United States Patent [19]

Matthews et al.

[11] **3,923,084**

[45] **Dec. 2, 1975**

[54] **APPARATUS FOR PACKAGING FLUID MATERIALS IN PACKETS**

[75] Inventors: **Ernest L. Matthews; Ralph E. Matthews,** both of Decatur, Ala.

[73] Assignee: **Matthews Machine Company, Inc.,** Decatur, Ala.

[22] Filed: **May 29, 1974**

[21] Appl. No.: **474,164**

[52] **U.S. Cl.** **141/144;** 53/177; 53/385; 141/238; 214/21; 222/170

[51] **Int. Cl.²** **B65B 43/42;** B65B 9/06

[58] **Field of Search** 141/157, 144, 238, 131, 141/129, 145; 222/169–172; 214/21; 53/385, 180, 177

[56] **References Cited**

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3,631,903	1/1972	Huggins	141/144 X
3,753,331	8/1973	Sato	53/385 X

Primary Examiner—Harrison L. Hinson
Assistant Examiner—Leon Gilden
Attorney, Agent, or Firm—B. B. Olive

[57] **ABSTRACT**

A high productivity packaging apparatus and method utilize a drum and a plurality of circularly arranged trap chambers, or traps, which communicate and rotate with the drum as an integral, compact unit. During rotation of the drum, the level of material to be packaged is sensed within the drum and material is fed intermittently into the drum by a positive screw feed to replace material withdrawn. Each trap successively draws from the material stored within the drum a unit of material to be packaged, traps the unit, discharges any excess and during continued rotation directs the material toward a trap outlet for discharge at a discharge station in synchronism with the passage of packet containers. The packet containers are formed in a continuous strip of heat settable, coated, sheet material (e.g., paper, which is slit, folded, and transversely or "vertically" sealed at spaced intervals), are opened by use of pressurized air immediately prior to filling, and after filling are longitudinally or "horizontally" sealed and then cut into individual packets. Registration marks on the strip are detected and are used as a means to adjust the location of the formed containers with reference to the trap outlets.

5 Claims, 24 Drawing Figures

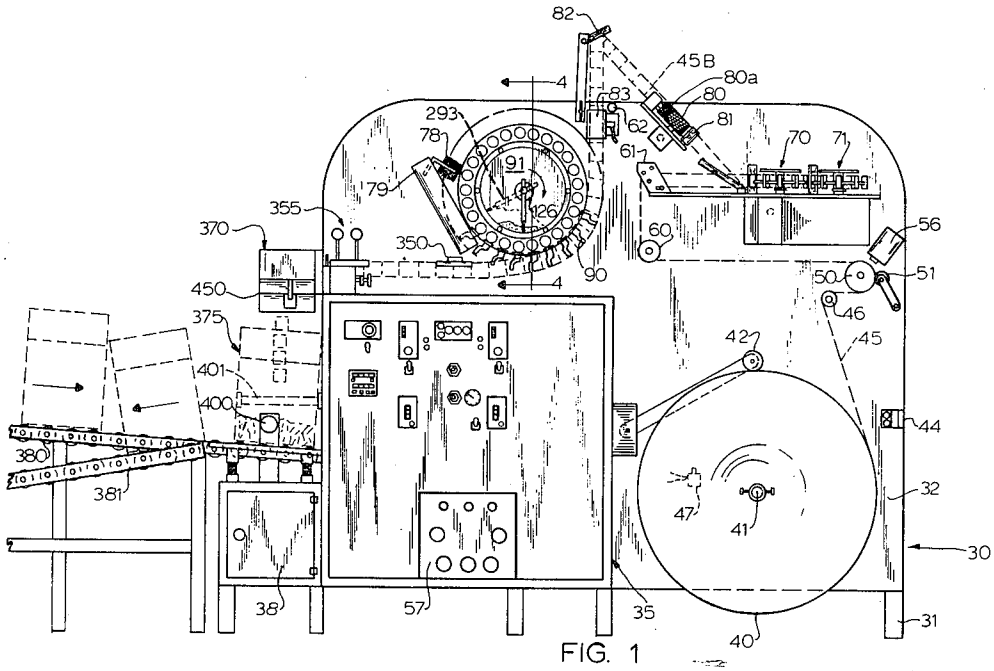
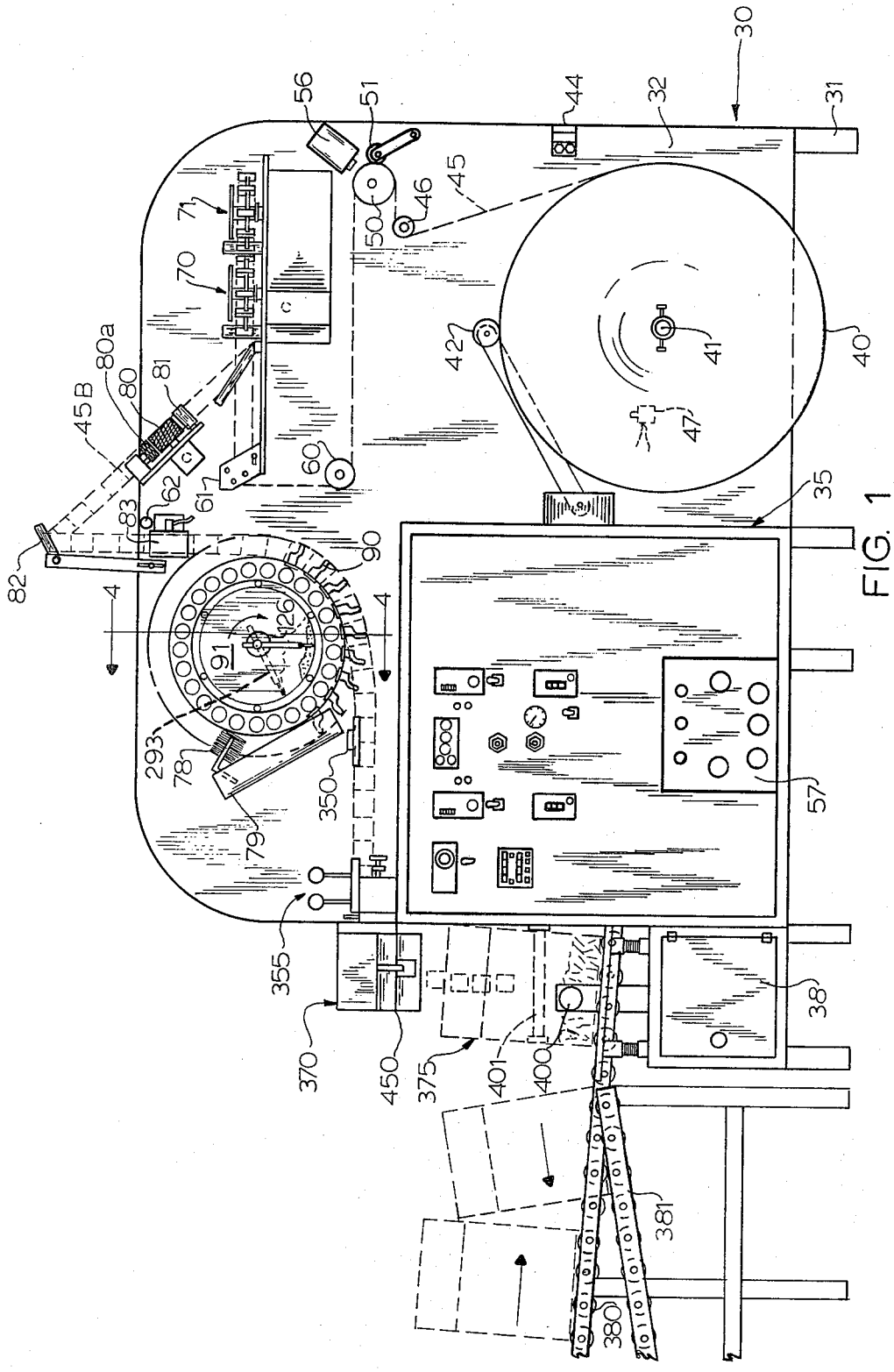


FIG. 1


30
56
51
44
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80a
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60
61
62
83
82
35
90
4
4
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126
293
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355
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375
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400
38
381
380

FIG. 1

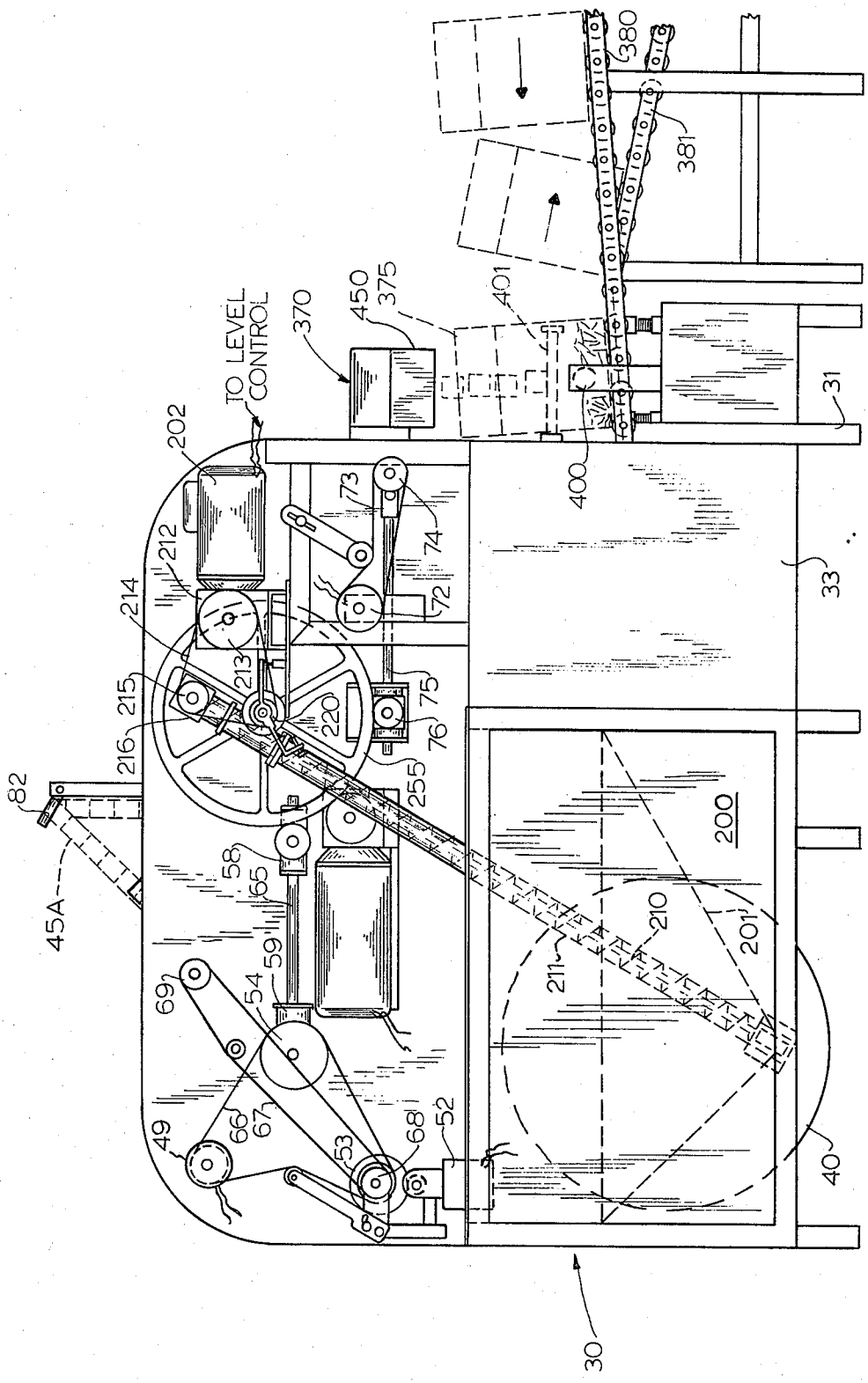

380
381
401
450
375
370
TO LEVEL CONTROL
202
212
214
215
216
213
220
73
74
72
75
76
255
400
31
33
82
45A
58
65
59
54
69
66
67
68
52
53
49
200
210
211
201
40
30

