April 11, 1967 S. C. RUSTAD ETAL 3,313,089

BAG CLOSING MACHINE

Filed Oct. 7, 1964 14 Sheets-Sheet 1

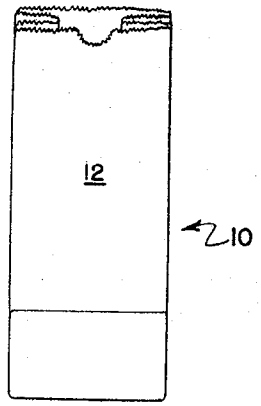


FIG. 1A

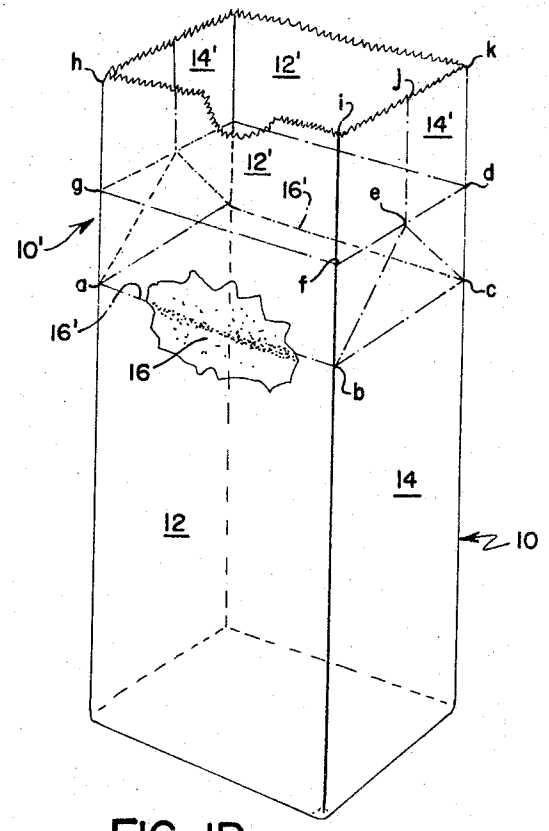


FIG. 1B

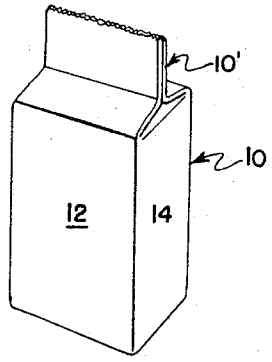


FIG. 1C

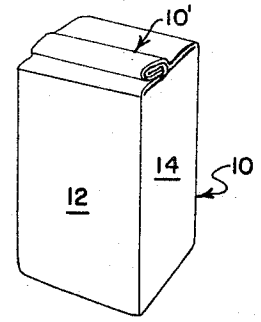


FIG. 1D

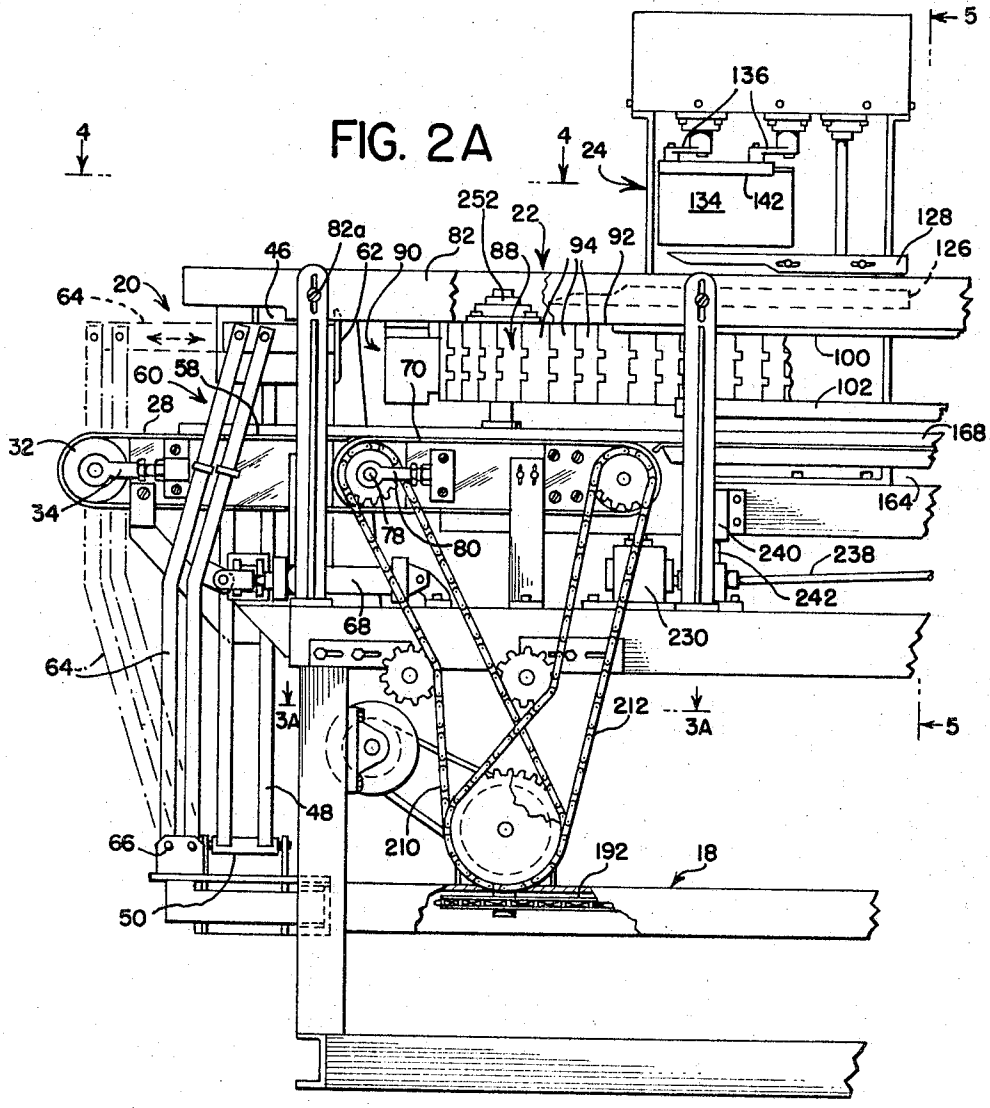
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BAG CLOSING MACHINE

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FIG. 2A



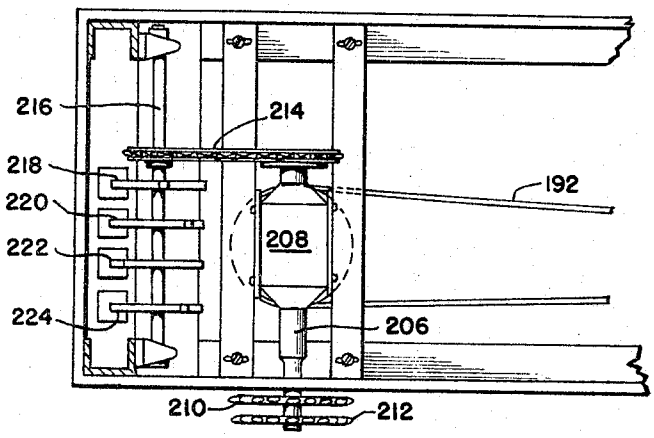


FIG. 3A

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BAG CLOSING MACHINE

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FIG. 2B

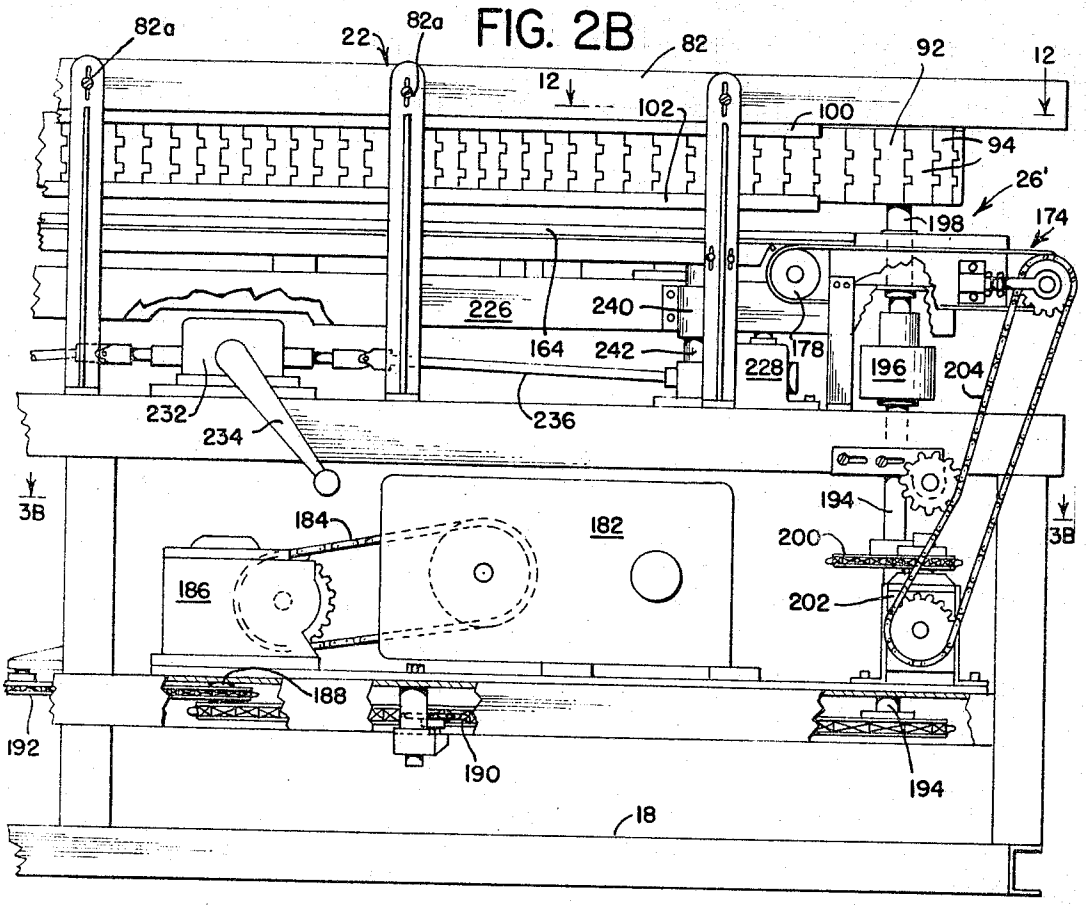
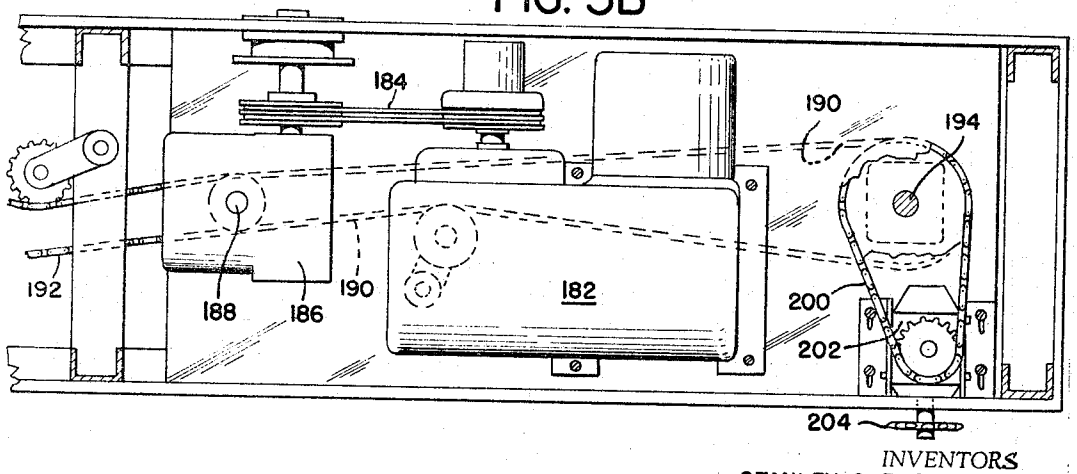


