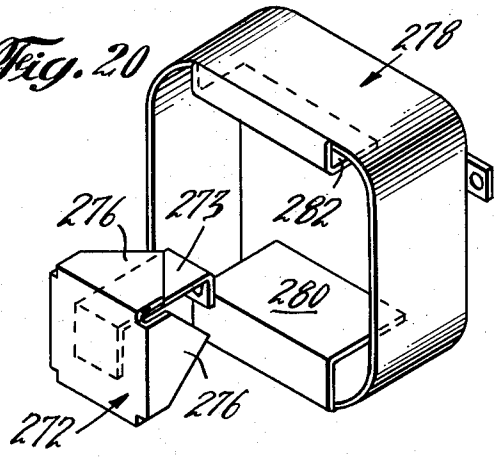


Fig. 21

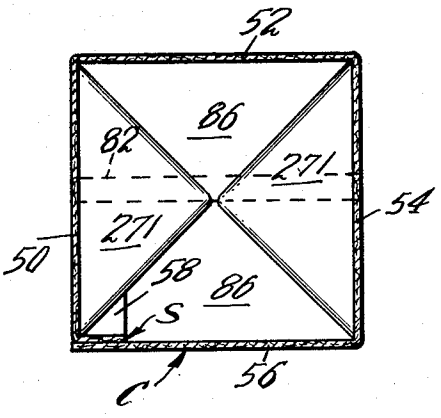


Fig. 22

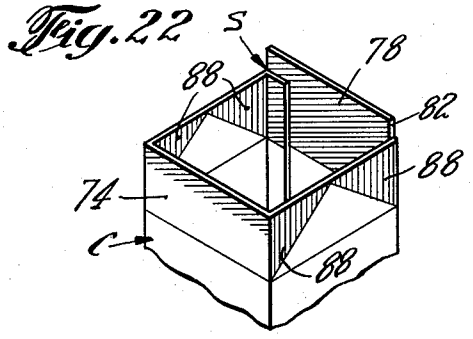


Fig. 23

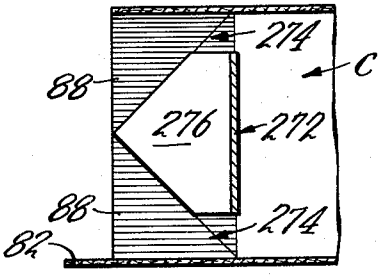


Fig. 25

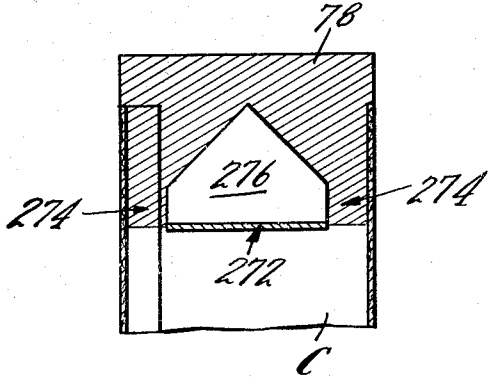
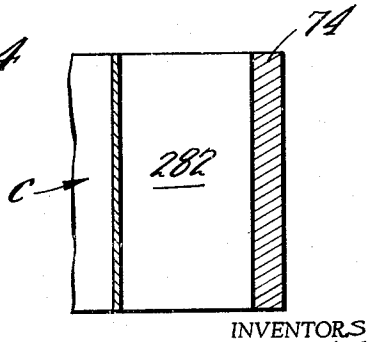


Fig. 24



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Oct. 20, 1964 F. F. BORKMANN ETAL 3,153,374

CARTON FORMING MACHINE

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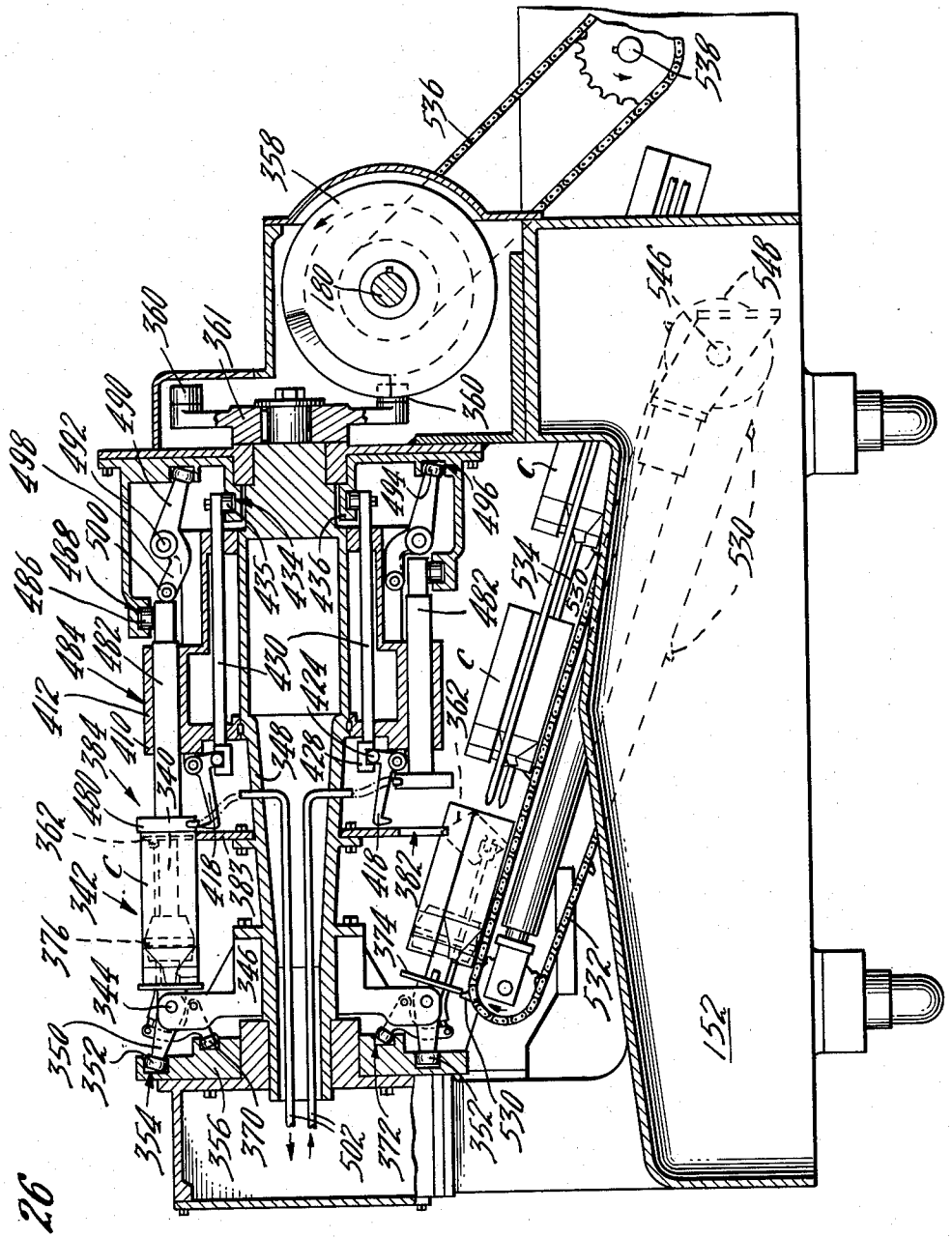