FIG. 2

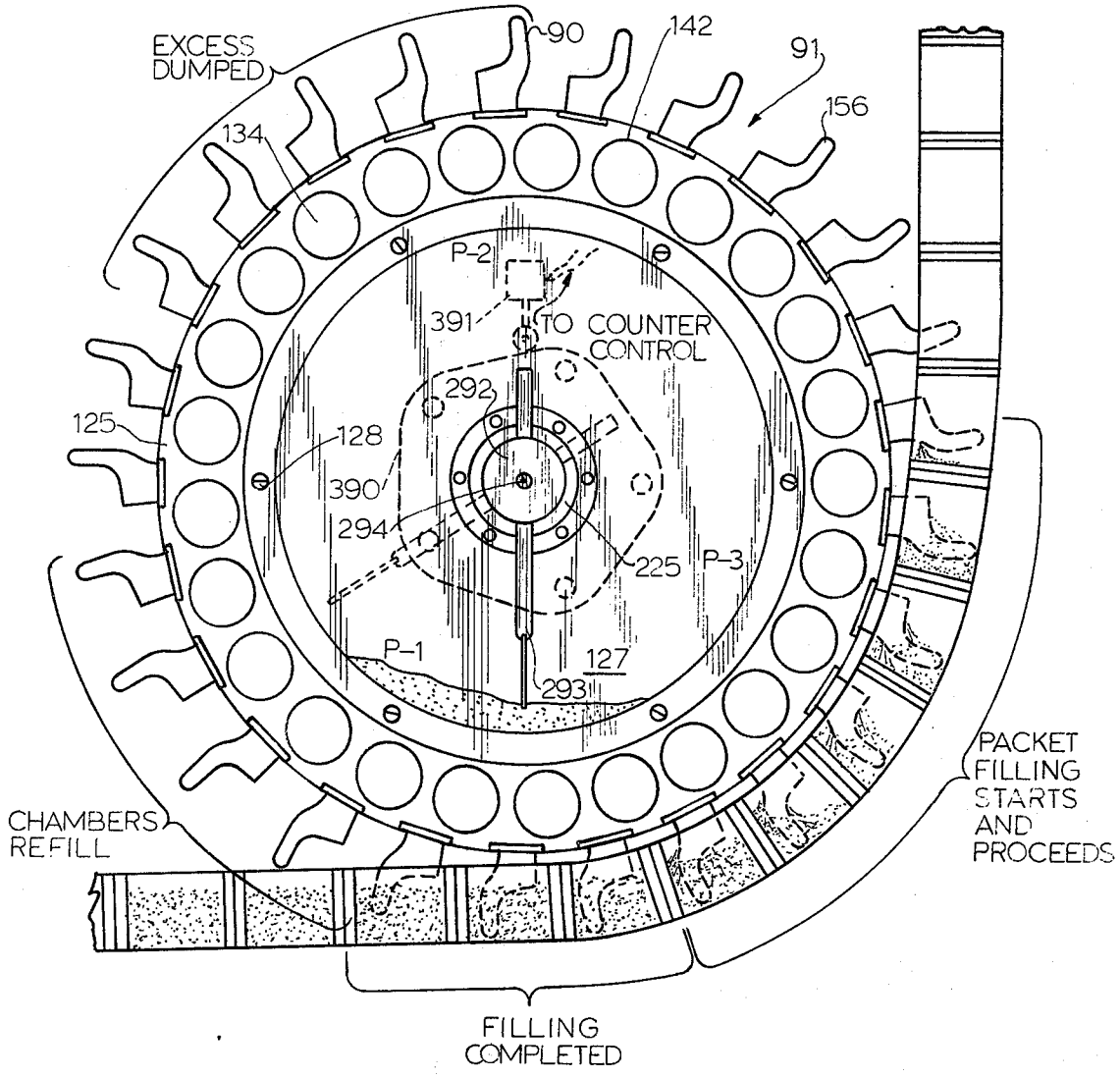

EXCESS DUMPED
90
142
91
156
134
P-2
391
TO COUNTER CONTROL
292
125
128
390
294
225
P-3
P-1
127
293
CHAMBERS REFILL
PACKET FILLING STARTS AND PROCEEDS
FILLING COMPLETED

