

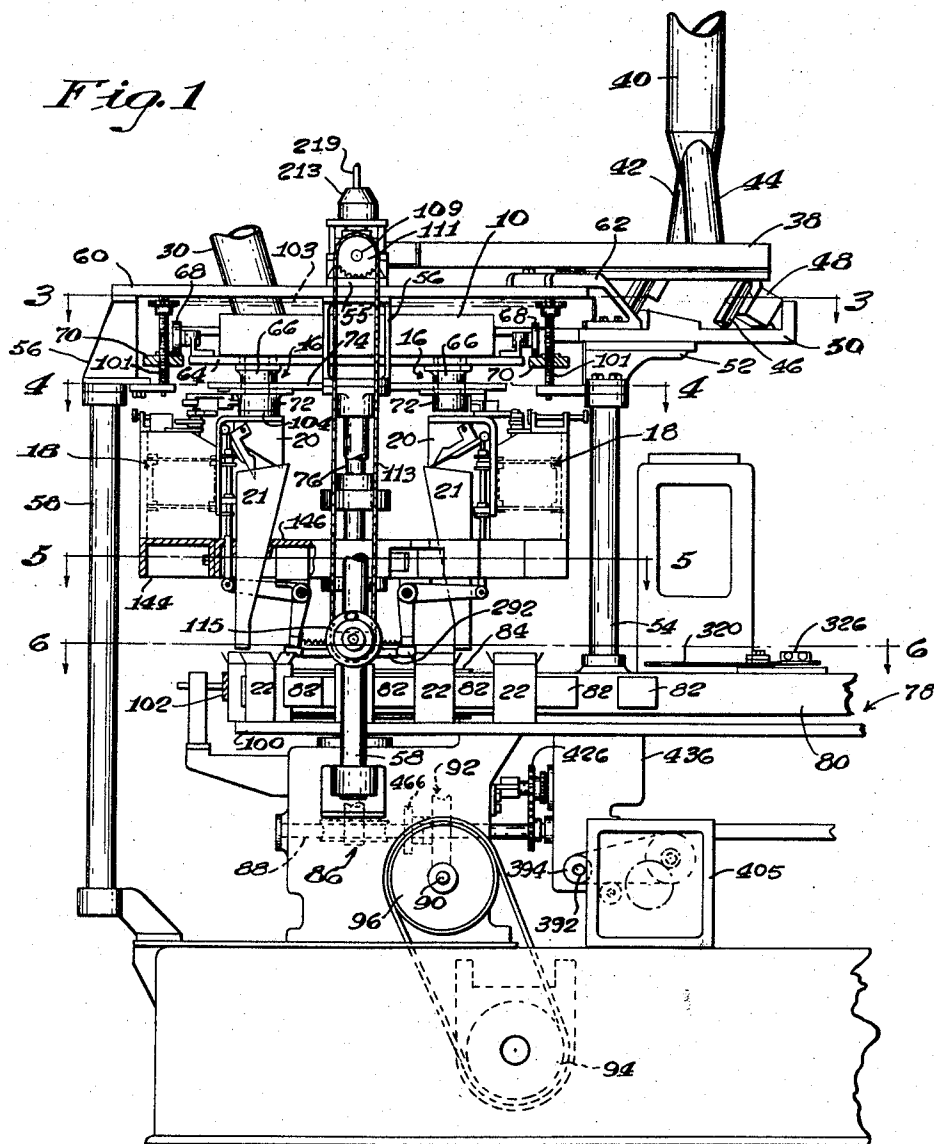
Jan. 13, 1959

T. P. HOWARD
PACKAGING MACHINE

2,868,375

Filed Dec. 9, 1954

15 Sheets-Sheet 1



INVENTOR.
Thomas P. Howard
BY
J. Stanley Churchill.
ATTORNEY

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Fig. 2

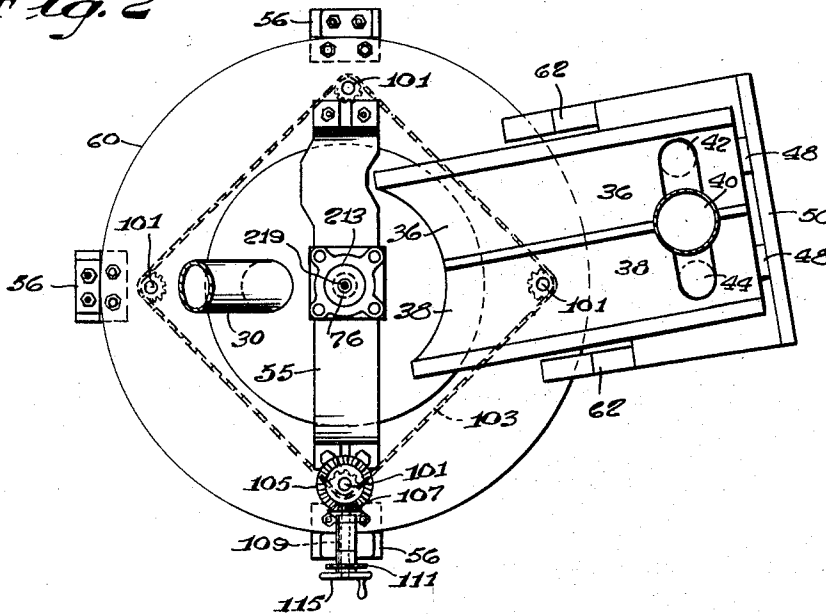
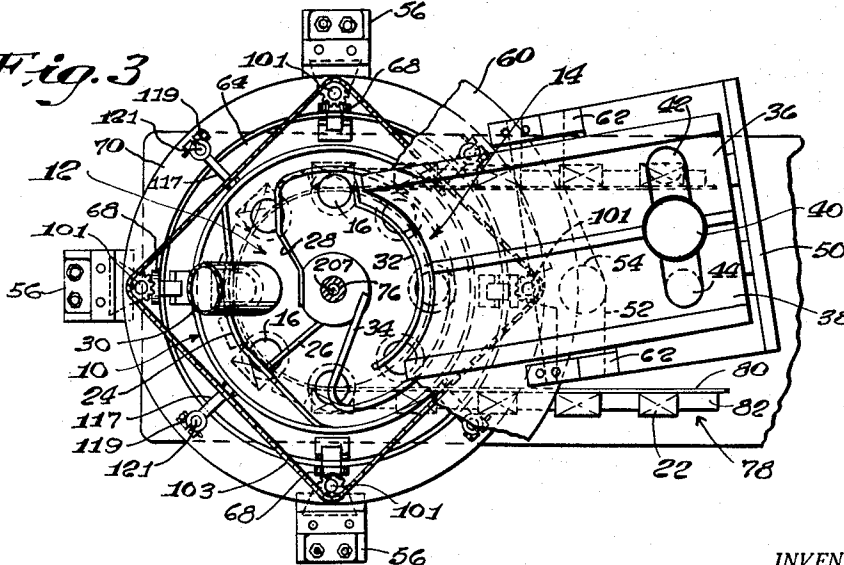


Fig. 3



INVENTOR.

Thomas P. Howard

BY

J. Stanley Churchill.

ATTORNEY

Jan. 13, 1959

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Fig. 5

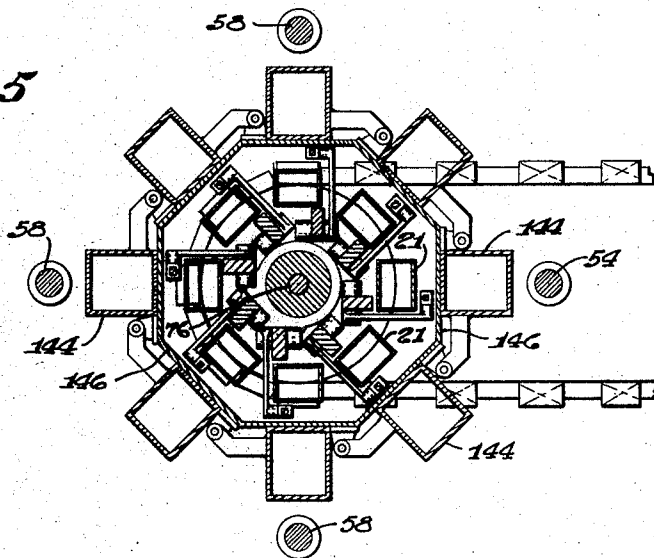


Fig. 4

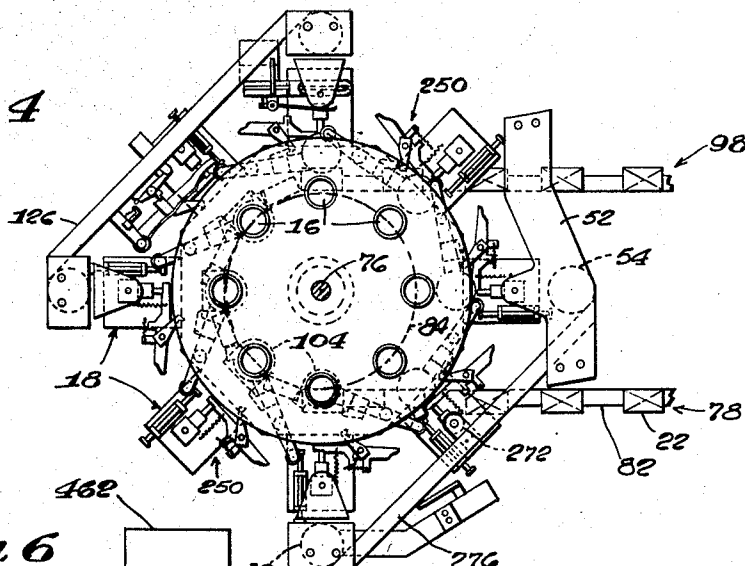
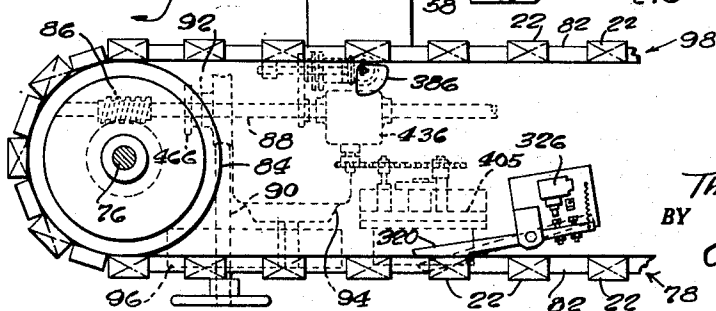