Fig. 26

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CARTON FORMING MACHINE

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Fig. 27

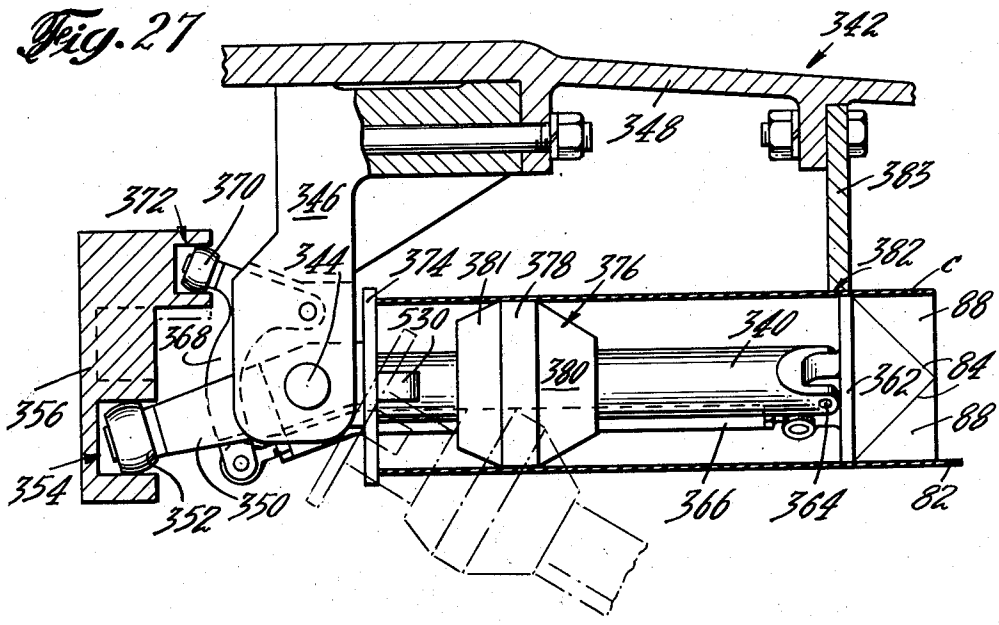


Fig. 28

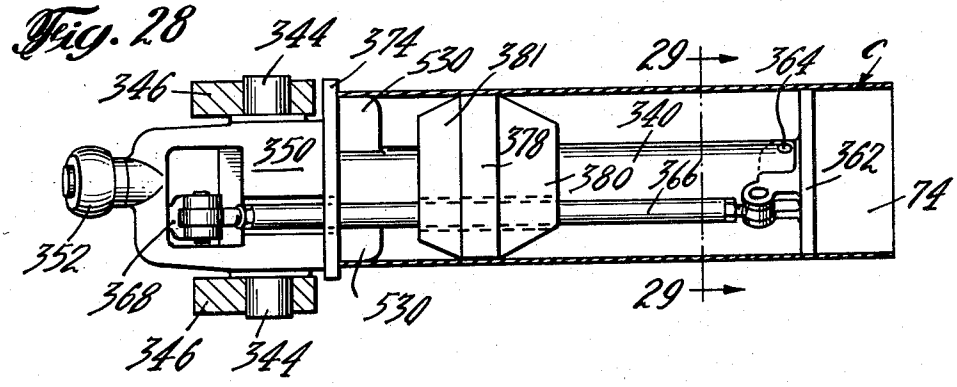
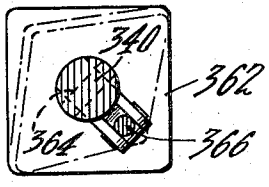


Fig. 29



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Fig. 34

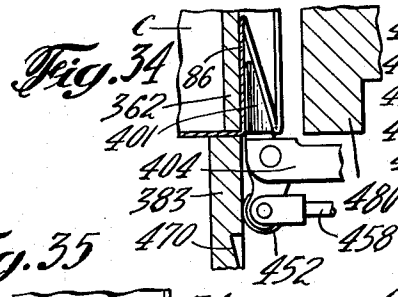


Fig. 30

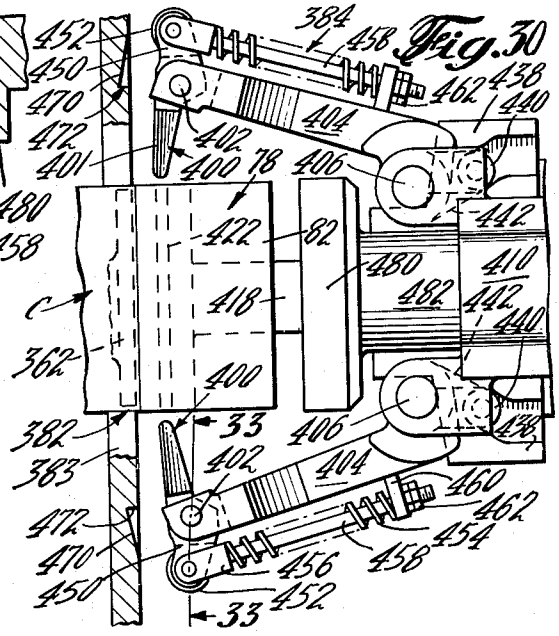


Fig. 35

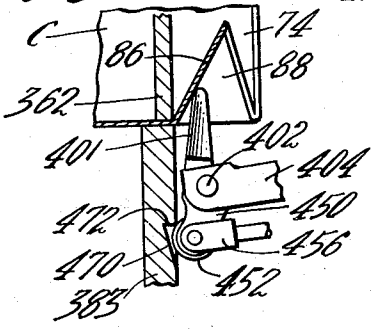
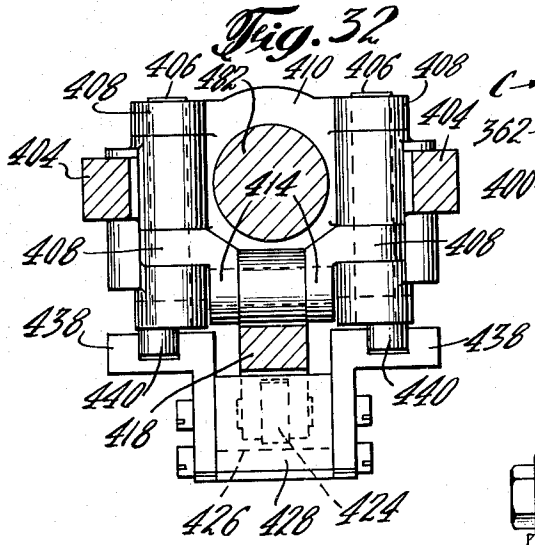


Fig. 32



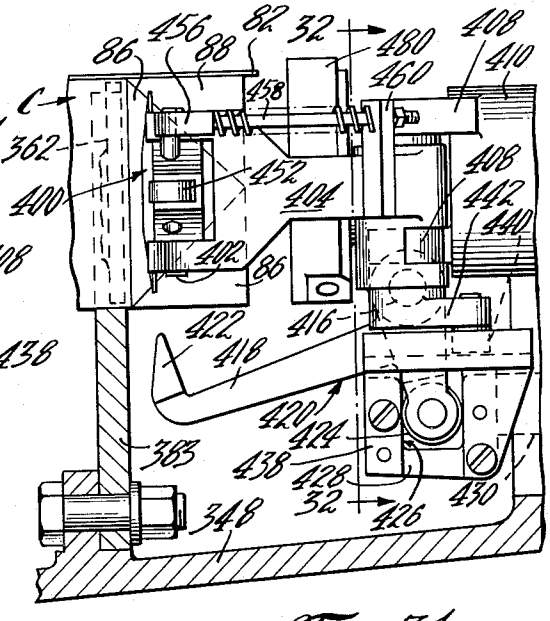
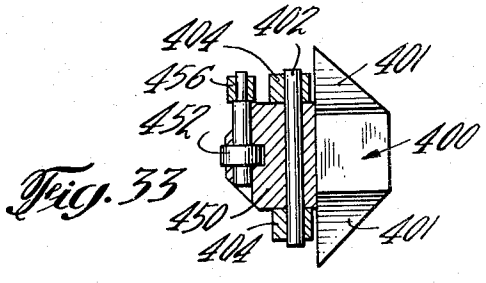