FIG. 5

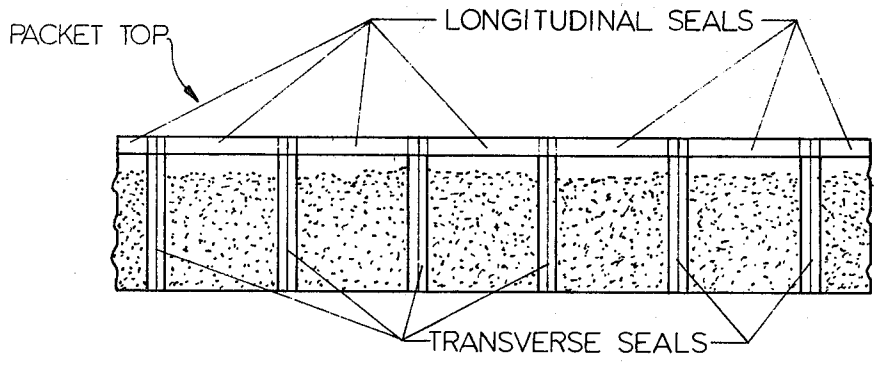

PACKET TOP
LONGITUDINAL SEALS
TRANSVERSE SEALS

FIG. 24

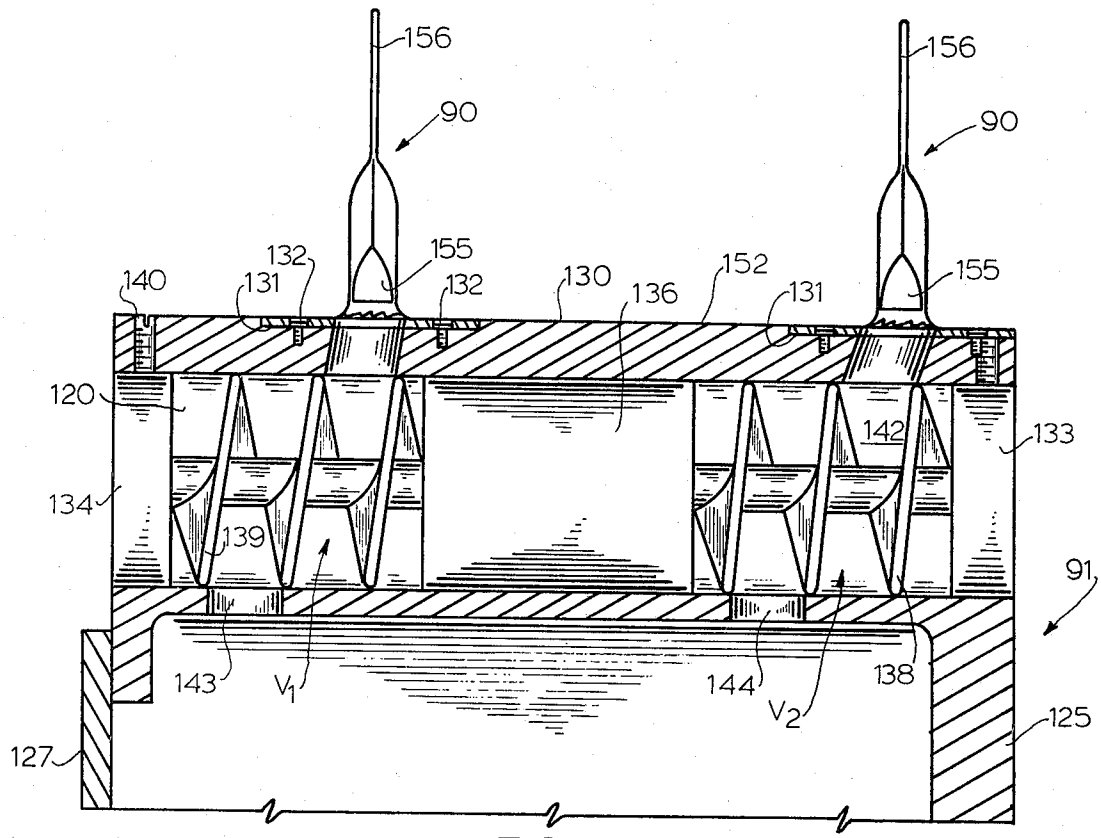


FIG. 6

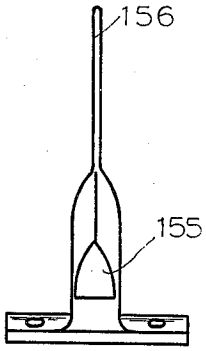


FIG. 9

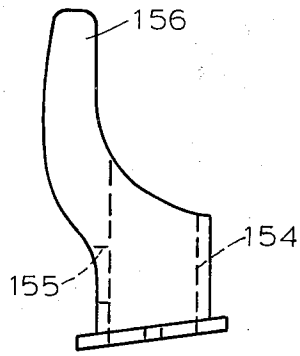


FIG. 8

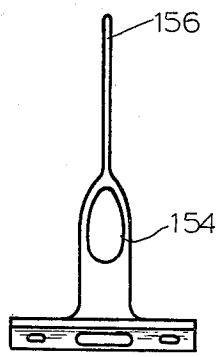


FIG. 7

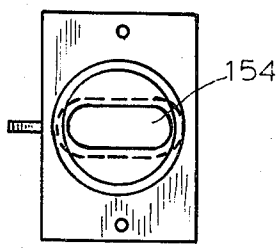
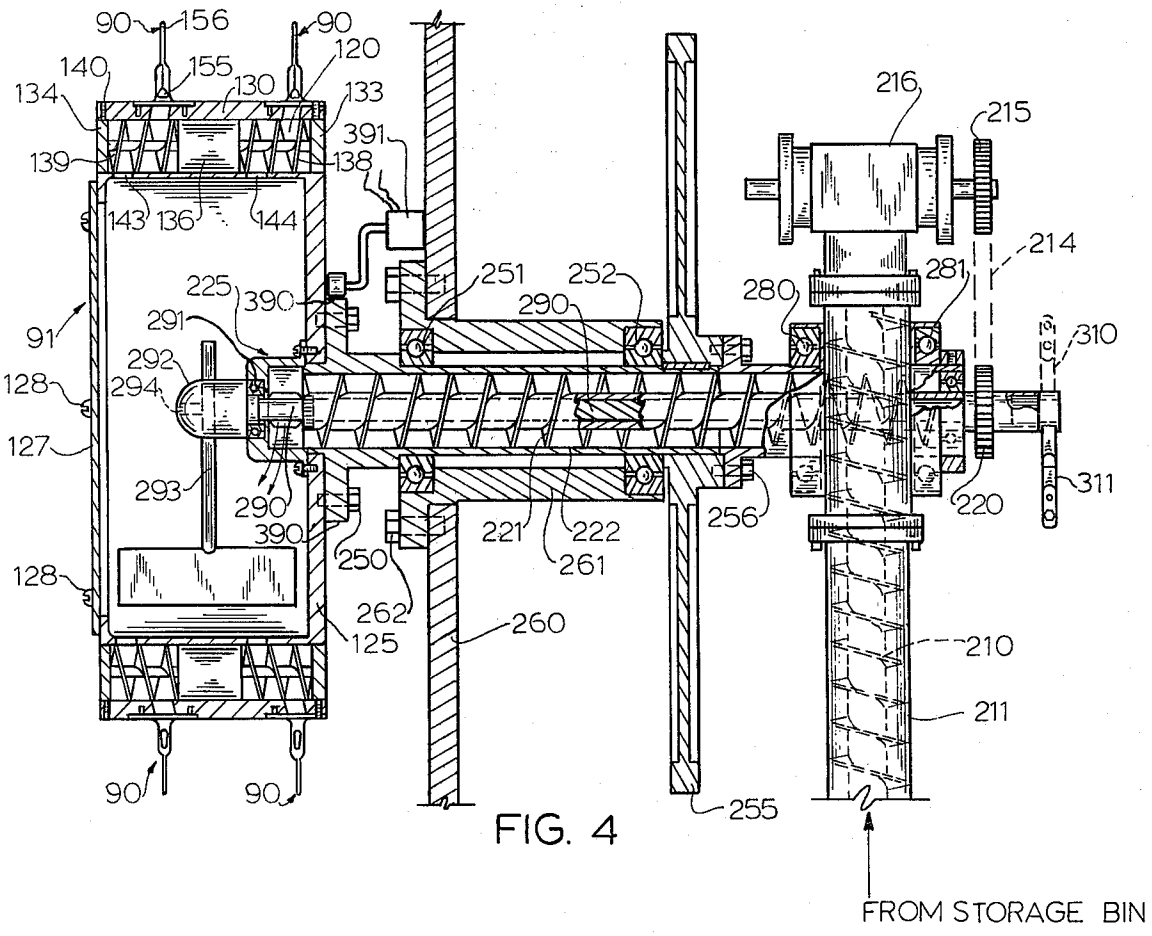


FIG. 10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281
291
310
91
292
294
128
127
293
290
390
311
220
256
221
222
261
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262
125
260
210
211
128
90
90
255
FROM STORAGE BIN

FIG. 4

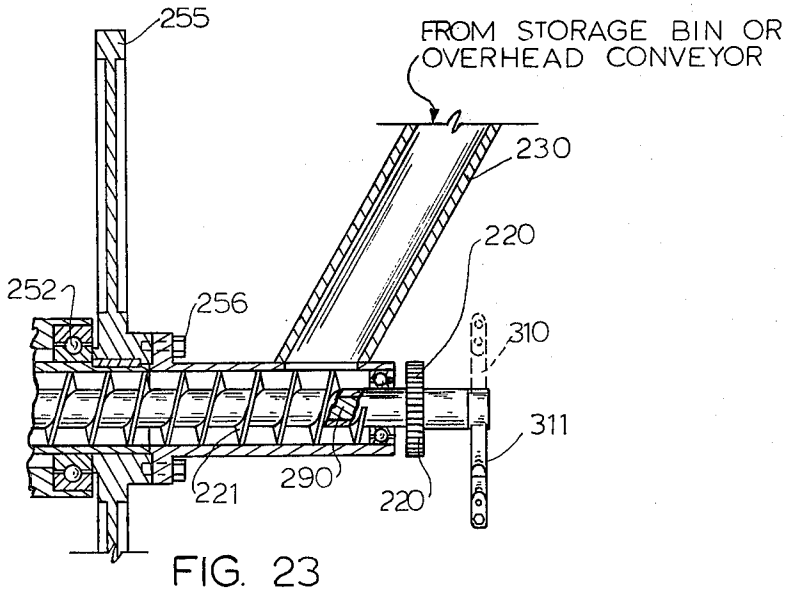
255
FROM STORAGE BIN OR
OVERHEAD CONVEYOR
230
220
252
256
310
311
221
290
220