Fig. 6



INVENTOR.
Thomas P. Howard
BY *J. Stanley Churchill*
ATTORNEY

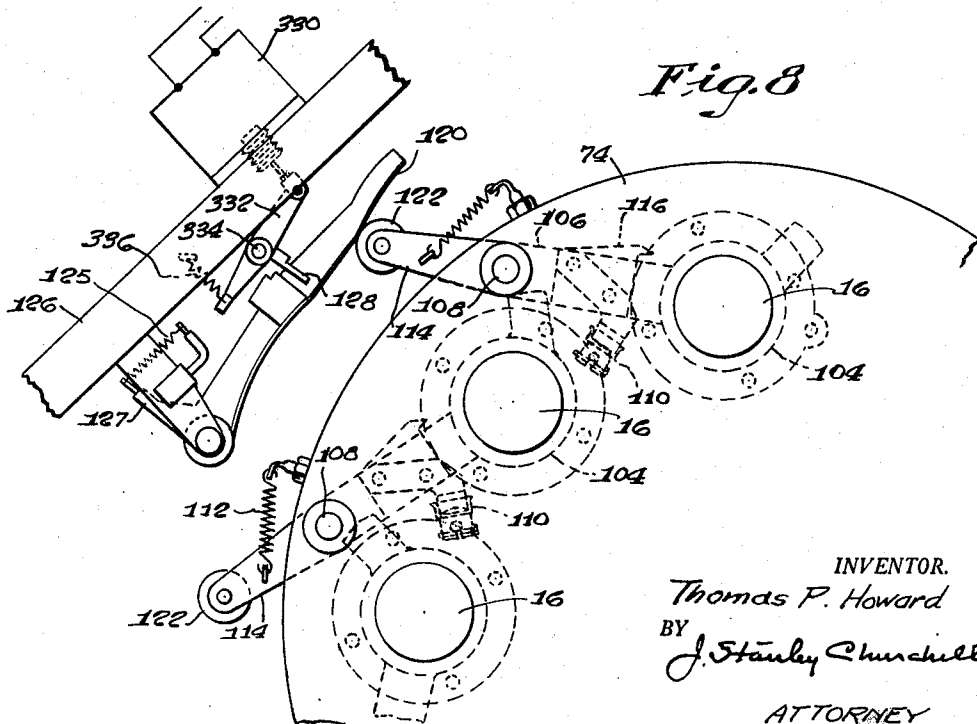
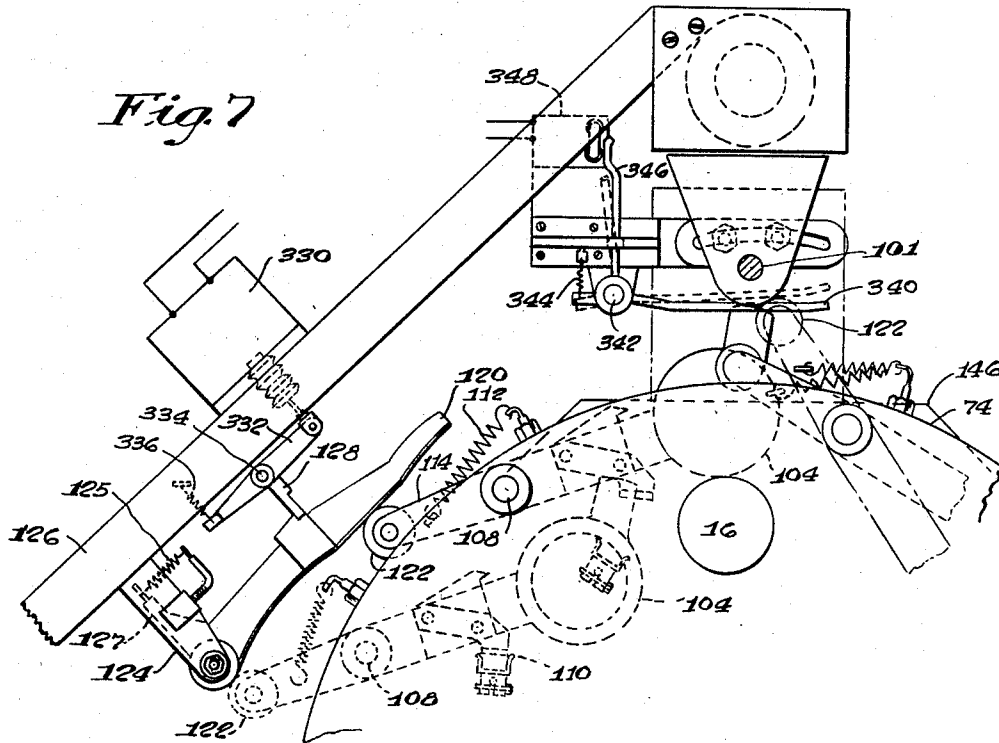
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INVENTOR.
Thomas P. Howard
BY
J. Stanley Churchill.
ATTORNEY

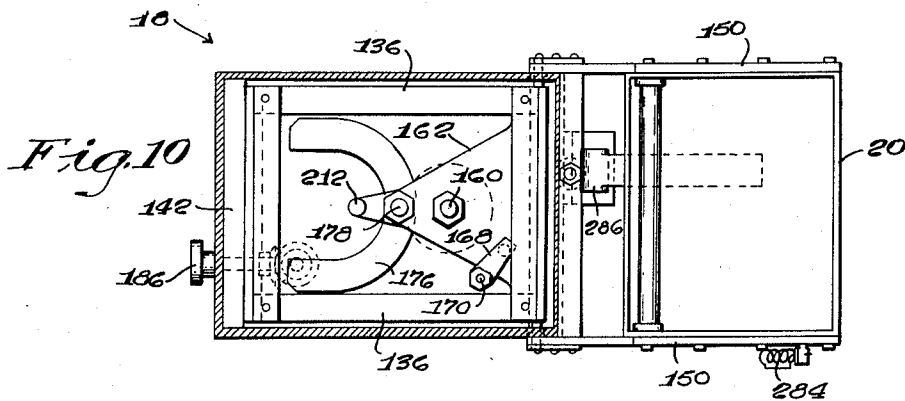
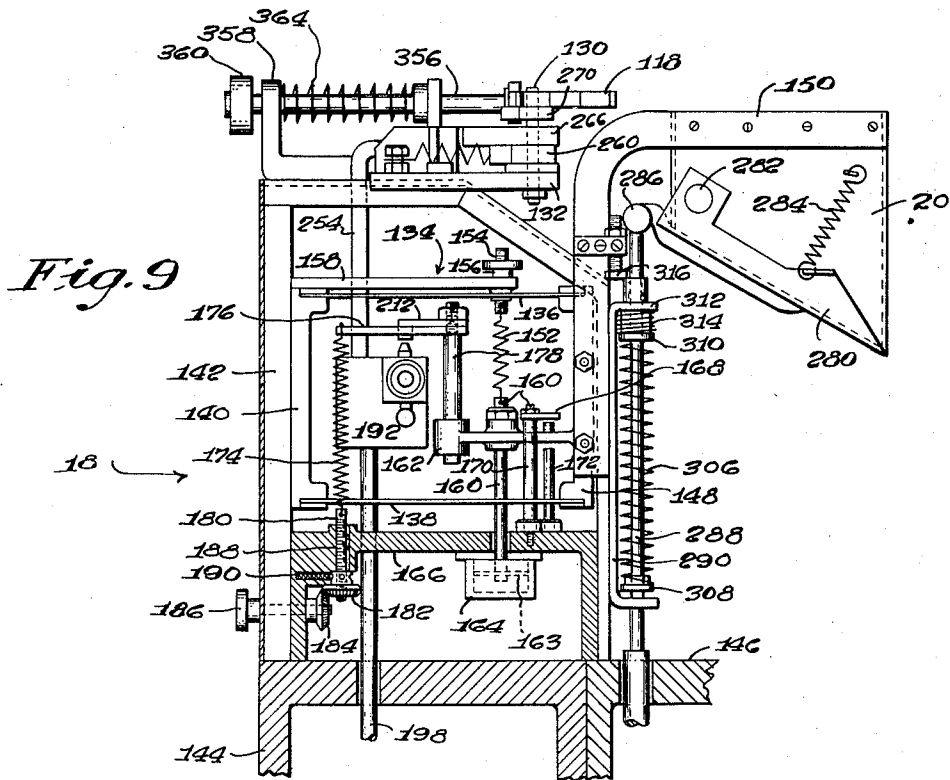
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INVENTOR.
Thomas P. Howard
BY *J. Stanley Churchill*
ATTORNEY

Jan. 13, 1959

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Fig.14

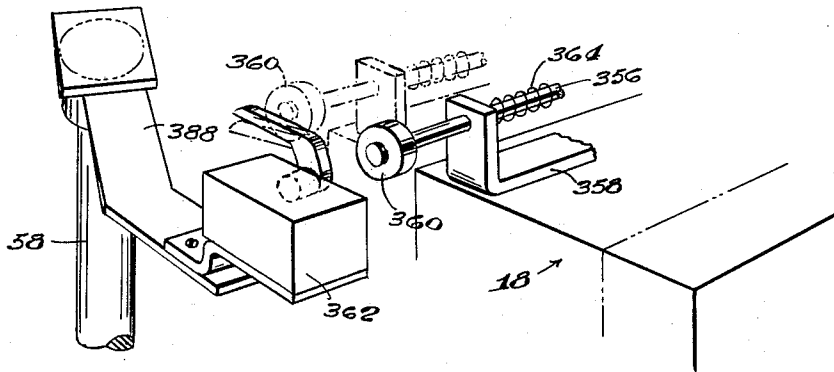
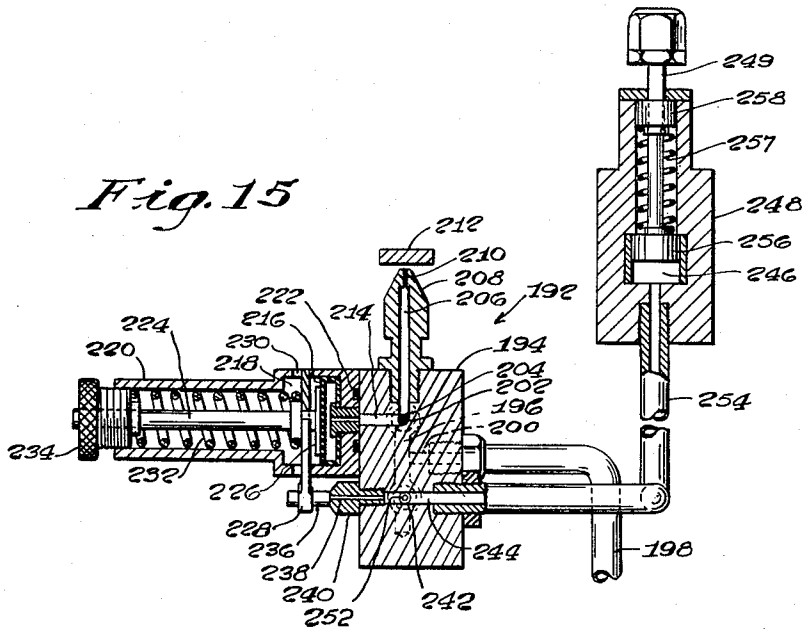


Fig. 15



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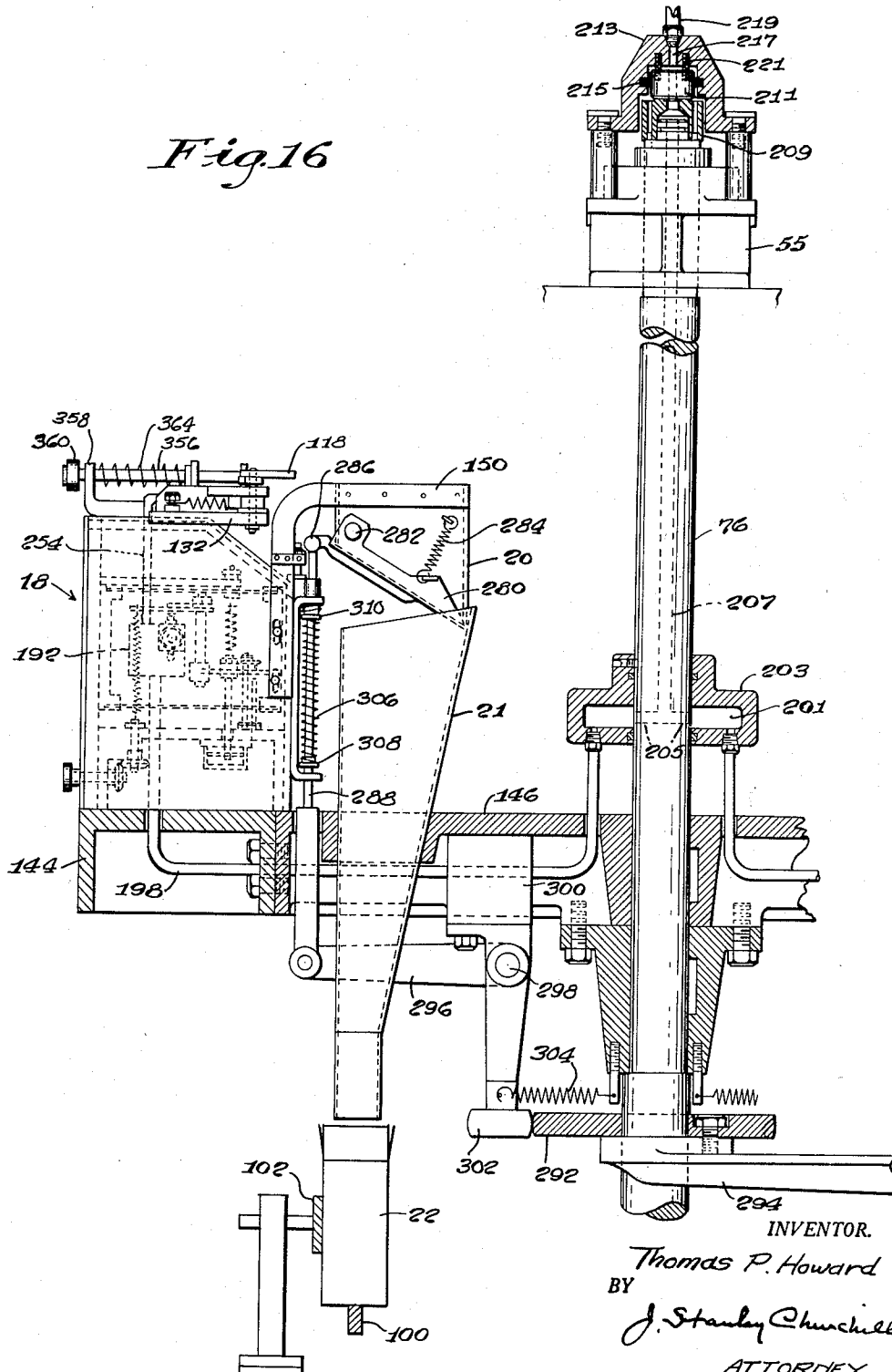
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Fig.16