Fig. 31

Fig. 33



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Oct. 20, 1964 F. F. BORKMANN ETAL 3,153,374

CARTON FORMING MACHINE

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Fig. 36

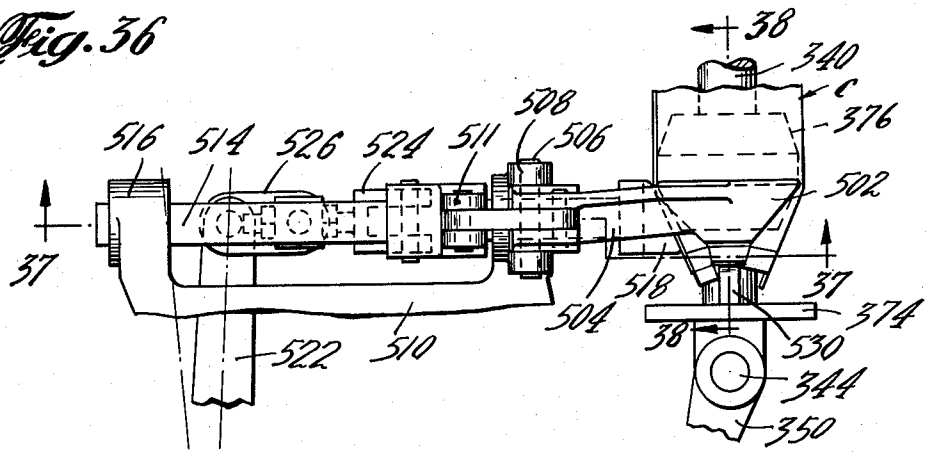


Fig. 37

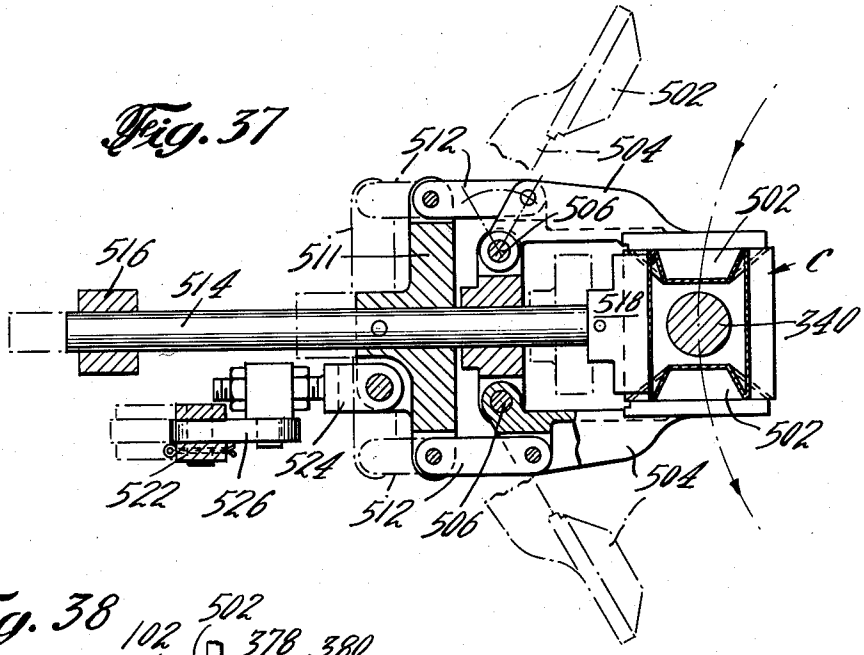
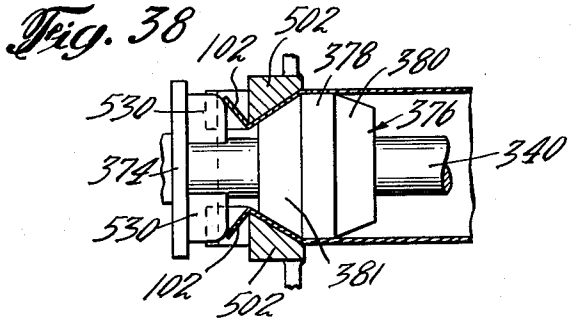


Fig. 38



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United States Patent Office 3,153,374 Patented Oct. 20, 1964

3,153,374

CARTON FORMING MACHINE

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Filed July 31, 1962, Ser. No. 213,706
22 Claims. (Cl. 93—44.1)

The present invention relates to machines for forming fibre cartons and has particular reference to a carton setting-up machine which forms leakproof bottom closures on fibre cartons which have their surfaces protectively coated with thermoplastic materials which are used as adhesives.

One of the most recent developments in the packaging field has been the introduction of a folding fibre milk carton having both its internal and external surfaces coated with a thin film of a protective plastic material such as polyethylene. In addition to providing a smooth, attractive, highly protective, fluidproof coating for the carton, the polyethylene has an additional advantage in that it is thermoplastic and can be utilized as a hot melt adhesive to form fluid-tight seals between the foldable end panels of the carton.

The present invention provides a machine wherein this heat sealing property of the polyethylene is utilized to form a folded, leakproof bottom closure in a folding fibre carton which is particularly adapted for the packaging of fluid products such as milk and milk products, orange juice, and the like. The machine also is provided with devices which prebend portions of the foldable top panels of the carton in order to condition them for the top end sealing operation which is effected in a separate machine.

An object of the invention therefore is the provision of a carton forming machine which opens up collapsed fibre cartons into tubular shape and forms their foldable bottom panels into leakproof bottom closures.

Another object of the invention is the provision of such a machine wherein the collapsed cartons are set-up into tubular shape by novel setting-up devices of simple and efficient design which overfold the carton corners past their normal 90° angles of bend while cartons are being fed from a supply magazine directly into the pockets of a transfer turret in order to insure that the formed cartons maintain the desired rectangular cross-sectional configuration.

Another object of the invention is the provision in such a machine of electrical heating heads which receive the bottom end panels of the set-up cartons prior to a panel folding operation, the heating heads being provided with suitable shielding devices which limit the direct application of heat to those surface areas of the panels which will come into mutual engagement with each other when the panels are later folded together to form the bottom closures of the cartons, thereby preventing pinholing and other possible degeneration of the coating on those portions of the panels which remain exposed in the sealed cartons.

Another object of the invention is the provision of such a machine having a plurality of such electrical heating heads mounted on a heating turret and wherein safety devices are associated with the heating turret to eject all cartons from the heating heads whenever the machine is stopped in order to prevent over-heating and burning of the cartons.

Still another object is the provision of a machine of the type described wherein the heated bottom panels of the cartons are folded and pressed together to form a leakproof bottom closure, the folding and pressing operation taking place while the cartons are positioned over internal sealing posts which form part of a separate bottom folding and sealing turret which is mounted closely adjacent the heating turret and disposed at an acute angle thereto in order to minimize the floor space required by the machine.

Another object is the provision in such a machine of novel means for effecting direct transfer of the cartons from the heating turret to the bottom folding and sealing turret.

Still another object of the invention is the provision of a machine wherein the bottom folding and sealing turret utilizes internal sealing posts which are pivotally mounted to facilitate transfer and discharge of the cartons.

Still another object of the machine is the provision of sealing posts which are provided with collapsible support plates to permit easy insertion of the cartons onto the posts.

Yet another object is the provision in such a machine of devices which prebend the top closure panels of the cartons while they are on the sealing posts to condition them for the final top sealing operation.

Still another object of the invention is to provide a single line machine which effects the bottom end sealing and top end prebending operations smoothly and reliably at high operating speeds.

Numerous other objects and advantages of the invention will be apparent as it is better understood from the following description, which, taken in connection with the accompanying drawings, discloses a preferred embodiment thereof.