FIG. 23

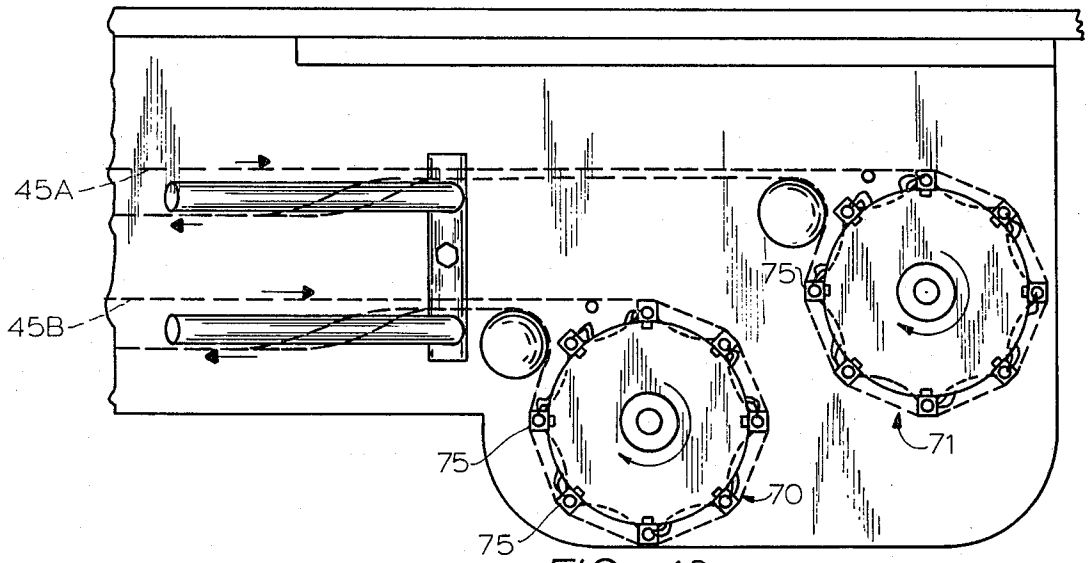

FIG. 12

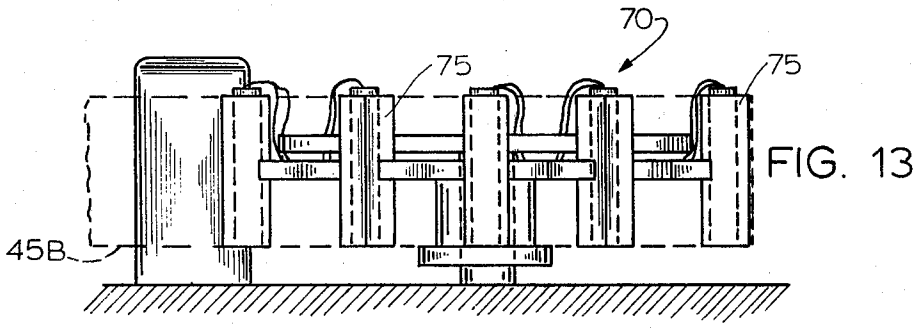

FIG. 13

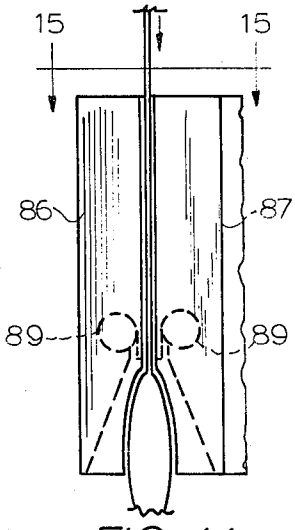

FIG. 14

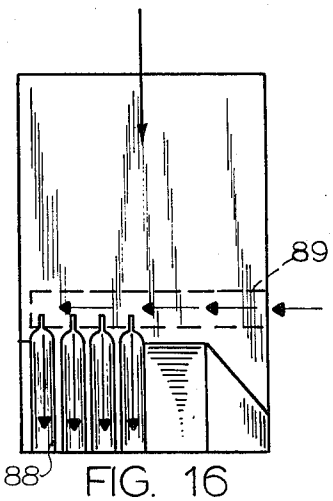

FIG. 16

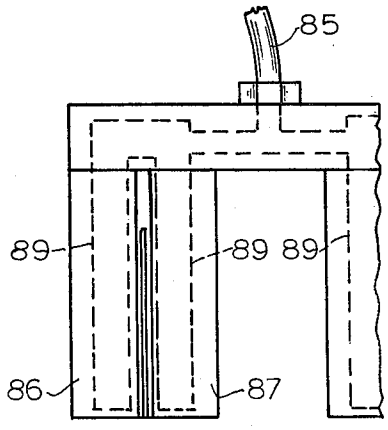

FIG. 15

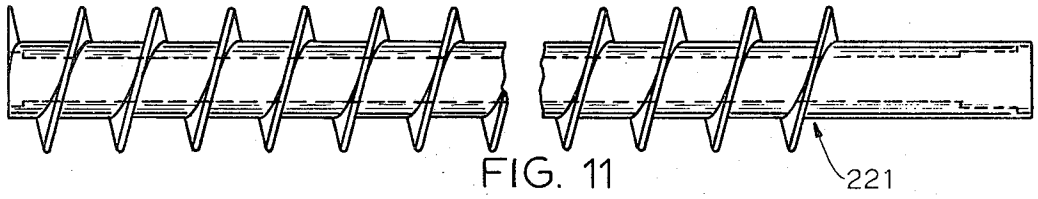

FIG. 11

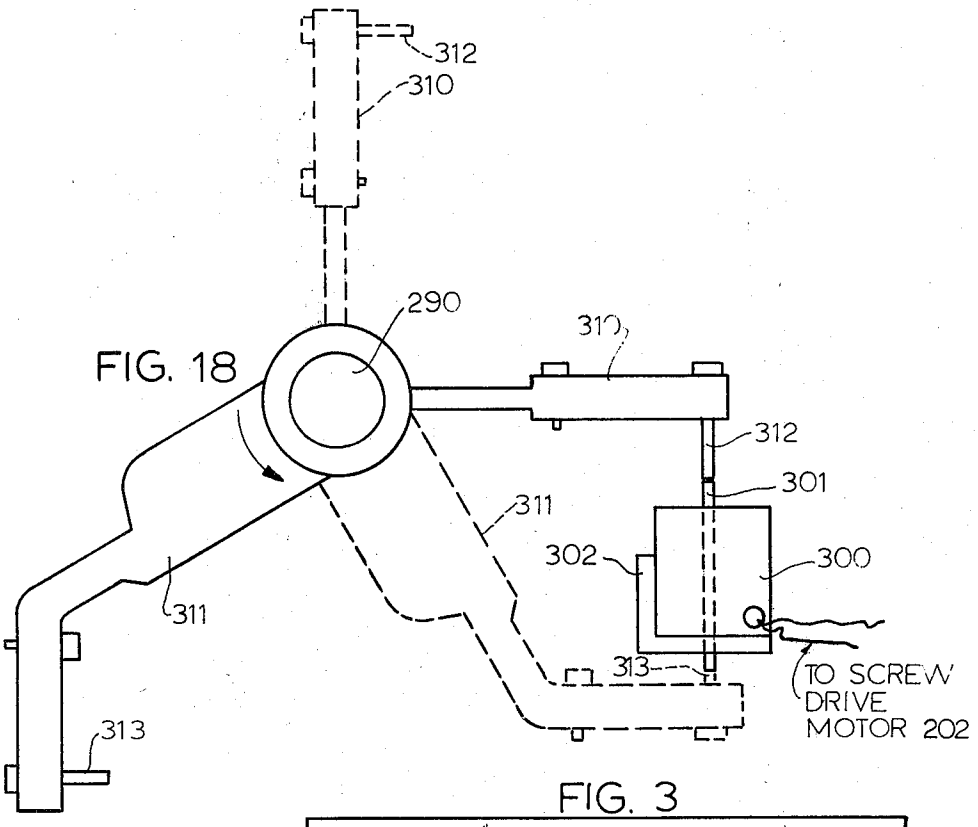

FIG. 18

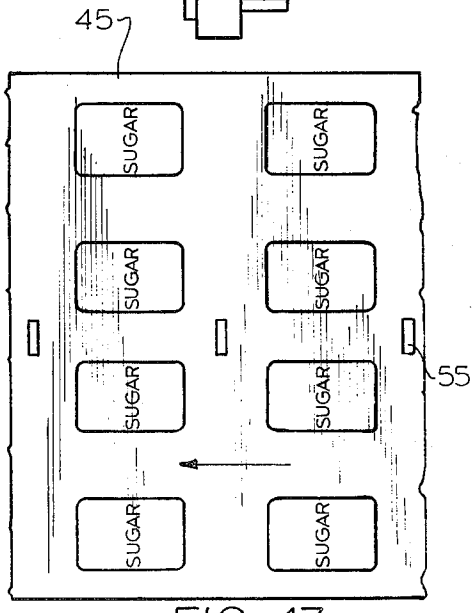

FIG. 17

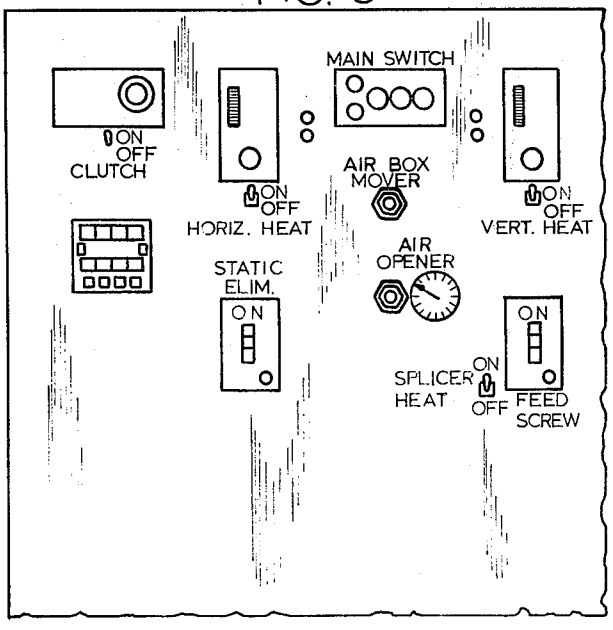

FIG. 3

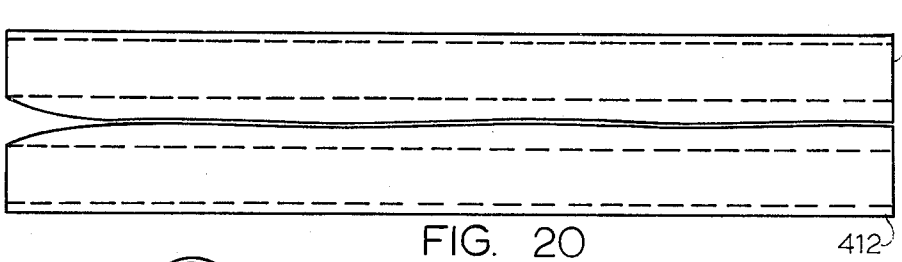

FIG. 20

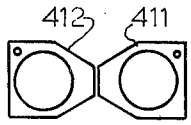

FIG. 21

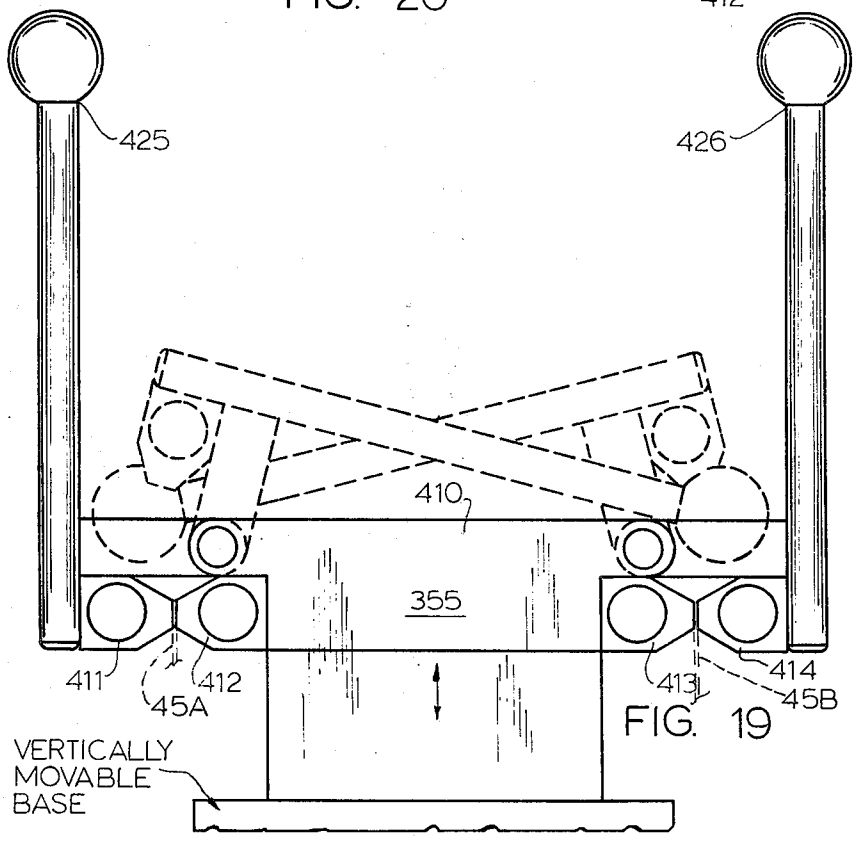

FIG. 19

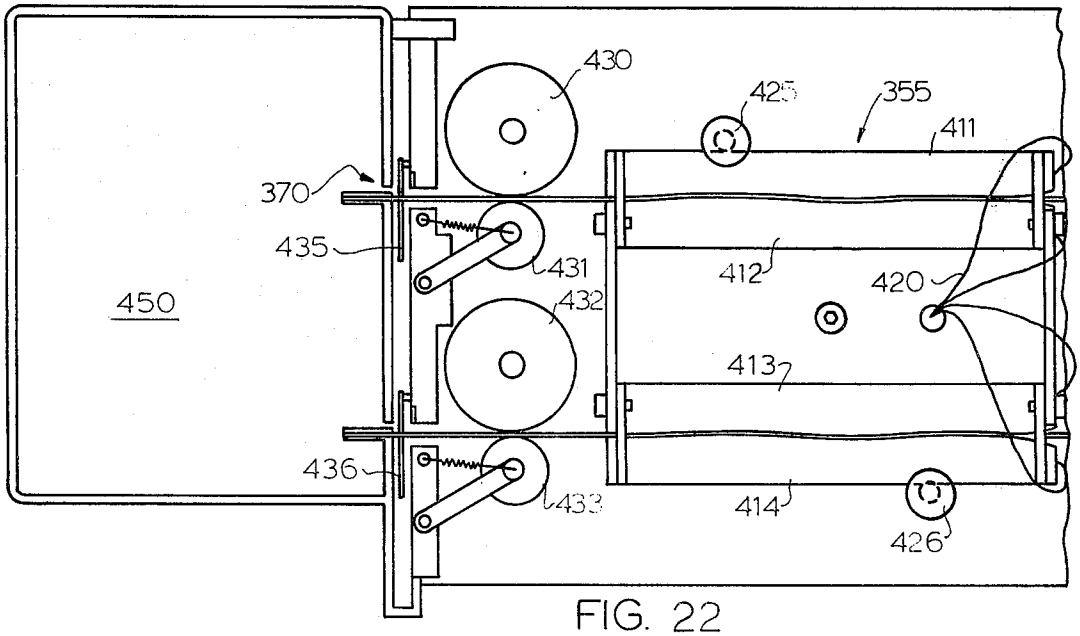

FIG. 22

APPARATUS FOR PACKAGING FLUID MATERIALS IN PACKETS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention pertains to fluid material measuring and dispensing, to the packaging art, and more particularly to condimenttype material packaging apparatus and methods for packaging individual serving type packages of, for example, sugar, salt, pepper, mustard, catsup, and the like.

2. Description of the Prior Art

U.S. Pat. Nos. **2,653,430, 2,746,223,** and **3,344,576** are cited as being merely representative of what is otherwise a voluminous prior art. The prior art apparatus generally is complex, requires substantial space and does not meet the increasing high productivity requirement. It has been proposed as seen in U.S. Pat. No. **3,344,576** to rotate plural material guides, i.e., funnels, which guide the material to the packets while being filled. It has also been proposed to rotate the packets themselves to facilitate filling. One also finds in the prior art various cam actuated operators which sit on the packets and which revolve and assist in the filling, metering or discharge functions which are inherent in any packaging apparatus. Metering is normally accomplished by stationary and relatively complex metering traps.