FIG. 3B



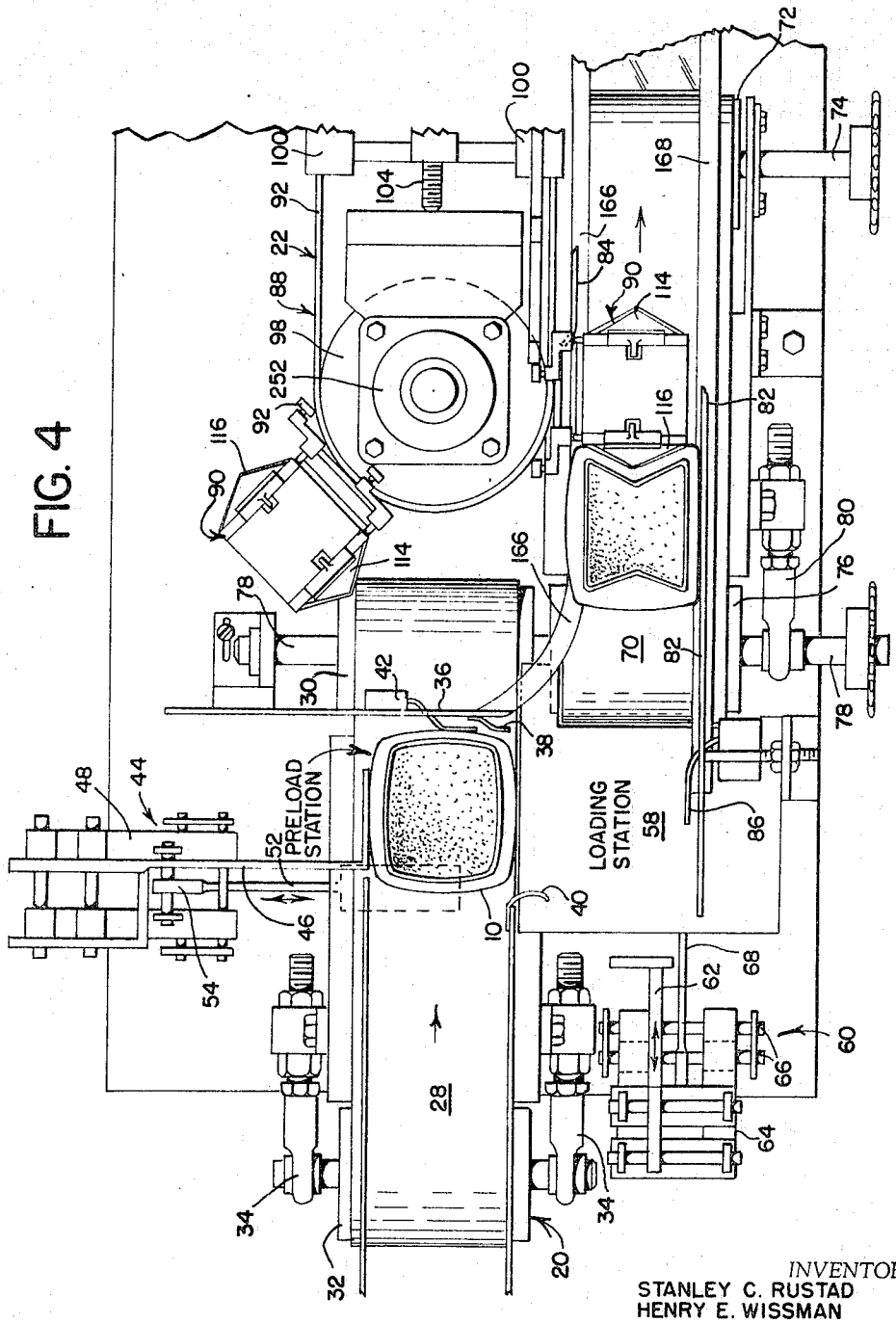
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BAG CLOSING MACHINE

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FIG. 4



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BAG CLOSING MACHINE

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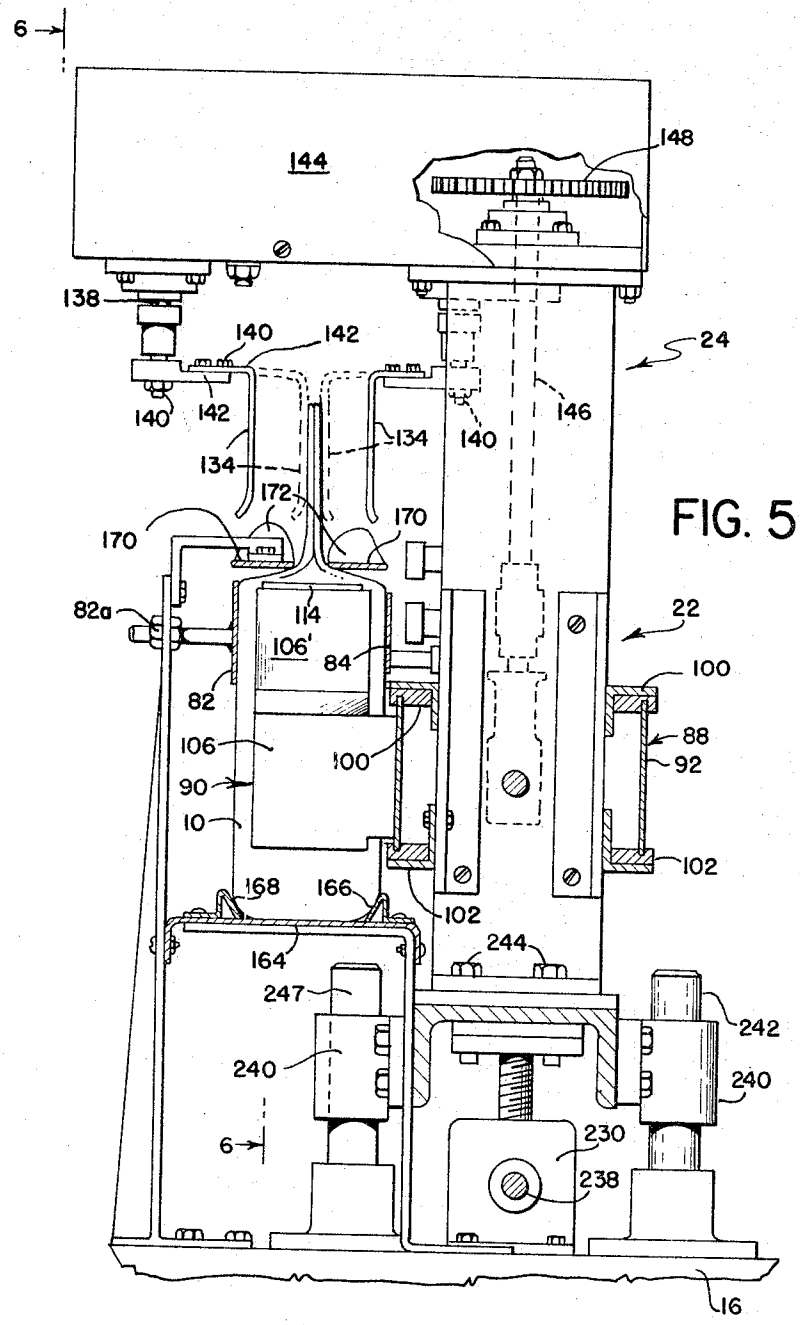


FIG. 5

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BAG CLOSING MACHINE

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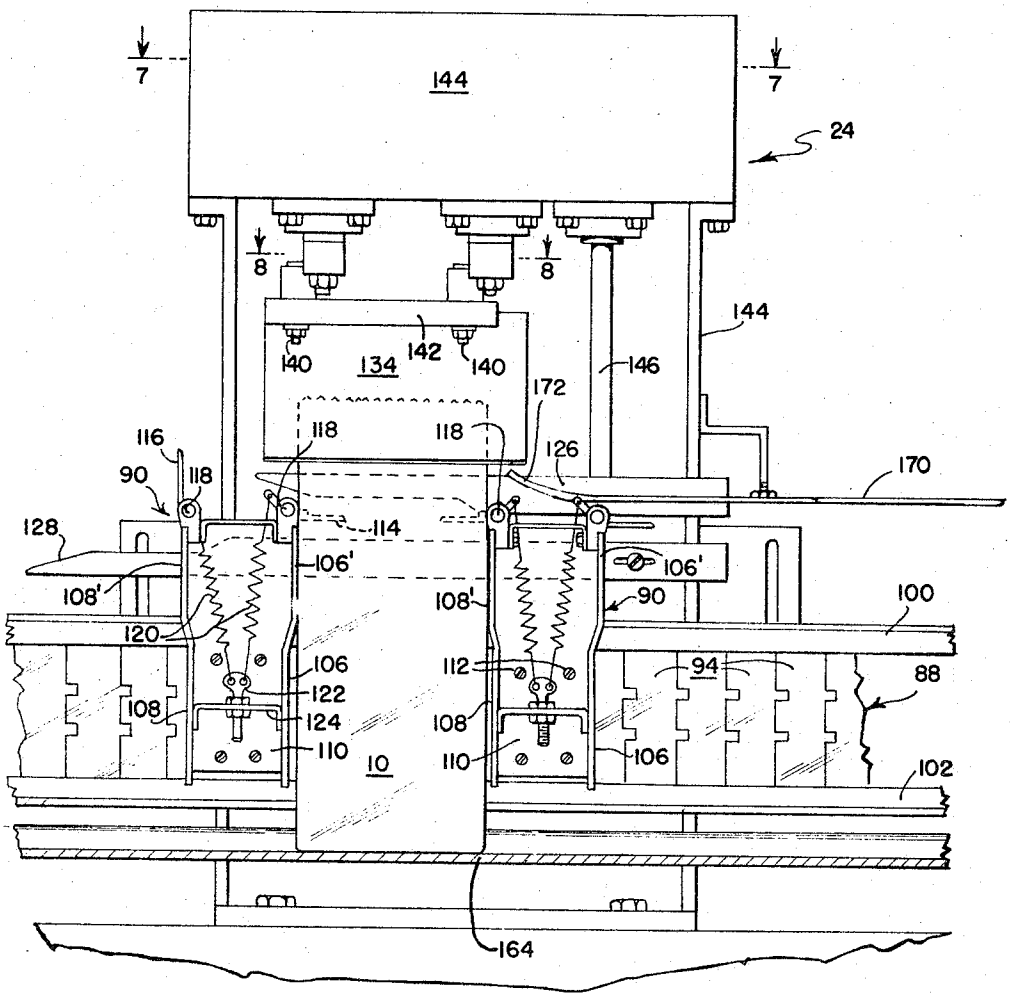


FIG. 6

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BAG CLOSING MACHINE

Filed Oct. 7, 1964 14 Sheets-Sheet 7

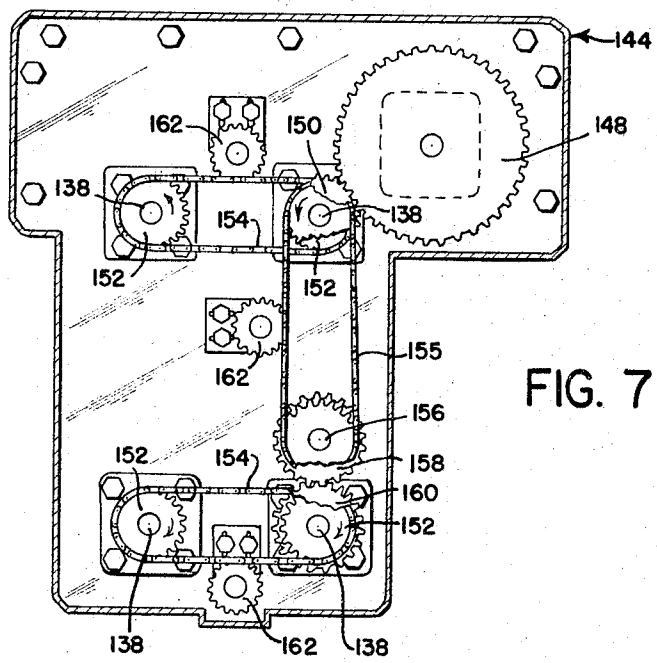


FIG. 7

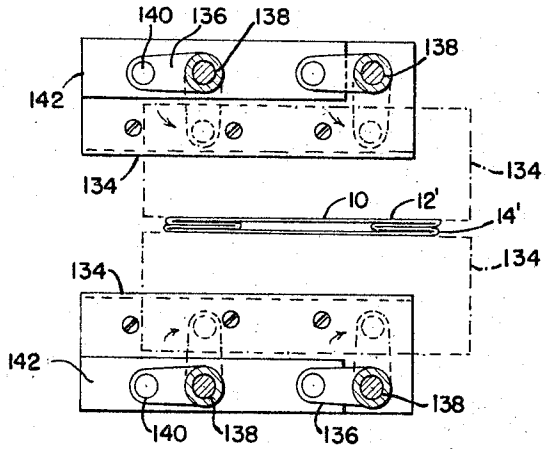


FIG. 8

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BAG CLOSING MACHINE

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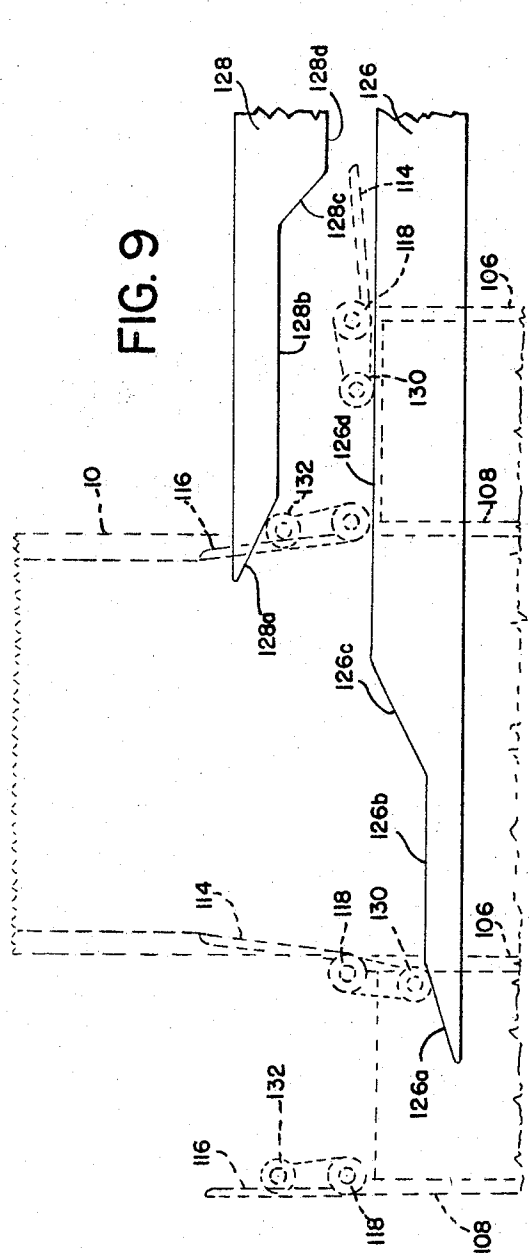