Referring to the drawings:

FIGURE 1 is a plan view of a machine embodying the principles of the instant invention;

FIG. 2 is a vertical section on an enlarged scale taken substantially along the line 2—2 in FIG. 1;

FIG. 3 is a vertical section taken substantially along the line 3—3 in FIG. 2;

FIG. 4 is a section taken substantially along the line 4—4 in FIG. 3;

FIG. 5 is a plan view of a flat one-piece blank from which the carton which is operated upon by the machine of the instant invention is made;

FIG. 6 is a perspective view of a sealed carton which has been formed from the blank of FIG. 5, the finel steps of the formation of the top closure of this carton being performed in a machine separate from the machine of the instant invention;

FIG. 7 is a perspective view of a collapsed carton having a sealed side seam, this view showing the carton in the form in which it is introduced into the instant machine;

FIG. 8 is a perspective view of the inverted bottom end portion of a carton after the carton has been opened into tubular form;

FIG. 9 is a perspective view of the bottom end portion of an inverted carton showing an intermediate state in the formation of its bottom closure;

FIG. 10 is a perspective view showing the converted, finished bottom closure of the carton which is made by the instant machine;

FIG. 11 is a perspective view of the top end portion of the carton after it has been opened into tubular form;

FIG. 12 is a perspective view showing how the upper portion of the carton is prefolded by the instant machine preparatory to its being finally folded and sealed in a separate machine;

FIGS. 13 through 16 are schematic views showing successive steps in the operation of the collapsed carton feeding and opening devices;

FIG. 17 is a vertical section taken substantially along the line 17—17 in FIG. 2, parts being omitted and other parts being broken away;

FIG. 18 is a sectional view of a heating head taken substantially along the line 18—18 in FIG. 2;

FIG. 19 is an elevational view taken substantially along the line 19—19 in FIG. 18;

FIG. 20 is an exploded view of the heating head shields which limit the direct application of heat to selected areas of the bottom closure panels of the carton;

FIG. 21 is a horizontal section taken substantially along the line 21—21 in FIG. 6 and showing the inside of the finished bottom closure of the carton;

FIG. 22 is a perspective view of the top end portion of the carton, the shade lines in this view indicating those portions of the top closure panels on which the polyethylene coating is softened by the direct application of heat in the heating head;

FIGS. 23 and 24 are sectional details taken substantially along the lines 23—23, 24—24, respectively, in FIG. 19;

FIG. 25 is a sectional detail taken substantially along the line 25—25 in FIG. 18;

FIG. 26 is a vertical section taken substantially along the line 26—26 in FIG. 2;

FIG. 27 is an enlarged sectional view of a portion of the folding and sealing turret of the machine, the view including one of the pivotally mounted sealing posts, parts being broken away;

FIG. 28 is a sectional view of the mechanism of FIG. 27, the view being taken at right angles to and from the bottom of FIG. 27, parts being omitted;

FIG. 29 is a section taken substantially along the line 29—29 in FIG. 28;

FIG. 30 is an enlarged sectional view showing the mechanisms for folding and sealing the bottom end panels, parts being broken away;

FIG. 31 is another sectional view of the mechanisms of FIG. 30, the view being taken at right angles to and from the bottom of FIG. 30, parts being broken away;

FIG. 32 is a section taken substantially along the line 32—32 in FIG. 31;

FIG. 33 is a section taken substantially along the line 33—33 in FIG. 30;

FIGS. 34 and 35 are views illustrating successive stages in the operation of the bottom panel folding fingers of FIG. 30;

FIG. 36 is a view illustrating the top closure panel prefolding mechanisms; and

FIGS. 37 and 38 are sections taken substantially along the lines 37—37, 38—38 in FIG. 36.

As a preferred and exemplary embodiment of the instant invention, the drawings illustrate a machine capable of operating on fibre cartons C of the general type disclosed in United States Letters Patent 3,022,930 and 3,024,959. As seen in FIGURE 5, each carton C is formed from a single blank 40 of suitable stiff fibre stock, both the inside and outside surfaces of which are covered by a thin continuous film of a suitable thermoplastic protective coating material such as polyethylene.

The blank 40 is formed with four vertical crease or score lines 42, 44, 46, 48 which divide the blank into four body side walls 50, 52, 54, 56 and a narrow side seam flap 58. The ends of the body side walls 50, 52, 54, 56 are defined by two parallel, horizontal crease or score lines 60, 62 which divide the top marginal edge portions of the blank into top closure panels 64, 66, 68 and 70 and the bottom marginal edge portion of the blank into bottom closure panels 72, 74, 76, and 78.

The bottom closure panel 78 extends beyond the other bottom panels to provide an overlap tab 82, while the bottom closure panels 72, 76 are formed with diagonal crease or score lines 84 which subdivide each of these panels into triangular center panel sections 86 and a pair of triangular wing sections 88 which permit these bottom panel portions to be folded together to form a leakproof bottom closure 89 (see FIGS. 6 and 21) as will hereinafter be described.

The top closure panels 64, 68 are subdivided by diagonal crease or score lines 90 into trapezoidal panel sections 92 and triangular wing sections 94. The upper edges of the top closure panels 64, 66, 68, 70 are defined by a horizontal score or crease line 96, and the edge of the blank above the score or crease line 96 is suitably notched to provide two long tabs 98, two short tabs 100, two free central tabs 102 and a pair of lap tabs 104, 106. The free central tabs 102 are set off from the surrounding tabs 98, 100 by cut lines 108, 110.

By virtue of this blank construction, the upper portion of the carton C is adapted to be ultimately folded and heat sealed together to form a gable top which is generally designated by the numeral 112 in FIG. 6. However, the present machine does not perform this ultimate top closure folding and sealing operation, but merely prefolds selected portions of the top closure panels to precondition them for the final folding and sealing operation which is effected in the separate sealing machine after the carton C has been filled with the desired product. Further and more detailed information respecting the specific construction of the gable top portion of the carton C may be had by referring to the previously mentioned United States Patents 3,022,930 and 3,024,959.

Prior to their introduction into the present machine, the blanks 40 are folded along the crease lines 44, 48 to bring the narrow flap 58 into underlying relationship with the marginal edge portion of the side wall 56, and these lapping portions are adhesively secured together in any suitable manner, as by fusing together their mutually facing polyethylene surfaces to create a side seam S and thereby form the blank 40 into a flatly collapsed carton C as seen in FIG. 7. If desired, a separate adhesive may be utilized to form the seam S.

The collapsed cartons C are introduced into the instant machine in stacked formation in an inclined magazine, generally designated by the numeral 150 (see FIGS. 1 and 2) which is secured to the main frame 152 of the machine. The magazine 150 comprises a suitable number of guide rails which are suitably arranged to hold the collapsed cartons C in stacked formation, the forwardmost or front carton C being held against suitable spring detents (not shown) by means of a slidable pressure plate 154 which is held against the rearmost carton C by a weight 156.

The front carton C is removed from the magazine 150 by a vacuum feed unit which comprises three vacuum or suction cups 158 which are mounted on a reciprocating slide 160 which operates in a track 162 which is secured to the machine frame 152 (see FIGS. 2 and 3). The slide 160 is secured to the long arm 164 of a bell crank 166 (see FIG. 2) which is pivotally mounted on the frame 152, the short arm 168 of the bell crank 166 being provided with a cam roller 170 which operates in the groove 171 of a face cam 172 which is mounted on a cross-shaft 174 which is continuously rotated from a continuously rotating main drive shaft 176 (see FIG. 1) through a pair of bevel gears 178, a shaft 180, a pair of spur gears 182, a shaft 183, a second pair of bevel gears 184, a long cross-shaft 186, a vertical endless chain 187 which connects shaft 186 with a short spur shaft 188, and a horizontal endless chain 189 which connects the shafts 174 and 188.