U.S. Pat. No. **3,578,778** teaches employment of a rotating filling wheel or drum having a plurality of cam actuated trap chambers or traps mounted on the drum periphery and which drum holds the material to be packaged. Each trap fills with material, isolates one or more units of material and discharges material units into synchronized individual packets or containers to be filled. While a marked advance over the prior art, the trap operations have required many moving parts.

U.S. Pat. No. **3,631,903,** over which this invention marks an improvement, resides around the concept of maintaining a supply of fluid material to be packaged in a rotatable drum, rotating the drum at some uniform speed in a constant direction, and simultaneously rotating a set of "traps," i.e., metering devices or trap chambers, which are arranged in a circular configuration and which are connected to and which rotate with the drum. Each trap provides an elongated, non-linear, material flow path between an inlet and outlet and in the embodiments disclosed in the patent such path is of helical shape. At a filling station each trap is positioned so that the material to be packaged is drawn from the drum through the trap inlet and so as to locate itself at one end of the helical path. As the valve rotates around the drum axis all material in excess of a unit of material is discharged through the inlet and the rotation causes the unit to move along the helical path and approach the trap outlet. As the trap reaches a separate discharge station, the unit of material reaches the end of its helical path and is discharged in synchronism with a packet or other container to be filled, mating with the trap outlet. Two or more such helical paths and two or more units of material may be discharged simultaneously.

While the packaging apparatus and method described in U.S. Pat. No. **3,631,903** represented a dramatic improvement over the apparatus described in U.S. Pat. No. **3,578,778** and other prior packaging apparatus and methods, use of such apparatus and methods have revealed the need for even further improvements. Specifically, there has developed a need for substantially reducing the length of the run of the packaging paper between the point where the paper leaves the roll supply and the point where the filled paper is cut into individual packets. Such reduction of run length is needed to reduce the possible points of breakdown, to facilitate threading, and to increase production. There has also developed a need to improve the manner in which the vertically sealed containers formed in the paper are opened just prior to entry of the filling spouts in order to insure positive opening and to prevent the spouts missing the containers. Experience with the apparatus and method disclosed in U.S. Pat. No. **3,631,903** has also revealed the need for maintaining registry between the formed containers and other moving components and a need for improvement in the horizontal sealing. While registration apparatus is well known, it has never been applied in a practical way with a filling apparatus of the type described in U.S. Pat. No. **3,631,903.** Finally, there has proven to be a need for improving the spout shape and for providing a more positive method of feeding the material, e.g., sugar, into the dispensing drum and maintaining level control.

SUMMARY OF THE INVENTION

The apparatus and method of the invention constitute improvements particularly upon the apparatus and method of U.S. Pat. No. **3,631,903.** The present invention constitutes a number of specific improvements which collectively provide a substantially improved packaging apparatus and method over that described in U.S. Pat. No. **3,631,903.** While the drum filling portion of the invention is applicable to packaging bottles, paper cartons, and the like, the description is directed to forming packets in a pliable sheet and packaging sugar and the like in such packets. From this description the broader applications of the new screw feed, filling drum and level control will be readily appreciated by those skilled in the art.

In substance, the present invention reduces the length of run of the packaging paper, provides a means for maintaining registration of the packaging paper and particularly the vertical seal locations, utilizes an air suction device for positively opening the vertically sealed packets just prior to their being filled, provides a more compact filling drum structure than previously provided, provides an improved filling spout, utilizes a substantially improved horizontal sealing apparatus and method, provides a unique level control and, most importantly, provides a means for positively replenishing material in the drum at a controllable and uniform rate.

The registration system of the invention detects registration marks on the packaging paper prior to the paper being vertically sealed and then causes the paper effectively to move or drift with reference to the vertical sealer and in either direction as required so that accurate forming of the vertical seals is obtained. The mentioned air opening device is designed effectively to suck the sides of the vertically sealed packets apart just prior to the packets receiving the filling spouts. Compactness of the filling drum is obtained by forming the traps as part of the filling drum itself rather than by forming them separately and attaching the traps to the drum periphery as taught in U.S. Pat. No. **3,631,903.** A pair of communicating sloped and horizontal screws are used

to elevate the sugar or other material from a storage bin and transfer it into the filling drum as required. The level control utilizes an improved oscillatory paddle and switch arrangement. The paddle senses the material level, rotates a shaft on which the paddle is mounted, and actuates a switch which energizes a screw drive motor, causing the material supply screws to operate when and as needed. The required horizontal seal is effected by an improved sealing apparatus and method designed to cause the horizontal paper surfaces requiring sealing to be sealed and to move back and forth between heated surfaces having constantly changing curvatures. The overall effect of the invention improvements is to provide a machine capable in its design speed of exceeding **2,500** packets per minute based on forming two packet strips simultaneously and which in actual practice has maintained a production rate of **2,000** packets per minute. It has thus become the primary object of the present invention to reduce the length of the paper run, make the paper easier to thread, improve the opening operation, improve the final horizontal sealing, improve the spout shape to improve filling, improve the material feeding from the main storage bin to the dispensing drum and to improve the construction of the dispensing drum and reduce its size. In substance, the object is to provide a vastly improved packaging machine and method of packaging, and the various improvements will be seen as the description proceeds.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a front elevation view of the preferred embodiment of the packaging apparatus.

FIG. **2** is a rear elevation view of the packaging apparatus of FIG. **1.**

FIG. **3** is an enlarged front elevation view of the packaging apparatus control panel.

FIG. **4** is a fragmentary section view taken on line **4-4** of FIG. **1.**

FIG. **5** is an enlarged front elevation view of the filling drum section and the filling spouts around the drum.

FIG. **6** is a fragmentary enlarged section of one of the trap measuring devices around the drum periphery.

FIG. **7** is a front elevation view of a filling spout employed in this invention.

FIG. **8** is a side elevation view of the device of FIG. **7,** the side not shown being a mirror image thereof.

FIG. **9** is a rear elevation view of the device of FIG. **7.**

FIG. **10** is a bottom view of the device of FIG. **7.**

FIG. **11** is a side elevation view of a horizontal screw used by the invention in supplying material to the drum.

FIG. **12** is a fragmentary plan view of the vertical sealer arrangement and the paper-turning device.

FIG. **13** is an enlarged side elevation view of one of the vertical sealer heads of FIG. **12.**

FIG. **14** is an end elevation view of an air opener used in this invention, two such openers being used in the embodiment described.

FIG. **15** is a plan view of the device of FIG. **14** and illustrating the air supply for the openers in a dual arrangement.

FIG. **16** is a plan view of the interior face of one of a pair of identical plates which make up the air opener.

FIG. **17** is a plan view of a section of the paper used in packaging the material and which is shown prior to being slit.

FIG. **18** is an enlarged end elevation view of a switch arrangement used to control the supply of material to the drum and filling spouts.

FIG. **19** is an end elevation view of the horizontal, wavy surfaced, heated sealers employed in the invention with the outside sealer bars being shown in dashed lines as for cleaning.

FIG. **20** is a top plan view of one pair of the two wavy sealer plates of FIG. **19** with dashed lines indicating the hollow tubular spaces reserved for the electrical heaters.

FIG. **21** is an end elevation view of one pair of the wavy sealer plates of FIG. **20.**

FIG. **22** is a top plan view of the horizontal sealer of FIG. **19** and also showing a cutter arrangement adjacent thereto for severing the filled series of packets into individual packs.

FIG. **23** is a fragmentary elevation section of an alternative means of supply of material to the horizontal screw of FIG. **4.**

FIG. **24** is a side view of a horizontally and vertically sealed filled packet strip prior to cutting.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A high production packaging apparatus and method according to the invention will now be described in reference to the appended drawings. Various commonly used frame bracing members, and the like, have been eliminated to simplify the drawings. Also, details of the electrical wiring, controls, switches, and the like, have not been shown but are described sufficiently to enable those skilled in the art to practice the invention.

The packager frame **30** consists of welded construction and as illustrated in FIGS. **1** and **2** is provided with floor mounting feet **31,** a front reinforcing panel **32,** a rear reinforcing panel **33** (shown in FIG. **2**), a control box **35,** and an inspection door **38.**

While, as later described, individual bottles, paper cartons, and the like, may be employed with the drum filling portion of the invention, the apparatus and method of the invention are specifically directed at the type of packaging used for forming individual packets or serving-type packages from heat settable paper, or the like, such as used for sugar, salt, pepper, mustard, catsup, and the like. There is provided a heat settable, coated paper roll supply **40** mounted for rotation on an axle **41** having a weighted drag roll **42.** The packet-forming paper **45** passes from the roll supply **40** over an idler guide roll **46** to a driven roller **50** which will be referred to as the bottom driven roller. The driving arrangement for bottom driven roller **50** will be described later in connection with FIG. **2.** A weighted idler roll **51** prevents slippage of paper **45** around bottom driven roll **50.** Idler roll **51** can be flipped back out of contact with roll **50** when the machine is being threaded. The paper **45** may be imprinted with appropriate advertising which may be used for registration purposes, or preferably, the paper is printed with longitudinally spaced registration marks **55** (FIG. **17**) which may be detected by a registration optical detector **56** and through appropriate registration controls **57,** later explained, used for purposes of registration. An electrically heated bar **44** is provided for sealing the trailing

end of a used roll to the leading end of a new roll. Bar **44** may be energized by a suitably placed switch **47** which is actuated by the drag roll **42** moving to a position corresponding to a depleted roll and which speeds up installation of a new roll. Switch **47** may also be used to actuate a warning signal and to stop the filling operation in the event the depleted roll is not observed by the operator.

To continue following the path of the paper in FIG. **1**, the paper next passes over an idler roll **60** and then through a slitter-folder **61** which causes the paper to be slit into two half-sections **45***a* and **45***b* for each half-section and folded as indicated in FIG. **12**. Here it should be understood that a single width paper could be employed and which would eliminate the use of slitter folder **61**. For the purpose of the present description, the use of a double width paper has been chosen though it should be understood that by duplicating the paper handling, sealing, filling, and cutting apparatus hereafter described, paper suitable to making up more than two packet-forming strips could be employed throughout the system being described.

Since the general practices of slitting, vertically sealing, filling, horizontally sealing and cutting individually filled packets are already known, the description will primarily describe in detail those parts of the apparatus and steps of the invention which are deemed novel and not apparent to those skilled in the art. In this regard, U.S. Pat. No. **3,631,903** furnishes useful background.

As best shown in FIGS. **1, 12** and **13,** the slitted and folded paper strips **45***a*, 45*b*, after leaving a slitter-folder **61,** are caused to pass over respective vertical sealing units **70, 71** such that strip **45***a* is caused to be vertically sealed by vertical sealer **71** and strip **45***b* is caused to be vertically sealed by vertical sealer **70.** The common problem of static electricity may be reduced by use of a conventional static eliminator bar **62** (FIG. **1**). Since the slitters, folders, and vertical sealers referred to are well known, no detailed explanation of either is deemed to be required. In general, the vertical sealers **70, 71** are conventional and each constitutes a wheel-like arrangement on which are mounted a plurality of electrically heated sealing bars **75.** As the respective heat sealable paper strips **45***a*, 45*b* move around the positively driven heater bars **75,** the so-called vertical seals are formed. The space between each vertical seal eventually constitutes a "container" or "packet" for the material to be packaged.