FIG. 9

FIG. 10

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BAG CLOSING MACHINE

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FIG. 14

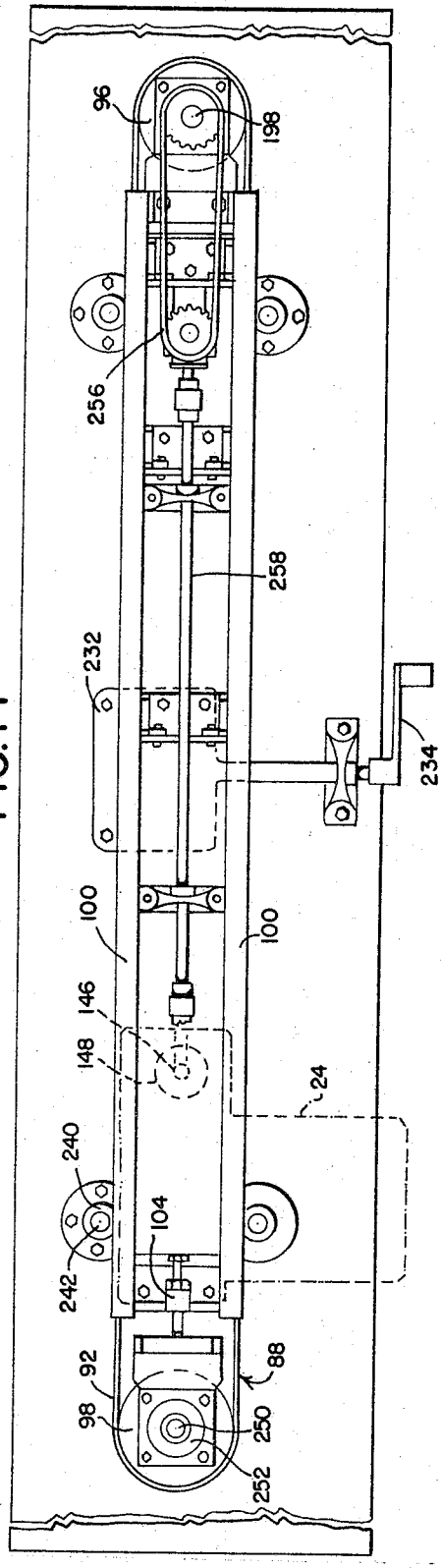
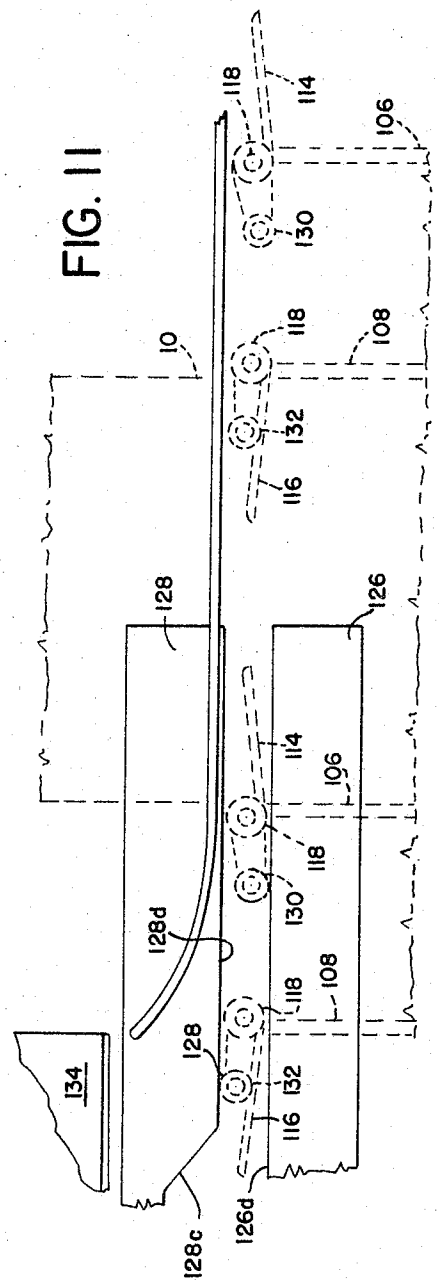


FIG. 11



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BAG CLOSING MACHINE

Filed Oct. 7, 1964 14 Sheets-Sheet 10

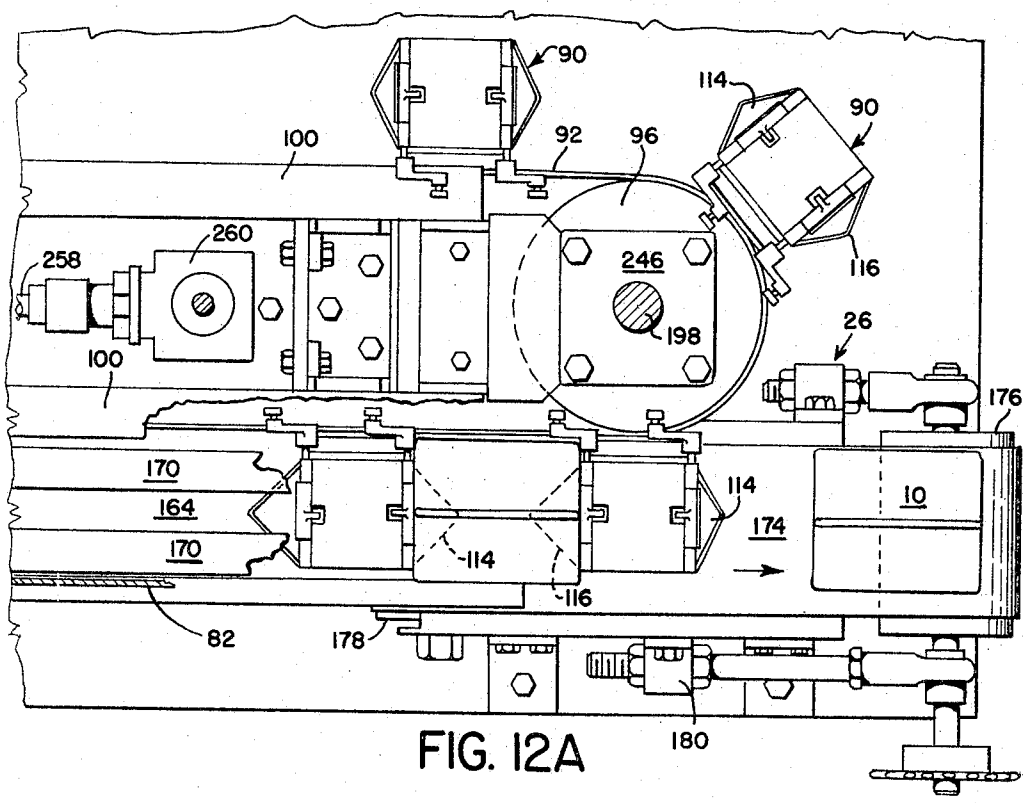


FIG. 12A

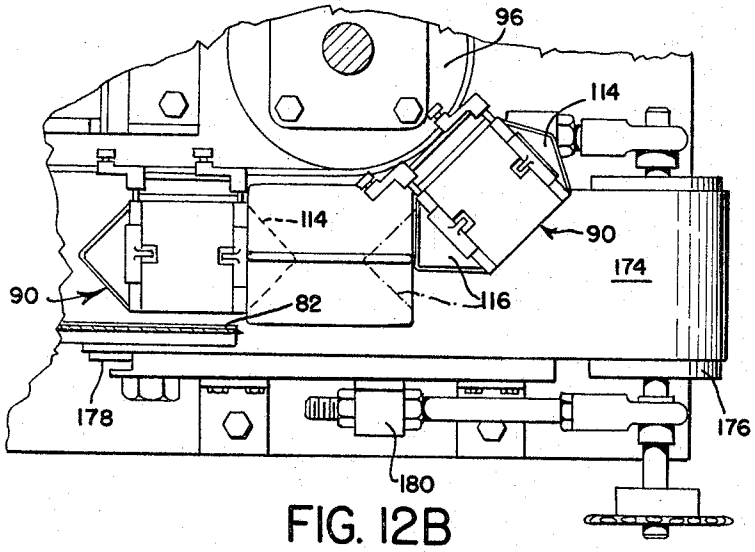


FIG. 12B

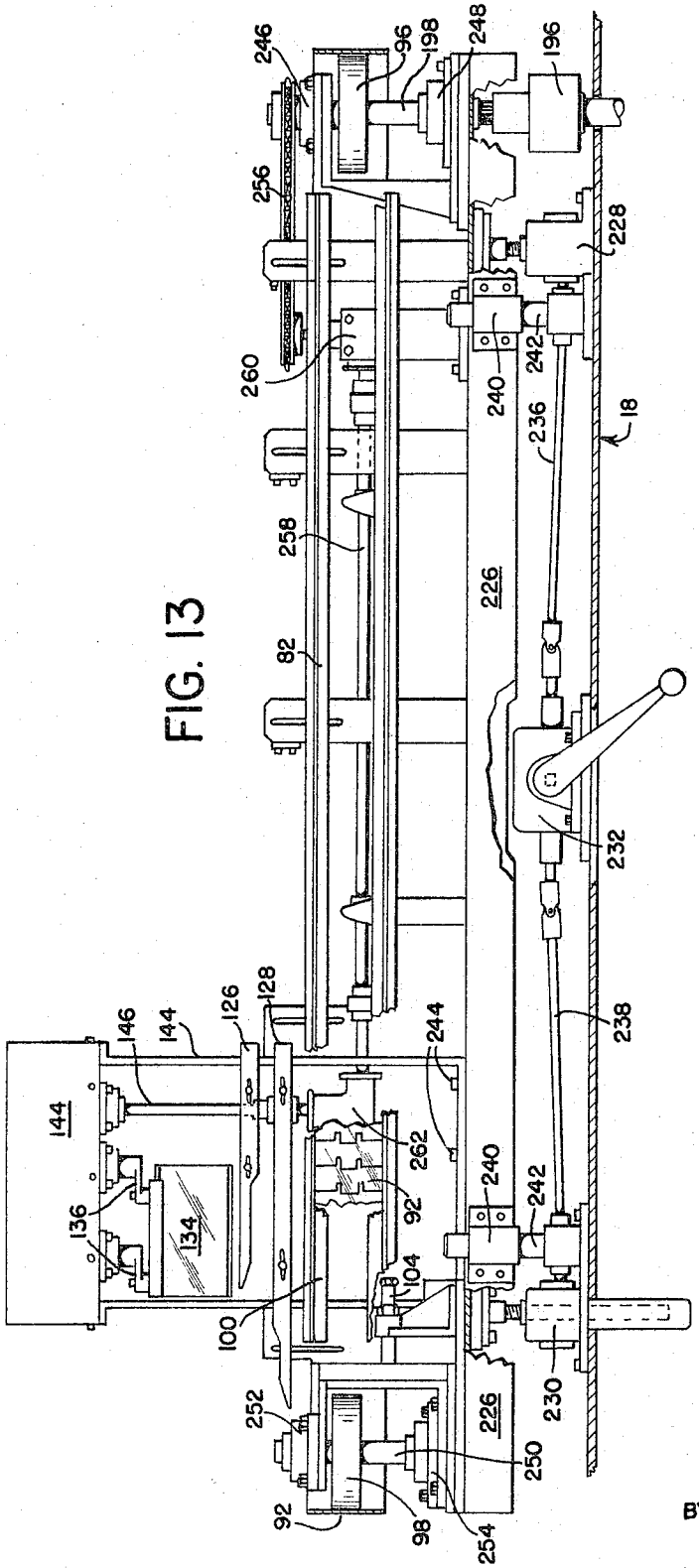
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BAG CLOSING MACHINE