On its forward stroke, the slide 160 moves the suction cups 158 into contact with the body side wall 52 of the front collapsed carton C in the magazine 150. The vacuum cups 158 are connected to a suitable source of vacuum (not shown) by means of a flexible hose 190 (see FIG. 2) and suitable bores (not shown) which are formed in the slide 160, a vacuum valve (not shown) actuated by a rotary switch 161 being provided in order to connect and disconnect the vacuum cups 158 and the source of vacuum, as required.

Just prior to engagement of the vacuum cups 158 with the front carton C in the magazine 150, the vacuum cups

158 are brought into communication with the source of vacuum. Consequently, upon being brought into contact with the front carton C (see FIG. 6), and actuated in their return stroke, the cups 158 obtain a firm grip on the front carton C and pull it from the magazine 150 toward a pocket 192 of a four pocket feed turret 194 which is mounted in alignment with the magazine 150 on a shaft 196 (see FIG. 2).

This motion of the carton C brings its body side wall 54 into engagement with an overfold blade 198 (see FIGS. 2 and 13) which is mounted on a shaft 200 which carries a small spur gear 202 and which meshes with a gear segment 204 which is mounted on the upper arm of a pivoted lever 206. The lever 206 is pivotally mounted on a shaft 207 and is oscillated by a face cam 208 which is carried on the shaft 174, a cam roller 210 being carried at the end of the lower arm of the lever 206 for engagement in the groove of cam 208.

As a result of the oscillation of the gear segment 204, the overfold blade 198 rotates downwardly to bend the carton C from its collapsed position to a squared up position as seen in FIG. 14. At this point, a dwell in the groove 171 of cam 172 causes the vacuum cups 158 to temporarily discontinue their return movement. The overfold blade 198, however, continues its downward motion and overfolds the carton C past its squared-up position of FIG. 14 to the parallelogrammatic cross-sectional configuration of FIG. 15, at which point the gear segment 204 oscillates in the opposite direction and moves the overfold blade 198 upwardly, thus releasing the carton C, which thereupon springs open and reassumes a square cross-sectional configuration which it thereafter retains, the stretching of the fibre stock at the corners of the carton C which results from the overfolding operation being just sufficient to cause this result.

As soon as the carton C assumes its final tubular squared-up configuration, the vacuum cups 158 resume their return movement and pull the carton C into the aligned pocket 192 of the turret 194 (see FIG. 16). At this point, the suction cups 158 are disconnected from the source of vacuum and vented to the atmosphere, thereby releasing the carton C. The feed turret 194 is now rotated through an angle of 90° to bring the squared-up carton C into alignment with a pocket 220 of a seven pocket heating turret generally designated by the numeral 222 (see FIG. 2) which is keyed to a shaft 224 which is journalled in suitable bearings formed in the machine frame 152 and is intermittently rotated by any suitable mechanism which produces intermittent rotation.

In the present machine this intermittent rotation of the heating turret 222 is effected by a large continuously rotating barrel cam 230 (see FIGS. 3, 4) which is mounted on the main drive shaft 176 and which is formed with an open-ended cam groove 232, a portion 233 of which is pitched along the longitudinal axis of the cam 230 and which successively receives each of a plurality of cam rollers 234 which are radially mounted in uniformly spaced arcuate relationship on the arms of a spider 236 which is keyed to the shaft 224, there being one cam roller 234 for each pocket 220 of the heating turret 222. During each rotation of the shaft 176, one of the cam rollers 234 is engaged by the cam groove 232 and is shifted longitudinally of the cam 230 to thus partially rotate the turret through an intermittent indexing step.

The feed turret 194 is indexed in synchronized relationship to the heating turret 222 by an endless chain 240 (see FIG. 3) which operates around sprockets which are keyed to the shafts 224 and 196.

The squared-up carton C is transferred upwardly from the pocket 192 of the feed turret 194 into a pocket 220 of the heating turret 222 by a pair of laterally spaced transfer fingers 242 which are pivotally mounted on the main frame 152 (see FIG. 2) and actuated from a face cam 244 (see FIG. 3), carried by the shaft 174, through a bell crank 246 and a connecting rod 248. The transfer fingers 242 hold the carton C in the pocket 220 until the heating turret 222 is rotated sufficiently during the first part of its next indexing step to move the carton C onto a support plate 250, the outer end of which carries a short, inwardly extending cam 252 which engages the outer end of the carton C, which end contains its top closure elements and will hereinafter be called the top end. Thereafter, the fingers 242 are moved downwardly into position to feed the next carton C from the feed turret 194.

Continued rotation of the heating turret 222 causes the stationary cam 252 to move the tubular carton C axially of the heating turret 222, thereby inserting its inner, or bottom end, into a heating head 254, one of which is mounted on the heating turret 222 in alignment with each pocket 220, the seven heating heads 254 being bolted to a plate 256 (see FIG. 3) which is carried by and forms a part of the heating turret 222. A ring 258 of a suitable insulating material is interposed between the heating heads 254 and the plate 256 and an annular insulated flange 260 is provided which substantially encloses the heating heads 254 (see FIGS. 2 and 3).

As soon as the bottom end of the carton C is fully inserted into the heating head 254, the carton C rides off the support plate 250 and onto a pair of arcuate rails 262 which are mounted outwardly of the heating turret 222 and thereafter maintain the carton C in the turret pocket 220.

Each heating head 254 comprises an inner heating coil 264 and an outer heating coil 266, these coils 264, 266 being concentric and preferably comprising heating units of the sealed electrical resistance type, such as those which are commercially available under the trademark "Calrod." The coils 264, 266 are connected to a suitable source of electrical energy by pairs of leads 268, 270, respectively, as best seen in FIGS. 3 and 18.

The bottom end of carton C is inserted into the space between the coils 264, 266 to the full depth of its bottom closure panels 72, 74, 76, 78 as seen in FIG. 18, so that both surfaces of all of these bottom closure panels face one or the other of the heating coils 264, 266 which function to heat soften the polyethylene coating on these panels so that when the panels are subsequently folded and pressed together to form the bottom closure 89, the heat softened polyethylene acts as an adhesive to form a liquidproof seal between the panels.

To properly soften the polyethylene, it must be heated to a temperature above its melting point, which is about 230° F., but less than about 640° F., at which point deleterious oxidation is encountered. The temperature required to create satisfactory liquidproof closures in the instant machine is affected by a number of variables, and so no exact temperature can be specified. However, it is desirable to melt the polyethylene only on those portions of the bottom closure panels which will come into face-to-face contact with other panel portions in the bottom closure 89, and to leave the polyethylene on those portions which will be exposed in the bottom closure 89 comparatively unheated and unsoftened so that they will not be disrupted by pinholes or other imperfections which frequently result when the polyethylene is heated close to or above its melting point. Those portions of the bottom flaps which must be heated are indicated by the shade lines in FIG. 22.

As seen in FIGS. 21 and 22, internal triangular portions of all four bottom closure panels 72, 74, 76, 78 are exposed to the product in the finished container. These comprise the portions 86 of the panels 72, 76, and similarly shaped portions 271 of the panels 74, 78. In order to prevent the melting of the polyethylene on these four triangular panel portions, a suitably configured inner shield 272, preferably made of a metal such as stainless steel, is positioned in closely spaced proximity around the inner heating coil 264 so that it is interposed between the coil 264 and the bottom closure panels 72, 74, 76, 78.

This shield 272, which is mounted on a bracket 273, is symmetrical in shape and is formed with four triangular shielding legs 276 which intercept the heat which is radiated by the inner coil 264 and prevent it from impinging directly on the triangular panel portions 86, 271, except for small areas 274, adjacent the corners of the portions 86, 271 (see FIGS. 23, 25). The remaining portions of these panels 72, 74, 76, 78 which comprise the smaller triangular portions which are disposed adjacent the shielded sections 86, 271, are not shielded, and the polyethylene coating on these unshielded sections is melted by the heat from the coil 264 and rendered tacky to provide a liquidproof seal in the finished closure 89.