The now vertically sealed and folded paper strips **45***a*, 45*b* are directed between respective pairs of driven knurled rollers **80** which are duplicated for each paper strip which is folded and which will be referred to as the top driven rollers and which are between pairs of smooth surfaced fixed rod guides **81.** Smaller knurled idler rollers **80***a*, under spring load, fit against larger rollers **80.** Rollers **80***a* are spring loaded so that they may be backed off from rollers **80** when threading the paper between rollers **80, 80***a*. Rollers **80, 80***a* are preferably hardened to reduce the effects of wear and it is desirable that a constant tension be upon the paper strips **45***a*, 45*b* as they pass around the respective vertical sealers **70, 71.** Constant tension upon strips **45***a*, 45*b* allows for quick and complete penetration of heat and facilitates obtaining a satisfactory vertical seal. Rollers **80** are preferably slightly overdriven through a slip clutch in order to maintain proper tension. Each paper strip continues its respective path over smooth surfaced rod guides **82** and each paper strip **45***a*, 45*b*, prior to being filled, enters a unique air opening device **83** which is shown in more detail in FIGS. **14, 15,** and **16.** It should be understood that for each paper strip there will be provided one such air opener **83** whose purpose is that of opening the now formed vertically sealed packets just prior to their moving to the position where they are to receive the material to be packaged, e.g., sugar.

With specific reference to FIGS. **14, 15** and **16,** each air opener **83** is provided with a suitable pressurized air supply through an air-supply tube **85.** The exact pressure is not critical and a suitable pressure can be obtained simply by observing the opening under a stroboscopic light and adjusting the opening and pressure to obtain the desired opening effect. The opener consists of a pair of spaced blocks **86, 87** having a plurality of formed depressions **88** which communicate with an air channel **89** which in turn receives air from air supply tube **85.** Aluminum blocks have been used but many other materials such as plastic, glass, or the like, could be similarly formed. As the folded and vertically sealed paper strip passes downwardly through the respective air opener **83,** the sides of each packet container formed between each pair of vertical seals tend to be sucked outwardly towards the respective plates **86, 87** and which in turn tends to open the container. This is due to the venturi effect of the air exiting depressions **88** on the sides of each packet. As the sides of the packet are thus sucked outwardly, the mouth of the packet is caused to open and each paper strip **45***a*, 45*b*, after leaving its respective air opener **83,** is time to cause the mouth of each respective opened packet to engage a respective filling spout **90** on the filling drum **91.** Thus, each packet and its respective filling spout are assured of coming together in a positive engagement with each respective spout properly seated in its packet.

As can best be seen in FIG. **5,** the inner and outer edges of the respective folded packet strips which pass position P-3 are caused to be bent or curved so as to generally follow the curvature of the drum as the strip packets move past position P-3 and around the horizontal axis of the drum **91.** This method of handling the portions of the packet strips being filled has been found in practice to assist in puckering and opening the packets for filling. For example, with a drum outside diameter of about 16¼ inches, a filling spout depth of about 2 inches, and a folded packet width of about 1¾ inches, the packet strips in practice can be seen to pucker and open when moving in the arcuate path depicted in FIG. **5.** The inner and outer edges of the respective packet strips, while depicted as smooth curves in FIG. **5,** will, of course, have some wrinkles conforming to being curved as shown.

The body **125** (FIG. 4) of drum **91** is of one piece, pan-shaped, cast metal construction and has its front face covered by a transparent cover plate **127** which is secured by the screws **128** to provide a hollow drum or container for the material. The body **125** is affixed to the bearing tube **222** by means of screws **250,** as later referred to, and is concentrically mounted with respect to its axis of rotation by means of bearings **251, 252.** The external peripheral wall **130** of the body **125** is provided with externally machined surfaces **131** (FIG. **6**) on which are mounted the uniformly and peripherally spaced spouts **90** by means of screws **132** and

which are associated with the metering and dispensing trap chambers **120.**

Here it should be understood that the word "trap" or "trap chamber" is used somewhat arbitrarily since, as later described, the "traps" of the invention have no moving parts and do more than provide a flow path. The traps of the invention act in fact as a means for receiving, metering, guiding, and discharging units of material on each rotation of drum **91.**

The metering and dispensing traps **120** and their associated spouts **90,** which are shown in greater detail in FIGS. **4** through **10,** are adapted to package two packets simultaneously; however, more or fewer packets may be packaged with the appropriate modifications to the apparatus. The "packets" are preferably in continuous strip form, as in FIGS. **1, 5, 12** and **13.** However, discrete containers such as bottles or boxes, not shown, may be used with the drum or filling wheel portion of the invention apparatus.

Each metering and dispensing trap **120** is formed with a hollow, cylindrical opening **142** whose ends are closed by circular nylon discs **133, 134** held by set screws **140** (FIG. **6**). Openings **142** are formed by equally, peripherally spaced holes bored through the cast-metal body **125** of drum **91.** This construction both reduces construction and maintenance costs and lends itself to a more compact drum arrangement as contrasted with the traps which are separately formed and secured to the drums as taught in prior art U.S. Pat. No. **3,631,903.** A cylindrical spaced block **136** is snugly fitted and centered in the interior of opening **142** and effectively divides opening **142** into two independent trap sections V_1 and V_2. A pair of snugly fitted helical screws **138, 139** are located on opposite sides of spacer block **136.** Screws **138, 139** provide respective helical flow paths for the material. Material is fed to trap section V_1 through inlet **143** and to trap section V_2 through inlet **144.** Block **136** and screws **138, 139** are of nylon. While described as separate items, discs **133** and **134,** screws **138** and **139,** and block **136** are preferably molded from nylon as a single integral part for each trap assembly.

Inlets **143, 144,** of course, communicate with the interior of drum **91** and as drum **91** rotates the material residing inside drum **91** is forcibly injected into the trap inlets **143, 144** by gravitational and centrifugal forces.

Further improvements are provided in the packet filling spouts **90** which serve as respective outlet ports for trap sections V_1 and V_2. Filling spouts **90** are thin walled, tubular members which are flush mounted with the outer surface **152** of the drum body **125** and project from the drum body a sufficient distance to insure entry into the packet, bottle, box or other container without the loss of any material being transported thereby. While the filling spouts may, of course, be shaped to conform to the particular type of container being packaged, FIGS. **8–10** show a preferred embodiment for packaging sugar and the like.

In particular, each spout **90** provides for the material to be expelled both through central, axially extending port **154** (FIG. **8**) and a lateral port **155** which communicates with port **154** proximate the drum body **125.** Each spout **90** also includes a rigid, thin, tip portion **156** which first engages the packet opening which, as drum **91** rotates (see FIG. **5**), gradually inserts itself into the near full depth of the packet. The wider portion of the spout **90,** containing ports **154** and **155,** is also at this stage inserted into the packet and material will normally first pour through lateral port **155** and then through axial port **154** until the measured amount has been drawn. Such arrangement insures positive spout-packet engagement and also insures a positive and quick discharge which maximizes the drum speed and packaging rate.

The operation of screw members **138, 139** follows the teaching of U.S. Pat. No. **3,631,903** but for a better understanding of the improvements related to the present invention it will be shown how they act to receive the material, measure out units of material, and then dispense the respective units of material through the improved filling spouts **90.** In this regard, it will be noted that when the trap is in the position P-**1,** FIG. **5,** the left ends of the screws **138, 139,** as seen in FIG. **6,** will fill through the respective inlets **143, 144.** As the trap moves on to position P-**2,** the trap is inverted and excess material is dropped back into drum **91** through inlets **143, 144.** At the same time, other material, by reason of the spiral screw effect, is trapped in the respective turns of the screw members **138, 139** and is advanced axially in the direction of the respective filling spouts **90.** It is this trapped material that now constitutes a measured material unit in each respective trap section V_1, V_2. As the trap continues to rotate around the axis of drum **91,** it will be noted that the spiralling screw action will continue to advance the trapped material axially in each respective screw member **138, 139.** Once the trap reaches the position P-**3** or thereabouts, the trapped unit of material in each respective screw member **138, 139** will have been advanced to the point that it reaches the respective outlet and is free to pour out of the respective filling spouts **90.** At the same time, new material begins to pour into the respective inlets **143, 144** for screw members **138,** 139, but the new material, because of the respective screw member positions at P-**3,** remains isolated from the material being dispensed. As the trap moves on again to positions P-**1,** P-**2** and back to P-**3,** the cycle, of course, repeats. Thus, each trap section V_1, V_2 receives, measures off, stores, and discharges a unit of material on each rotation. Of particular interest to the present invention is the fact that the improved trap construction, improved air opener, improved spout construction, improved horizontal sealing, improved registration, improved material feeding and sensing of the present invention all adapt themselves to utilizing the screw trapping concept at substantially higher production rates than heretofore obtained.

So long as the drum **91** rotates at some uniform speed and is kept filled to some predetermined level of material, as later explained, the traps will sequentially fill, dump excess material and move to the respective filling spouts **90,** predetermined units of material which will always be of uniform amount. It can also be seen that the material "unit" is determined by the diameter, pitch, blade thickness, speed of rotation and nature of material, which factors, once determined and fixed, insure a uniformity in measuring the respective units. Further, simply by changing the pitch or diameter of the screw being employed, the volume in the material unit can be changed and in some cases simply by speeding or slowing rotation, the volume in the material unit can be changed. A brush **78** and excess material guide **79** are employed to remove any excess material which

clings to the spouts **90** prior to their moving back to a filling position.

Drum **91,** of course, always rotates in the same direction and the speed of rotation while constant for a given material is preferably adjusted to the nature of the material. That is, to gain maximum advantage of both gravitational and centrifugal forces, the speed should be adjusted to be sufficiently fast so that the trap tends to fill in excess of one unit of material on each rotation, with the excess being eliminated by the fact that each respective trap when it inverts to position P-2 will retain only one unit of material. Some paste-like and semi-liquid materials, therefore, may be found compatible with the apparatus and method of the invention though they may require a different range of speed than is required for liquid and granular materials and in some cases the materials are expected to be heated and dried as part of the packaging process.

The improved screw conveyor system for storing and transferring the material prior to introduction to the drum forms an important part of the present invention. Reference is made to U.S. Pat. Nos. **3,578,778** and **3,631,903** over which the present invention represents an improvement. In the apparatus and method of these patents it will be noted that the material is elevated from a storage bin to an auxiliary hopper and is then fed directly to the drum by gravity through a pipe which connects the hopper with the drum interior. Such an arrangement has worked, but it has required the use of vibrators and has been found sensitive to changes in humidity when handling sugar and similar granular material. Also, the sugar, for example, cannot always be fed into the drum at the same rate since the amount of sugar vibrated loose in the hopper is subject to many variables. This aspect of the present invention thus seeks to provide for more positive feeding and control over the material fed to the drum.