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FIG. 13



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BAG CLOSING MACHINE

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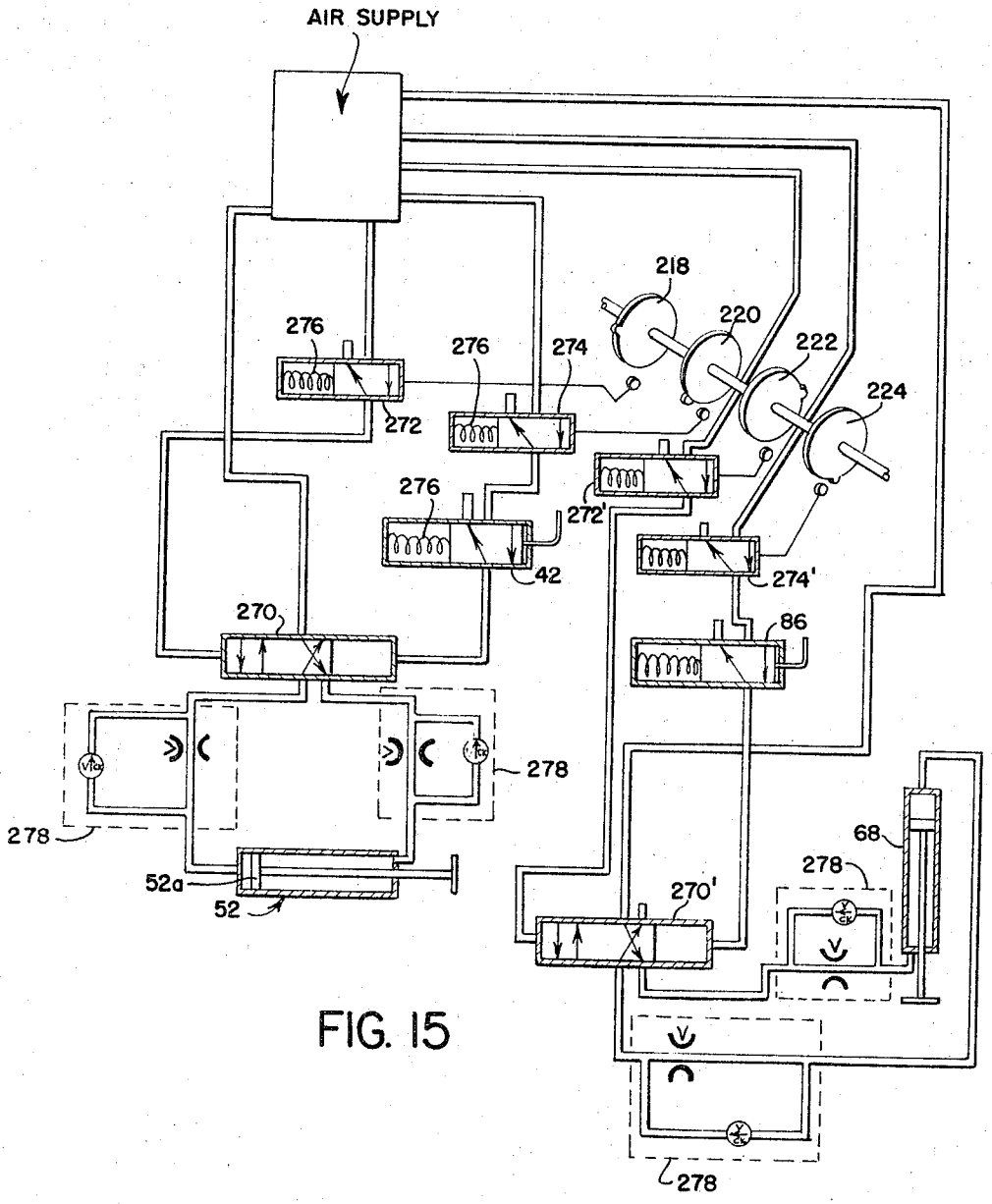


FIG. 15

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BAG CLOSING MACHINE

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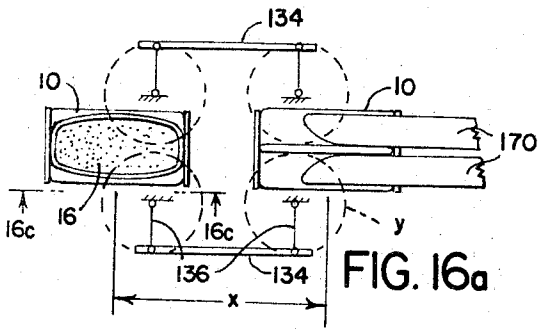


FIG. 16a

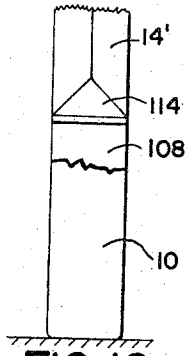


FIG. 16b

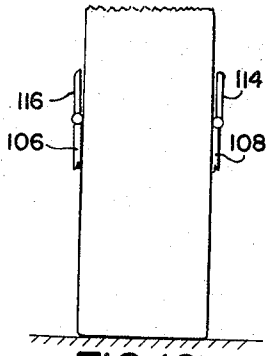


FIG. 16c

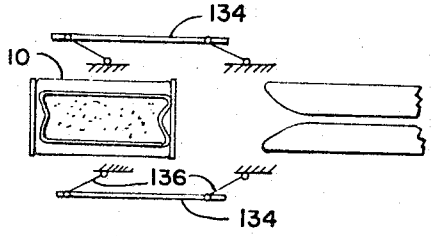


FIG. 17a

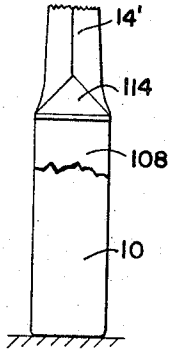


FIG. 17b

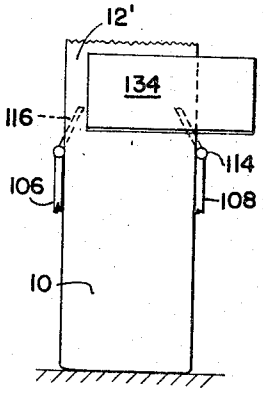


FIG. 17c

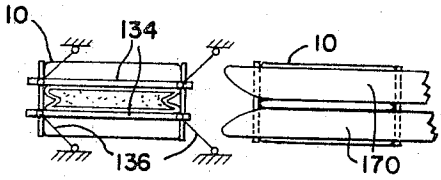


FIG. 18a

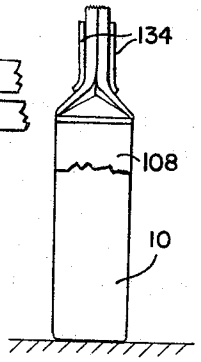


FIG. 18b

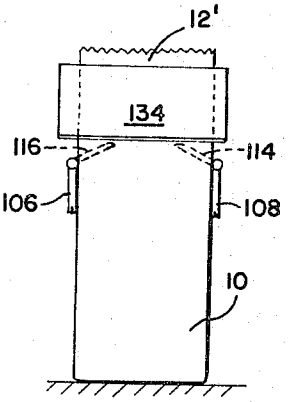


FIG. 18c

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April 11, 1967 S. C. RUSTAD ETAL 3,313,089

BAG CLOSING MACHINE

Filed Oct. 7, 1964 14 Sheets-Sheet 14

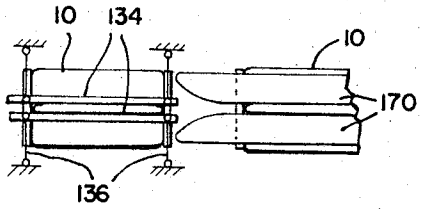


FIG. 19a

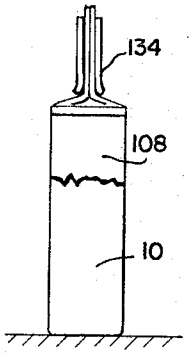


FIG. 19b

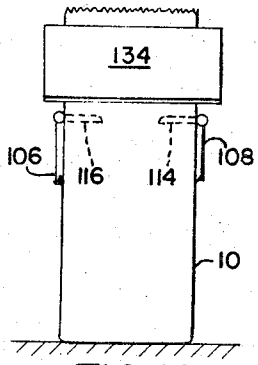


FIG. 19c

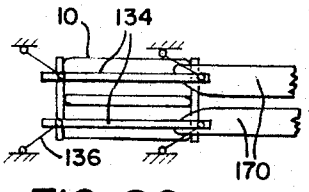


FIG. 20a

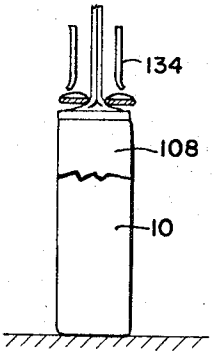


FIG. 20b

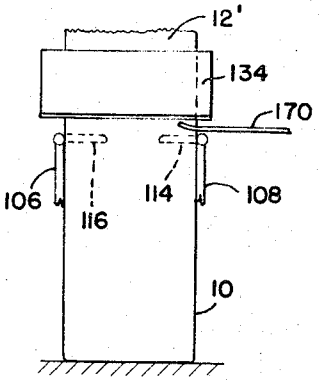


FIG. 20c

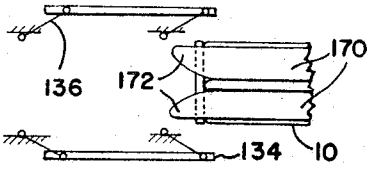


FIG. 21a

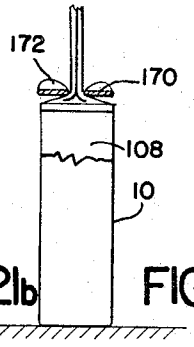


FIG. 21b

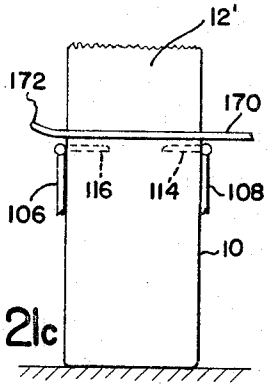


FIG. 21c

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United States Patent Office 3,313,089 Patented Apr. 11, 1967

3,313,089

BAG CLOSING MACHINE

Stanley C. Rustad, Minneapolis, Henry E. Wissman, St. Paul, and Robert D. Siverson and Mark Hasten, Minneapolis, Minn., assignors to General Mills, Inc., a corporation of Delaware

Filed Oct. 7, 1964, Ser. No. 402,223
25 Claims. (Cl. 53—371)

This invention relates to an improved machine to close filled bags.

It is a principal object of the present invention to provide a machine which will close filled paper bags in a manner that the bags are consistently folded down neatly without any substantial amount of wrinkling.

It is a further object to attain the ends of the above recited object by means of a machine which in its structure and operation is relatively simple, and will perform its intended functions reliably and effectively, and with a relatively high rate of output. In this regard, it is noted that in this machine the bags are indexed into a continuously moving conveying mechanism, and the bags are folded while moving at a constant rate of travel to the discharge end of the apparatus, the apparatus being such that possible malfunctions or irregularities in its operation are kept to a practical minimum.

It is a more particular object that the apparatus of this invention function in such a manner that with each bag being held in a neatly folded position, further closing operations (e.g. sewing, taping, gluing, or further folding the bags) can effectively be performed while the bag is being carried by the conveying mechanism of the apparatus.

It is a further particular object that the apparatus be so arranged that without detracting from ends of the other objects recited herein, it can easily be adjusted to accommodate bags filled to different levels.

These and other objects and features of the invention will be more readily understood and appreciated from the following detailed description of the preferred embodiments thereof selected for purposes of illustration and shown in the accompanying drawings, in which:

FIGURES 1A through 1D show a bag of the type which is closed by the machine of the present invention, through successive stages of a complete closing operation;

FIGURES 2A and 2B, shown on separate drawings, are arranged to be viewed in side by side relationship to present a side elevational view of the entire apparatus of the present invention;

FIGURES 3A and 3B are sectional views taken on, respectively, lines 3A—3A of FIGURE 2A and lines 3B—3B of FIGURE 2B; FIGURES 3A and 3B also are arranged to be viewed in side by side relationship to present a plan sectional view along the plane designated by lines 3A—3A and 3B—3B to show the drive mechanism of the present invention;

FIGURE 4 is a fragmentary top plan view of the infeed portion of the apparatus of the present invention, as seen from the location indicated at 4—4 in FIGURE 2A;

FIGURE 5 is a transverse sectional view taken along line 5—5 of FIGURE 2A, this section being taken at a location to better show the fold-in mechanism of the present invention;

FIGURE 6 is a fragmentary longitudinal sectional view taken on line 6—6 of FIGURE 5, also to show the fold-in mechanism of the present invention;

FIGURE 7 is a plan sectional view taken along line 7—7 of FIGURE 6 to illustrate the drive for the fold-in mechanism of the present invention;

FIGURE 8 is a plan sectional view taken along line 8—8 of FIGURE 6 to illustrate the operation of the fold-in plates of the present invention;

FIGURES 9, 10 and 11 are schematic views, taken generally in side elevation, showing the operation of a cam mechanism of the present invention in three successive stages of operation;

FIGURES 12A and 12B are fragmentary plan sectional views, each being taken along line 12—12 of FIGURE 2B, and illustrating successive stages of operation of the outfeed portion of the present invention;

FIGURE 13 is a "stripped-down" side elevational view, illustrating those portions of the apparatus of the present invention which are vertically adjustable to accommodate bags filled to different heights;

FIGURE 14 is a plan view of that portion of the apparatus shown in FIGURE 13;

FIGURE 15 is a diagrammatic sketch of the actuating and interlock mechanism for the infeed pushers of the present invention, and

FIGURES 16A, B, and C through 21A, B, and C are a group of diagrammatic drawings showing successive stages of operation as a bag is being folded by the apparatus of the present invention.

It is believed a clearer explanation of the present invention will be achieved if the detailed description thereof is preceded by a brief discussion of the problems encountered in closing a filled paper bag and of the general approach taken in the present invention to solve such problems.

By referring to FIGURES 1A–1D, wherein is shown the type of bag which is folded down by the apparatus of the present invention, it can be seen that the make-up of the bag and the configuration to which it is folded are both conventional. Such bags come prefolded in the manner shown in FIGURE 1A. In the overall packaging operation, each bag is opened to assume the general configuration of a rectangular prism, and a predetermined portion of the product to be packaged is then poured into the bag up to a certain level (as shown in FIGURE 1B), after which the top portion of the bag is folded in the manner shown in FIGURE 1C. With the bag in the folded configuration of FIGURE 1C, further operations such as cutting off the top of the bag, sewing and/or taping the bag can be performed. Finally, the bag can, if desired, be folded down and over so as to be adjacent the top level of the contained product (as shown in FIGURE 1D).

The operation of folding the bag from the open configuration of FIGURE 1B to the position of FIGURE 1C is especially critical in obtaining a neat and proper closure, and it is with this portion of the bag closing operation that the present invention is especially concerned. However, as indicated previously, it is also of significance in this invention that this folding operation be performed in such a way that subsequent operations, such as cutting off the top of the bag, sewing, taping, gluing, folding down, etc., can be conveniently and properly performed.