As best seen in FIG. 10, only the complete surface of the bottom closure panel 78, and the outside surface of the panel 74, with the exception of that portion of panel 74 which underlies the flap 82 of panel 78, remain exposed in the finished bottom closure, all other outside surfaces of the bottom closure panels 72, 74, 76, 78 being disposed in the interior of the bottom closure 89 and hidden from sight. To prevent the heating of the polyethylene on these exposed panel portions, an outer shield member 278 is provided which comprises a rectangular frame 279 which surrounds the outer heating coil 266 and is formed with a pair of rectangular shielding surfaces 280, 282 which are disposed inwardly of the coil 266 and are interposed between the coil 266 and the outer surfaces of the panels 74, 78 to shield these surfaces and prevent them from being heat softened. As best seen in FIG. 18, the shield 280 is longer than the shield 282, and fully shields the panel 78, including the tab 82. The shield 282 is somewhat shorter so that the portion of the panel 74 which underlies the flap 82 in the finished closure 89 is not shielded, but is heated, as indicated in FIG. 22.

The bottom end of the carton C remains in the heating head 254 until just before the carton C reaches a transfer station, generally indicated by the letter T, at which point the heating cycle is completed and the polyethylene coating on the unshielded portions of the bottom closure panels has been heated to the desired temperature.

Just prior to the time the carton C reaches the transfer station T, it is removed from the heating head 254 by a pivotally mounted knock-out finger 300 (see FIG. 17) which operates through an elongated slot 302 (see FIGS. 2 and 17) formed in the plate 256 and insulating ring 258 of the heating turret 222 rearwardly of each heating head 254 and in alignment with a bottom edge portion of the carton C. The knock-out finger 300 is actuated by a barrel cam 304 which is keyed to the shaft 186, the finger 300 being provided with a cam roller 306 which rides in the groove of the cam 304.

For various reasons, it is sometimes necessary to stop the instant machine while the cartons are in the heating turret 222. In order to prevent overheating and the possible burning of the cartons C which are in the heating heads 254, means are provided to effect removal of those cartons C from the heads. To make this possible, the machine is preferably driven through a clutch which will disengage only at the end of an indexing stroke of the heating turret 222. Thus, each time the machine stops, the carton C which is present at the transfer station T will have been removed from its heating head 254 by the knock-out finger 300.

To provide for removal of the other cartons C which are in the four succeeding heating heads of the heating turret 222 between the transfer station T and the station at which the cartons C are received from the feed turret 194, four auxiliary knock-out pins 308 (see FIGS. 1 and 3) which are mounted on an arcuate carrier member 310 are provided in alignment with the slots 302. The carrier member 310 is carried at the outer end of the piston rod 312 of a pneumatic cylinder 314 (see FIG. 3) which is controlled by a solenoid valve (not shown) which is energized whenever the machine is stopped. As a result, each time the machine stops, the auxiliary fingers 308 are projected through the slots 302 to remove the cartons C from their associated heating head 254, and are thereafter immediately returned to their retracted position. These cartons C, which will not be properly heated, will preferably be discarded when later discharged from the machine.

As previously stated, the knock-out finger 300 removes each properly heated carton C from its heating head 254 just prior to the time it reaches the transfer station T. Consequently, as the carton C enters the transfer station T, it clears a blade 316 which is carried at the front end of a transfer rod 318. As a result, the blade 316 is positioned behind the leading, rearwardly disposed corner of the carton C, as best seen in FIG. 2, when the turret 222 dwells at the transfer station T. At this time, the transfer rod 318 is actuated through its forward stroke by a barrel cam 320 which is mounted on the shaft 186 and which is operatively connected to the transfer rod 318 by means of a pivoted lever arm 322, thus causing the blade 316 to engage the adjacent corner of the carton C and push it from the pocket 220 onto a swingable internal sealing post 340, six of which are carried by a six pocket folding and sealing turret which is generally designated by the numeral 342 (see FIG. 26).

Each sealing post 340 is pivotally mounted in a pocket 343 of the turret 342 on a pivot pin 344 which is carried in a bracket 346 which is bolted to the hub 348 of the folding and sealing turret 342. At its outer end, the sealing post 340 is formed with a short arm 350 which carries a cam roller 352 which operates in a cam groove 354 of a stationary face cam 356 which is secured to the main frame 152.

As best seen in FIG. 1, the axis of the folding and sealing turret 342 is disposed at an acute angle to and in the same horizontal plane as the axis of the heating turret 222, and the folding and sealing turret 342 is intermittently rotated in synchronism with the heating turret by an intermittent drive mechanism which comprises a barrel cam 358 carried by the shaft 180 and a group of six uniformly spaced cam rollers 360 which are mounted on a spider 361 which is keyed to the turret hub 348 in alignment with the turret pockets 343. This intermittent drive mechanism is similar to the mechanism which intermittently drives the heating turret 222 and which is clearly shown in FIG. 4, and therefore no further description of it need be given here.

As stated, the carton C is transferred from the heating turret 222 to the folding and sealing turret 342 at the transfer station T, at which time both turrets are in their dwell position. At this point the sealing post 340 which receives the carton C is held by the cam 356 in outwardly swung position wherein it is in alignment with the pocket 220 of the heating turret 222.

The inner end of the sealing post 340 carries on it a pressure plate 362, which has circumferential outline which corresponds closely to the inner cross-sectional shape of the carton C. To facilitate the transfer of the carton C onto the sealing post 340, the pressure plate 362 is pivotally mounted on a pivot pin 364 (see FIGS. 27, 28) which is carried by the sealing post 340, and is pivotally connected to an actuating rod 366, the opposite end of which is pivotally connected to one arm of a bell crank 368 which is pivotally mounted on the bracket 346. The other arm of the bell crank 368 carries a cam roller 370 which operates in a second cam groove 372 formed in the face cam 356, the cam groove 372 being so designed that when the sealing post 340 reaches the transfer station T, the pressure plate 362 is held in a pivotally collapsed position which is best seen in FIG. 17 and is also indicated by the dot and dash lines in FIG. 29, so that there is no danger of interference between the leading edge of the carton C and the sealing plate 362, as there might otherwise be if the carton C were not in perfectly squared condition.

The carton C is pushed forward by the blade 316 until its top edge seats against a stop plate 374 which is carried

by the sealing post 340, after which the blade 316 returns to its original position. The sealing post 340 also carries a block 376 which is formed with a central flat portion 378 which in cross-section corresponds to the desired internal cross-section of the carton C. The inner end 380 of the block 376 is tapered to smoothly receive the leading edges of the carton C while its outer end 381 is oppositely tapered for a purpose which will hereinafter be described.

As soon as the carton C has been fully seated on the sealing post 340, the folding and sealing turret is rotated through an indexing stroke 342 by the cam 358. During this indexing stroke, the sealing post 340 is swung by the cam groove 354 to its inward position (as shown in solid lines in FIG. 27), wherein it is parallel to the axis of the folding and sealing turret 342, thus moving the carton C into a pocket recess 382 which is formed in a ring plate 383 which is carried by the turret hub 348 (see FIGS. 2, 26, 27). Simultaneously, the pressure plate 362 is swung from its collapsed position to its normal position wherein it is disposed in a plane which is normal to the axis of the turret 342, as seen in FIGS. 27, 28. Thus, the carton C is rigidly maintained in its squared-up position by the block 376, pressure plate 362 and the edge of pocket recess 382. It is in this position that the bottom closure panels 72, 74, 76, 78 of the carton C are folded and pressed together to form a liquid-tight bottom closure by devices which will now be described.