A storage bin **200** of welded metal or other suitable construction is employed. Appropriate sloping walls **201** provide a limited volume base to facilitate pick-up, and rest on the floor. Storage bin **200** is affixed to the machine frame **30** by suitable frame means and the operator dumps into bin **200,** as required, material to be packaged which may be, for example, **100**-pound bags of sugar.

The manner in which the material is elevated from the storage bin **200** to the level of the filling drum **91,** the manner in which the material is then transferred into the filling drum and the manner in which a predetermined level is maintained in the filling drum **91** all constitute coordinated and important aspects of the invention. In particular, there is provided a vertically sloped and positively driven screw **210** which mounts within a tube **211** which extends into the limited-volume base of the storage bin **200.** A suitable driven motor **202,** through a right angle gear drive **212,** turns a gear **213** which drives a chain **214** which in turn drives a gear **215** which through another right angle gear drive **216** causes screw **210** to rotate whenever motor **202** is energized. It will also be noticed that chain **214** drives a gear **220** which rotates a separate horizontal screw **221** (FIGS. **4, 11** and **23**) mounted inside a horizontal tube **222** which at its material recovery end communicates with tube **211.** Thus, when screw **210** is turning, the material to be packaged, e.g., sugar, is transferred upwardly from bin **200** by vertical screw **210,** is then transferred to screw **221** and is then moved horizontally towards the filling drum **91** where it exits through a perforated cap **225.** Here it can be seen that by properly designing the screws **210** and **221** and controlling and synchronizing their speeds, the sugar or other material can be drawn from bin **200** in positive measured amounts and lumps can be broken up in transit. Thus, by sensing the material level in drum **91,** as later explained, replacement material can be drawn into drum **91** as needed at a substantially uniform rate. Also, this method of replenishing drum **91** allows drum **91** to move at a relatively high rate of packaging since material replenishing can be done positively and at a fast rate.

Tube **222** is secured on its discharge end to drum **91** by means of bolts **250,** as best shown in FIG. **4.** Tube **222** is also rotatably supported by bearings **251, 252** and at its opposite end is secured to the drive gear **255** by means of bolts **256.** Bearings **251, 252** are in turn supported by frame member **260** and hub member **261** which is secured to frame member **260** by bolts **262.** Turning of drive gear **255** thus causes drum **91** to rotate, However, conveyor screw **221** is connected to be separately driven by means of gear **220** which mounts on conveyor screw **221** and is driven by chain **214** through gear **213.** Added bearing support for the tube **222** is provided by bearings **280, 281.** What should be appreciated here is that this coaxial drum-screw arrangement allows drum **91** to rotate continuously and screw **221** to rotate intermittently about the same axis.

Before describing improved level control of material in drum **91,** which controls when conveyor screws **210** and **221** operate, a brief review of the conveyor screw operation will be given. In particular, it will be noted that when screw drive motor **202** is energized, both conveyor screw **210** and conveyor screw **221** are caused to operate. Conveyor screw **210** will elevate material from storage bin **200** and transfer it to conveyor screw **221,** which will then carry material into drum **91.**

Referring next to the level control, it will first be noted that conveyor screw **221** is of a hollow construction as seen in FIGS. **4** and **11.** A shaft **290** extends through conveyor screw **221** and is supported by a bearing **291** mounted in cap **225.** A cap extension **292** mounts a material level sensing paddle **293** which can be adjusted radially by means of set screw **294.** At the opposite end of shaft **290** there is mounted a lever switch arrangement best depicted in FIGS. **2, 4** and **18.** To best understand this arrangement and how the level control operates, it is first necessary to observe and appreciate that shaft **290** rotates independently of conveyor screw **221** and also rotates independently of tube **222** which surrounds screw **221** and which drives drum **91.** Thus, even though drum **91** may be continuously turning with tube **222,** screw **221** can be stationary and at the same time shaft **290** can be stationary. For example, if the machine is being run with no material for test purposes, drum **91** can be caused to rotate while screw **221** and shaft **290** remain stationary. Also, shaft **290** can shift its rotative position while screw **221** remains stationary or shaft **290** can be changing its rotative position at a time when screw **221** is turning.

Referring particularly to FIG. **18,** the level control incorporates a two-position microswitch **300** having a two-position switch plunger **301** and supported on a frame member **302.** When plunger **301** is depressed, switch **300** is closed and when plunger **301** is elevated,

switch **300** is opened. Switch **300** is in circuit with the screw drive motor **202.** Thus, when plunger **301** is pushed down, screw drive motor **202** is energized. To further explain this operation, plunger **301** is depressed by means of a lever **310** rigidly secured to shaft **290** and plunger **301** is elevated by means of a lever **311** which is also rigidly mounted on shaft **290.** Levers **310, 311** have switch engaging pins **312, 313.** Referring to FIG. **1,** the paddle **293** (also seen in FIG. **4**) is shown in a vertical position corresponding to the drum being empty or substantially empty. In this empty condition, lever **310** will occupy the solid-line condition shown in FIG. **18** which will cause switch **300** to close, screw drive motor **202** to be energized and the respective conveyor screws **210, 221** to operate and transfer material from bin **200** to the interior of drum **91.** As the amount of material in drum **91** increases, paddle **293** will be caused to move in a clockwise direction as seen in FIG. **1** and levers **310, 311** will be caused to move in a counterclockwise direction as seen in FIG. **18** until they move to the respective dotted line positions shown in FIG. **18** whereupon switch **300** will be opened, screw drive motor **202** will be deenergized and the respective conveyor screws **210, 221** will stop turning. As the material is depleted in drum **91,** the paddle **293** will return to the vertical position shown in FIGS. **1** and **5** whereupon levers **310, 311** will be caused to move back to the respective solid line positions shown in FIG. **18,** switch **300** will be closed and screw drive motor **202** will be energized to cause screws **210, 221** to operate and convey more material to drum **91.** Thus, during a normal packaging operation, drum **91** will operate continuously, subject only to paper replacement and breakdowns, and paddle **293** will oscillate between vertical and off-vertical positions as drum **91** empties, refills, empties, refills, etc., and motor **202** will switch on and off in the same sequence.

While it is contemplated that conventional sugar and like packaging practices will dictate use of the dual screw arrangement just described, it is recognized that the material can be fed from an overhead source directly to screw **221** and this embodiment is generally represented in FIG. **23.** Here it can be seen that an inlet tube **230** connects directly to tube **222** and thus provides a path of entry for the incoming material. The unique level control previously described nevertheless is equally adapted to this embodiment and would, as required, control the overhead source operation.

To continue with the description, the dual packet strips, after being filled, are passed under a guide **350** and then into a horizontal sealing unit **355** whose details are important to the invention and are later explained. From horizontal sealer **355,** the now sealed packets are pulled through a conventional packet knife cutter **370** which is synchronized to cut through the vertical or transverse seals of the dual packet strips and drop the now individual packets into hopper **450** from which they drop to a suitable shipping container **375.** As best shown in FIG. **1,** the shipping container **375** arrives below the knife cutter **370** on a conveyor **380,** is filled below the knife cutter **370** and is then ejected by an appropriate means onto a discharge conveyor **381** for final packaging and shipment. In order to fill each container **375** with the same number of packets, there is provided a cam **390** which is secured and rotates with drum **91,** as shown in FIG. **5.** Cam **390** operates a counting switch **391** which in turn is connected to a counter control of conventional construction. Since the mechanism for receiving the shipping containers, counting the packets and ejecting the filled shipping containers follow conventional practice, the same are not dealt with in further detail. The mechanism for pushing the shipping container **375** from the incoming conveyor **380** is schematically represented by mechanism **400** and the ejecting mechanism for pushing the filled shipping container **375** onto discharge conveyor **381** is schematically represented by mechanism **401** as best seen in FIGS. **1** and **2.** Such mechanisms conventionally use pneumatic rams, or the like, with appropriate controls to perform the described functions.

Referring again to the subject of horizontal sealing, the present invention offers a substantial improvement for packaging sugar, and the like, and accomplishes horizontal sealing in a completely novel manner which substantially overcomes many of the problems encountered in previous horizontal sealers. The past practice during horizontal sealing has been to pass the vertically sealed and filled packets between two heated bars providing narrowly spaced straight opposed heated surfaces. This method has not accommodated to the problem of extraneous grains of material which are often found on the paper surfaces where the horizontal seal is made. Faulty seals are often made and the paper is often burned, resulting in rejected work. Also, maintenance problems have been substantial and particularly since any kind of heated surface which contacts sugar, or the like, requires periodic cleaning under the most ideal circumstances.

Referring particularly to FIGS. **19-22,** there are shown various views of the improved horizontal sealing unit **355** and in FIG. **22** the relation of the sealer to the knife unit **370** is also shown. In particular, the horizontal sealing unit **355** comprises a base structure **410** which mounts on each side respective pairs of sealing bars **411, 412, 413** and **414.** Each bar is in effect an electrically heated bar. The mating surfaces of each pair of sealing bars **411, 412,** e.g., follow a wavy path as best seen in FIGS. **20** and **22.** That is, the paper being sealed is forced into contact with parallel, heated, opposed surfaces of changing curvature. In one embodiment, the contacting surfaces of the bars between which the packet paper is passed and horizontally sealed have heated areas on each bar approximating **6** inches × ½ inch. Conventional tubular electric heaters are mounted in the hollow interiors of the respective sealing bars **411–414** and are energized by suitable electrical connections **420.**

To facilitate maintenance which cannot be avoided when handling sugar, and the like, the outer sealing bars **411, 414** are pivoted as best shown in FIG. **19** and are provided with handles **425, 426** such that when pivoted inwardly to the dotted line positions shown in FIG. **19** the mating heated surfaces are available for cleaning, removal of burnt materials, and the like, such as encountered in normal packaging practice.

The changing bar surface curvatures used in the longitudinal sealers of the present invention tend to minimize packet burning because each side of the packet tends to be in only intermittent contact with a heated bar surface. In contrast conventional straight bar surfaces afford the probability of bringing each side of the packet into continuous contact with a heated bar surface. A further advantage of the longitudinal sealers of the invention is that uniformity in duration of contact

between packet and heater surface is assured whereas the straight surfaces of conventional longitudinal sealers permit lateral flutter of the packet strip and, hence, intermittent contact. A still further advantage is seen in the fact that the filling of packets in a packet strip tends to shorten the effective length of the bottom of the strip due to bulging of the packets and consequent concave "pucker" in the outside bottom of said packets, all of which tends to bow the packet strip upward between the filling and cutting operations. The wavy gap between the two halves of each longitudinal sealer employed in the invention counters this tendency by causing the top edge of each corresponding packet strip to assume a sinusoidal shape and hence to effectively shorten the strip.

As best seen in FIG. **22**, the packets once horizontally sealed are drawn between respective pairs of driven and idle rollers **430, 431** and **432, 433.** The rollers are provided with knurled surfaces to facilitate gripping the paper. The packets then pass the respective knife blades **435, 436** from which they drop into a suitable hopper **450** for packaging into containers **375,** as previously mentioned. The usual hopper gate and its mechanism are not shown since the same follow conventional practice.