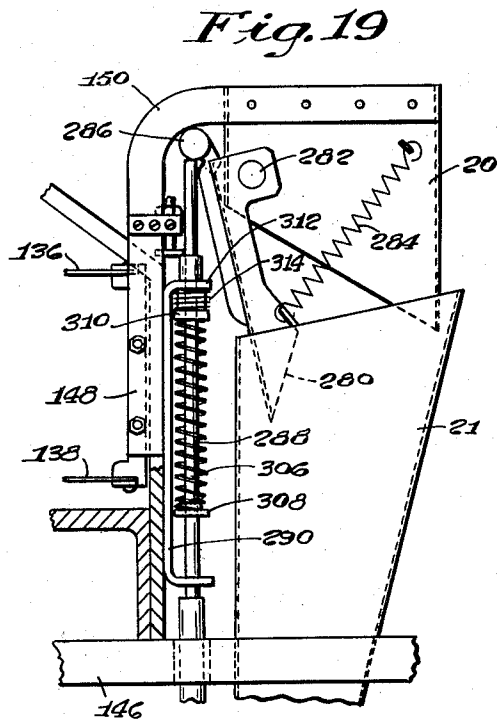
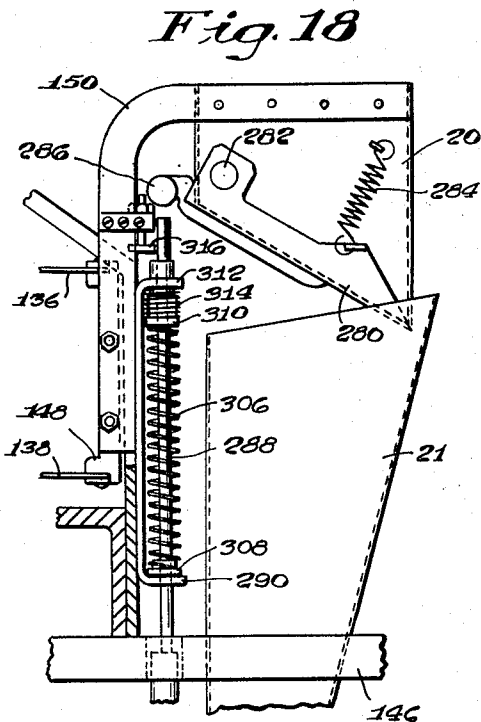
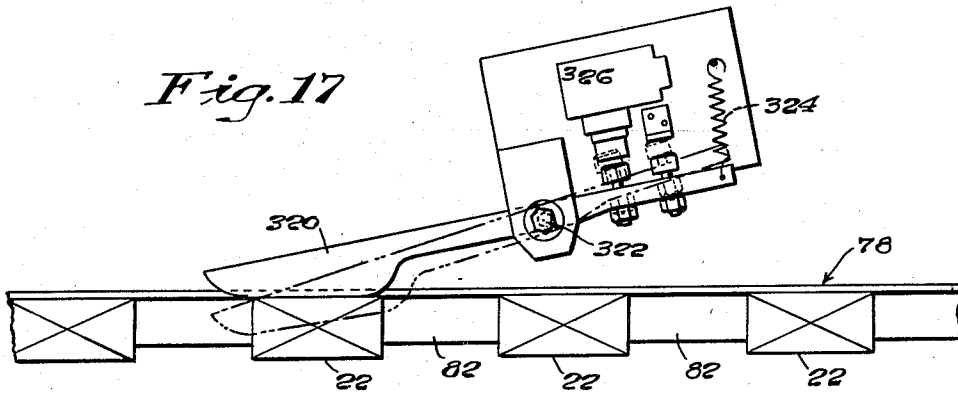
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INVENTOR.
Thomas P. Howard
BY
J. Stanley Churchill.
ATTORNEY

Jan. 13, 1959

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Fig. 20

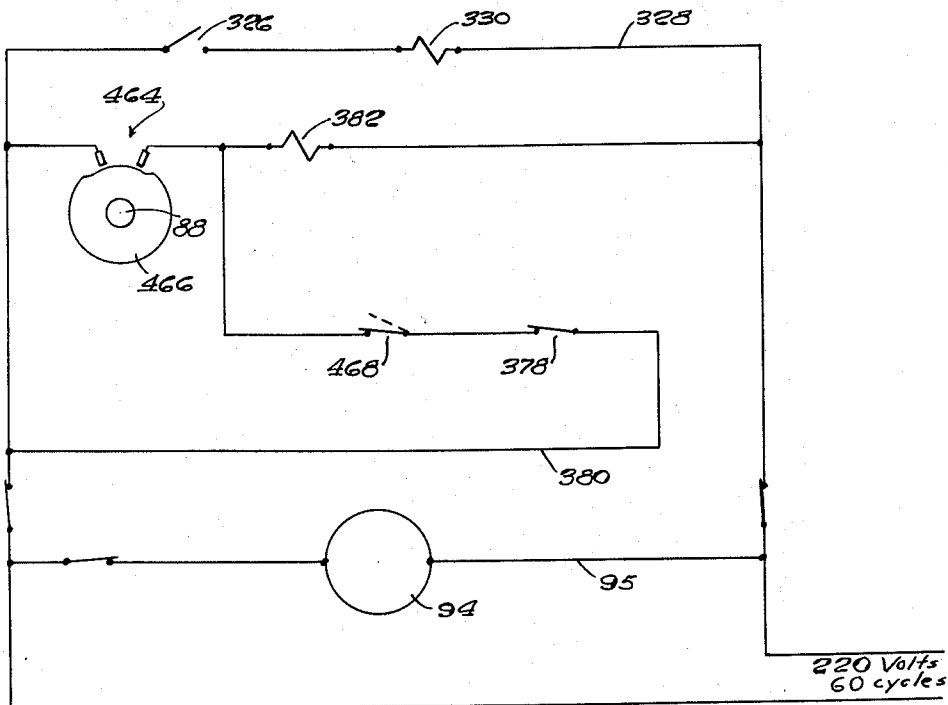
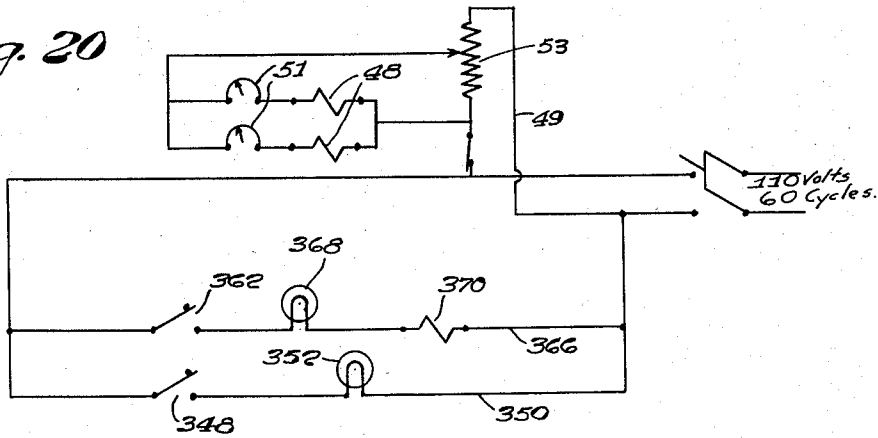


Fig. 21

INVENTOR.
Thomas P. Howard
BY
J. Stanley Churchill
ATTORNEY

Jan. 13, 1959

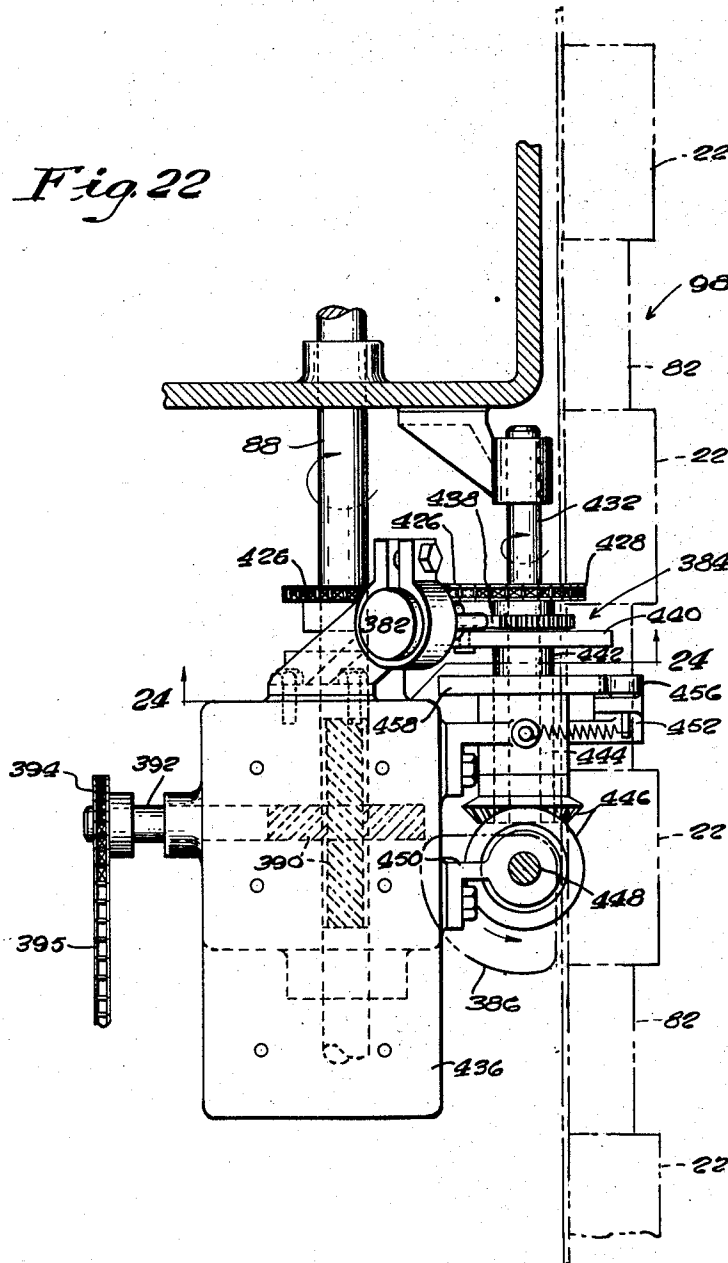
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Fig 22



INVENTOR.
Thomas P. Howard
BY *J. Stanley Churchill*
ATTORNEY

Jan. 13, 1959

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Fig. 23

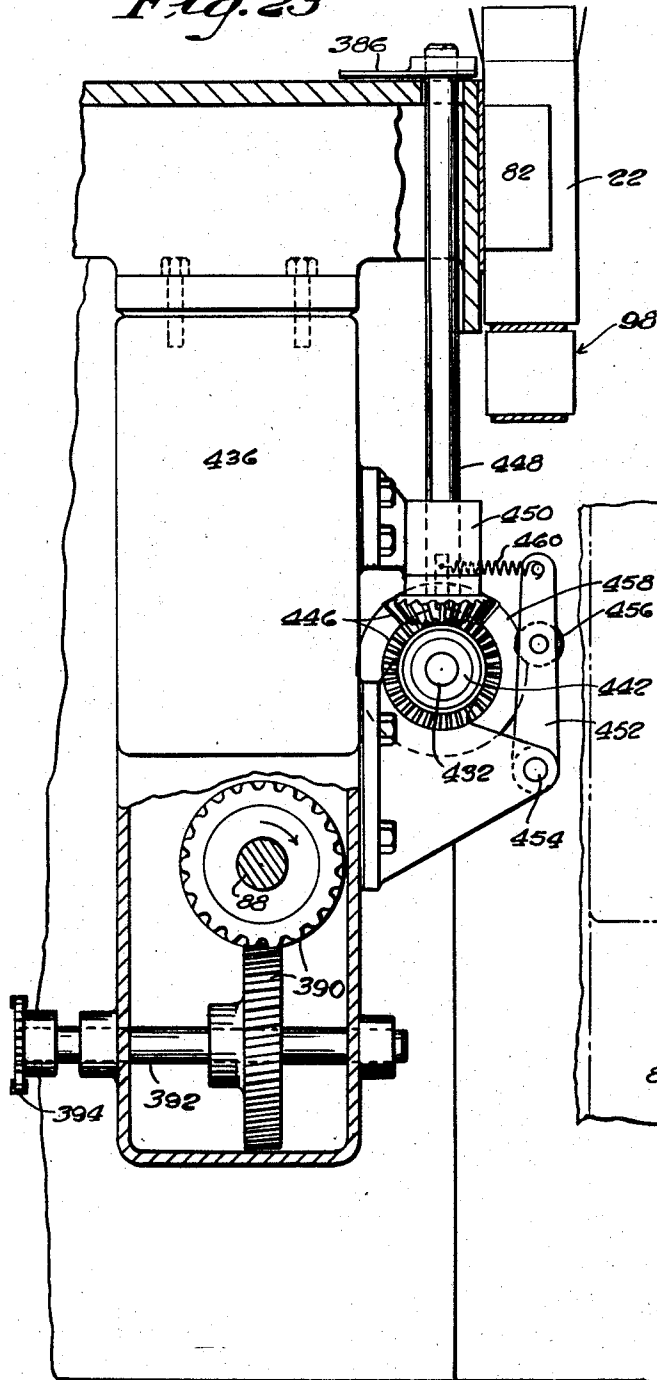
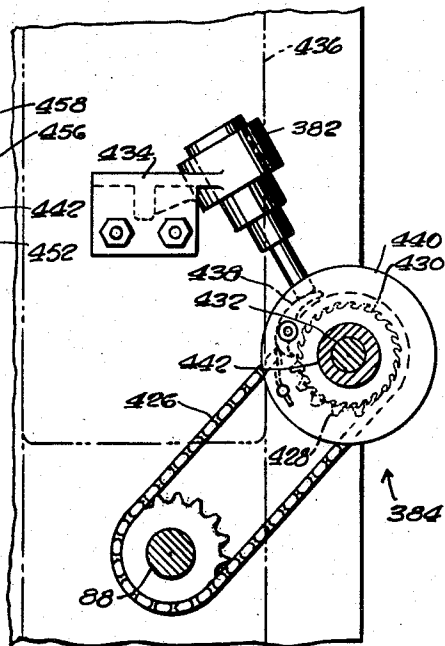


Fig. 24



INVENTOR.
Thomas P. Howard
BY
J. Stanley Churchill
ATTORNEY

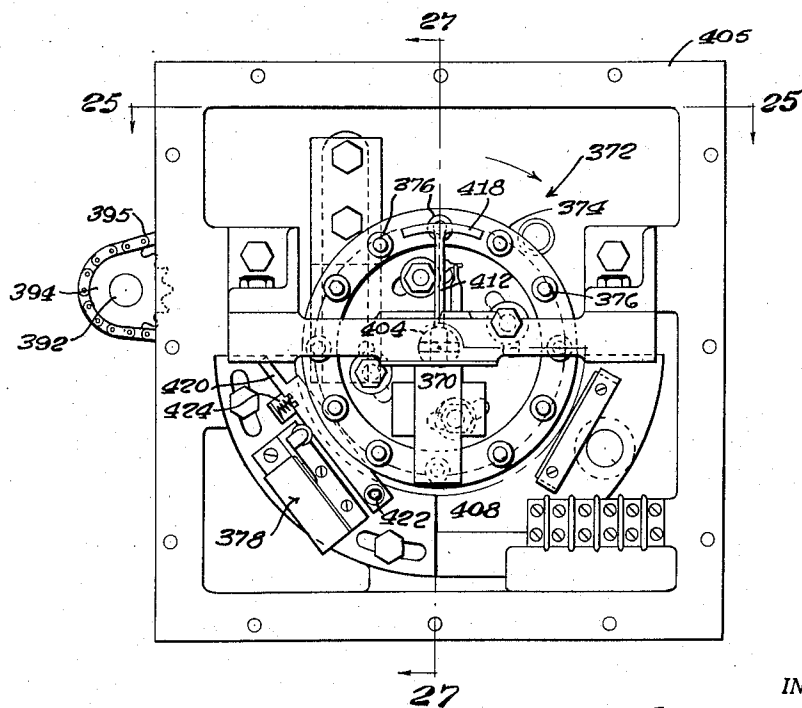
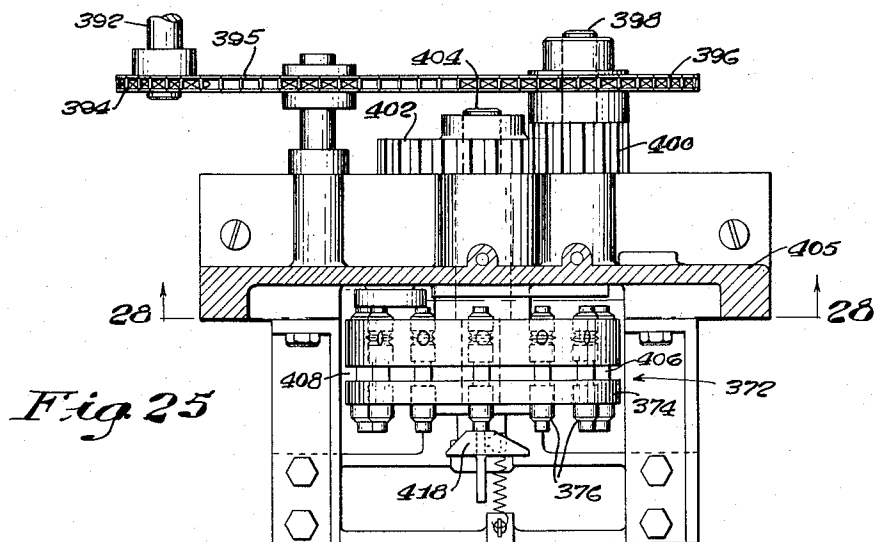
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PACKAGING MACHINE

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INVENTOR.

Thomas P. Howard
BY

J. Stanley Churchill,

ATTORNEY

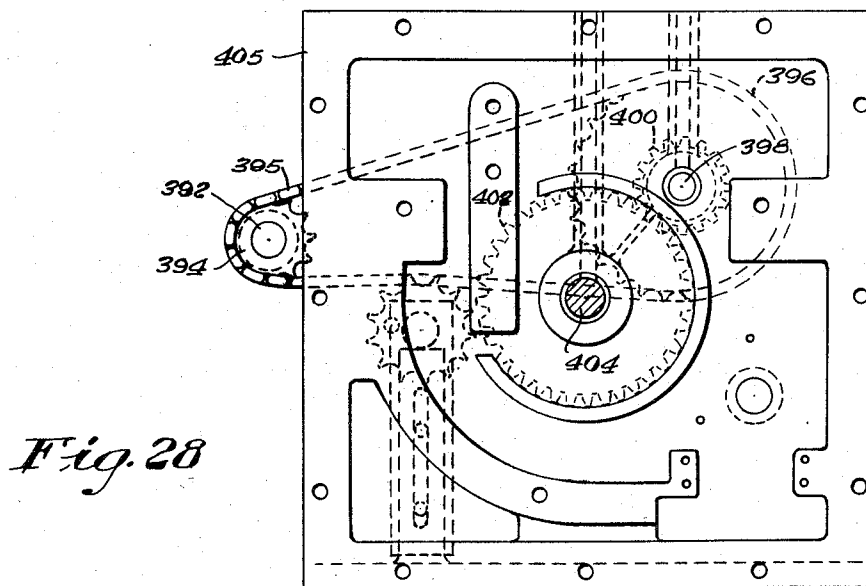
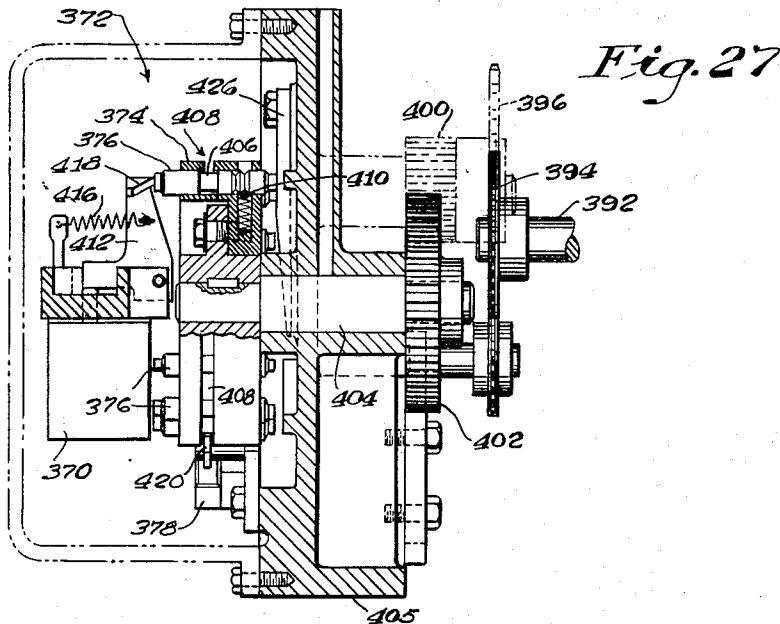
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PACKAGING MACHINE

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INVENTOR.
Thomas P. Howard
BY
J. Stanley Churchill.
ATTORNEY