The bottom panel folding and sealing operation is effected by devices which are carried on a folding and sealing head, which is generally designated by the numeral 384 (see FIGS. 30, 31), one of which is mounted on the folding and sealing turret 342 in alignment with each sealing post 340. Each folding and sealing head 384 comprises a pair of folding fingers 400 formed with tapered side edges 401. The fingers 400 are pivotally mounted on pins 402 carried in the yoked ends of a pair of oppositely disposed pivot arms 404 which are mounted on pivot pins 406 journalled in bearings 408 formed in a boss 410 which comprises a portion of an annular cage 412 which is secured to the hub 348 of the folding and sealing turret 342.

The boss 410 also has formed in it a set of bearings 414 which carry a pivot pin 416 on which is pivotally mounted a third pivot arm 418 which operates at right angles to the pivot arms 404. The pivot arm 418 comprises one arm of a bell crank 420 and carries at its extremity a tucking finger 422 which has a width substantially equal to the width of the adjacent side of the carton C (see FIGS. 31, 32). The other, shorter arm 423 of the bell crank 420 carries a roller 424 which is disposed in a short track 426 which is formed in the enlarged head 428 of a slide rod 430. At its other end the slide rod 430 carries a cam roller 432 which operates in a barrel type cam groove 434 which is formed in a stationary frame 436 which is fixedly mounted to the main frame 152 (see FIG. 26).

The enlarged head 428 of the slide rod 430 has bolted to its opposite sides a pair of short cams 438 in which operate a pair of cam rollers 440 which are mounted on short extensions 442 of the pivot arms 404. Consequently, when the slide rod 430 is actuated toward the carton C (to the left as seen in FIGS. 26, 30, 31) the folding fingers 400 are cammed toward each other and into contact with the adjacent triangular portions 86 of the bottom panels 72, 76 of the carton C, thus folding these panels inwardly along the crease lines 84, 62.

Each finger 400 is provided with a short rearward extension 450 which carries a cam roller 452, and the finger 400 is normally held at a predetermined angle to the arm 404 by means of a spring 454 which is interposed between a shoulder 456 of a bolt 458 carried by the extension 450 and a lug 460 formed in the arm 404, the bolt 458 passing through a hole in the lug 460 and being provided with a pair of lock nuts 462 to provide for adjustment of the finger 400.

As stated, as the fingers 400 move inwardly toward each other, they fold the carton C along the crease lines 84. The arcuate motion of the pivot arm 404 moves the cam rollers 452 into short notches 470 which are formed in the plate 383. Continued motion of the arms 404 forces the cam rollers 450 against sharp shoulders 472 which are formed at the ends of the recesses 470, thus compressing the springs 454 and imparting a pivotal action to the folding fingers 400 which changes their angular relationship to the arm 404, thereby folding the triangular sections 86 into substantially right angled relationship relative to the corresponding side walls 50, 54 of the carton C (as seen in FIG. 34).

The forward movement of the slide rod 430 also results in a pivotal action of the pivot arm 418 which is synchronized with the movement of the pivot arms 404. Thus, as the folding fingers 400 fold the panels 72, 76 along their crease lines 84, the tucking finger 422 engages the panel 74 and presses it inwardly, thereby insuring that its edge is disposed beneath the flap 82 of the opposite panel 78.

As soon as the folding and tucking action has been substantially completed by the fingers 400, 422, the slide rod 430 is retracted to withdraw these fingers, and the folded bottom panels of the carton C are engaged and pressed against the pressure plate 362 by a pressure pad 480 which is carried at the inner end of a slide 482 which operates in a slide bearing 484 formed in the cage 412. At its opposite end, the slide 482 carries a cam roller 486 which operates in a second cam groove 488 which is formed in the frame 436.

The bottom closure panels are pressed between the pressure plate 362 and the pressure pad 480 for a period of time sufficient to permit the softened polyethylene on the heated surfaces of these panels to solidify and fuse together to thereby form a liquid-proof seal. Cooling water may be circulated through the pressure pad 480 to expedite the setting of the heated polyethylene, suitable water conduits 502 (see FIG. 26) being provided for this purpose.

To relieve the strain on the offset cam rollers 486 during this period of compression and to increase the compressive force exerted on the bottom closure panels, a pressure arm 490 which is pivotally mounted on a pin 492 in alignment with the slide 482 is provided. The outer end of the pressure arm 490 carries a cam roller 494 which operates in a third cam track 496 which is formed in the frame 436, while the inner end of the pressure arm 490 is formed with an offset portion 498 which carries on it a roller 500 which is held clear of the slide 482 when the pressure arm 490 is in in-operative position (as seen in the bottom of FIG. 26), and which swings in behind the slide 482 and presses it toward the sealing plate 362 when the pressure arm 490 is swung into its operative position (as shown in the top of FIG. 26).

Pressure is maintained on the bottom closure panels of the carton C, while the folding and sealing turret 342 is indexed through its successive steps. When the carton C reaches a prefolding station, which is indicated by the letter P in FIGS. 1 and 2, its top closure panels are operated upon by a prefolding device which comprises a pair of prefolding pads 502 which are mounted at the extremities of a pair of pivot arms 504 which are pivotally mounted on pins 506 carried in a bearing 508 which is formed in a bracket 510 which is secured to the main frame 152 (see FIGS. 1, 36, 37).

The arms 504 are also connected to a slide yoke 511 by means of a pair of pivotally mounted connecting links 512, the yoke 511 being secured to a slide rod 514 which is mounted in the bearing 508 and in a second bearing 516 which is also formed in the bracket 510.

The slide rod 514 carries at its forward end a pressure

block 518 having a tapered front face, and is actuated from a barrel cam 520, which is carried on the shaft 186, through a bell crank 522 which is secured to the yoke 511 through an adjustable link 524 and a connecting link 526.

As soon as the carton C is stopped at the prefolding station P by the dwell of the folding and sealing turret 342, the yoke 511 is moved through its forward stroke by the cam 520, thus pressing the pressure block 518 against the top closure panel 70 and simultaneously causing the arms 504 to pivot inwardly from their open position (shown in dot and dash lines in FIG. 37) to their closed position (as shown in solid lines in FIGS. 36 and 37), thus folding the top closure panels 64, 68 along their crease lines 90, to the position shown in FIGS. 12, 36, 37 and 38. To insure accurate folding, the tapered face 381 of the inner support block 376 functions as an anvil for the pressure pads 502 and the pressure block 518.

In order to bias the free central tabs 102 of the carton C into an outwardly extending position as required for the final top sealing operation, they are wiped against a pair of oppositely disposed lugs 530 which are carried by the sealing post 340, thus causing the tabs 102 to bend outwardly at their bases along the score line 96 as the trapezoidal panel sections 92 to which they are connected are pressed inwardly by the sealing pads 502.

After this prefolding operation has been completed, the carton C is carried to a discharge station D by the turret 342. During this period of travel, the sealing plate 362 is pivoted to its collapsed position, as seen in FIG. 26, thus engaging the inside of the completed bottom closure 89 and moving the carton C away from the stop plate 374 of the sealing post 340. Simultaneously, the sealing post 340 is swung to its outward position, thus enabling a lug 530 carried on a takeaway chain 532 to engage the top edge of the carton C and strip it from the sealing post 340 into a discharge runway 534 and discharge it from the machine to any suitable place of deposit. As the carton C is stripped from the post 340, its prefolded top end is forced back into its initial square shape by the central portion 381 of the block 376, but because of the inherent springiness of the fibre stock, it thereafter reassumes a prefolded configuration which is somewhere between the squared-up configuration and the configuration of FIGS. 12, 36 and 37.

The takeaway chain 532 is intermittently driven from the shaft 180 through a drive train which includes an endless chain 536, a shaft 538, an intermittent drive mechanism, generally designated by the numeral 540 which is similar to the mechanism disclosed in FIG. 4, a shaft 542, bevel gears 544, a shaft 546, and a sprocket 548 around which the chain 532 operates.