Probably the main source of difficulty in folding the bag so as to get a neat closure without any substantial wrinkling is that when a granular product is poured into the bag, the sides of the bag will bulge out so that a section taken horizontally through the bag at the middle or top portion thereof will have a somewhat oval or rounded configuration. The difficulties which this bulging creates are best understood by examining FIGURE 1B which illustrates a bag having a configuration of a perfect rectangular prism (i.e. without any such bulging) and showing in broken lines the fold lines along which the bag would be folded in an ideal situation to obtain a perfectly neat closure. This bag is designed generally by numeral 10, and the side and end panels thereof are

designated **12** and **14**, respectively. The level to which the product **16** is filled in the bag **10** is designated **16'**, and the portions of panels **12** and **14** which extend above the product level **16'** (these being the closure portion of the bag **10**), are accordingly designated **12'** and **14'**, respectively, and collectively are designated **10'**.

Letter designations for the points at which the various fold lines intersect have been applied only on the front and side panel closure portions **12'** and **14'** which are wholly exposed in FIGURE 1B. In the following description, when such letter designations are used in defining various lines and parts of the panel closure portions **12'** and **14'**, the line or part so defined by certain letters on one panel portion **12'** or **14'** is also intended to refer to the corresponding line or part on the opposite panel closure portion **12'** or **14'**.

The "hinge lines," "*a, b*" and "*b, c*," along which the sides **12** and end panels **14** are folded in, coincide with the product level **16'**. Each triangular portion "*b, e, c*" is folded flat against the product **16**, and is overlayed by triangular portions "*b, e, f*" and "*c, e, d*"; the rectangular portions adjacent the hinge line "*a, b*" (one of which is defined by points "*a, b, f, g*") overlie these triangular portions, and also lie adjacent the top level **16'** of the product **16**. The rectangular portions "*g, f, i, h*" of panel **12** and its corresponding rectangular portion from the other side panel **12** are caused to be moved in adjacent one another so as to be upstanding from the longitudinal center line of the bag closure, and the uppermost rectangular portions (one of which is seen to be defined by points "*f, d, k, i*" of the end panels **14**) are contained between the side panel rectangles "*g, f, i, h*," and are formed with a reentrant fold, as along line "*e, j*."

However, when the open bag **10** is filled so that the product **16** causes the panels **12** and **14** of the bag **10** to bulge, it is apparent that the straight-lined geometric figures defined by the above recited fold lines will suffer some distortion. Notably, the rectangle "*a, b, f, g*" of each side panel **12** will curve outwardly, and when it is attempted to fold in each rectangle "*a, b, f, g*" along its hinge line "*a, b*," wrinkles will form, especially near the end portions of the rectangle where the curvature is greatest.

Recognition of this problem suggests a possible solution that during the closing operation the sides of the bag be restrained in such a manner that the bag assumes the rectangularly prismatic shape from which a perfect closure fold can be made. However, after the bag is closed and after it is no longer restrained in this prismatic shape, with only moderate jostling in the subsequent handling of the bag, the product settles in the bag to bulge out the sides thereof and the product level drops away from closure portion of the bag. With the resulting "loose pack" of the product, the top of the bag easily becomes crushed down, and the appearance of the bag, when it does reach the final consumer, is less than wholly desirable. Also, if the product is such that it is easily blown by air currents, the air pocket which forms at the top of the bag can be a source of "sifting." That is to say, pressure applied to the top of the bag will cause air turbulence in the void or air pocket in the top of the bag, and the product can be blown out through small passages which are sometimes present in the closure portion of the bag.

The practical approaches to this dilemma have varied. One is simply to permit the product to bulge the sides of the bag outwardly and make a loose closure at the top of the bag (i.e. the closure assuming a tent-like configuration), which closure may be crushed down in subsequent handling. Another has been to make a tight pack and accept the fact that there will be wrinkles formed in the same. Also different types of closures have been attempted, with varying degrees of success. There are, of course, many other problems which arise when it is attempted to close the bags mechanically in a commercial operation. Among these are properly orienting the bag in the machine, handling the filled bags in such a way as not to disturb the level of the product in the bag, and many other problems relating to the mechanics of engaging the bag, folding the same, etc.

In the present invention, filled bags are received at random spacing and are fed or indexed into pockets on a continuously moving chain. The top portion of each bag is squared up to some extent in its pocket, and as each bag is carried through a folding zone, it is carefully folded in (by a mechanism to be described with some particularity hereinafter) in a manner that wrinkling of the bag is obviated to a large extent and yet the bag is closed in such a way that a reasonably tight pack of the product is achieved. While the bag is still in the machine, it can very conveniently be sewn, taped, glued and/or folded over, and then be discharged from the machine.

Continuing now to a detailed description of the present invention, a view of the entire machine is presented in side elevation when FIGURES 2A and 2B are placed side by side. As shown herein, the construction of the machine is such that its length is considerably greater than its width, with the open bags entering at one end of the machine and being discharged at the opposite end thereof. To establish a basis for orienting the various components in the following description, the longitudinal axis of the machine will be considered as coincident with the lengthwise dimension of the machine; the progression of the bags in the machine will be considered as being forward so that the infeed end of the machine is the rear end and the outfeed end the front end; and right and left will be oriented with respect to a person at the rear of the machine looking to the front end thereof. The terms "clockwise" and "counter-clockwise" will be taken from a reference location above the machine looking down toward the same, and "inward" and "outward," as used in describing the folding operation, will denote proximity to the vertical center axis of each bag being folded.

As illustrated in FIGURES 2A and 2B, the entire apparatus is mounted from a base frame **18**, the lower portion of which carries the various drives for the apparatus (to be described in the latter part of this description) and the upper portion of which carries the working components of the machine. For purposes of description, the working components of the present invention can be considered as making up four parts of the machine: (a) an infeed portion **20** which receives open filled bags **10** at random intervals and indexes them into the machine, (b) a conveying mechanism **22** which receives the bags **10** from the infeed portion and moves the same from the rear to the front end of the machine, (c) a fold-in mechanism **24** located above conveying mechanism and between the ends thereof, which fold-in mechanism **24** cooperates with the conveying mechanism to fold the closure portions **10'** of the filled bags **10**, and (d) a discharge mechanism **26** located at the front of the machine, which mechanism, as its name implies, moves the bags **10** from the machine.

The infeed portion **20** (best illustrated in FIGURE 4) comprises a first longitudinally aligned belt conveyor **28** which functions to receive filled bags **10** at random intervals and carries each to a preload station at the forward end of the belt **28**. This belt **28** trains over front and rear rollers **30** and **32**, respectively, which are in turn journal mounted to the base frame **18**, with the rear roller **32** being provided with a longitudinally adjustable screw device **34** so that proper tension may be maintained on the belt **28**. A vertical, transversely aligned stop plate **36** is positioned above the belt **28** at the forward end thereof to detain each bag **10** on the forward end of the belt **28** at a location which can be termed a "pre-load station," at which a bag **10** is shown situated in FIGURE 4. (The belt **28** is moving continuously and merely slides beneath the bag **10** as it is held by the plate **36** at the preload station.) A pair of resilient fingers **38** and **40** are provided to engage the upper portion of each bag **10** on

the front and rear sides thereof to prevent the bag 10 from toppling over when it is moved laterally from the pre-load station to a loading station. Also, it will be noted that there is a contact switch 42 located at this pre-load station. This switch 42 is closed by the bag 10 moving into the preload station, and (as will be described more fully hereinafter) functions to cooperate with other components of a timing or interlock mechanism to move the bags 10 through the infeed mechanism 20 and into the conveying mechanism 22 at properly timed intervals.

Located to the left (as seen in FIGURE 4) of the preload station, is a preload pushing mechanism, generally designated 44, which functions to move each bag 10 from the preload station to a loading station from which the bag 10 is indexed or fed into the conveying mechanism 22. This preload pusher 44 comprises a transversely and horizontally aligned push bar 46 swing mounted by a parallel linkage 48 pivotly secured at 50 by the lower end thereof about a longitudinally aligned axes to the base frame 18. An air cylinder and piston unit 52 is connected by one end at 54 to the parallel linkage 48 and by the other end (this connection not being illustrated) to the base frame 18 so as to be able to cause the push bar 46 to move transversely and push a bag 10 from the preload station to the loading station and then retract the bar 46 to its original position.

The bag 10, at its loading station, rests upon a stationary horizontal platform 58 (i.e., a loading platform), from which an indexing or loading push mechanism, generally designated 60, moves each bag 10 forwardly into the conveying mechanism 22. This push mechanism 60 is, in its structure and operation, similar to the preload push mechanism 44, although oriented at right angles with respect thereto. Accordingly, the mechanism 60 comprises a push bar 62 mounted from a parallel linkage 64, which in turn is pivotally mounted at 66 to the base frame 18 and is actuated by an air cylinder and piston unit 68 connected between the linkage 64 and the base frame 18.

Immediately forward of the loading platform 58 and coplanar therewith is a longitudinally disposed forwardly traveling conveyor belt 70, which, in cooperation with the indexing push mechanism 60, functions to load each bag 10 into the conveying mechanism 22. This belt 70 trains over a front live roller 72 driven by a shaft 74, and over a rear roller 76, which for convenience is rotatably mounted on a shaft 78 which is fixedly secured to, and serves the additional function of a drive shaft for, the drive roller 30 of the belt 28. So that slack may be taken up in the belt 70, the right end of the drive shaft 78 is journal mounted from a longitudinally adjustable bracket 80.

A right and a left guide rail 82 and 84, respectively, are provided for the bags 10, which guide rails 82 and 84 extend forwardly from the loading platform 58 along substantially the entire length of the conveying mechanism 22. While the rear end of the left guide rail 84 begins just forward of the loading platform 58, the rear end of the right guide rail 82 extends further rearward to serve the function of a stop plate for each bag 10 as it is pushed by the preload mechanism 44 to the loading station. A second contact switch 86 is mounted at the loading station in a manner that it is closed by each bag 10 being moved by the preload mechanism 44 into the loading station. This switch 86 serves a similar function to the switch 42 in that it cooperates with other components of an interlock mechanism (to be described hereinafter) to properly index the bags 10 in the conveying mechanism 22.

The conveying mechanism 22 comprises a conventional endless chain "table top" conveyor, generally designated 88, on which are mounted at evenly spaced intervals a plurality of units 90 (called "pocket assembly units") which serve not only to move the bags 10 through the machine, but, as will be disclosed more fully hereinafter, also cooperate with the fold-in mechanism 24 in folding the bags 10. (For clarity of illustration only one such unit 90 is shown in FIGURE 2.) This conveyor 88 comprises an endless chain 92 made up of a plurality of links 94, each of which has a general plate-like configuration, and the chain 92 trains around front and rear sprockets 96 and 98, respectively. The entire "table top" conveyor 88 is turned on its side so that the sprockets 96 and 98 each rotate about a respective vertical axis and the chain 92 travels a completely horizontal path (which, as seen in top plan view, is counterclockwise), with the plane of each link 94 being at all times vertically disposed. The right and left run (i.e. forward and rear run, respectively) of the chain 92 are each provided with an upper and a lower guideway 100 and 102 which engage, respectively, the upper and lower edge of each plate link 94 passing therethrough so as to support the same and maintain the proper alignment thereof. So that the chain 92 can be kept taut, the rear sprocket 98 is provided with a suitable screw adjustment device such as that indicated at 104.

Each adjacent pair of pocket assemblies 90 define therebetween a pocket into which the infeed mechanism 20 indexes a bag 10 (the manner in which this is accomplished being best illustrated in FIGURE 4), and each such assembly or unit 90 also performs a folding function in cooperation with the fold-in mechanism 24 (this function being best illustrated in FIGURE 6, wherein a pair of such units 90 is shown moving a bag 10 through the folding station of the apparatus of the present invention). Each unit 90 comprises a forward and rearward plate 106 and 108, respectively, both of which are fixedly secured to a related mounting plate 110, which is in turn bolted, as at 112, to a related plate link 94 of the chain 92. The plates 106 and 108 are vertically aligned and extend outwardly from, and at right angles to, their related plate link 94, with the result that the rearward plate 108 of one unit 90 cooperates with the forward plate 106 of the next rearward unit 90 to become, respectively, front and rear transverse walls of a related pocket to accommodate a bag 10.

The manner in which each bag 10 is indexed into a related pocket is best explained with reference to FIGURE 4, wherein one pocket assembly unit 90 is shown beginning a path of travel along the forward run of the chain 92, and a following unit 90 is shown traveling a semi-circular path about the periphery of the rear sprocket 98. With these two units 90 so angled with respect to one another, the pocket defined therebetween is expanded to an open position. The aforementioned loading pusher bar 62 and the loading conveyor 70 are in alignment with the forward path of travel of the pocket assembly units 90, and the front end of the conveyor 70 extends forward a moderate distance beneath the rear portion of the forward path of travel of the pocket assembly units 90. The infeed timing mechanism (to be described later herein) is so arranged that a bag 10 is moved by the loading pusher mechanism 60 from the loading station forwardly against the rearward plate 108 of the unit 90 which is just beginning its forward path of travel. The conveyor 70 moves at a rate slightly faster (e.g. 20% faster) than the linear speed of the chain 92. Consequently, after the loading push bar 62 moves a bag 10 against the rearward plate 108 of the unit 90, the conveyor continues to move the bag 10 forward so that the bag 10 maintains contact with the plate 108 (the conveyor belt 70 will slide beneath the bag to some extent because of the somewhat greater speed of the belt 70 relative to the chain 92), until the succeeding pocket assembly unit 90 has completed its arcuate path of travel about the periphery of the rear sprocket 98 and engages the rear of the bag 10 with its forward plate 106. At this stage, the pocket is "closed," with a bag 10 held snugly between the two units 90, which then carry this bag 10 through the fold-in station and thence to the discharge end of the machine.

To consider now the components by which the bags 10 are folded in, there are pivotally mounted about a re-

spective transverse horizontal axis at the top edge of, respectively, the plates **106** and **108**, two delta-shaped plates **114** and **116** (called "gusset plates"), which function to fold in the closure portions **14'** of the end walls **14** of a related bag **10**. Each gusset plate **114** or **116** has the general configuration of a right isosceles triangle and is hinge mounted, as at **118**, by its hypotenuse side about an axis closely adjacent to the proximate bag end panel **14** and at about the same elevation as the product level **16'** in the bag **10**. The triangular configuration of each gusset plate **114** or **116** is such as to be generally congruent with a related one of the two triangular portions *b*, *e*, *c* (see FIGURE 1B) of the bag closure portion **14'**, and each gusset plate **114** or **116** is so positioned that during the folding operation it is adjacent to, and coincides with, its related triangular bag portion *b*, *e*, *c*, which, as will be disclosed hereinafter, it folds in and down. As shown herein, this is conveniently accomplished by locating the axis of the hinge **118** slightly above the product level **16'** of the bag **10**, and fixing the related gusset plate **114** or **116** so that in its upstanding position, it is tangent to such hinge **118** along a tangent line proximate the bag **10** which it is folding.

Each gusset plate **114** or **116** is urged to an upstanding position by means of a related tension spring **120** which is secured by one end to its related gusset plate **114** or **116** and by the other end (by means of an adjustable screw **122** so that the tension on the spring **120** can be adjusted) to a bracing plate **124** at the lower end of the unit **90**. To cause each pair of gusset plates **114** and **116** which are adjacent to a pocket to move inwardly and downwardly in unison in a predetermined manner so as to accomplish their intended folding function, there is provided a pair of cams **126** and **128** to engage respective cam followers **130** and **132** of gusset plates **114** and **116**. The manner in which the cams **126** and **128** move the gusset plates **116** and **114** is best illustrated in FIGURES 9, 10 and 11 which disclose the cam surfaces of cams **126** and **128** as each being made up of for parts, designated **126***a*, *b*, *c* and *d*, and **128***a*, *b*, *c* and *d*, respectively. The gusset plates **114** and **116** are normally upright, although for purposes of illustration, when shown in plain view, they are shown as slanting to a moderate degree. The "*a*" cam surface portion of each of the cams **126** and **128** serves to move the related gusset plates **114** or **116** from an upright position slightly inward (i.e. about 15° from the vertical) so as to push in the related end closure portions **14'** inwardly to a moderate extent, and the gusset plates, **114** and **116** remain at this position as the cams **130** or **132** move along the "*b*" sections of their respective cam surfaces **126** and **128** (as shown in FIGURE 10). The *c* portions of the cam surfaces next engage the cam followers **130** and **132** to move the gusset plate **114** and **116** down to a near horizontal position, with the *d* portion of the cam surfaces then functioning to hold each gusset plate **114** or **116** in this "hold-down" near horizontal position (as shown in FIGURE 11).

The fold-in mechanism **24** of the present invention (best illustrated in FIGURES 5 through 8) functions to move a pair of vertically and longitudinally aligned parallel fold-in plates **134** inwardly and forwardly in timed relation with the travel of the bags **10** and with the movement of the aforedescribed gusset plates **114** and **116** to fold in the side panel closure portions **12'** of each bag **10**. To accomplish this fold-in motion, each plate **134** is carried by a related pair of horizontally disposed, parallel mounting arms **136**, each of which is fixed by its root end to a respective vertical shaft **138**, and is pivotally connected by its outer end, as at **140**, to a mounting piece **142** bolted to a flange formed integrally with its related fold-in plate **134**. The two drive shafts **138** for the right hand fold-in plate **134** rotate clockwise, while the other two shafts **138** for the left hand fold-in plate **134** rotate counter-clockwise, with the result that the two plates **134**, while maintaining their parallel relationship, follow counter rotating circular paths which come nearly tangent to one another along a plane coinciding with the longitudinal center line of the forward path of travel of the bags **10**, this being shown in FIGURES 5 and 8.

This fold-in mechanism **24** is mounted from an overhead frame **144** which contains a drive mechanism to rotate the shafts **138** of the fold-in plates **134** in the aforedescribed manner. As illustrated in FIGURE 5, a main drive shaft **146** for the fold-in mechanism **24** reaches upwardly into the frame **144** and is fixed to a main drive gear **148** which in turn engages a second gear **150** fixed to one of the drive shafts **138**. Each of the shafts **138** has fixed thereto a respective one of four sprockets **152**, and the two sprockets **152** of the right hand shafts **138** are interconnected by a chain **154**, as are the two gears **152** of the left hand shaft **138**. As shown in FIGURE 7, (the two left hand shafts **138** are driven in a counter-clockwise direction through the gear **150**. To cause the two right hand shafts **138** to rotate in an opposite direction, a chain and sprocket drive **155** driven from a left hand shaft **138** turns an intermediate shaft **156** on which is fixedly mounted a gear **158** meshing with another gear **160** fixed to one of the right hand drive shafts **138**. Suitable idler sprockets **162** are provided to place the proper tension on the various chain drives.

To provide vertical support for the bags **10** as each is carried by the chain conveyor **88**, there is a longitudinally aligned horizontal platform **164** over which the bags **10** slide between a pair of longitudinal guideways **166** and **168**, fixed to or integral with, and upstanding a short distance from, the platform **164**. To minimize any wrinkling in the closing of the bag **10**, it is important not only that the bag **10** be carefully located with respect to the components which fold the same, but that the portion of the bag just below the product level **16'** be squared up to some extent (this being best understood with reference to FIGURES 5 and 6). Thus, each bag is restrained by the rails **82** and **84** and by the walls **108** and **106** of, respectively, the pocket assembly units **90** located in front of and behind the bag **10**. The guide rails **82** and **84** are so disposed that the upper edge of each is at, or just below, the product level **16'** of the bag **10**, with the lower edge of the rails **82** and **84** being moderately above the midheight of the bag **10**. In like manner, the upper portions **106'** and **108'** of, respectively, the pocket assembly walls **106** and **108** are joggled inwardly to a moderate degree at about the same height as the lower edges of the rails **82** and **84**. The effect is that the upper portion of each bag **10** below the closure portion **10'** thereof is restrained or pushed in on all four sides so as to assume a somewhat rectangular configuration, while the middle and lower portions of the bag **10** are permitted to bulge outwardly. The bag engaging surfaces of the rails **82** and **84** are desirably faced with a low friction material so that these rails **82** and **84** can exert adequate pressure against the bag **10** and yet permit the same to slide between the rails **82** and **84**.

Immediately forward of the fold-in station (i.e. the location at which the fold-in plates **134** and gusset plates **114** and **116** cooperate to collapse the closure portion **10'** of each bag **10**) there is a pair of longitudinally extending hold-down arms **170**. These arms **170** are horizontally disposed so as to occupy a single plane just above the product level **16'** of each of the bags **10** traveling through the conveying mechanism **24**, and are spaced laterally to a moderate degree so as to define therebetween a somewhat narrow longitudinal slot (as shown in FIGURE 5) to accommodate the extreme upper end portion of each bag **10** which portion remains upstanding after the bag **10** has passed through the fold-in station. The rear end portion **172** of each of the arms **170** has a moderate upward and outward bend (in a general "plow share" con-

figuration) so that as each bag travels forwardly from the fold-in station, the two rectangular portions *a*, *b*, *f*, *g* of the side panel closure portions **12'** (see FIGURE 1B) are engaged by these rear arm portions **172** and pressed downwardly against the product level **16'** of the bags **10**.

With the bag's closure portion **10'** being so held by the arms **170** (as shown in FIGURE 5) and with the bag **10** being moved by the conveying mechanism **22** to the discharge end of the machine, other closure operations can conveniently be performed. Thus the top edge of the bag **10** can be cut off, the bag sewn, and possibly glued and folded down to the configuration shown in FIGURE 1D. Since various devices which are able to perform such further closure operations are well known in the art, it is believed not to be necessary for a full understanding of the present invention, to describe such devices in any detail. Accordingly, it is believed to be enough to indicate that devices such as a bag cutting and stitching apparatus and a glue applicator could be mounted on the machine at locations above the conveying mechanism **22** and forward of the fold-in mechanism **24**.

The operation of the discharge mechanism **26** will be best understood with reference to FIGURES 2B, 12A and 12B. It will be noted that when each bag **10** is closed at the folding station, the gusset plates **114** and **116** reach into the closure portion **10'** of the bag **10**, with each gusset plate **114** or **116** overlying a related bag triangular portion *b*, *c*, *e*, and with the other related triangular portions *e*, *f*, *b* and *e*, *d*, *c* and the proximate end portions of the rectangles *a*, *b*, *f*, *g* overlying the guseet plates **114** or **116**. As each bag **10** moves from the fold-in station, the aforementioned cam surface portions **126***d* and **128***d* hold the gusset plates **114** and **116** down until the hold down arms **170** are able to press down against the rectangular bag portions *a*, *b*, *f*, *g* and hold the bag closure portion **10'** and the guseet plates **114** and **116** in this down position. In most bag closing operations where the present invention is used, each bag **10**, while it is held by the arms **170**, will be closed so that the rectangular portions *a*, *b*, *f*, *g* of the side panel closure portions **12'** are in somewhat closed proximity to the product level **16'** of the bag **10**, for example, as shown in FIGURE 1D. The result is that when each bag **10** moves forward in the machine to the extent that it is free of the hold-down arms **170**, the gusset plates **114** and **116**, although urged upwardly with moderate force by the tension springs **120**, will not be able to spring up free of the bag closure portion **10'**.

To accomplish the discharge of the bags **10** from the machine in a manner that the gusset plates **114** and **116** are removed from the bag closure portion **10'**, there is provided a conveyor belt **174** which trains over front and rear rollers **176** and **178**, respectively, with the front roller **176** having a longitudinally adjustable mounting **180** so that the belt **174** may be kept reasonably taut. The forward upper run of the belt **174** is located immediately in front of the bag supporting platform **164** and is longitudinally aligned and coplanar therewith. As a pair of pocket assembly units **90** carry a bag to the front end of the conveying mechanism **22**, the bag **10** slides from the stationary platform **164** onto the belt **174** which moves at a rate moderately faster (e.g. 20% faster) than the linear rate of travel of the chain **92** of the conveyor **88**. As the unit **90** in front of the bag **10** begins to travel in an arcuate path about the front sprocket **96** of the conveyor **88**, its rearwardly extending gusset plate **116** slips out of the closure portion **10'** of the bag **10** (as illustrated in FIGURE 12B). Also, the front pocket-defining plate **108** swings away from the bag **10** with the result that the conveyor belt **174**, moving moderately faster than the units **90** mounted on the chain **92**, carries the bag **10** forwardly away from the rear pocket-defining plate **106** (as illustrated in FIGURE 12A) of the succeeding unit **90**, so that the bag **10** moves free of the gusset plate **114**. Each bag **10** can then be carried from the belt **174** either manually or by some other apparatus.

As indicated previously, the drive mechanism for the present invention is mounted in the lower portion of the base frame **18**. Power is supplied to the machine from a motor **182** which through a chain and sprocket drive **184** and a speed reducing gear box **186** turns a vertically aligned main drive shaft **188**. Two chain and sprocket drives **190** and **192** are powered from the shaft **188** and extend, respectively, forwardly and rearwardly therefrom. The forward chain and sprocket drive **190** rotates a vertical shaft **194** which through a splined connection **196** powers another shaft **198** (which is, in effect, an upward extension of the shaft **194**), which shaft **198** drives the front sprocket **96** of the chain conveyor **88**. (As will be disclosed more fully hereinafter, the splined connection **196** permits the shaft unit **194–198** to be elongated or shortened when the machine is adjusted vertically.) The shaft **194** through another chain and sprocket drive **200**, a right angle gear box **202** and a second chain and sprocket drive **204** rotates the front roller **176** of the discharge belt **174**.

The aforementioned chain and sprocket drive **192** which extends rearwardly from the main drive shaft **188**, turns a transversely horizontally aligned shaft **206** through a right angle gear box **208**. The two conveyor belts **28** and **70** of the infeed mechanism **20** are driven from this drive shaft **206** through chain and sprocket drives **210** and **212**, respectively. It will be noted, as illustrated in FIGURE 3A, that a chain and sprocket drive **214** is also driven from the gear box **208** to turn a shaft **216** on which are mounted four cam members, designated **218**, **220**, **222** and **224**. As will be disclosed more fully hereinafter, these cam members are part of an interlock mechanism which cooperates with the infeed mechanism **20** so that the bags **10** are properly indexed in the conveying mechanism **22**.

As indicated previously, the machine of the present invention receives bags **10** which have been filled to a predetermined product level **16'**. In the event that it is desired to fill the bags **10** to a different level, the machine is provided with a vertical adjustment feature to permit the machine to be adapted to this change in the bag product level. This feature is best illustrated by referring to FIGURES 5, 13 and 14, the latter two figures being "stripped down" views to better expose the manner in which certain of the components of the present invention are made vertically adjustable.

Located below and aligned with the chain conveyor **88** is a longitudinally extending secondary frame **226** which is vertically supported by front and rear screw jacks **228** and **230**, respectively. These jacks **228** and **230** are driven in unison from a single transmission unit **232** (powered manually by means of a handle **234**) through respective longitudinal drive shafts **236** and **238**. To maintain the horizontal alignment of the secondary frame **226** there is bolted thereto a front and rear pair of vertically aligned guide sleeves **240**, each of which slidably engages a respective vertically aligned post **242** fixedly mounted to the base frame **18**.

As a rough generalization, it may be said that the infeed mechanism **20** and outfeed mechanism **26** are mounted directly to the base frame **18**, so as to remain at a constant elevation with respect thereto, while the conveying mechanism **22** and the fold-in mechanism **24** are both mounted directly to the secondary frame **226** so as to be vertically movable therewith. Thus, the mounting frame **144** of the fold-in mechanism **24** is bolted, as at **244**, to the secondary frame **226**, as are the aforementioned chain conveyor guideways **100** and **102**, the left guide rail **84**, the hold-down plates **170**, and the adjustment device **104** for the rear sprocket **98** of the conveying mechanism **22**. The aforementioned drive shaft **198** for the front drive sprocket **96** of the conveying mechanism **22** is mounted to the secondary frame **226** through upper and lower thrust and journal bearings **246** and **248**, respectively, and the rear

sprocket 98 is similarly mounted through a shaft 250 to upper and lower bearings 252 and 254 in the frame 226.

The drive assembly for the fold-in mechanism 24 is powered from the front drive sprocket 96 of the conveying mechanism 22, and is carried by the vertically adjustable secondary frame 226. This drive comprises a chain and sprocket unit 256 driven from the shaft 198 and operatively connected to a longitudinal drive shaft 258 through a right angle gear box 260. This shaft 258 in turn powers the aforementioned main drive shaft 146 for the fold-in mechanism 24 by means of a second right angle gear box 262.

When it is desired to close bags having a product level 16' higher or lower than the level for which the machine is set, the jacks 228 and 230 are raised or lowered accordingly by means of the handle 234. For practical reasons relating to the particular arrangement of the various components of the machine, the right hand guide rail 82 is not mounted to the vertically adjustable secondary frame 226 but is mounted from the base frame 18 by a vertically adjustable screw mounting 82*a*, which must be manually adjusted in addition to raising or lowering the jacks 228 and 230.

As indicated previously, the preload pusher 44 and the loading pusher 60 operate in timed relationship with the conveying mechanism 22 to properly index each bag 10 into a related one of the pockets defined by the units 90 carried by the chain conveyor 88. The control or interlock mechanism by which this is accomplished is best disclosed with reference to FIGURE 15, wherein the same is shown schematically. The cylinder and piston unit 52 for the preload pusher 44 is controlled through a four-way valve 270, which in its right hand position holds pistons 52*a* of the unit 52 in its extended position, and in its left hand position (as it is in FIGURE 15) retracts the unit 52 to push a bag 10 from the preload station to the loading station. To control the action of the four-way valve 270, there are provided three switches, one being the aforementioned preload contact switch 42, and the other two, designated 272 and 274, being operated, respectively, from cams 218 and 220. Each of these three switches 42, 272 and 274 is urged to its off position by a spring 276 contained therein. The switches 42 and 274 are connected in series between the air supply and the valve 270, in a manner that when both switches 42 and 274 are closed (so as to permit air to pass therethrough), the four-way valve 270 is urged to its left position where it contracts the unit 52 so that the pusher 44 moves a bag 10 from the preload station to the loading station. When the other valve 272 is opened, it feeds air from the air supply to the four-way valve 270 in a manner that the valve 270 is urged to its right hand position so as to extend the cylinder and piston unit 52 so as to retract the preload pusher 44 and permit another bag 10 to be moved into the preload station.

As illustrated in FIGURE 15, the interlock control for the cylinder and piston unit 68 for the loading pusher 60 is substantially identical to that of the cylinder and piston unit 52 for the preload pusher 44, and accordingly components associated with the loading pusher 60 which have not previously been given numerical designations will be given the same numerical designations as corresponding compenents associated with the preload pusher 44, with a prime (') designation distinguishing those associated with the loading pusher 60. Thus the cylinder and piston unit is operated through a four way control valve 270', which is in turn controlled by the aforementioned contact switch 86 and two other switches 272' and 274', with the latter two switches 272' and 274' being operated by cams 222 and 224, respectively. The lines which lead to the air cylinder and piston units 52 and 68 are each provided with a valve unit 278 which permits free flow into its related cylinder and controlled variable flow from the cylinder, so that the speed with which the units 52 and 68 act can be controlled.

With there being a positive drive from the main drive shaft 188 to both the chain conveyor 88 and the cams 218–224, the action of the cams 218–224 is in timed relationship with the movement of the conveying mechanism 22 in a manner that the cams 218–224 are caused to go through one cycle of revolution as the chain conveyor moves an increment of distance equal to the spacing between the pocket assembly units 90. To follow the interlock mechanism through a sequence of operation, initially the four-way valves 270 and 270' are each in its right-hand position so that the cylinder and piston units 52 and 68 are extended. When a bag 10 is carried by the preload conveyor 28 to the preload station, this bag 10 presses the switch 42 to its closed position. The bag 10 remains at this preload station until the cam 220 engages the switch 274 to close the same, this causing a pulse of air to travel into the right side of valve 270 to move the same to its left-hand position and contract the cylinder and piston unit 52. This causes the push bar 46 to move the bag 10 from its preload station to the loading station, permitting the switch 42 to spring back to its off position. At the same time the cam 220 has rotated through a short increment of travel to permit the switch 274 to move to its off position. Immediately after this, the cam 218 closes the switch 272, and a pulse of air moves into the left side of the valve 270 to move the same to its right-hand position so that the unit 52 becomes extended to retract the push bar 46 so that a second bag 10 may be moved into the preload station.

The manner in which the components of the interlock mechanism which are associated with the cylinder and piston unit 68 operate to push the bag 10 into the conveying mechanism 22 is substantially the same as that described in the immediately preceeding paragraph. Movement of the bag 10 into the loading station closes the contact switch 84, and when the cam 224 moves the valve 274' to its closed position, the four-way valve 270' is moved to its left-hand position to contract the cylinder and piston unit 68 and cause the push bar 62 to move the bag 10 from the loading station into an open pocket defined by a pair of pocket assembly units 90 (as shown in FIGURE 4). Immediately after this, the valve 272' is engaged by the cam 222 to extend the unit 68 and retract the bar 62. Thus it can be seen that the preload pusher 44 and the loading pusher 60 will operate only when a bag is at respectively, the preload station and the loading station, and then only in timed relationship with the conveying mechanism 22 as determined by the action of the cams 218, 220, 222 and 224.

To describe now the overall operation of the present invention, the machine receives open bags 10, each of which has been filled with the product 16 to a predetermined level 16', these bags 10 being fed onto the preload conveyor belt 28 at random intervals. The conveyor belt 28 carries each bag 10 to the preload station, and the bag 10 remains at the station until the pocket assembly units 90 on the chain conveyor 88 of the conveying mechanism 22 have reached a predetermined location so that the associated cam 220 (which makes one revolution each time the chain conveyor moves through an increment of travel equal to the spacing of the units 90) initiates the timed loading or indexing of the bags 10 from the preload station to the loading station and into the conveying mechanism 22. As previously described, the preload pusher 44 pushes the bag 10 from the preload station to the loading station and then (by the action of the cam 218) immediately retracts so that a second bag 10 can be fed into the preload station. Next, the indexing or loading pusher 60 (activated by the cam 224) moves the bag 10 from the loading station onto the loading conveyor 70 and against the rearward plate 108 of a pocket assembly unit 90 which is just beginning its forward path of travel through the machine. Immediately after so moving the bag 10 into the conveying mechanism, the indexing pusher 60 retracts (by the action of the cam

222) so that a following bag **10** may be moved into the loading station.

When the bag **10** is so moved against the rearward plate **108** of one pocket assembly unit **90**, the loading conveyor **70**, moving moderately faster than the chain conveyor **88**, keeps the bag **10** moving with the conveyor **88** until the next succeeding pocket assembly unit **90** completes its arcuate path around the periphery of the rear chain conveyor sprocket **98** and engages the bag **10** by its forward plate **106**. As previously indicated, at this stage of the operation, the upper portions of the four sides **12** and **14** of the bag **10** just below the product level **16'** are constrained by the upper plate portions **106'** and **108'** and by the guide rails **82** and **84** so that this upper portion of the bag **10** is "squared up" to some degree.

With regard to the folding in of each bag **10**, the mechanical action of the fold-in plates **134** and the gusset plates **114** and **116** have been described hereinbefore in some detail, so it is believed any amplification of the same would be merely redundant. However, it is believed a better appreciation of the manner in which these components **114**, **116** and **134** cooperate to fold the bags **10** will be attained by showing the sequence of operation of the same schematically, as in FIGURES 16 through 21. For clarity of illustration, only the bags **10**, the side plates **134** with their mounting arms **136**, the gusset plates **114** and **116** and the hold-down arms **170** are shown, and the mounting arms **136** for the plates **134** are represented as being pivotally connected to the plates **134** at the plane along which the plates **134** make contact with the bag **10**. Also no attempt has been made to show the gusset plates **114** and **116** in top plan views of FIGURES 16A, 17A . . . 21A, since the B and C portions of FIGURES 16–21 show the position of these plates **114** and **116** quite clearly.

FIGURE 16 shows a bag **10** moving into the folding station and a preceeding bag **10** moving from the folding station and coming into engagement with the hold-down arms **170**. The drive mechanism for the machine is so arranged that the side or fold-in plates **134** move through one complete revolution in the same period of time that it takes the chain conveyor **88** to move each bag **10** a distance equal to the spacing of each proximate pair of bags **10**. As illustrated in FIGURE 16, the linear distance of travel (designated *x*) of each bag **10** during one revolution of the plates **134** is about ¾ the linear distance of the circumferential path (designated *y*) traveled by any selected point on either of the fold-in plates **134**.

As shown in FIGURES 16B and 16C, the gusset plates **114** and **116** are substantially upright before the bag **10** moves into the fold-in station. As the bag **10** begins to move into the fold-in station, this being shown in FIGURES 17A, B and C, the gusset plates **114** and **116** are caused to be moved moderately inward so that the end panel closure portions **14'** are pushed slightly inward. (As previously indicated, this moderate inward movement of the gusset plates **114** and **116** is caused by their respective cam followers **130** and **132** engaging the cam surface portion **126***a* and **128***a*.) As the side plates **134** come into engagement with the side panel closure portions **12'** so as to move the same inwardly (as shown in FIGURE 18), the gusset plates **114** and **116** begin to move in and down. (As described previously, this is caused by the action of the cam surfaces **126***c* and **128***c*.) By the time the side plates **134** have moved to the furthest extent inward so as to push the upper portion of the side panel closure portions **12'** together (as in FIGURE 19), the gusset plates **114** and **116** have moved to a horizontal position so that the triangular portions *b*, *e*, *c* of the end panel closure portions **14'** are pushed down against the product **16**.

As previously indicated, the linear speed of the side plates **134** is moderately greater than the speed of the bags **10** as they are carried by the chain conveyor **88**. When the mounting arms **136** are in the position shown in FIGURE 18, the forward component of travel of the plates **134** is approximately the same as the forward speed of the bags **10**. However, when the plates **134** reach the position shown in FIGURE 19, the plates **134** are moving forward somewhat faster than the forward rate of travel of the bags **10**, and as the plates press the side panel portions **12'** together, the plates **134** slide against the side panel closure portions **12'** to some extent. Also it will be noted that the lower edge of each of the plates **134** is moderately above the product level **16'**. Thus, when the bag is foldeed in, as shown in FIGURE 19, the rectangular portions *a*, *b f*, *g* of the side panel closure portions **12'** are disposed not only inward but moderately upward (as shown in FIGURE 19B).

As the bag **10** leaves the fold-in station, as shown in FIGURE 20, so that the fold-in plates **134** are moving away from the bag closure portion **10'**, the gusset plates **114** and **116** are still held in their horizontal position (as shown in FIGURE 20*c*). As described previously herein, this is because of the action of the cam surfaces **126***d* and **128***d*. When the bag **10** moves clear of the fold-in plates **134**, the rear "plow share" portions **172** of the hold-down arms **170** engage the rectangular portions *a*, *b*, *f*, *g* of the side panel closure portions **12'** and press the same down tightly against the top of the bag as shown in FIGURES 21A, B and C. While the bag is so held by the arms **172**, as indicated previously, other closure operations (e.g., cutting, sewing, gluing, etc.) can be performed. After each bag **10** leaves the fold-in station, it is carried by the chain conveyor **88** to the forward end thereof to be discharged by the conveyor **174** of the discharge mechanism **26** in in the aforedescribed manner.

It should be understood that the foregoing is merely illustrative of a certain embodiment of the invention and many variations may be made by those skilled in the art without departing from the spirit and scope of the invention.

Now therefore we claim:

1. A machine to close filled bags, each of which has two side panels and two end panels, each of the upper portions of said side and end panels being a respective closure portion thereof, said machine being arranged to close each bag in a manner that each end panel closure portion has a lower triangular part thereof tucked in and down so that an upper part thereof is formed with a vertical reentrant fold, and the side panel closure portions are moved inwardly so that lower parts thereof are folded in and down, and upper parts thereof are moved against one another so as to enclose therebetween said upper end panel closure parts, said machine comprising:

(a) chain conveyor means which travel in a continuous manner a predetermined course from an infeed station forwardly through a folding station to a discharge station;

(b) a plurality of pocket forming members secured to said chain conveyor means, proximate pairs of said pocket forming members defining therebetween respective bag engaging pockets;

(c) sprocket means at said infeed station to direct said chain conveyor means in a curved path, whereby proximate pairs of pocket forming members are spread angularly with respect to one another as they travel said curved path to define spread pockets;

(d) infeed means to move filled bags into said spread pockets at said infeed station;

(e) folding means to engage each bag at said folding station, said folding means comprising side closure members to engage the side panel closure portions, and end closure members to engage said end panel closure portions at the lower triangular parts thereof to fold said lower triangular parts inwardly and down;

(f) said side closure members being movable inwardly and forwardly to engage and move with said side panels at said folding station, and

(g) said end closure members being movable with said

chain conveyor means so as to move with said bags while performing their folding function.

2. The apparatus as recited in claim 1, wherein there are second sprocket means for said chain conveyor means at said discharge station, said second sprocket means directing said chain conveyor means in a second curved path, whereby proximate pocket forming members are spread angularly with respect to one another as they travel said second curved path to permit removal of said bags.

3. The apparatus as recited in claim 2, wherein there is an outfeed conveying means to move said bags from said spread pockets at the discharge station, said outfeed conveying means imparting to said bags a substantial component of motion generally parallel to the path of travel of said bags into said discharge station.

4. The apparatus as recited in claim 3, wherein said outfeed conveying means comprises a conveying belt having a linear speed greater than the rate of travel than said chain conveyor means, so that when a forward one of two proximate pocket forming members begins to travel said curved path at said discharge station, said conveyor belt is able to move each bag from its related spread pocket.

5. A machine to close filled bags, each of which has two side panels and two end panels, each of the upper portions of said side and end panels being a respective closure portion thereof, said machine being arranged to close each bag in a manner that each end panel closure portion has a lower triangular part thereof tucked in and down so that an upper part thereof is formed with a vertical reentrant fold, and the side panel closure portions are moved inwardly so that lower parts thereof are folded in and down, and upper parts thereof are moved against one another so as to enclose therebetween said upper end panel closure parts, said machine comprising:

(a) a chain conveyor arranged to travel in a continuous manner in a predetermined course including a course portion from a rear infeed station forwardly through a folding station to a front discharge station;

(b) a front and a rear sprocket means over which said chain conveyor trains at, respectively, said infeed station and said discharge station, each of said sprocket means being aligned with, and rotatable about, a respective generally vertical axis;

(c) a plurality of pocket forming members secured to said chain conveyor at predetermined spaced locations therealong and extending outwardly therefrom, in a manner that pairs of proximate pocket forming members define therebetween respective pockets which are spread when their related pocket forming members are traveling around either said front or rear sprocket means, and which are closed when their related pocket forming members are traveling forwardly through said folding station;

(d) infeed means to feed filled bags into said pockets at said infeed station, and

(e) folding means to engage each bag at said folding station, said folding means comprising side members to engage the side panel closure portions, and end closure members to engage said end panel closure portions at the lower triangular parts thereof.

6. The apparatus as recited in claim 5, wherein said infeed means comprises a bag loading means aligned to push a bag from a loading station against a forward one of two proximate pocket forming members at said infeed station, and a bag carrying infeed conveyor having a component of motion generally aligned with said course portion of said chain conveyor and traveling to said infeed station, said infeed conveyor moving said bag with said forward pocket forming member while a rearward one of said two proximate pocket forming members travels around said rear sprocket to close its related pocket.

7. The apparatus as recited in claim 6, wherein there is a pre-load means to move each bag from a pre-load station into said loading station, and there is interlock means operatively connected between said chain conveyor and said loading means and pre-load means, whereby a bag is moved from said pre-load station to said loading station, and from said loading station to said infeed station in timed relationship with movement of said chain conveyor.

8. The apparatus as recited in claim 7, wherein said interlock means comprises first switch means which is closed by a bag moving into said preload station and second switch means which is closed by a bag moving into said loading station, and there is other switch means connected in series with said first and second switch means, said other switch means being closed in relation to the movement of said chain conveyor to a predetermined location, whereby said loading means and said pre-loading means operate only when a bag is at, respectively, said loading station and said pre-load station and when said other switch means is closed by said chain conveyor being at a predetermined location.

9. The apparatus as recited in claim 6 wherein there is an interlock means comprising switch means which is closed by a bag moving into said loading station and other switch means in series with said first named switch means, which is closed by said chain conveyor moving to a predetermined position, whereby said loading means operates only when a bag is at said loading station and when said chain conveyor is at a predetermined position.

10. A machine to close filled bags, each of which has two side panels and two end panels, each of the upper portions of said side and end panels being a respective closure portion thereof, said machine being arranged to close each bag in a manner that each end panel closure portion has a lower triangular part thereof tucked in and down so that an upper part thereof is formed with a vertical reentrant fold, and the side panel closure portions are moved inwardly so that lower parts thereof are folded in and down, and upper parts thereof are moved against one another so as to enclose therebetween said upper end panel closure parts, said machine comprising:

(a) bag conveying means which moves continuously along a predetermined course which includes a course portion along which said bag conveying means travels from an infeed station forwardly through a folding station to a discharge station;

(b) said bag conveying means comprising an endless chain conveyor;

(c) said bag conveying means also comprising a plurality of pocket forming members secured to said chain conveyor at predetermined spaced locations therealong and extending outwardly therefrom in a manner that pairs of proximate pocket forming members define therebetween respective pockets to contain said bags;

(d) pairs of front and rear end panel folding members carried by said bag conveying means, each front end panel folding member being located at the front of a respective pocket, and each rear end panel folding member being located at the rear of a respective pocket, each end panel folding member being so located and disposed as to be movable inwardly toward its related pocket to engage the lower triangular part of its related end panel to fold the same in and down; and

(e) side panel folding members to engage the side panel closure portions of said bag and fold the same inwardly and down in timed relationship with the action of said end panel folding members.

11. The apparatus as recited in claim 10, wherein said side panel folding members are located on opposite sides of said predetermined course portion and are arranged to move inwardly and forwardly to move upper portions of the side panel closure portions against one another.

12. The apparatus as recited in claim 11, wherein said side panel folding members are carried by mounting means which are rotatable about vertical axes, and there is drive means to turn the side panel folding members

in counter rotating directions to engage said side panel closure portions.

13. The apparatus as recited in claim 12, wherein the length of the circumferential path of each of said side panel folding members is moderately greater than the linear spacing of proximate pockets defined by said pocket forming members, and said drive means rotates the side panel folding members at the rate of one revolution for each increment of travel of said chain conveyor equal to the spacing of a proximate pair of pockets.

14. The apparatus as recited in claim 10, wherein said end panel folding members are each swing mounted about an axis adjacent a proximate end panel of a bag in its related pocket, said axis being at the approximate product level of the bag in its related pocket, and generally horizontal and perpendicular to said course portion.

15. The apparatus as recited in claim 14, wherein there is hold down means located forward of said folding station, which hold down means engages the side panel closure portions of the bags to hold the side panel closure portions over the end panel folding members, whereby further closure operations can be performed with said end panel folding members reaching into the closure portions of their related bags.

16. The apparatus as recited in claim 15, wherein said hold down means comprises longitudinally extending hold down arms located at a level just above the product level of said bags.

17. The apparatus as recited in claim 15, wherein there is a sprocket means for said chain conveyor at said discharge station, said sprocket means directing said chain conveyor in a curved path, whereby proximate pocket forming members are spread angularly with respect to one another as they travel said curved path to form spread pockets at said outfeed station, and there is outfeed conveyoing means to move said bags from said spread pockets at the discharge station, said outfeed conveying means imparting to said bags a substantial component of motion generally parallel to the path of travel of said bags into said discharge station whereby as each bag moves into the discharge station, the end panel folding member of a forward pocket forming member moves angularly out of the closure portion of said bag and the bag is moved by said outfeed conveying means from its rear end panel folding member to free said bag therefrom.

18. The apparatus as recited in claim 14, wherein there are side guide rails aligned with said course portion, which guide rails engage said bags at the upper product containing side panel portions thereof at a height proximate the product level of said bags, so as to square up the upper portion of each bag while permitting the lower portion thereof to bulge.

19. The apparatus as recited in claim 18, wherein said pocket forming members have bag constraining means to engage the upper end panel product containing portions of said bags proximate the product level of said bags so as to square up the upper portion of each bag while permitting the lower portion thereof to bulge.

20. The apparatus as recited in claim 14, wherein each end panel folding member has the general configuration of a right isosceles triangle and is hinge mounted by the hypotenuse side thereof.

21. The apparatus as recited in claim 14, wherein said end panel folding members are provided with cam means which cause movement of said end panel folding members inwardly and down, said cam means being such that as a pair of forward and rear end panel folding members approach said folding station, said pair of end panel folding members swing inwardly a moderate degree before said side panel folding members engage the side panels of the bag being folded.

22. The apparatus as recited in claim 14, wherein said chain conveyor comprises a plurality of vertically aligned links, said links having constraining means by which the angular positions thereof are constrained as said links move along said course portion, each pocket forming member being fixedly secured to a related link and comprising a front and a rear plate member, which serve as, respectively, rearward and forward plates for proximate pockets, each front and rear plate having a respective end panel folding member swing mounted thereto.

23. The apparatus as recited in claim 22, wherein each pocket forming member is provided with spring means to urge its related end panel folding members to a generally upstanding position, and there is cam means to move said end panel folding members inwardly and down at said folding station against the urging of said springs.

24. A machine to close filled bags, each of which has two side panels and two end panels, each of the upper portions of said side and end panels being a respective closure portion thereof, said machine being arranged to close each bag in a manner that each end panel closure portion has a lower triangular part thereof tucked in and down so that an upper part thereof is formed with a vertical reentrant fold, and the side panel closure portions are moved inwardly so that lower parts thereof are folded in and down, and upper parts thereof are moved against one another so as to enclose therebetween said upper end panel closure parts, said machine comprising:

(a) a base frame for said apparatus;

(b) a secondary frame mounted from said base frame and movable vertically with respect thereto;

(c) bag conveying means mounted to said secondary frame, which bag conveying means moves continuously along a predetermined course which includes a course portion along which said bag conveying means travels from an infeed station forwardly through a folding station to a discharge station;

(d) said bag conveying means comprising an endless chain conveyor;

(e) said bag conveying means also comprising a plurality of pocket forming members secured to said chain conveyor at predetermined spaced locations therealong and extending outwardly therefrom in a manner that pairs of proximate pocket forming members defined therebetween respective pockets to contain said bags;

(f) said bag conveying means also comprising a front and a rear sprocket means over which said chain conveyor trains at, respectively, said infeed station and said discharge station, each of said sprockets being aligned and rotatable about a respective generally vertical axis;

(g) pairs of front and rear end panel folding members carried by said bag conveying means, each front end panel folding member being located at the front of a respective pocket, and each rear end panel folding member being located at the rear of a respective pocket, each end panel folding member being so located and disposed as to be movable inwardly toward its related pocket to engage the lower triangular part of its related end panel to fold the same in and down;

(h) side panel folding members mounted from said secondary frame and arranged to engage the side panel closure portions of said bag and fold the same inwardly and down in timed relationship with the action of said end panel folding members;

(i) a platform mounted from said base frame and arranged to support said bags at the bottom thereof as said bags travel said course portion, and

(j) means to adjust said secondary frame vertically with respect to said base frame, whereby bags filled to different product levels can be closed by said apparatus.

25. A machine to close filled bags, each of which has two side panels and two end panels, each of the upper portions of said side and end panels being a respective closure portion thereof, said machine being arranged to close each bag in a manner that each end panel closure

portion has a lower triangular part thereof tucked in and down so that an upper part thereof is formed with a vertical reentrant fold, and the side panel closure portions are moved inwardly so that lower parts thereof are folded in and down, and upper parts thereof are moved against one another so as to enclose therebetween said upper end panel closure parts, said machine comprising:

(a) a chain conveyor arranged to travel in a continuous manner in a predetermined course including a course portion from a rear infeed station forwardly through a folding station to a front discharge station;

(b) a front and a rear sprocket means over which said chain conveyor trains at, respectively, said infeed station and said discharge station, each of said sprocket means being aligned with, and rotatable about, a respective generally vertical axis;

(c) said chain conveyor comprising a plurality of vertically aligned links;

(d) said links having constraining means by which the angular positions thereof are maintained as said links move along said course portion;

(e) a plurality of pocket forming members, each of which is secured to a related link and extending outwardly therefrom, in a manner that pairs of proximate pocket forming members define therebetween respective pockets which are spread when their related pocket forming members are traveling around either said front or rear sprocket means, and which are closed when their related pocket forming members are traveling forwardly through said folding station;

(f) infeed means to feed filled bags into said spread pockets at said infeed station;

(g) pairs of front and rear end panel folding members, each of which is swing mounted adjacent a related pocket forming member about an axis adjacent a proximate end panel of a bag in its related pocket, said axis being at the approximate product level of the bag in its related pocket, and generally horizontal and perpendicular to said course portion;

(h) means to move each end panel folding member inwardly and down into its related pocket in a manner that each end panel folding member engages a triangular fold portion of its related proximate end panel to fold the same inwardly and down;

(i) side panel folding members located on opposite sides of said predetermined course portion and are arranged to move inwardly and forwardly to move upper portions of the side panel closure portions against one another;

(j) means to so move said side folding members, and

(k) outfeed conveying means to move said bags from said spread pockets at the discharge station, said outfeed conveying means imparting to said bags a substantial component of motion generally parallel to the path of travel of said bags into said discharge station.

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