Jan. 13, 1959

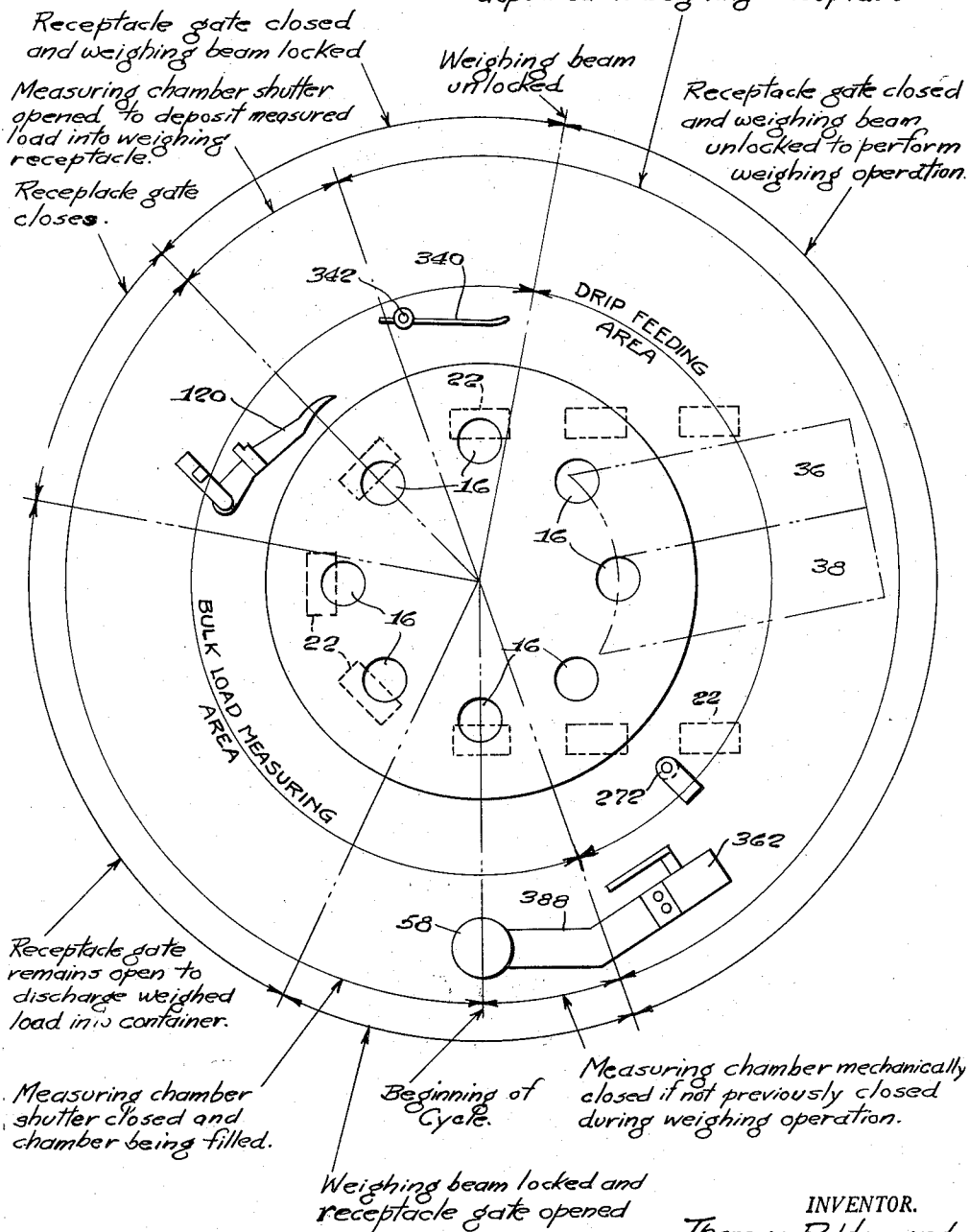
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Fig. 29



INVENTOR.
Thomas P. Howard
BY
J. Stanley Churchill
ATTORNEY

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PACKAGING MACHINE

Thomas P. Howard, Milton, Mass., assignor to Pneumatic Scale Corporation, Limited, Quincy, Mass., a corporation of Massachusetts

Application December 9, 1954, Serial No. 474,170

8 Claims. (Cl. 209—121)

This invention relates to a packaging machine and more particularly to a weighing machine.

In its broader aspects the invention has for an object to provide a weighing machine having a plurality of continuously moving weighing units for forming successive accurately weighed loads and wherein provision is made for first forming a plurality of measured bulk loads and delivering the same to the load receiving members of successive weighing units and for thereafter delivering a drip stream to the continuously moving weighing units to complete the weighed loads.

The invention has for a further object to provide a novel and improved packaging machine provided with a plurality of continuously moving weighing units arranged to deliver successive weighed loads into successive containers moved along therewith and wherein a plurality of measured bulk loads are first formed by continuously moving measuring chambers and delivered to the weighing units and, thereafter a drip stream is delivered to the weighing units whereby to form successive accurately weighed loads in a rapid and efficient manner.

With these general objects in view and such others as may hereinafter appear, the invention consists in the packaging machine and in the various structures, arrangements and combinations of parts hereinafter described and particularly defined in the claims at the end of this specification.

In the drawings illustrating the preferred embodiment of the invention:

Fig. 1 is a side elevation of the present packaging machine;

Fig. 2 is a plan view of the upper portion of the machine;

Fig. 3 is a cross sectional plan view, as seen from the line 3—3 of Fig. 1;

Figs. 4, 5 and 6 are cross sectional plan views taken on the lines 4—4, 5—5 and 6—6 respectively of Fig. 1;

Fig. 7 is a plan view detail of shutter opening mechanism and control means for preventing opening of the shutter in the event no container is present, and also illustrating an overweight detecting switch;

Fig. 8 is a similar view showing the parts in a different position of operation;

Fig. 9 is a side elevation, partly in cross section, of one of the weighing units embodied in the present machine;

Fig. 10 is a plan view partly in cross section of the same;

Fig. 11 is a detail plan view of the shutter latching mechanism showing the shutter in its open or latched position and also illustrating pneumatically operated control mechanism for unlatching the shutter;

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Fig. 12 is a similar view showing the shutter in its closed or unlatched position;

Fig. 13 is a plan view detail of auxiliary means for unlatching the shutter to assure closing of the shutter at the start of a new cycle of operation;

Fig. 14 is a perspective view of an underweight detecting switch;

Fig. 15 is a cross sectional view of pneumatically operated control mechanism associated with the weighing units;

Fig. 16 is a cross sectional view of a portion of the machine including the central rotating shaft and illustrating the vacuum supply lines through the shaft to the several weighing units;

Fig. 17 is a plan view detail of a container engaging switch for detecting the absence of a container in the line;

Fig. 18 is a side elevation of the weighing receptacle and associated mechanism for opening the same;

Fig. 19 is a similar view showing the parts in a different position of operation;

Fig. 20 is a wiring diagram of a 110 v. circuit which includes signal lamps for indicating an underweight and an overweight container.

Fig. 21 is a wiring diagram of a 220 v. circuit which includes control means for the container rejecting mechanism;

Fig. 22 is a plan view of the container rejecting mechanism as seen from the line 22—22 of Fig. 23;

Fig. 23 is a side elevation, partly in cross section of the container rejecting mechanism;

Fig. 24 is a detail view in side elevation of a one-revolution clutch mechanism for driving the rejecting mechanism, as seen from the line 24—24 of Fig. 22;

Fig. 25 is a plan view, as seen from the line 25—25 of Fig. 26 of control mechanism responsive to detection of an underweight container for actuating the container rejecting mechanism;

Fig. 26 is a front elevation of the control mechanism shown in Fig. 25;

Fig. 27 is a side elevation in cross section as seen from the line 27—27 of Fig. 26;

Fig. 28 is a front elevation of the drives to the control mechanism as seen from the line 28—28 of Fig. 25; and

Fig. 29 is a timing chart indicating the sequence of operations in forming, weighing and delivering successive loads into their respective containers.

In general the present invention contemplates a novel packaging machine and more particularly a weighing machine having a plurality of continuously moving weighing units for forming successive accurately weighed loads and wherein provision is made for first forming a plurality of measured bulk loads and delivering the same to the load receiving members of successive weighing units and for thereafter delivering a drip stream to the continuously moving weighing units to complete the weighed loads.

The invention is herein illustrated as embodied in a rotary machine of the general type shown and described in the United States patent to Stanley R. Howard, No. 2,678,185, issued May 11, 1954, wherein a plurality of measured loads are formed and delivered into successive containers during the continuous operation of the machine, and in accordance with the present invention a weighing unit is associated with each measuring chamber to receive a measured primary or bulk load therefrom, the final or drip load being thereafter delivered directly into the weigh-

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ing units to complete the weighed loads which are subsequently released into the containers.

In the illustrated embodiment of the invention a generally circular non-rotating feed hopper 10 may and preferably will be divided to provide a bulk load delivery portion 12 and a drip load delivery portion 14 for cooperation with rotary measuring chambers 16 and weighing units 18. In general in the operation of the machine the bulk loads formed in successive measuring chambers are formed and delivered into the receptacles 20 of corresponding weighing units 18 during a portion of one cycle or rotation of the rotary units, and the drip loads in the form of a continuously flowing uniform stream of material are delivered through the open measuring chambers and directly into the weighing receptacles during another portion of said one cycle of rotation. During the succeeding cycle of operation the weighing receptacles are opened to discharge their weighed loads through guide funnels 21 and into successive containers 22, and simultaneously therewith the measured bulk loads for the succeeding weighed loads are being formed to be delivered into the weighing receptacles after they have discharged their previously weighed loads and have been again closed. Thus, in operation after the initial cycle of operation to form the first weighed loads, successive weighed loads are discharged into successive containers 22 during the continuous operation of the machine. The weighing units 18 may and preferably will include cantilever spring weighing beams cooperating with pneumatic pressure responsive control units capable of rapid and accurate weighing performance during the continuous movement of the weighing units.

In general provision is made in the preferred embodiment of the invention for detecting an overweight load and for actuating a signal to apprise the operator of this condition to be corrected. Provision is also made for detecting an underweight load, and rejecting mechanism responsive to the detector is arranged to subsequently reject a container which has received such underweight load. Provision is also made for detecting the absence of a container 22 in the line of containers being conveyed into operative relation to their respective weighing units, and control means responsive to such detection is arranged to prevent release of material to the corresponding weighing unit when no container is present to receive the load.

Referring now to Figs. 1 and 3, it will be observed that the bulk load forming portion 12 of the non-rotary hopper 10 is defined by partition members, 24, 26, 28 and may be supplied with material by gravity through a supply pipe 30. The drip feeding portion 14 of the hopper is defined by partition members 32, 34 and may be provided with material by one or more vibratory feeders 36, 38 arranged to receive the material by gravity through a supply pipe 40 and branch pipes 42, 44 respectively. The vibratory feeders 36, 38 may be of the type capable of feeding a substantially uniform stream of material at a constant rate of speed, and as herein shown, may comprise horizontally extended troughs supported by thin metal straps 46, and each trough is arranged to be vibrated by a vibratory motor 48 secured to a bracket 50 which in turn is attached to a tie piece 52 supported on the upper end of a vertical post 54 extended from the machine frame. The upper stationary structure also includes brackets 56 supported on similar upright posts 58 and which support an upper annular plate 60, a bracket 62 being connected between the plate 60 and the bracket 50. A bracket 55 is also mounted on the upper plate 60. As illustrated in Fig. 20, the vibratory motor 48 may be included in a circuit 49 which may include the usual rheostats 51 and variable transformer 53.

As herein shown, the measuring chambers 16 are carried by a rotary member or disk 64 and may comprise telescopically adjustable chambers equally spaced in a circle and mounted to revolve beneath the hopper 10, the rotary member forming the bottom of the hopper. The upper

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portion of each telescopically adjustable chamber 16 may comprise a flanged tube 66 depending from the rotary disk 64, and the latter may be provided with a plurality of rollers 68 arranged to ride on and be supported by a vertically adjustable supporting ring 70. The lower portion of each measuring chamber 16 may comprise a corresponding tube 72 telescopically fitted about the upper tube 66 and supported in a rotary disk 74 secured to a continuously rotated central shaft 76, the telescoping connection imparting rotary movement to the upper portions of the chambers 66 during the operation of the machine.

The containers 22 may be delivered to the machine along a conveyer 78 by an upstanding flexible metal belt 80 having a series of spaced blocks 82 attached thereto and between which the cartons are engaged. The belt 80 is arranged to cooperate with a driving pulley 84 fast on the central shaft 76 and is arranged to register successive containers in alignment with their respective weighing units. The central shaft 76 may be driven through a worm gear drive 86 connected to a shaft 88 which in turn may be connected to a drive shaft 90 through a second worm gear drive 92. The drive shaft 90 may be driven by an electric motor 94 belted to a pulley 96 fast on the shaft 90. The motor 94 may be included in a circuit 95 as shown in the wiring diagram, see Fig. 21. In the operation of the machine the containers may be delivered along the conveyer 78 from a supply thereof, and successive containers are arranged to come into alignment with successive weighing units at the point of tangency with the semicircular path through which the containers are guided in the machine, the containers remaining in alignment with their respective weighing units through 180° and then being delivered from the machine on a discharge conveyer 98. The containers may be guided through the semicircular path on a bottom supporting rail 100 and by a side rail 102, as shown in Fig. 1.

As herein illustrated, the telescopic measuring chambers 16 may be manually adjusted to vary the volume thereof through connections including a plurality of screws 101 rotatably mounted in the machine frame and arranged to cooperate with threaded portions formed in the supporting ring 70. The screws 101 may be connected to rotate together by a chain and sprocket drive 103, and one of the screws may be provided with a bevel gear 105 arranged to mesh with a bevel gear 107 fast on a shaft 109 mounted for rotation in the machine frame. In operation rotation of the screws in one direction will effect elevation of the upper portion 66 of the measuring chambers to increase the volume, and rotation of the screws in the opposite direction will effect a decrease in the volume. As shown in Figs. 1 and 2, the shaft 109, provided with the bevel gear 107, may be provided with a sprocket 111 forming a part of a chain and sprocket connection 113 to a hand wheel 115 for effecting manual adjustment of the chambers. Thus it will be seen that in operation the supporting ring 70 may be manually raised and lowered, and the upper chambers 66 supported thereby through the roller connections 68 are adjusted vertically to vary the volume. It will also be observed that the hopper 10 is supported from the ring 70 by radially extended studs 117 provided with hubs 119 adjustably clamped to upright rods 121 secured to the supporting ring 70, as shown in Fig. 3, so that during adjustment of the chambers 16 the hopper 10 will be moved along in operative relation thereto.

As herein illustrated, each measuring chamber 16 is provided with a bottom closure valve or shutter 104, and in the operation of the machine successive measuring chambers 16 are filled as they pass under the filling or bulk loading portion 12 of the hopper at which time the bottoms of the hoppers are closed by the shutters 104, the latter being thereafter opened to deposit the bulk loads into successive weighing receptacles 20. As shown in Fig. 11, each shutter 104 may be carried by one arm 106 of a two-armed lever pivotally mounted on a stud 108 fast in

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the rotary disk 74. Each shutter 104 is arranged to be urged into a closed position against a stop 110 by a spring 112 connected to the second arm 114 of the two-armed lever, and each shutter is also provided with a latch 116 arranged to cooperate with a latch member 118 to hold the shutter in an open position. In operation successive shutters 104 are arranged to be opened and latched in their open position at a predetermined point in the cycle of rotation by a cam piece 120 arranged to cooperate with a roller 122 carried by the second arm 114 of each two-armed lever. As shown in Fig. 7, the cam piece 120 is pivotally supported in a bracket 124 secured to a tie piece 126, the cam piece being urged to rock in a clockwise direction by a spring 125 connected to an arm 127 extended from the cam piece. During the normal operation of the machine successive rollers 122 in engagement with the cam piece 120 are arranged to urge the pivotally mounted cam piece 120 against a pivotal stop member 128 which forms a part of a control mechanism to prevent opening of a particular shutter when a container is absent in the line, as will be described. Thus, during the normal operation of the machine, successive shutters 104 will be rocked into an open position by the cam piece 120 as the rollers engage therewith to deposit the measured loads into successive weighing receptacles 20, and the shutters will be held in an open position by the latch member 118 during the passage of the chambers through the drip feeding and weighing portion of the cycle of rotation. The latch member 118 is clamped to a stud 130 carried by a plate 132 extended from each weighing unit 18 and forms a part of the control mechanism arranged to effect release of the shutter to a closed position when a predetermined weight is reached.

Referring now to Figs. 9 and 10 illustrating one of the weighing units 18 disposed beneath each measuring chamber 16, it will be observed that each weighing receptacle 20 is attached to and forms a part of the free end of a cantilever spring beam 134 herein shown as comprising two upper and two lower relatively stiff cantilever leaf springs 136, 138 of equal length, the leaf springs being connected at their inner ends to a rigid fixed member 140 attached to and extended from an upstanding frame member 142 mounted on a base member 144 attached to an octagonal supporting member 146 keyed to and rotatable with the central shaft 76. The other ends of the leaf springs 136, 138 may be secured to a second rigid member 148 to which the weighing receptacle 20 is attached by angle straps 150. The two rigid members 140, 148 together with the leaf springs 136, 138 constitute a four bar linkage so that when a load is placed within the weighing receptacle, the weight thereof results in imparting to the receptacle a straight line motion in a vertical direction so that every particle in the weighing receptacle moves with the same displacement, direction and velocity and so that any particle produces the same spring deflection no matter where it is located in the receptacle. The weighing beam 134 is also provided with a coil spring 152 arranged to exert a counterforce upon the spring beam, the spring 152 being connected at its upper end to a bolt 154 adjustably secured by nuts 156 in a bracket 158 attached to the fixed member 140, as shown in Fig. 9. The lower end of the coil spring 152 may be connected to a rod 160 fast in an arm 162 extending from and integral with the rigid member 148 of the spring beam 134. The rod 160 may extend below the arm 162 and may be provided with a piston 163 operating in oil contained in a dash pot 164 attached to the underside of a bracket 166 mounted on the base member 144. The cantilever spring beam 134 may be adjustably limited in its upward vertical movement by an upper stop plate 168 carried by an upstanding pin 170 attached to the bracket 166, the plate being engageable with a pin extended from the arm 162, and is limited in its downward movement by a lower stop screw 172 secured to the base 166 and engageable with the undersurface of the extended portion 162. In prac-

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tice the coil spring 152 serves to counteract the weight of the weighing receptacle 20 and associated parts which are mounted upon the outer ends of the leaf springs, the coil spring 152 being of such strength as to support nearly all of the weight of the measured load being checked weighed without deflection of the leaf springs so that the deflection of the leaf springs may be proportionate to the deviation in weight above a predetermined minimum weight limit. For example, a load weight of 15 ounces may be used, and weights above 15 ounces will deflect the leaf springs proportionately to the excess above 15 ounces. A second coil spring 174, adapted for fine adjustment of the weighing unit, is connected at its upper end to an arm 176 extended from the upper end of a rod 178 supported in the arm 162, the lower end of the spring 174 being connected to a threaded spring stud 180 cooperating with a bevel gear nut 182 supported in a clearance opening in the base 166. The bevel gear nut 182 is arranged to mesh with a second bevel gear 184 which is arranged to be rotated by a handle 186 to effect manual adjustment of the coil spring 174 to increase or decrease the tension thereof. The threaded stud 180 may be provided with a key 188 slidable in the base opening to prevent rotation of the stud 180, and a spring pressed ball and socket connection, indicated at 190, may be provided to hold the parts in their adjusted position.

In the illustrated embodiment of the invention provision is made for measuring the deflection of the spring beam 134 when depressed by the load being weighed to indicate the weight of the load. In practice the stiff cantilever springs 136, 138 are selected so that the weighing beam has a relatively small deflection value, and sensitive pneumatically operated control means, indicated generally at 192, is arranged to cooperate with the present spring beam for indicating or measuring the relatively small deflection of the spring beam when depressed by the load being weighed. The pneumatically operated unit 192 is constructed so that a large pressure change occurs upon deflection of the spring beam through a minute distance, and in general the deflection of the spring beam is arranged to increase the pressure in the pneumatically operated unit by an amount proportionate to the deflection.

As shown in Fig. 15, the pneumatically operated measuring unit 192 includes a block 194 having a vertical passageway 196 connected to a regulated source of air under pressure by a pipe 198 and passageway 200, the upper end of the vertical passageway communicating with a horizontal chamber 202 through restricted throat portion 204 arranged to offer a substantial resistance to the flow of air therethrough. The chamber 202, which may be designated as the primary air chamber, in turn communicates with a vertical conduit 206 formed in a jet member 208 attached to the block 194, the member 208 having a small discharge orifice 210 arranged to cooperate with a valve member 212 carried by the weighing element to be movable therewith. Normally, the valve member 212 is spaced slightly from the orifice 210, and the construction of the pneumatically operated unit is such that a large pressure change occurs upon minute movement of the valve member 212 toward the orifice 210 when the weighing element is deflected through a correspondingly minute distance. A second horizontal chamber 214, arranged at right angles to the chamber 206, is connected to an expansible bellows 216 supported in a chamber 218 formed in a laterally extended hollow member 220, attached to the block 194. The bellows 216 has a substantial area and is urged outwardly by the air pressure in the primary air chamber. A suitable resilient sealing ring 222 is provided in a recessed portion of the member 220 for engagement with the adjacent face of the block to provide a tight seal. The bellows 216 is arranged to cooperate with a piston rod 224 supported for horizontal reciprocation in the member 220 and having an enlarged head portion 226 engageable with the outer face or end of the

bellows. The rod 224 may be provided with a depending arm 228 fast thereon, the arm extending through upper and lower slots 230 formed in the hollow member 220 for limiting the movement of the rod 224. A spring 232 coiled about the rod 224 and interposed between the arm 228 and an adjustable bearing member 234 supported in the outer end of the hollow member 220 is arranged to normally urge the rod 224 to the right, movement to the left being effected by an increase in pressure in the chamber 218 to inflate or expand the bellows 216 when the valve member 212 is moved toward the discharge orifice 210.

As herein illustrated, the lower end of the arm 228 extends through the member 220 and is provided with a valve 236 for cooperation with the orifice 238 of a second jet member 240 forming a part of and communicating with a secondary air chamber 242. The air chamber 242 communicates through the chamber 244 with a chamber 246 in a hollow member 248 attached to the upper portion of the weighing unit 18, as seen in Fig. 11. The hollow member 248 is provided with a spring pressed rod or plunger 249 for actuating the latch tripping mechanism, indicated generally at 250 in Fig. 11. The lower horizontal chamber 242 communicates with the lower end of the vertical passageway 196 through a restricted throat portion 252, and the chamber 242 communicates with the through passageway 244 arranged at right angles to the chamber 242, one end of the passageway 244 communicating with the orifice 238 in the jet member 240, and the other end of the passageway 244 being connected by a pipe 254 to the chamber 246 of the member 248 and in which the piston 256 of the rod 249 is received. A spring 257 coiled about the rod 249 and interposed between the piston head 256 and a bearing member 258 supported in the hollow member 248 is arranged to normally urge the rod and piston downwardly, and when the jet orifice 238 is closed, as illustrated, the pressure in the chamber 246 is sufficient to retain the piston and rod in its upwardly extended position, as shown.

In operation the valve member 212 carried by the weighing element may be adjusted to normally provide a small space between the valve member 212 and the orifice 210 when the weighing element is in its elevated position, and upon minute deflection of the weighing element under the influence of the load, the valve 212 is moved toward the discharge orifice 210 a minute amount, thereby effecting a substantial pressure rise in the chamber 214 tending to expand the bellows 216 against the pressure of the coil spring 232. When the pressure in the primary air chamber, acting on the bellows, overcomes the spring the secondary valve 236 is thus moved to the left, viewing Fig. 15, to expose the opening 238 in the jet 240, thus reducing the pressure in the chamber 246 and permitting the spring 257 to move the piston rod 249 downwardly to trip the material feed control latch and terminate the feeding of material into the weighing receptacle 20 when a predetermined weight is reached.

As illustrated in Fig. 16, the weighing units 18 are supported on the individual base members 144 secured to the rotary supporting member 146, and the inlet pipe 198 of each pneumatically operated unit 192 is connected to a chamber 201 formed in a hollow member 203 secured to and rotatable with the central shaft 76. The chamber 201 is arranged to communicate with horizontal passageways 205 and a central vertical passageway 207 formed in the continuously rotated central shaft 76. The upper end of the shaft 76 is supported in the bracket 55 and is provided with a reduced end portion extended into a hollow member 209 secured to and rotatable with the shaft 76. The upper end of the central passageway 207 opens into a chamber formed in the hollow member 209, the chamber being in airtight engagement with a central opening formed in a stationary bearing member 211 mounted within the hollow portion of a cap member 213 secured to the upper frame structure. A sealing ring

215 carried in a grooved portion formed in the cap member 213 is arranged in airtight relation with the periphery of the bearing member 211, and a passageway 217 formed in the upper end of the cap member 213 is connected by a supply pipe 219 to the source of air, thereby enabling the pneumatically operated units 192 to be supplied with air during the continuous rotation of the weighing units 18 with the shaft 76. As shown in Fig. 16, the bearing member 211 is movable vertically in the cap member 213 relative to the sealing ring 215 and is retained in airtight engagement with the upper surface of the rotating hollow member 209 by compression springs 221 interposed between the underside of the cap member 213 and the top of the bearing member 211.

Referring now to Figs. 11 and 12 illustrating the latch tripping mechanism 250 for terminating the feed of the material when a predetermined weight is reached, it will be observed that the piston rod 249, forming a part of the pneumatically operated pressure responsive control means 192, is arranged to cooperate with the outer end of a latch releasing arm 260 pivotally mounted on the stud 130 and which is adapted to release the shutter 104 to cut off the drip stream passing through the measuring chambers 16 when the predetermined weight is reached. The arm 260 is maintained in engagement with the end of the rod 249 by a spring 262 and is also provided with an adjustable stop screw 264 engageable with an arm 266 clamped to the latch stud 130 to which the latch member 118 is clamped. A spring 268 connected to the arm 266 is arranged to maintain the same in engagement with the stop screw 264 carried by the arm 260. In the normal operation of the machine when the pressure in the member 248 is decreased, as described, to permit the rod 249 to move inwardly, the latch member 118 is rocked in a counterclockwise direction to release the shutter arm 106 and cut off the feed through the chamber 16, as illustrated in Fig. 12.

In the event that insufficient material has been introduced into the weighing receptacle 20 to reach a predetermined weight during the weighing period in the cycle of operation, auxiliary means is provided for mechanically closing the shutters as the weighing units approach the end of the weighing period in order to assure closing of the chambers at the start of a new cycle of operation when the weighing receptacles are opened to discharge their weighed loads into the containers. As illustrated in Fig. 4 and in detail in Fig. 13, this may be accomplished by a second arm 270 clamped to the stud 130 and which is arranged to engage a roller 272 carried by a bracket 274 attached to a tie piece 276. In operation when the arm 270 engages the roller 272 the latch member 118 will be rocked in a counterclockwise direction to effect release of the shutter 104 independently of the pneumatic control unit 192. As will be hereinafter described, provision is made for detecting such underweight load and for subsequently rejecting a container into which such load has been discharged.

From the description thus far and by reference to the timing chart shown in Fig. 29, it will be seen that in the operation of the machine the measuring chambers 16 are closed at the beginning of a cycle of operation and are filled as they pass under the bulk loading area of the hopper 10 whereupon the chambers may be opened to deposit the measured loads into the receptacles 20 of successive weighing units 18. Thereafter, the measuring chambers remain open as they pass under the drip feeding area of the hopper 10, and when a predetermined weight is reached the pneumatic control unit 192 effects closing of the shutter 104 to cut off the drip stream.

Referring now to Fig. 16, it will be observed that each weighing receptacle 20 is provided with a bottom closure gate 280 pivotally mounted at 282 and normally maintained in its closed position by a spring 284. Provision is made for opening the gate 280 of each receptacle at

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the beginning of a cycle of rotation to effect discharge of the weighed load into a container 22, and as herein shown, each gate is provided with a cylindrical extension 286 at its inner end arranged to be engaged by a vertically reciprocable rod 288 slidably supported in a U-shaped bracket 290 carried by each weighing unit. The rod 288 is arranged to be reciprocated by a stationary cam 292 which surrounds the central rotary shaft 76 and is supported in a fixed position by a bracket 294 secured to a fixed portion of the machine. As herein shown, the lower end of the rod 288 is connected to one arm of a bell crank 296 pivotally mounted on a stud 298 carried by a bracket 300 secured to the underside of the bracket 146. The other arm of the bell crank is provided with a roller 302 cooperating with the cam 292, and a spring 304 serves to hold the roller against its cam. The rod 288 is normally urged downwardly as shown in Fig. 18 by a coil spring 306 interposed between a collar 308 fixed on the rod 288, and a loose collar 310 arranged to cooperate with the underside of the upper leg of the U-shaped bracket 290. The cam 292 is arranged to effect elevation of the rod 288 at the beginning of a cycle of operation to open the gate 280, as shown in Fig. 19. Simultaneously with the gate opening operation, provision is made for locking the weighing beam 134. As herein shown, an intermediate shouldered portion of the loosely mounted collar 310 is normally maintained out of engagement with the underside of the upper leg 312 of the U-shaped bracket by a spring 314 interposed between the underside of the leg and a flange formed on the collar 310. As shown in Fig. 18, at this time the upper end of the collar 310 is also maintained out of engagement with the head of a stop screw 316 adjustably carried by the angle strap 150. In operation upon initial elevation of the rod 288, the spring 306 is arranged to overcome the spring 314 so as to move the collar 310 to present the intermediate shoulder in engagement with the underside of the leg 312 at which time the upper end of the collar 310 engages the stop screw 316 to maintain the weighing beam in a locked position. Thereafter, the rod 288 will slide through the collar 310 to engage the cylindrical extension 286 and effect opening of the gate 280.

Thus in the operation of the machine it will be seen that at the start of a cycle of operation the bulk loads for the succeeding weighed loads are being formed in the chambers 16 while the gates 280 of the weighing receptacles are open to discharge the instant weighed loads into the containers, and the gates remain open for a predetermined portion of the cycle whereupon the gates are closed in readiness to receive the bulk loads being formed. It is preferred to maintain the weighing beams 134 in their locked position when the bulk loads are discharged into the closed weighing receptacles, the cam 292 being designed to maintain the rod 288 in an intermediate position, as shown in Figs. 9 and 16, wherein the weighing beam 134 is locked and the gate 280 is closed. As indicated in Fig. 29, immediately after the bulk loads are deposited into the weighing receptacles 20, the weighing beam 134 may be unlocked by the cam 292 to perform the weighing operation, the weighing beam being again locked at the start of a new cycle of operation and the receptacle gates opened to discharge the loads into the containers as described.

The description thus far relates to the normal operation of the machine, and as herein shown, provision is made for detecting the absence of a container in the line being conveyed into the machine and for preventing introduction of material into the weighing receptacle 20 which would normally discharge its load into such container. As illustrated in Fig. 6 and in detail in Fig. 17, a detector arm 320 pivotally mounted at 322 is arranged in the path of the incoming containers on the conveyer 78 and is urged in a counterclockwise direction against the sides of the containers by a spring 324. The

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engaging face of the arm 320 is of sufficient length to straddle the space from the trailing edge of one container to the leading edge of an adjacent container when a continuous supply of containers is advanced so that normally the arm will remain in the full line position shown in Fig. 17. However, in the event a container is absent the arm 320 will be rocked by the spring 324 to the dotted line position to actuate a switch 326 in a circuit 328, see Fig. 21, which also includes a solenoid 330 arranged to trip the pivotal stop member 128 and release the pivotally mounted cam piece 120, as shown in Fig. 8. The solenoid 330 is connected to an arm 332 fast on a stud 334 on which the stop member 128 is mounted, and the stop member is urged into latching relation to the cam piece 120 by a spring 336. Thus in operation, when the solenoid 330 is energized the stop 128 will be rocked in a counterclockwise direction to release the cam piece 120 which will be rocked outwardly by engagement of a cam roll 122 therewith. The cam piece 120 is subsequently rocked inwardly or in a clockwise direction to permit latching engagement with the stop member 128 by the spring 125. As a result of releasing the cam piece 120, as described, the shutter 104 above the receptacle 20 associated therewith will remain closed during the remainder of the cycle of operation so that when the receptacle is opened at the start of a new cycle of operation in alignment with the space normally occupied by the absent container, no material will be discharged therefrom. As shown in Fig. 6, the detector arm 320 is spaced a distance of five containers preceding the point of tangency of the container with the rotary portion of the machine which corresponds to the number of stations between the cam piece 120 and said point of tangency so that the empty receptacle will register with the space normally occupied by the absent container. The previously filled chamber 16 may then again pass through the bulk feeding portion of the cycle and resume normal operation.

Referring now to Figs. 7 and 29, in the event that the weighing beam 134 is stripped immediately after the weighing beam is unlocked so as to effect closing of the shutter 104 before the measuring chamber 16 enters the drip feeding area, such action indicates an overweight load, and provision is made for detecting such condition. As herein shown, a detecting finger 340 pivotally mounted at 342 is arranged to be engaged by the roller 122 of a shutter 104 when the latter is closed at such time, as indicated in dotted lines in Fig. 7. Normally, when the shutter 104 remains open the roller 122 will pass the detecting finger without engaging the same. The detecting finger 340 is urged inwardly by a spring 344 and is provided with an arm 346 arranged to actuate a switch 348 when the detecting finger is rocked outwardly by the roller 122. As shown in Fig. 20, the switch 348 forms part of a circuit 350 which includes a signal lamp 352 to apprise the operator of such abnormal condition so that he may effect manual adjustment of the chambers to reduce the volume, as described.

Provision is made in the preferred embodiment of the invention for detecting an underweight load deposited in a receptacle 20 and for subsequently rejecting the container into which such underweight load has been discharged. As hereinbefore described, in the normal operation of the machine the shutter 104 remains open, as shown in Fig. 11, until a predetermined weight is reached in the receptacle 20 whereupon the shutter 104 is automatically released to cut off the feed of the material into the receptacle, as shown in Fig. 12. It will be observed that the shutter 104 is provided with an extension 354 arranged to engage one end of a spring pressed pin 356 slidably mounted in a bracket 358 movable with and supported on top of each weighing unit 18. The outer end of the pin 356 is provided with a roller 360 arranged to engage and close an underweight detecting switch 362 when the roller is maintained in an

extended position by the open shutter, as shown in Fig. 11, the spring 364 serving to urge the roller inwardly out of the path of the switch 362 when the shutter is closed, as shown in Fig. 12. The switch 362 forms part of a circuit 366, as shown in Fig. 20, which includes a signal lamp 368 and a solenoid 370 which latter is arranged to actuate a timing mechanism, indicated generally at 372, in Figs. 25, 26 and 27.

In general the timing mechanism 372 includes a continuously rotated timing wheel 374 having a plurality of circumferentially spaced pins 376 arranged to cooperate with a switch 378 when moved into switch engaging position by the solenoid 370. The switch 378 forms part of a circuit 380, shown in Fig. 21, which includes a normally energized solenoid 382, as shown in Figs. 22 and 24, the solenoid 382 being arranged to cooperate with a one revolution pawl and ratchet clutch indicated generally at 384. The one revolution clutch forms a part of the driving mechanism to the rejecting mechanism, the rejecting member comprising a rotary segmental member 386 arranged to engage and tip the underweight container off the conveyor 98 as it is being conveyed out of the machine. The one revolution clutch 384 is maintained disengaged by the normally energized solenoid 382, and when the circuit 380 is opened the solenoid 382 is deenergized to permit operative engagement of the one revolution clutch with the driving mechanism.

As illustrated in Figs. 14 and 29, the detecting switch 362 is supported on a bracket 388 extended from an upright column 58 and is disposed at a point near the end of the drip feeding area immediately preceding the start of a new cycle of operation, and the rejecting member 386 is located on the outgoing conveyor 98 a distance of eight containers or stations from the point at the start of a new cycle of operation, see Fig. 6. As shown in Fig. 26, the timing wheel 374 is provided with twelve pins 376, a solenoid actuated pin being spaced eight pins or stations from the switch 378. In operation the timing wheel 374 is continuously driven in timed relation to the continuously moving containers so that when the underweight container has travelled eight stations a solenoid actuated pin 376 will also have travelled eight stations to actuate the rejecting mechanism when the underweight container arrives at the rejecting station.

The timing mechanism 372 is supported in a bracket 405 arranged to be driven in timed relation to the travel on the containers through the machine by connections from the main drive shaft 88 which, as shown in Fig. 23, is connected by helical gears 390 to a shaft 392 provided with a sprocket 394. As shown in Fig. 28, the sprocket 394 is connected by chain 395 to a sprocket 396 fast on a shaft 398 which is provided with a pinion 400, the pinion being in mesh with a gear 402 fast on the shaft 404 to which the timing wheel 374 is keyed.

As illustrated in Fig. 27, the pins 376 are slidably supported in the timing wheel 374, each pin being provided with a reduced diameter portion 406 normally in alignment with a peripheral groove 408 formed in the wheel. Each pin 376 is frictionally retained in such normal position by a spring pressed ball 410 engaging one of two V-grooves formed in the pin, as shown. The solenoid 370 is arranged to cooperate with a bell crank 412 pivotally mounted at 414, the bell crank being rocked in a counterclockwise direction out of operative engagement with the pins 376 by a spring 416. The bell crank is provided with a cam plate 418 also, as shown in Fig. 25, engageable with the outer ends of the pins 376, and in operation when the solenoid 370 is energized the armature of the solenoid engages the tail of the bell crank to rock the cam plate 418 in a clockwise direction to effect shifting of the adjacent pin 376 inwardly into a position to present a larger diameter portion of the pin into alignment with the peripheral groove 408, the pin being maintained in such position by

engagement of the spring pressed ball 410 with the second V-groove formed in the pin, as shown.

As illustrated in Fig. 26, the switch 378 is provided with an arm 420 pivotally mounted at 422 and arranged to operate in the groove 408, one edge of the arm being urged into engagement with the pins 376 by a spring 424. Normally, the arm 420 engages the reduced diameter portions 406 of the pins to maintain the switch in its normally closed position, but when a pin is pressed inwardly the larger diameter portion of the pin presented within the groove will effect rocking of the arm to open the circuit 380 to the one revolution clutch solenoid 382. In practice the pins 376 are reset during the continued rotation of the wheel 374, after they have passed the switch 378, by a stationary cam piece 426 engageable with the inner ends of the pins, as shown in Fig. 27. The switch 378 may be adjustably mounted relative to the pins 376, as shown in Fig. 26.

As shown in Figs. 22 and 23, the rotatable rejecting member 386 is also arranged to be driven from and in timed relation to the rotary weighing machine through connections from the main drive shaft 88 including a chain drive 426 to a sprocket 428 formed integrally with the ratchet 430 of the one revolution clutch 384, the integral sprocket and ratchet being fast on a shaft 432. The solenoid 382 is supported in a bracket 434 attached to the drive housing 436 in operative relation to depress a spring pressed pawl 438 of the one revolution clutch, the pawl being pivotally mounted on a disk 440 forming part of a sleeve 442 rotatably mounted on the shaft 432 and supported in a bearing member 444. The other end of the sleeve 442 is connected by bevel gears 446 to a vertical shaft 448 supported in a bearing bracket 450, the rotary rejecting member 386 being mounted fast at the upper end of the vertical shaft 448. An arm 452 pivotally mounted at 454 is provided with a roller 456 for engagement with an arcuate cutout in a disk 458 carried by the sleeve 442, a spring 460 urging the arm inwardly to engage the roller in the cutout to bring the sleeve to rest at the end of one revolution.

From the description thus far it will be seen that in the operation of the machine when the weighing beam 134 fails to make its weight after passing through the drip feeding area of the weighing cycle the shutter 104 will not automatically be closed by depression of the weighing beam, and as a result the switch engaging roller 360 will be maintained in its outwardly pressed position to engage the underweight detecting switch 362 at the end of the weighing period which closes the circuit 366 to light the signal lamp 368 to apprise the operator of an underweight condition and to also energize the timing device solenoid 370 to depress one of the pins 376 in the timing wheel 374. The shutter 104 is subsequently closed mechanically by the stationary roller 272 engaging the arm 270 in readiness for a succeeding cycle of operation, and during the continued operation of the machine the underweight load contained in the receptacle 20 is discharged into a container 22 at the start of a new cycle of operation. Thereafter, when the underweight container reaches a point adjacent the rejecting station, the pin 376 which was previously pressed inwardly by the solenoid actuated member 418 will have arrived at a point in the rotation of the timing wheel 374 to actuate the switch 378 which opens the circuit to the normally energized solenoid 382 to permit the one revolution clutch 384 to be operatively engaged to rotate the rejecting member 386. The underweight container is preferably engaged at its upper end by the rotary rejecting member to tip the container off the conveyor 98 into a bin 462 or other receptacle placed therebelow.

As illustrated in Fig. 21, in order to effect rotation of the rejecting member 386 at exactly the time the underweight container arrives at the rejecting station a switch 464 having commutator type terminals is arranged to

cooperate with a cam 466 fast on the main cam shaft 88. The switch 464 is also in series with the solenoid 382 and is arranged to maintain the circuit to the solenoid closed to prevent operation of the one revolution clutch 384 except at a predetermined time in each cycle of operation, such time corresponding to the arrival of a container at the rejecting station. As shown in Fig. 21, the cam 466 is provided with a low spot to open the circuit at the switch 464 at such time in the cycle. Thus, the circuit must be opened at both switches 378 and 464 before the solenoid 382 will be deenergized to permit the one revolution clutch to be engaged to rotate the rejecting member 386. A manually operated switch 468 may also be included in the circuit, as shown.

From the above description it will be seen that the present structure of continuously operated weighing machine is capable of weighing successive loads in a rapid and efficient manner and to discharge successive weighed loads, preferably into containers moved along therewith, the measured primary or bulk loads being formed and introduced into the weighing receptacles prior to initiation of the weighing cycle so that only a relatively small amount of material is required to be introduced into the weighing receptacles during the drip feeding period of the cycle to bring the load up to a predetermined weight in a relatively short time. It will also be seen that embodiment of a cantilever type weighing beam capable of accurately indicating variations in weight through a relatively small depressing movement of the beam in combination with a sensitive pressure responsive pneumatically operated control for measuring such relatively small movement of the beam and to effect discontinuance of the feed when a predetermined weight is reached is conducive to rapid and accurate weighing performance.

While the preferred embodiment of the invention has been herein illustrated and described, it will be understood that the invention may be embodied in other forms within the scope of the following claims.

Having thus described the invention, what is claimed is:

1. In a machine of the character described, in combination, a plurality of weighing mechanisms, each having a weighing receptacle provided with a gate and mounted to be continuously moved in a closed path, continuously moving container conveying means, a member mounted for and continuously moved in a corresponding closed path and having a plurality of measuring chambers, each measuring chamber having a shutter closing the bottom thereof, means for filling said chambers to form measured bulk loads of flowable solid material during their movement through one portion of said closed path, means for opening said shutters to deliver successive bulk loads into successive weighing receptacles, means for feeding a drip stream of said material through said open measuring chambers directly into said receptacles during their movement through another portion of said closed path, control means responsive to the operation of successive weighing mechanisms when a predetermined weight is reached for effecting closing of successive shutters, means for opening said gates to discharge successive weighed loads from said receptacles into successive containers during the continuous movement of the weighing mechanisms, container rejecting means, means for detecting an underweight load formed in a receptacle during its travel through said closed path, and control means responsive to said underweight load detecting means for actuating said rejecting means to effect rejection of the container into which said underweight load is discharged.

2. A weighing machine as defined in claim 1 wherein the rejecting means is disposed remote from said closed path and wherein the control means includes a timing device responsive to said detecting means and arranged to actuate the rejecting mechanism when the underweight container arrives at said remote position.

3. A weighing machine as defined in claim 2 wherein the rejecting means includes a rotary rejecting member,

means for rotating said rejecting member including a one-revolution clutch arranged to be actuated by said timing device to permit rotation of said rejecting member when the underweight container arrives at said remote position.

4. A weighing machine as defined in claim 1 wherein the detecting means is actuated by failure of a shutter to close after passing through the drip feeding portion of said closed path.

5. A weighing machine as defined in claim 3 wherein the control means includes an electrical circuit having a switch for detecting an underweight container and a solenoid for setting said timing device when an underweight load is detected, and a second circuit having a switch controlled by said timing device and a solenoid operatively connected with said one-revolution clutch for actuating said rejecting member when the underweight container arrives at said remote position.

6. A weighing machine as defined in claim 1 which operates in successive cycles and wherein the rejecting means is disposed remote from said rotary path, said control means including a timing device responsive to said detecting means and arranged to actuate the rejecting mechanism when the underweight container arrives at said remote position, and cyclical means cooperating with said control means for assuring operation of the rejecting mechanism at a time in a cycle when the underweight container arrives at said remote position.

7. In a machine of the character described, in combination, a plurality of weighing mechanisms, each having a weighing receptacle provided with a gate and mounted to be continuously moved in a closed path, continuously moving container conveying means, a member mounted for continuous movement in a corresponding closed path and having a plurality of measuring chambers, each measuring chamber having a shutter closing the bottom thereof, means for filling said chambers to form measured bulk loads of flowable solid material during their movement through one portion of said closed path, means for opening said shutters to deliver successive bulk loads into successive weighing receptacles, means for feeding a drip stream of said material through said open measuring chambers directly into said receptacles during their movement through another portion of said closed path, control means responsive to the operation of successive weighing mechanisms when a predetermined weight is reached for effecting closing of successive shutters, and means for opening said gates to discharge successive weighed loads from said receptacles into successive containers during the continuous movement of the weighing mechanisms, and means for latching said shutters in their open position, said control means operating to release the latching means when said predetermined weight is reached, and auxiliary means for positively releasing said latching means to effect closing of said shutters near the end of the drip feeding portion of said closed path in the event said predetermined weight is not reached during the movement of the weighing mechanism there-through.

8. In a machine of the character described, in combination, a plurality of weighing mechanisms, each having a weighing receptacle provided with a gate and mounted to be continuously moved in a closed path, continuously moving container conveying means, a member mounted for continuous movement in a corresponding closed path and having a plurality of measuring chambers, each measuring chamber having a shutter closing the bottom thereof, means for filling said chambers to form measured bulk loads of flowable solid material during their movement through one portion of said closed path, means for opening said shutters to deliver successive bulk loads into successive weighing receptacles, means for feeding a drip stream of said material through said open measuring chambers directly into said receptacles during their movement through another portion

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of said closed path, control means responsive to the operation of successive weighing mechanisms when a predetermined weight is reached for effecting closing of successive shutters, and means for opening said gates to discharge successive weighed loads from said receptacles into successive containers during the continuous movement of the weighing mechanisms, means for detecting the absence of a container on said conveying means, and means responsive to said detecting means for rendering the shutter opening means inoperative when a container

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is absent whereby to prevent discharge of material into the receptacle corresponding to said absent container.

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