After the carton C has been removed from it, the sealing post 340 is retained in its outward position and carried around to the transfer station T where it receives another carton C from the heating turret 222.

It is thought that the invention and many of its attendant advantages will be understood from the foregoing description and it will be apparent that various changes may be made in the form, construction, and arrangement of the parts without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the form hereinbefore described being merely a preferred embodiment thereof.

We claim:

1. A machine for folding and bottom sealing a collapsed carton having bottom closure panels which are coated on both surfaces thereof with a thermoplastic material,
comprising means for opening said carton,
means for heating only selected portions of said bottom closure panels on both surfaces thereof which are to be brought into face-to-face contact in the sealed bottom closure to thereby soften the thermoplastic coating thereon,
means for folding said bottom closure panels across the bottom end of said opened carton,
and means for pressing said folded bottom closure panels together to bring said selected heated portions into mutual engagement and for holding them in pressured engagement until said heated thermoplastic material has set to form a sealed bottom closure.

2. A machine for folding and bottom sealing a collapsed carton having bottom closure panels which are coated on both surfaces thereof with a thermoplastic material,
comprising means for feeding said collapsed carton from a magazine,
means for opening said collapsed carton to tubular form,
said opening means including means for temporarily overfolding said carton past its desired final configuration,
means for transferring said opened carton to a heating turret,
heating means in said heating turret for heating only selected portions of said bottom closure panels on both surfaces thereof which are to be brought into face-to-face contact in the sealed bottom closure to thereby soften the thermoplastic coating thereon,
means for transferring said heated carton to a folding and sealing turret,
means in said folding and sealing turret for folding said bottom closure panels across the bottom end of said carton,
and means in said folding and sealing turret for pressing said folded bottom closure panels together to bring said selected heated portions into mutual engagement and for holding them in pressured engagement until said heated thermoplastic material has set to form a sealed bottom closure.

3. The machine of claim 2
wherein said feeding means includes a feed turret and a vacuum member which operates between said magazine and said feed turret through a feed stroke which includes a dwell,
and wherein said opening means comprises a pivotally mounted finger which engages said carton and overfolds it past the desired final configuration during the dwell of said vacuum member.

4. The machine of claim 2
wherein said heating means comprises a pair of spaced heating elements which enclose both surfaces of the bottom closure panels of said carton.

5. The machine of claim 4
wherein shielding means are provided adjacent said heating coils to prevent the direct application of heat from said coils to the portions of said panels on both surfaces thereof which are not to be disclosed in face-to-face contact in the sealed bottom closure.

6. A machine for folding and bottom sealing a collapsed carton having bottom closure panels which are coated with a thermoplastic material,
comprising a rotary heating turret for applying heat to said bottom closure panels,
a rotary folding and sealing turret for folding said bottom closure flaps across an end of said carton and pressing them together to form them into a bottom closure,
and transfer means for transferring a carton from said heating turret to said folding and sealing turret,
said turrets being disposed at an acute angle relative to each other,
said folding and sealing turret being provided with an internal sealing post for receiving a carton from said heating turret,
said sealing post being pivotally mounted for movement into alignment with said heating turret to receive a carton therefrom and comprising collapsible means for supporting the carton during the folding and pressing operations.

7. The mechanism of claim 6

wherein said collapsible supporting means comprises a pressure plate which is pivotally mounted on an end of said sealing post,

and wherein said pressure plate is easily receivable within and closely corresponds to the inner cross-sectional size and shape of said carton.

8. The mechanism of claim 6

wherein said heating turret carries a heating head for heating the thermoplastic material on the bottom closure panels of said carton,

and wherein said folding and sealing turret carries a folding and sealing head which folds said panels and presses them together,

and wherein means are provided to selectively align said sealing post with said heating head and with said folding and sealing head to facilitate transfer of said carton between said turrets.

9. The mechanism of claim 8

wherein said sealing post is normally positioned parallel to the axis of said folding and sealing turret,

and wherein said sealing post is swingable to a position wherein it is disposed at an acute angle to said axis to facilitate transfer of said carton onto and off said sealing post.

10. The mechanism of claim 9

wherein said transfer means moves said carton in a substantially straight line to transfer it from said heating turret onto said sealing post.

11. The mechanism of claim 9

wherein means are provided to strip said carton from said sealing post while the latter is disposed at an acute angle to the axis of said folding and sealing turret after said bottom closure has been completed.

12. A machine for forming cartons

comprising a first treating turret mounted for rotation around a first axis,

a container holding pocket formed in said first turret and disposed parallel to said first axis,

a second treating turret mounted for rotation around a second axis disposed at an angle to said first axis,

a swingable post mounted on said second turret and adapted for engagement within a container,

said post being normally disposed in parallelism with said second axis but being movable into longitudinal alignment with said pocket to receive a container therefrom,

means for moving a container in a straight line from said pocket onto said post,

and means movably mounted on said post for supporting said container after it is positioned on said post.

13. In a machine for forming a closure on a tubular carton having tubularly extended foldable closure panels which are coated on both surfaces thereof with a thermoplastic material

the improvement which comprises a heating head,

said heating head comprising a pair of spaced, substantially concentric electrical heating coils for receiving the said closure panels therebetween,

and shielding means disposed between the said heating coils and the portions of said closure panels on both surfaces thereof which are not to be disposed in face-to-face contact in the finished closure, thereby to intercept the heat radiated from said coils and to limit the direct application of heat from said coils to the unshielded portions of said closure panels which are to be disposed in face-to-face contact in the finished closure.

14. The mechanism of claim 13

wherein a carton holding pocket is mounted in alignment with a said heating head,

and wherein means are provided to move a carton in said pocket longitudinally of said pocket to insert its closure panels between said coils.

15. The mechanism of claim 13

wherein a plurality of said pockets and heating heads are mounted on an intermittently rotatable turret,

and wherein a plurality of cartons are simultaneously disposed in said turret in inserted position in said heating heads while they are being carried around by said turret with the unshielded portions of their closure panels exposed to said heating coils,

and wherein means are provided to eject said cartons from said heating heads in the event the machine is shut down while said cartons are in said heads.

16. A machine for forming a bottom closure on a tubular carton having tubularly extended foldable closure panels formed at one end thereof,

comprising a sealing post engageable within said carton,

a pressure plate movably mounted on said sealing post adjacent said closure panels, said pressure plate corresponding closely to the inner cross-sectional size and shape of the tubular carton,

folding means mounted externally of said sealing post for folding said closure panels across the said end of said carton,

a pressure pad mounted externally of said sealing post and in alignment with said pressure plate,

and means for creating relative movement between said pressure plate and said pressure pad to compress said folded closure panels therebetween to form them into a closure.

17. The machine of claim 16

wherein prefolding means are mounted adjacent said sealing post for prefolding top closure panels which are provided at the other end of said carton,

said means being operable on said top closure panel while the carton is on said sealing post,

and wherein said sealing post is provided with means for internally supporting said carton adjacent said top closure panels during the prefolding thereof.

18. The machine of claim 16

wherein said folding means comprise a pair of folding fingers which are mounted in opposition to each other and are actuated toward each other across the end of said bottom carton to fold the said closure panels.

19. The machine of claim 18

wherein said folding fingers are pivotally mounted at the ends of a pair of pivot arms and normally disposed at a predetermined angle relative thereto,

and wherein means are provided to pivot said fingers relative to said arms while said fingers are in engagement with said bottom closure panels.

20. The machine of claim 19

wherein a tucking finger is provided which operates at right angles to said folding fingers and which cooperates therewith to fold said bottom closure panels across the end of said carton.

21. The machine of claim 20

wherein said pressure plate is pivotally mounted on said sealing post and is movable to a collapsed position to facilitate transfer of said carton.

22. The machine of claim 21

wherein said sealing post is pivotally mounted for swinging movement out of alignment with said pressure pad.

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