The register system employed makes use of conventional components of a photoelectric registration system available to the trade but incorporates these components in a unique manner useful to the purposes of the invention. Reference is made to a pamphlet entitled "E.M.P. Model No. **102** Two-Way Preprint Registration Cut-Off Control Systems" and to a pamphlet entitled "EMP Positive, Dependable, Photoelectric Systems For Cut-Off On All Web Fed Machinery," both of which are published by Electronic Machine Parts, Inc., **128-11** 18th Avenue, College Point, New York. The pamphlets explain the basic operation of the so-called EMP Model **102** two-way registration system which has been found useful for the apparatus of this invention. With the description set forth in these pamphlets in mind, the photoelectric scanner **56,** FIG. **1,** is connected through the registration controls **57** to a selector switch **49,** FIG. **2,** and to a registration adjustment motor **52** which controls a mechanical differential **53.** The selector switch **49** establishes a correction zone as well as a dwell area between advance and retard and the differential **53** causes the paper to drift in either direction on the vertical sealers as later explained. The vertical sealers **70, 71** are in turn positively driven at a constant speed by gear **54** which in turn is driven by the main drum gear **255** through gear boxes **58, 59** and connecting shaft **65.**

The vertical sealer drive gear **54** drives a chain **66** which drives the rotating dial of selector switch **49** and also acts to drive the differential **53.** Differential **53** in turn drives through its differential mechanism a chain **67** which drives a gear **68** which drives the bottom drive roller **50** and a gear **69** which drives the top drive rollers **80** shown in FIG. **1.**

In operation, the paper registration marks **55** shown in FIG. **17** are detected and, if registration is within defined limits, the bottom drive roller **50** and top drive rollers **80** continue to operate at some predetermined speed and the vertical seals are formed at properly spaced locations on vertical sealers **70, 71.** However, if the registration marks lead or lag beyond defined limits, such fact is detected which causes the registration adjustment motor **52** to adjust the differential **53** so that gears **68, 69** either speed up or slow down as required which effectively causes the paper to drift or slide on the vertical sealers **70, 71** which in turn causes a relocation of the vertical seals to their proper positions with reference to the registration marks.

Another registration adjustment for the cutting of the vertical seals is also provided in the arrangement which drives the end driven rollers **430, 432** shown in FIG. **22** and which pulls the finished packets just prior to cutting. In this connection, rollers **430, 432** are connected by shaft means, not shown, to be driven through an adjustable magnetic clutch **72,** shown in FIG. **2.** Clutch **72** is in turn driven by chain **73** off gear **74** which is driven through shaft **75** and gear box **76** off the main drum gear **255.** In practice, it has been found that by adjusting the magnetic clutch slippage, the degree of slippage of the paper on rollers **430, 432** can be controlled and this can be used to control the degree of tightness of the paper on the vertical sealers **70, 71** which provides a simple method of controlling the width of the vertical seal. Furthermore, a coarse adjustment of the width or depth of the horizontal seal can be obtained by use of a vertically movable base for the horizontal sealer as schematically illustrated in FIG. **19.** Thus, both location and size of the vertical and horizontal seals illustrated in FIG. **24** are adjustable.

The term "vertical seal" has been used to refer to the transverse, lateral or crosswise seal; the term "horizontal seal" to refer to the longitudinal or lengthwise seal at the outer edges opposite the folded packet bottom and the "top" of the packet to refer to the portion of the packet sealed by the horizontal or longitudinal seal. Thus, even though these portions of the packets are sometimes shown in the drawings oriented in non-vertical, non-horizontal, or other positions, the terms "vertical" and "horizontal" have been employed to simplify the description for those skilled in the art. In this same regard, it is also recognized that packaging operations may be carried out according to the invention with the transverse and longitudinal sealers operating and the seals being formed in orientations and positions different from those disclosed in the drawings. Thus, the embodiment described illustrates only one such orientation. The word "paper" has also been used in a generic sense to mean any packaging material suited to the invention. For example, while coated, heat settable paper has been mentioned, transparent polyethylene sheet material has also proven practical as an alternate method.

Finally, mention should be made that another important overall advantage achieved by the compact arrangement shown is that the length of the paper run between the supply roll **40** and the knife cutter **370** is substantially less than that obtained in prior art packagers. This reduction in turn leads to substantial reduction in time required to rethread and in number of potential breakdown points. Overall, the invention provides a vastly improved packaging apparatus and method.

We claim:

1. An apparatus for dividing fluid material into uniform units and for packing the units, comprising:

a. a hollow cylindrical filling drum having a peripheral body portion and containing a volume of fluid material to be dispensed in discrete units;

b. a plurality of uniformly spaced and circularly arranged metering trap chambers formed in said pe-

ripheral body portion of said drum for rotation as an integral filling structure around a central horizontal axis, each chamber having a hollow housing formed with said peripheral body portion and a helical screw member having its axis oriented parallel to said central axis and fixed within said housing, each said chamber providing an open elongated fluid material flow path formed by said screw member and extending between an inlet communicating with the interior of said drum and an outlet laterally displaced along said flow path, said screw member being dimensioned to measure said unit;

c. means for rotating said filling structure at a uniform predetermined speed and in a constant direction around said central axis, each chamber being adapted on each rotation and at said speed to communicate its respective inlet with the interior of said drum at a first rotative station, to receive a portion of said fluid material into said flow path, to discharge through said inlet as said chamber rotates away from said first station all except a quantity equal to one unit of said material, and to guide said unit along said flow path towards said outlet under the influence of the rotative forces asserted thereon as said chamber rotates at said speed towards a second rotative station whereby said unit is discharged from said outlet during passage of said chamber past said second station;

d. a storage receptacle containing a volume of said material stored below the level of said drum axis;

e. conveyor means arranged to convey said material from said receptacle to said drum along a conveying path which conveying path at the drum receiving end includes horizontal screw conveyor means comprising a helical conveyor screw surrounding a hollow hub and adapted for rotation independent of said drum around said central axis and communicating at its discharge end with said drum interior and at its intake end with said storage receptacle and includes in addition to said horizontal screw conveyor means an operatively associated additional screw conveyor means communicating at one lower end with the material in said storage receptacle and at the other end with the intake end of said horizontal screw conveyor means; and

f. leveling means independently controlling said conveyor means including said horizontal screw and additional screw conveyor means whereby said conveyor means may operate independently of said drum and being effective to operate said conveyor means intermittently as required to maintain a predetermined level of material in said container, said leveling means including a shaft mounted for rotation independent of, within and extending the length of said hub, said shaft having one forward end extending into said drum interior and having mounted thereon a rotatable sensing member for contacting and sensing the level of said material and controlling the rotative position of said shaft according to such level, said shaft having a rearward end mounting switch actuating means controlled by the rotative position of said shaft, and electric drive means controlled by said switch-actuating means for simultaneously driving said screw conveyor means during those times when said sensing member rotates within some predetermined angular range corresponding to a depleniished supply of material in said drum.

2. An apparatus as claimed in claim **1** and including at a packet opening position located proximate and above said second station a packet opening means, said opening means comprising a pair of spaced blocks providing opposed surfaces between which the unsealed top edge portions of said packets may be drawn, said surfaces having a plurality of openings adapted to discharge air and produce an air-suction effect and means to convey pressurized air to said surfaces for discharge through said surface openings to cause said edge portions to be sucked outwardly and said packets opened for filling prior to said second station.

3. An apparatus for dividing fluid material into uniform units and for packaging the units, comprising:

a. a hollow cylindrical filling drum having a peripheral body portion and containing a volume of fluid material to be dispensed in discrete units;

b. a plurality of uniformly spaced and circularly arranged metering trap chambers formed in said peripheral body portion of said drum for rotation as an integral filling structure around a central horizontal axis, each chamber having a hollow housing formed with said peripheral body portion and a helical screw member having its axis oriented parallel to said central axis and fixed within said housing, each said chamber providing an open elongated fluid material flow path formed by said screw member and extending between an inlet communicating with the interior of said drum and an outlet laterally displaced along said flow path, said screw member being dimensioned to measure said unit;

c. means for rotating said filling structure at a uniform predetermined speed and in a constant direction around said central axis, each chamber being adapted on each rotation and at said speed to communicate its respective inlet with the interior of said drum at a first rotative station, to receive a portion of said fluid material into said flow path, to discharge through said inlet as said chamber rotates away from said first station all except a quantity equal to one unit of said material, and to guide said unit along said flow path towards said outlet under the influence of the rotative forces asserted thereon as said chamber rotates at said speed towards a second rotative station whereby said unit is discharged from said outlet during passage of said chamber past said second station;

d. a storage receptacle containing a volume of said material;

e. conveyor means arranged to convey said material from said receptacle to said drum along a conveying path which conveying path at the drum receiving end includes horizontal screw conveyor means comprising a helical conveyor screw surrounding a hollow hub and adapted for rotation independent of said drum around said central axis and communicating at its discharge end with said drum interior and at its intake end with said storage receptacle; and

f. leveling means independently controlling said conveyor means including said horizontal screw conveyor means whereby said conveyor means may operate independently of said drum and being effective to operate said conveyor means intermittently as required to maintain a predetermined

level of material in said container, said leveling means including a shaft mounted for rotation independent of, within and extending the length of said hub, said shaft having one forward end extending into said drum interior and having mounted thereon a rotatable sensing member for contacting and sensing the level of said material and controlling the rotative position of said shaft according to such level, said shaft having a rearward end mounting switch actuating means controlled by the rotative position of said shaft, and electric drive means controlled by said switch-actuating means for simultaneously driving said screw conveyor means during those times when said sensing member rotates within some predetermined angular range corresponding to a deplenished supply of material in said drum.

4. An apparatus as claimed in claim **3** wherein said storage receptacle is located below and stores said material below the level of said horizontal screw conveyor means and said conveyor means comprises in addition to said horizontal screw conveyor means an operatively associated additional screw conveyor means communicating at one lower end with the material in said storage receptacle and the other end with the intake end of said horizontal screw conveyor means, and said leveling means simultaneously controls both said horizontal and additional screw conveyor means independently of said drum.

5. An apparatus as claimed in claim **3** and including at a packet opening position located proximate and above said second station a packet opening means, said opening means comprising a pair of spaced blocks providing opposed surfaces between which the unsealed top edge portions of said packet may be drawn, said surfaces having a plurality of openings adapted to discharge air and produce an air suction effect proximate said opposed surfaces and surrounding said top edge portions and means to convey pressurized air to said surfaces for discharge through said surface openings to cause said edge portions to be sucked outwardly toward said opposed surfaces and said packets opened for filling prior to said second station.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,923,084 Dated December 2, 1975

Inventor(s) Ernest L. Matthews and Ralph E. Matthews

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 6, line 32, "time" should be --timed--

Col. 15, line 52 "container" should be --drum--

Col. 17, line 1, "container" should be --drum--

Signed and Sealed this

twenty-seventh Day of *April 1976*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks