

July 17, 1956

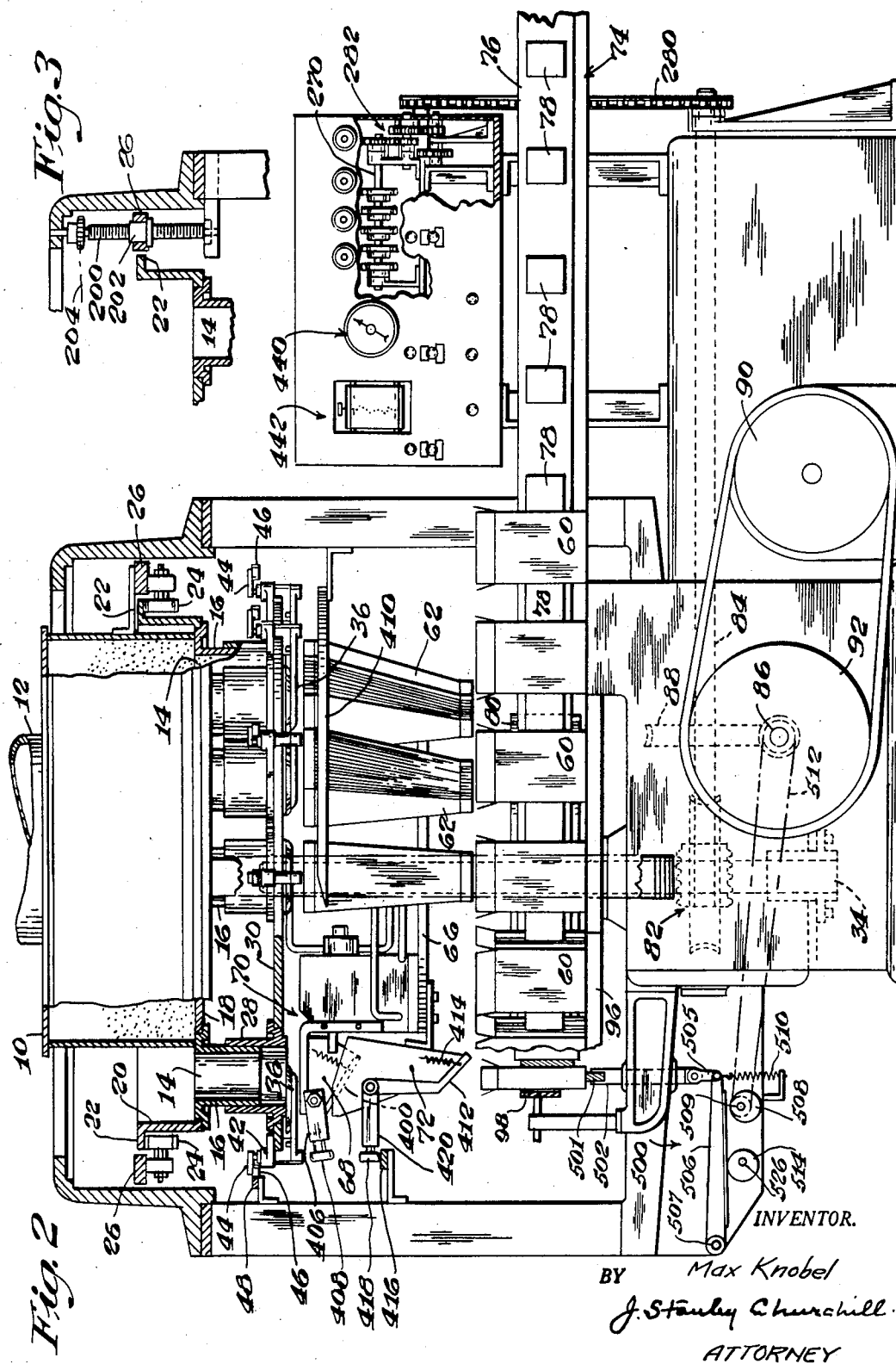
M. KNOBEL

2,755,007

CONTAINER FILLING MACHINE

Filed Nov. 10, 1954

10 Sheets-Sheet 2



July 17, 1956

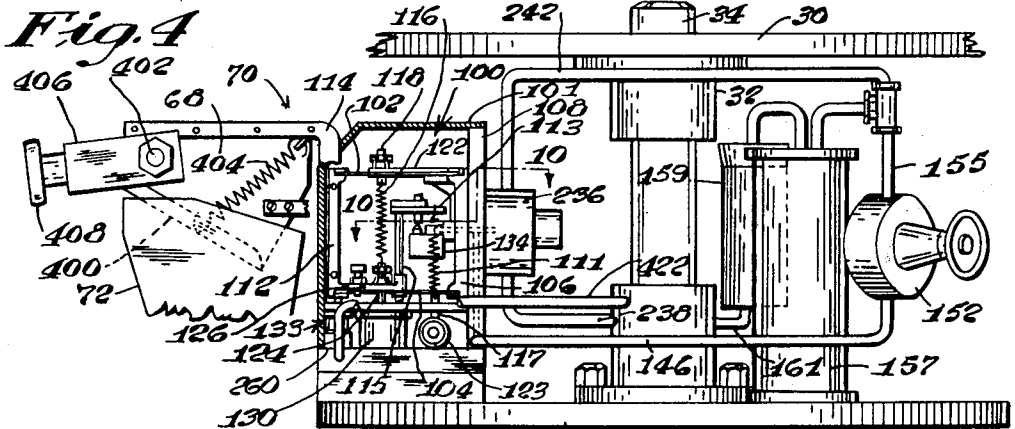
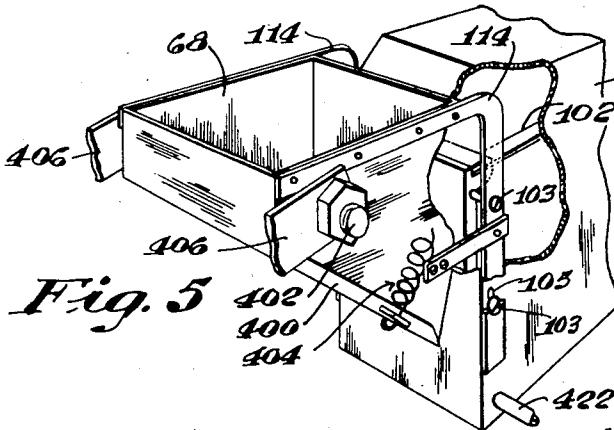
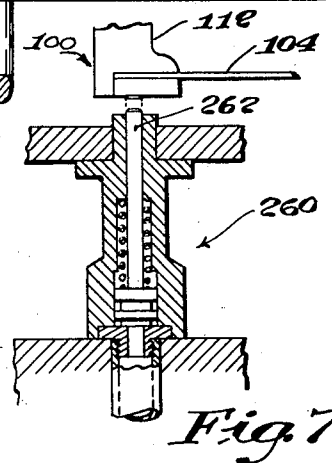
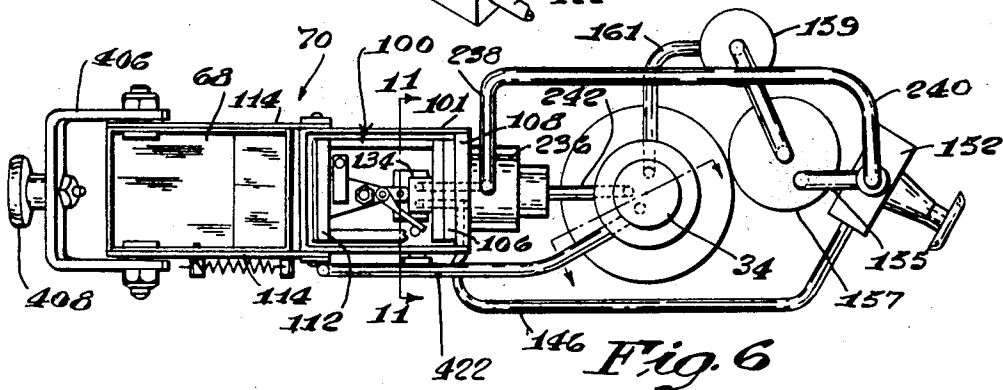
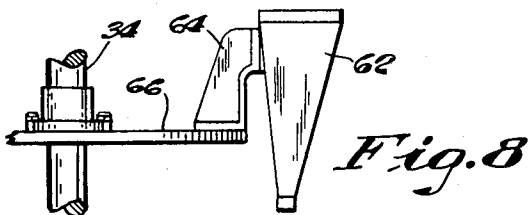
M. KNOBEL

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10 Sheets-Sheet 3



INVENTOR.
Max Knobel
BY
J. Stanley Churchill
ATTORNEY

July 17, 1956

M. KNOBEL

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Filed Nov. 10, 1954

10 Sheets-Sheet 4

Fig. 9

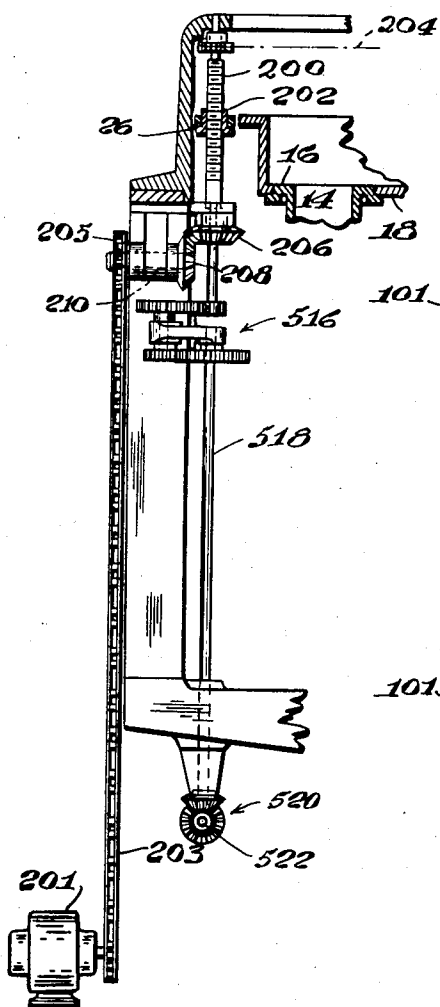


Fig. 10

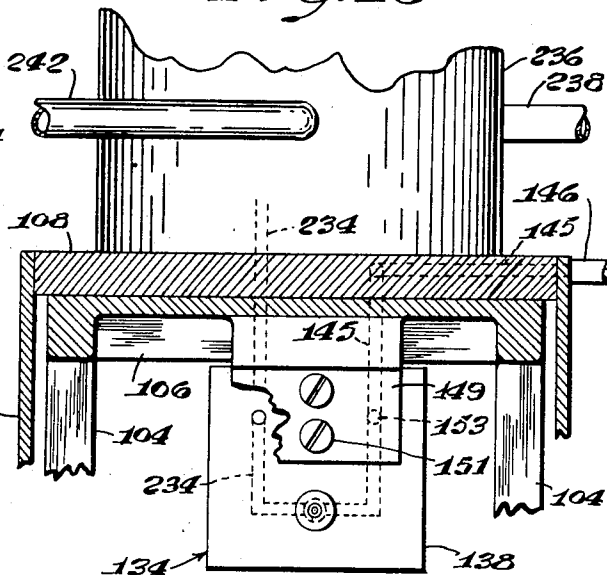
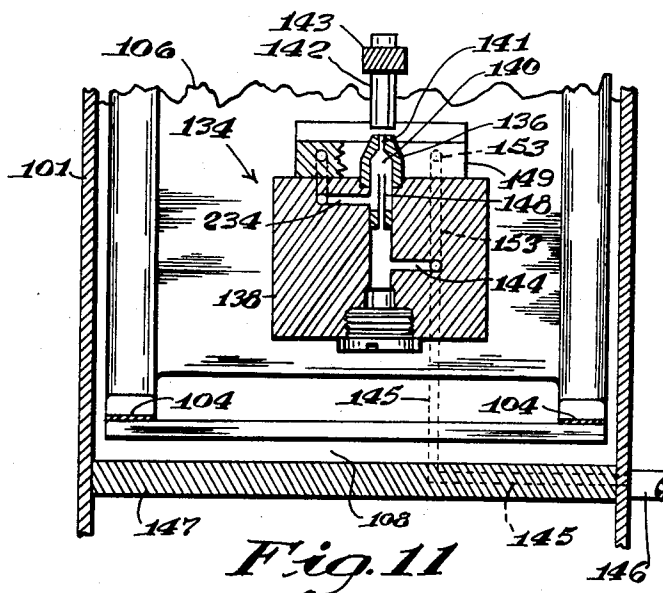


Fig. 11

INVENTOR.

Max Knobel

BY

J. Stanley Churchill

ATTORNEY

July 17, 1956

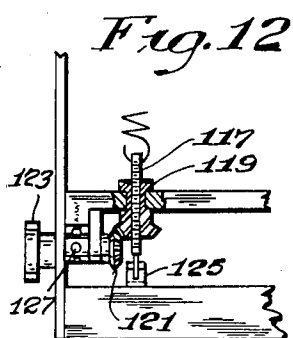
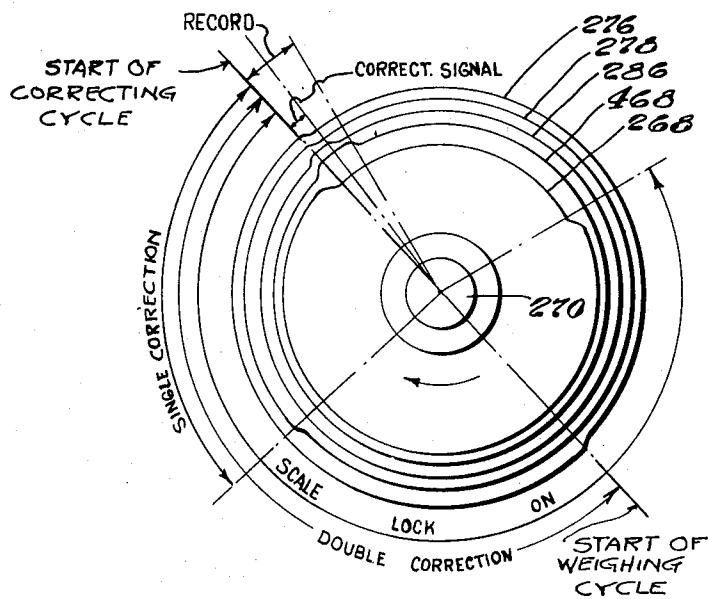
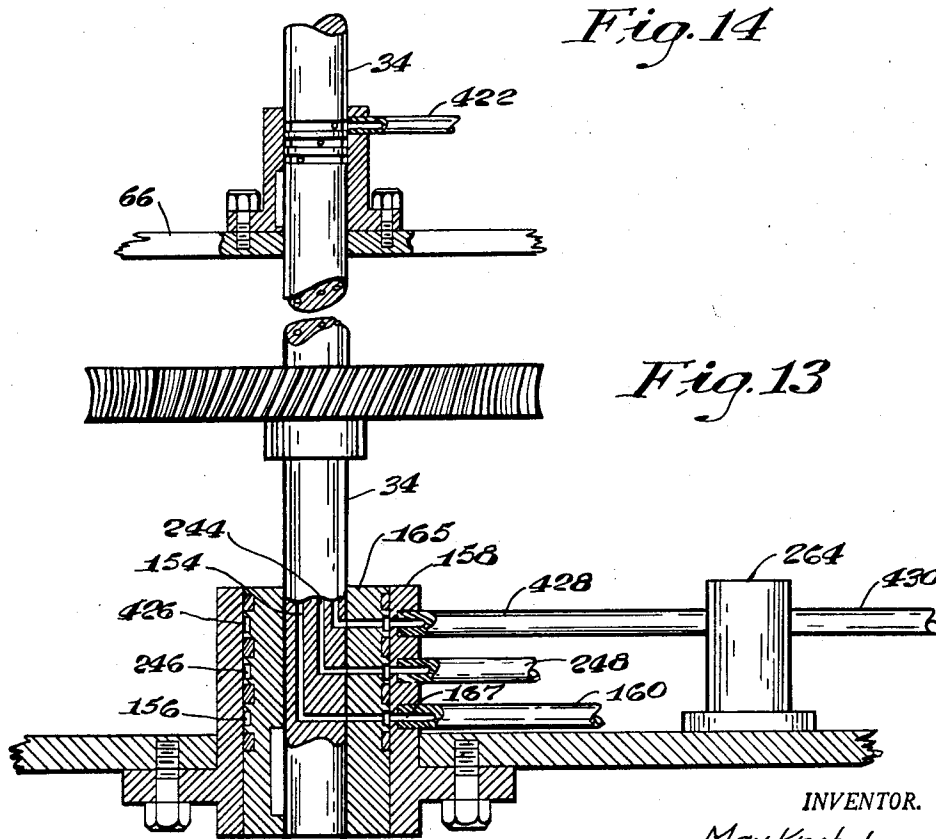
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10 Sheets-Sheet 5



INVENTOR.
Max Knobel
BY
J. Stanley Churchill.
ATTORNEY

July 17, 1956

M. KNOBEL

2,755,007

CONTAINER FILLING MACHINE

Filed Nov. 10, 1954

10 Sheets-Sheet 6

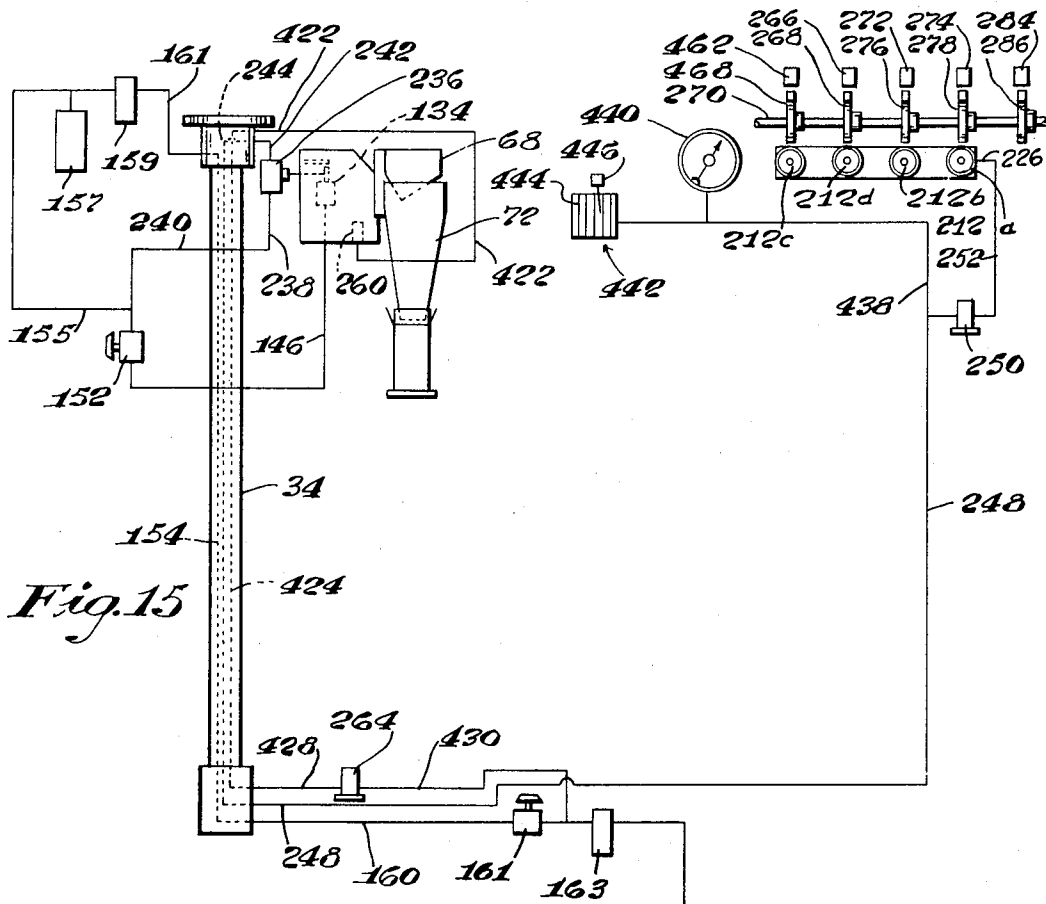
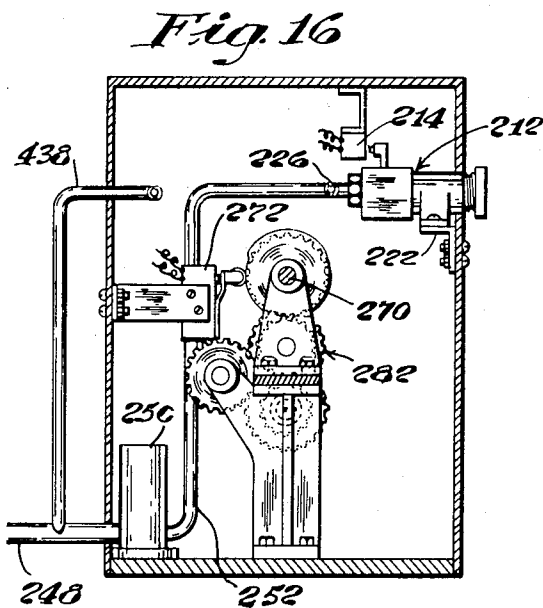


Fig. 15



July 17, 1956

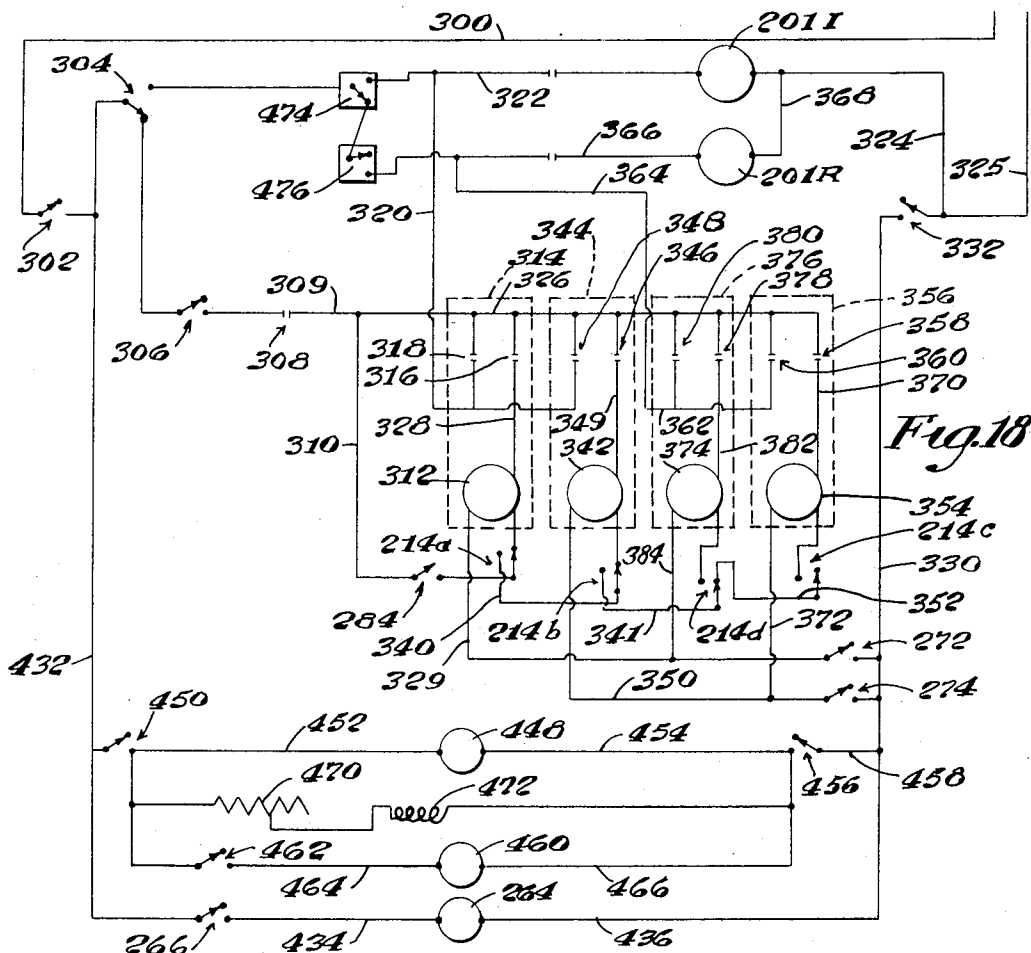
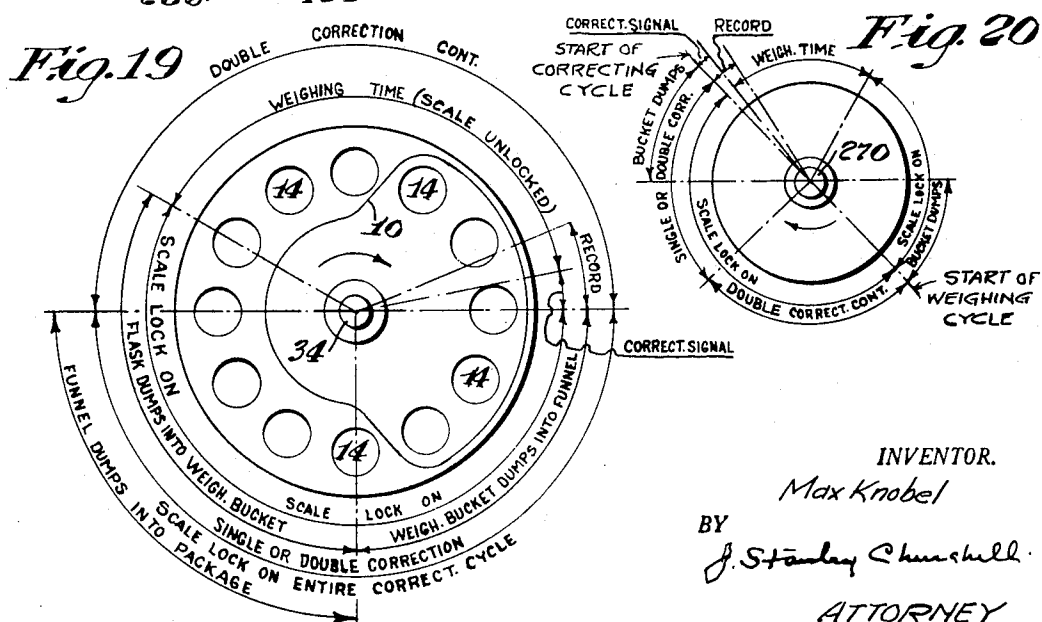
M. KNOBEL

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CONTAINER FILLING MACHINE

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INVENTOR.

Max Knobel

BY

J. Stanley Churchill.

ATTORNEY

July 17, 1956

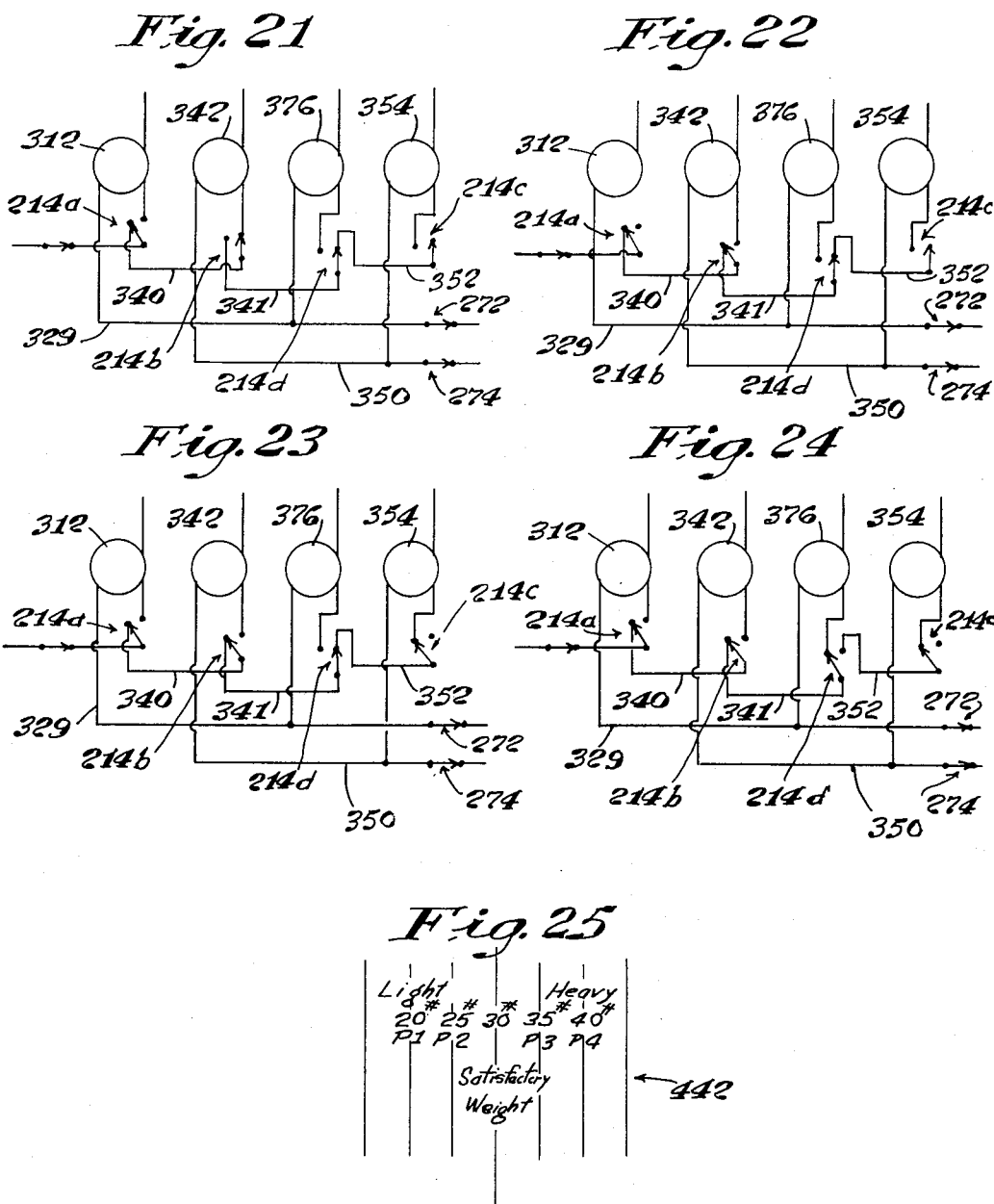
M. KNOBEL

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10 Sheets-Sheet 8



INVENTOR.
Max Knobel
BY
J. Stanley Churchill
ATTORNEY

July 17, 1956

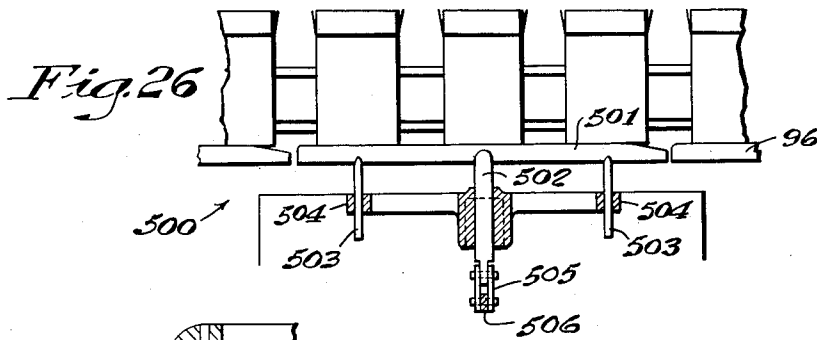
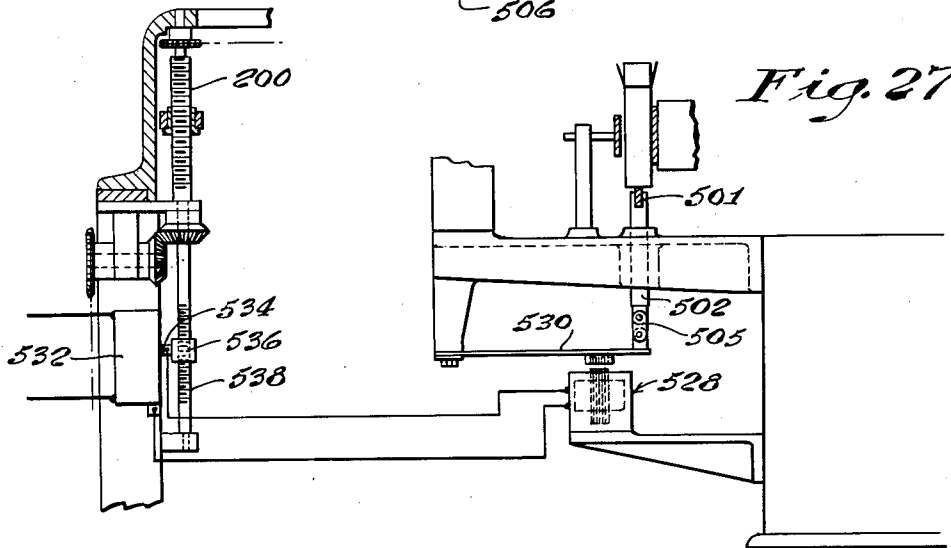
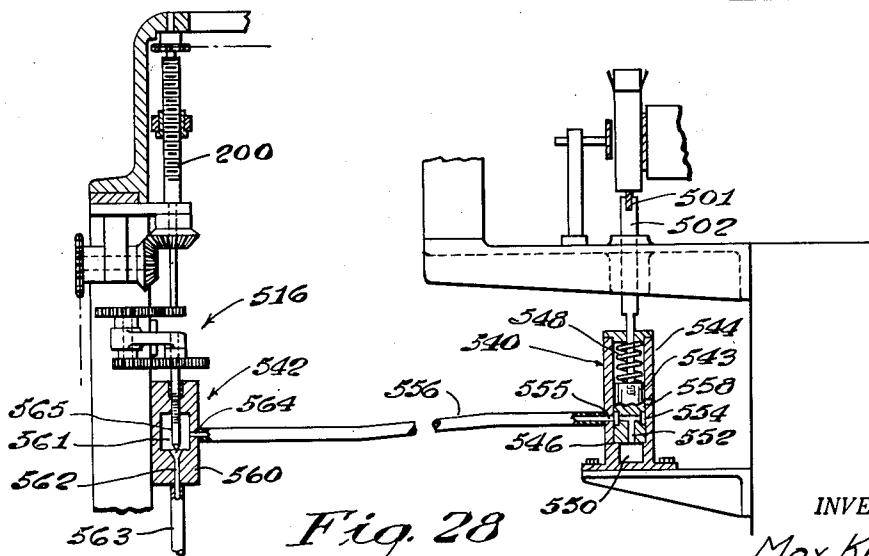
M. KNOBEL

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10 Sheets-Sheet 9



INVENTOR.

Max Knobel

BY

J. Stanley Churchill

ATTORNEY

July 17, 1956

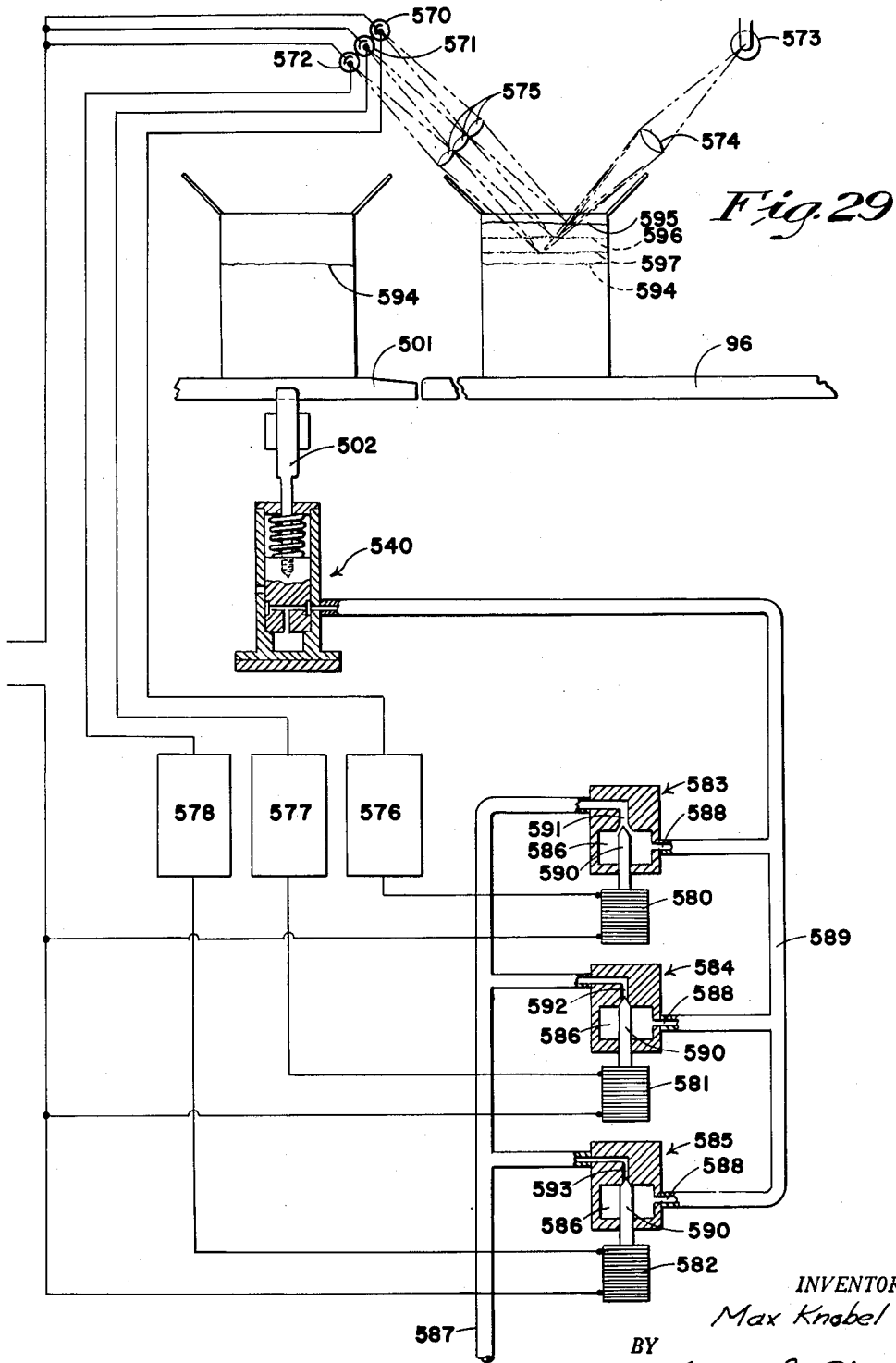
M. KNOBEL

2,755,007

CONTAINER FILLING MACHINE

Filed Nov. 10, 1954

10 Sheets-Sheet 10



INVENTOR.

Max Knobel

BY

J. Stanley Churchill.

ATTORNEY

1

2,755,007

CONTAINER FILLING MACHINE

Max Knobel, Boston, Mass., assignor to Pneumatic Scale Corporation, Limited, Quincy, Mass., a corporation of Massachusetts

Application November 10, 1954, Serial No. 467,920

13 Claims. (Cl. 226—72)

This invention relates to a packaging machine and more particularly to a container filling machine.

The invention has for an object to provide a novel and improved filling machine adapted to form and deposit successive loads of substantially uniform weight into successive containers and having provision for settling the material in the containers and for automatically controlling the settling operation in accordance with the density of the load in the container.

A further object of the invention is to provide a novel and improved volumetric filling machine for measuring a plurality of loads and depositing the same into successive containers wherein provision is made for varying the volume of the loads in accordance with the density of the material whereby to maintain substantial uniformity in the weights of the loads and which is characterized by means for settling the loads in the containers and for automatically varying the amount of settling in accordance with variations in the density of the material to the end that successive containers may be filled to a substantially uniform height.

With this general object 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 embodiments of the invention:

Fig. 1 is a plan view of the present packaging machine;

Fig. 2 is a side elevation of the machine, the upper portion being in cross section as viewed from the line 2—2 of Fig. 1;

Fig. 3 is a detail view of the upper portion taken on the line 3—3 of Fig. 1;

Fig. 4 is a side elevation of the check weighing mechanism shown in Fig. 2, some of the parts being broken away and shown in cross section;

Fig. 5 is a perspective view of the weighing receptacle showing the attachment to the cantilever weighing beam;

Fig. 6 is a plan view of the check weighing mechanism showing the pneumatic connections forming a part of the control mechanism;

Fig. 7 is a cross-sectional detail view of the pneumatically operated scale lock indicated in Fig. 4;

Fig. 8 is a detail view showing the mounting for the material guiding formula;

Fig. 9 is a detail view of the correcting mechanism as viewed from the line 9—9 of Fig. 1;

Fig. 10 is a cross-sectional view of the pneumatically operated control mechanism associated with the cantilever weighing beam, as viewed from the line 10—10 of Fig. 4;

Fig. 11 is a cross-sectional view taken on the line 11—11 of Fig. 6;

Fig. 12 is a detail view, partly in cross section, of a manually operated adjusting mechanism for the cantilever weighing beam;

Fig. 13 is a cross-sectional view showing the com-

2

pressed air supply lines for the pneumatic control mechanism as connected to and extended through the central shaft;

Fig. 14 is a diagrammatic view of the circuit closing cams indicating the timing for the selective correcting operations;

Fig. 15 is a diagrammatic view of the air lines for the pneumatic control mechanism;

Fig. 16 is a cross-sectional view of a portion of the control mechanism as viewed from the line 16—16 of Fig. 1;

Fig. 17 is a longitudinal cross-sectional view of the pneumatically operated switch mechanism shown in Fig. 16;

Fig. 18 is a wiring diagram associated with the selective control mechanism;

Fig. 19 is a diagrammatic plan view indicating the sequence of operation performed during successive cycles of the packaging machine;

Fig. 20 is a timing chart to be referred to;

Figs. 21, 22, 23 and 24 are views showing a portion of the wiring diagram in Fig. 18, illustrating the pneumatically controlled switches in different positions of operation for different pressure ranges as controlled by the check weighed load;

Fig. 25 is a chart indicating the various pressure ranges to be referred to;

Fig. 26 is a front elevation detail partly in cross section of the settling mechanism shown in Figs. 1 and 2;

Fig. 27 is a more or less diagrammatic view of a modified form of settling mechanism;

Fig. 28 is a similar view illustrating another modified form of settling mechanism; and

Fig. 29 is a more or less diagrammatic view of a still further modified form of settling mechanism embodying the present invention.

In general the present invention contemplates a novel packaging machine wherein successive measured loads are formed by volumetric measuring instrumentalities and in which provision is made for periodically check weighing one or more of a series of the measured loads thus formed. The machine is preferably constructed so that the volumetric filling instrumentalities are continuously moved, and preferably, the measured loads thus formed are delivered into containers being moved along with the continuously moved measuring instrumentalities so that after the measured loads have been formed they are delivered into the containers. Provision is also made for check weighing one or more of a series of the measured loads, preferably during the continuous movement of the filling instrumentalities and for adjustably varying the volume of the filling instrumentalities in response to and by an amount which is substantially proportionate to the variation of the weight of a particular weighed load from a predetermined amount. In other words the correction to be applied to the volumetric measuring instrumentalities may be described as being graduated as distinguished from a fixed correction. The graduated degree of correction may be effected by a correction which is proportionate in a general way to the total variation and may be effected by a series of separate increments.

In the preferred embodiment of the invention provision is made for automatically correcting the volume of the measuring chambers and for selectively controlling the correcting mechanism to change the volume of the measuring chambers different amounts in accordance with different variations in weights of successive check weighed loads. Thus, in practice when the weight deviation of a check weighed load is within a relatively small range over or under a predetermined weight, the volume of the measuring chambers is corrected a relatively small amount, and when the weight deviation of the check

weighed load exceeds the smaller range and extends into a larger range over or under the predetermined weight, the volume of the measuring chambers is corrected a relatively larger amount. Thus, in operation the present control mechanism is capable of correcting the volume of the measuring chambers during the continuous movement thereof in the event of any deviation in weight from a predetermined weight and is of particular advantage to effect correction of the volume of the measuring chambers in the event of any sudden and relatively great changes in the density of the material being supplied to the measuring chambers whereby to cause the weights of the successive measured loads to closely approach a predetermined weight.

In the operation of the present machine, variations in density of different batches of the material being handled will be detected by the weighing mechanism to effect an increase or a decrease in the volume of the measuring chambers to maintain substantially uniform weights of successive loads. In practice such variations in volume of the loads cause variations in the filling level of the containers. In accordance with the present invention provision is made for controlling the operation of the settling means in accordance with the density of the load in the container. These and other features of the invention will be apparent from the following description of the illustrated embodiment of the invention.

Referring now to the drawings, the invention is herein illustrated as embodied in a rotary filling machine of the general type illustrated and described in the United States patent to Delamere et al., No. 1,527,030, and which, as herein shown, may comprise a generally circular non-rotating hopper 10 containing a supply of the material delivered thereto by gravity or otherwise through a pipe 12 connected to a main source of supply, and a series of telescopically adjustable measuring chambers 14 preferably equally spaced in a circle and mounted to revolve beneath the hopper 10 to receive their loads. As illustrated in plan in Fig. 1, the hopper 10 is irregular in shape having a side wall 11 of large radius in one portion of its periphery arranged to extend over a number of the chambers 14 to effect filling thereof as the chambers pass under the extended portion of the hopper. The hopper is also provided with a side wall 13 formed on a smaller radius so that as the chambers are rotated around such side wall they are maintained out of contact with the material in the hopper and are open to the atmosphere.

As illustrated in Fig. 2, the upper portions of the telescopically adjustable measuring chambers 14 may comprise a plurality of flanged tubes 16 supported in and depending from a rotary disk 18 which forms the bottom of the hopper. The rotary disk 18 is provided with an upstanding annular side wall 20 having a flange or track portion 22 arranged to ride on and be supported by a plurality of rollers 24 carried by a vertically adjustable supporting ring 25. The lower portions of the measuring chambers 14 may comprise a plurality of corresponding upstanding tubes 28 telescopically fitted about the upper tubes 16 and supported in a rotary disk 30 secured by a flange member 32 to the upper end of a continuously rotated central shaft 34, the telescoping connection imparting rotary movement to the upper portions of the chambers 14 during the operation of the machine.

As herein shown, each chamber 14 is provided with a cam-operated bottom closure valve 36, and in the operation of the machine successive measuring chambers are filled as they pass under the filling portion 11 of the hopper 10 at which time the bottoms of the chambers 14 are closed by the valves 36, and when the chambers pass out from under the filling portions of the hopper, the valves may be moved to open the bottoms of the chambers to release the measured loads. Each cam-operated valve 36 is fast on a vertical stud rockingly supported in a bearing member 42 attached to the rotary disk 30, the upper end of the stud being provided with

an arm 44 carrying a roller 46 for cooperation with a cam piece 48 supported from the machine frame. The valve may be urged to a closed position against a stop by spring means, not shown, and engagement of the rolls 46 with the cam piece 48 is arranged to rock the valve into an open position to effect release of the measured load.

In the operation of the machine all of the measured loads in the chambers 14, except one load, are released into successive cartons 60 being moved along therebeneath, the material being guided into the cartons through funnels 62 supported by brackets 64 attached to a rotary disk 66 fast on the central shaft 34. The remaining measured load may and preferably will be deposited in a weighing receptacle 68 forming a part of the check weighing mechanism, indicated generally at 70, such check weighed load being subsequently released into a second receptacle 72 disposed beneath the weighing receptacle, and thereafter the load is released from the lower receptacle 72 into a carton 60 disposed therebeneath during a succeeding revolution of the filling units, as will be hereinafter more fully described.

As shown in Fig. 1, the cartons 60 may be delivered to the machine along a conveyor 74 by an upstanding flexible metal belt 76 having a series of spaced blocks 78 attached thereto and between which the cartons are engaged. The belt 76 is arranged to cooperate with a driving pulley 80 fast on the central shaft 34 and arranged to register successive cartons in alignment with their respective filling units, the belt being provided with suitable projections for engagement in sockets, not shown, formed in the pulley 80. As illustrated in Fig. 1, the central shaft 34 may be driven through a worm gear drive 82 connected to a shaft 84 which in turn may be connected to a drive shaft 86 through a second worm gear drive 88. The drive shaft 86 may be driven by an electric motor 90 belted to a pulley 92 fast on the shaft 86. In the operation of the filling machine the cartons may be delivered along the conveyor 74 from a supply thereof, and successive cartons 60 are arranged to come into alignment with successive filling units at the point of tangency with the semicircular path through which the cartons are guided in the machine, the cartons remaining in alignment with their respective filling units through 180° and then being delivered from the machine on a discharge conveyor 94. The cartons may be guided through the semicircular path on a bottom support rail 96 and by a side rail 98, as shown in Fig. 2.

Provision is made in accordance with the present invention for automatically correcting the volume of the telescopic measuring chambers 14 by adjusting the upper portion 16 of the chambers relative to the lower portions 28 when the weight of the measured load as detected by the check weighing unit 70 is found to deviate abnormally beyond a predetermined range, as will be hereinafter more fully described.

As illustrated in Figs. 3 to 6, the weighing unit 70 is disposed immediately beneath a measuring chamber 14, the weighing receptacle 68 being attached to and forming a part of the free end of a cantilever spring beam 100 herein shown as comprising two upper and two lower relatively stiff cantilever leaf springs 102, 104 of equal lengths, the leaf spring being connected at their inner ends to a rigid member 106 attached to an upstanding end frame 108 mounted on the rotary supporting disk 66. The other ends of the leaf springs 102, 104 may be secured to a second rigid member 112 to which the weighing receptacle 68 is attached by straps 114. As indicated in Figs. 4 and 5, the weighing beam and associated mechanism is enclosed in a casing 101, the straps 114 being connected to the member 112 by screws 103 extended through vertical slots 105 formed in the side walls of the casing.

The two rigid members 106, 112 together with the leaf springs 102, 104 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 100 is also provided with a coil spring 116 arranged to exert a counterforce upon the spring beam, the spring 116 being connected at its upper end to a bolt 118 adjustably secured in a bracket 122 attached to the rigid member 106, as shown in Fig. 4. The lower end of the coil spring 116 may be connected to a rod 124 fast in an arm 126 extending from the rigid member 112 of the spring beam 100. The rod 124 may extend below the arm 126 and may be provided with a piston operating in oil contained in a dash pot 130 attached to the base of the weighing unit. A second coil spring 111, adapted for fine adjustment of the weighing unit, is connected at its upper end to an arm 113 extended from the upper end of a rod 115 supported in the arm 126, the lower end of the spring 111 being connected to a threaded spring stud 117 cooperating with a bevel gear nut 119 supported in the base of the weighing unit, as illustrated in detail in Fig. 12. The bevel gear nut 119 is arranged to mesh with a second bevel gear 121 which is arranged to be rotated by a handle 123 to effect manual adjustment of the coil spring 111 to increase or decrease the tension thereof. Any usual or preferred means may be employed to prevent rotation of the spring stud 117, such as a slotted bracket 125 through which the flattened end of the spring stud may extend. A spring pressed ball and socket connection indicated at 127, may be provided between the base and an extended portion of the handle 123 to hold the parts in their adjusted position. The cantilever spring beam 100 may be adjustably limited in its vertical movement by stop means indicated generally at 133.

In practice the coil spring 116 serves to counteract the weight of the weighing receptacle 68 and associated parts which are mounted upon the outer ends of the leaf springs, the coil spring 116 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.

As herein shown, provision is made for measuring the deflection of the spring beam 100 when depressed by the load being checked weighed to indicate the weight of the load and more particularly to detect any deviation over or under a predetermined weight. In practice the stiff cantilever springs 102, 104 are selected so that the weighing beam has a relatively small deflection value, and sensitive pneumatically operated control means, indicated generally at 134 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 released from a measuring chamber 14. The pneumatically operated unit 134 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 vary the pressure in the pneumatically operated unit by an amount proportionate to the deflection, an overweight load effecting a relatively large increase in pressure, and an underweight load increasing the pressure a lesser amount, and such different pressures may be translated into movement to effect actuation of volume correcting mechanism whereby to effect a decrease or an increase respectively in the volume of the measuring chambers 14 when an abnormal deviation from a predetermined weight is detected. The present invention is characterized by novel correcting mechanism wherein provision is made for selectively adjusting the measuring chambers 14 to increase or decrease the volume a greater or lesser amount in accordance with different

pressure values preferably in different predetermined ranges.

As shown in Figs. 10 and 11, the pneumatically operated control mechanism 134 may include a conduit or jet member 136 carried by a block 138 having a relatively small pressure chamber 140 communicating with the jet and through which air under substantial pressure may be caused to flow to be discharged through a small discharge orifice 141 in the jet arranged to cooperate with a valve member 142 adjustably mounted in an arm 143 on the rod 115 carried by the arm 126 extended from the free end of the weighing beam unit 100. The inlet 144 may be supplied with a regulated source of air through a pipe 146 and connecting passageways 145 formed in a bottom tie member 147, end frame member 108 and through a forwardly extended portion 149 of the rigid member 105 of the weighing beam 100, the block 138 being attached to the extended portion 149 by screws 151, as shown in Fig. 10. The extension 149 is provided with openings communicating with passageway 153 formed in the block 138 and leading to the inlet 144 which communicates with a central passageway having a restricted throat portion 148 comprising a small tube arranged to offer a substantial resistance to the flow of air therethrough. As diagrammatically illustrated in Fig. 15, the inlet pipe 146 may be connected by a secondary regulator 152, air pipe 155, tank 157, secondary filter 159, and pipe line 161 to a passageway 154 formed in the continuously rotated central shaft 34, the lower end of the passageway 154 communicating with an annular chamber 156 formed in a bushing 165 fast on the lower end of shaft 34 and which is rotatably mounted in a flanged bearing member 158 having a communicating opening 167 therein, see Fig. 13, which in turn may be connected by a pipe 160 through a primary regulator 161 and a primary filter 163 to the source of air thereby enabling the pneumatically operated unit 134 to be supplied with air during the continuous rotation of the check weighing unit 70 with the shaft 34. In operation the spring beam unit 100 may be adjusted to maintain the valve member 142 in a slightly elevated position spaced from the small discharge orifice 141, and upon minute deflection of the spring beam under the influence of the load, the valve 142 is moved toward the discharge orifice a minute amount thereby effecting a substantial pressure rise in the chamber 140 between the discharge orifice 141 and the restricted throat portion 148.

As herein shown, provision is made for utilizing the increase in pressure in the chambers 140 through novel control mechanism adapted to automatically effect adjustment of the upper portion 16 of the measuring chambers 14 relative to the lower portion 28 thereof in a manner such as to vary the volume of the chamber different amounts in accordance with different deviations in the weights of the measured loads within selected ranges beyond commercially acceptable limits as detected by the check weighing mechanism. As illustrated in Fig. 9, the correcting mechanism may include a plurality of screws 200 rotatably mounted in the machine frame, see Fig. 3, and arranged to cooperate with nuts 202 secured in the supporting ring 26. The screws 200 may be connected to rotate together by a chain and sprocket drive 204, and one of the screws may be provided with a bevel gear 206 arranged to mesh with a bevel gear 208 fast on a shaft 210 mounted for rotation in the machine frame. Rotation of the screws 200 may be effected by control mechanism including a reversible electric motor 201 connected by a chain 203 to a sprocket 205 fast on the end of the shaft 210 on which the bevel gear 208 is mounted, the motor 201 forming part of a control circuit for selectively adjusting the chambers, as will be described. In operation rotation of the screws 200 in one direction will effect elevation of the upper portions 16 of the measuring chambers to increase the volume of subsequent loads, and rotation of the screws in the

opposite direction will cause the upper portions 16 to be lowered into the portions 28 to decrease the volume of the chambers.

In order to effect different adjustments of the measuring chambers 40 corresponding to different deviations in weights of the measured loads, a plurality of pneumatically controlled switch operating units 212 are provided, the switches 214 forming a part of the electrical circuit arranged to effect operation of the reversible motor in one direction or the other and for different periods of time. As illustrated in detail in Fig. 17, each pneumatically controlled switch operating unit 212 includes a contact engaging arm 216 extended from a disk 218 slidably mounted in a casing 220 supported in a bracket 222 from the machine frame. One end of the casing 220 is provided with a pressure responsive element herein shown as comprising a rubber bellows 224 in communication with an air pipe 226 forming a part of the pneumatic control system, the rubber bellows being engageable with one face of the disk 218. The other end of the casing is provided with an adjusting screw 228 and a coil spring 230 interposed between the opposite face of the disk 218 and the end of the screw. The spring 230 may be adjusted so that the contact engaging arm 216 is normally in engagement with the microswitch 214 to hold the same in an inoperative position, and so that in operation when the pressure in the bellows 224 reaches a predetermined amount the arm 216 is urged away from the switch to permit it to close a selected circuit to effect variable adjustment of the measuring chambers, as will be described.

As diagrammatically illustrated in Fig. 15, provision is made for amplifying and controlling the pressures built up in the chamber 140 of the pneumatic control mechanism 134 to provide sufficient air flow and pressure to operate the pneumatically controlled switch operating units 212, and as illustrated in detail in Figs. 10 and 11, the chamber 140 is connected by passageways 234 to a pressure transmitting unit 236 mounted on the end frame member 108. The transmitting unit 236 may comprise a commercially available unit functioning in the manner of an automatic pressure regulator and is provided with an inlet 238 connected by a branch air line 240 from the line 155. The outlet 242 is arranged to communicate with a return passageway 244 formed in the central shaft 34, the lower end of the passageway communicating with a second annular chamber 246 formed in the bushing 165 which in turn is connected through the flanged member 158 by a pipe line 248, solenoid valve 250, and pipe line 252 to the lines 226 leading to the pressure responsive bellows 224 of the pneumatically controlled switch operating units 212.

In practice the regulated pressure supplied to the pneumatic control mechanism 134 may be approximately forty pounds as controlled by the secondary regulator 152 for efficient operation, and the regulated pressure supplied to the transmitting unit 236 may be approximately sixty pounds as controlled by the primary regulator 161. In operation the variations in pressure in the chamber 140 as caused by depression of the weighing beam 100 are arranged to modify the pressure in the transmitting unit 236 an amount proportionate to the increase in pressure in the chamber 140 to effect operation of the pneumatically controlled switch operating units 212.

In the illustrated embodiment of the invention four pneumatically controlled switch operating units 212 are shown, each being arranged to be actuated upon progressively higher pressures in the chamber 140 of the pneumatic unit 134 as effected by the depression of the spring beam 100 under the influence of the check weighted load, each operating unit 212 being arranged to close a different circuit to effect a preselected correction in the volume of the chambers 14. In practice the operating units 212 may be adjusted so as to be actuated by pressures within

prescribed ranges over or under a correct or commercially acceptable weight, as indicated diagrammatically in Fig. 25. For example, if the measured load being check weighed depresses the spring beam 100 a relatively small amount, indicating a greatly underweight load, a relatively small increase in pressure below the point indicated by P1 in Fig. 25 is effected in the unit 134 which will actuate an operating unit 212a to effect closing of a circuit to the motor 201 arranged to increase the volume of the chambers 14 a relatively large amount; any increase in pressure in a range beyond the point P1 and up to P2, indicating an underweight load requiring a lesser adjustment of the chambers 14, will actuate a second operating unit 212b to effect closing of a circuit arranged to increase the volume a smaller amount. Any further increase in pressure in a range beyond P2, and up to P3, indicating a correct weight load within commercially accepted limits, will not actuate any of the operating units 212 so that no correction is made in the volume of the chambers. Any increase in pressure in a range between P3 and P4, indicating a slight overweight load, will actuate a third operating unit 212c to effect closing of a circuit to the motor 201 arranged to decrease the volume a small amount; and any increase in pressure beyond P4, indicating a relatively larger overweight load, will actuate a fourth operating unit 212d to effect closing of a circuit to the motor 201 arranged to decrease the volume of the chambers 14 a relatively greater amount.

In practice the present volumetric filling machine is arranged to operate in cycles with respect to the check weighing unit 70, wherein one revolution of the rotary filling unit comprises a check weighing cycle, and a succeeding revolution thereof comprises a correcting cycle, as diagrammatically indicated in Figs. 19 and 20 to be described. As herein shown, provision is made for locking the weighing beam 100 during the correcting cycle and for unlocking the weighing beam during a portion of the check weighing cycle to permit the beam to be depressed under the influence of the load and to actuate the selected operating unit 212. As illustrated in Fig. 7, the weighing beam lock may comprise a pneumatically operated unit 260 having a spring-pressed plunger 262 arranged to engage the underside of the beam 100 to hold it in inoperative position during the correcting cycle. As indicated in Fig. 15, the compressed air line to the beam locking unit 260 includes a solenoid operated valve 264 arranged to be actuated by closing of a switch 266 by a cam 268 fast on a cam shaft 270, the cam 268 permitting opening of the switch 266 to deenergize the solenoid and close the valve during a portion of the weighing cycle.

Provision is also made for limiting the duration of operation of the reversible chamber correcting motor 201 during the correcting cycle, and as herein shown, two cam-operated switches 272, 274 are provided in the motor circuit, the switch 272 being closed by a cam 276 fast on the cam shaft 270 and the switch 274 being closed by a cam 278 also fast on the shaft 270. The cam 276 is arranged to limit the time of operation of the motor 201 to effect a relatively large adjustment of the chambers 14 in either direction, and the cam 278 is arranged to limit the time of operation of the motor to effect a relatively small adjustment of the chambers 14 in either direction, the operating units 212 effecting closing of the selected circuit for operation of the motor in one or the other direction to increase or decrease the volume of the filling chambers 14.

In order to control the operation of the filling machine to provide successive check weighing and correcting cycles, the cam shaft 270 is arranged to be rotated at a ratio of one to two with relation to the rotation of the filling heads so that one-half revolution of the cam shaft 270 is equal to a full revolution of the filling heads, succeeding one-half revolution of the cam shaft corresponding to successive weighing and correcting cycles respectively of the filling heads. As illustrated in Figs. 2 and

16, the cam shaft 270 is arranged to be driven from the shaft 84 of the filling machine by a chain and sprocket drive 280 and through a gear train 282 to effect rotation of the cam shaft one-half revolution for each revolution of the filling heads.

Referring now to Fig. 18, the electrical diagram therein shown in association with the various pressure-operated switches 214 and the cam-operated switches defines the different circuits for effecting selective adjustment of the measuring chambers and includes four micro-switches 214a, 214b, 214c and 214d arranged to be actuated by their individual pneumatically operated units 212. The reversing motor 201 is indicated in the diagram by motor reversing starters 201 I for operating the motor in one direction to increase the volume and 201R for operating the motor in the other direction to reduce the volume of the measuring chambers. The cam-operated switches for determining the extent of adjustment are indicated at 272 and 274, and a third cam-operated switch 284 comprising a signal switch is arranged to be closed by a cam 286 at the beginning of the correcting cycle to energize the circuit and initiate the correcting operation.

The circuit to the motor reversing starters includes a line 300 from the main line, manually operated switches 302, 304, 306, a carton feed-operated switch 308, lines 309, 310 and signal switch 284 to a terminal of the first pneumatically operated switch 214a. As indicated in Fig. 18, the pneumatically operated switches 214a, 214b, 214c and 214d are arranged to be connected in series and are normally maintained in the position shown in Fig. 18, wherein the switch 214a is closed to energize a coil 312 of a magnetic switch 314 which operates to close the circuit at contacts 316 and 318, the circuit to one terminal of the motor starter 201I being completed through lines 320, 322, the other terminal of the motor starter 201I being connected by a line 324 to the main return line 325. The magnetic switch contacts 316 are arranged to close a holding circuit to the coil 312 from the line 309 through lines 326, 328 to one terminal of the coil, then through line 329 through the cam-operated switch 272, and through line 330 and manually operated switch 332 to the main line 325.

Thus, in operation when the check weighed load causes a relatively low pressure, below P₁, which may for example be any pressure in the range below twenty pounds air pressure, indicating that the load is greatly underweight requiring a large increase in the volume of the chambers, the switch 214a will remain in its normally closed position, and when the signal switch 284 and cam-operated switch 272 are closed at the start of the correcting cycle, the motor 201 will be energized to effect an increase in the volume of the measuring chambers, the cam-operated switch 272 holding the circuit closed for a relatively long interval of time to effect a relatively great increase in volume to correct the lightweight condition of the load. The motor circuit is opened by the cam switch 272 at the end of the predetermined time interval to discontinue the correcting operation and to de-energize the magnetic switch coil 312. It will be understood that the signal switch 284 is closed only momentarily, until the holding circuit is energized to initiate the correcting operation, the cam-operated switch 272 being closed substantially simultaneously with closing of the signal switch, as diagrammatically indicated in Fig. 14.

When the check weighed load effects an increase in pressure beyond P₁, in a range between twenty and twenty-five pounds for example, but below P₂, indicating that the check weighed load is only slightly underweight, the switch 214a is actuated to open the circuit to coil 312 and to close the circuit through line 340 to a terminal of a second normally closed pneumatically operated switch 214b, as indicated in Fig. 21. Thus, the circuit is closed to energize coil 342 of magnetic switch 344 which operates to close the circuit at contacts 346, 348, the circuit being continued through lines 320, 322

to one terminal of the motor starter 201I, the other terminal being connected to the main line 325 by line 324 to effect an increase in the volume of the measuring chambers. The contacts 346 forming a part of the holding circuit from line 326 continue the current through line 349 to one terminal of the coil 342, the other terminal being connected by line 350 to cam-operated switch 274, the switch continuing the circuit through lines 330 and switch 332 to the main line 325. The cam-operated switch 274 is arranged to be closed but a relatively short time to increase the volume of the chambers a smaller amount to correct the underweight condition.

When the check weighed load effects an increase in pressure beyond P₂, in a range between twenty-five and thirty-five pounds, but below P₃, indicating that the load is of a satisfactory weight within commercially acceptable limits, both pneumatically operated switches 214a and 214b will be actuated to open the circuits to their respective coils 312, 342, and since the switches 214c and 214d are normally opened, as indicated in Fig. 22, no correction in the volume is made. A pressure above P₃, in a range between thirty-five and forty pounds air pressure, but below P₄, indicating that the load is slightly overweight will effect actuation of switches 214a and 214b to continue the circuit through lines 340, 341 and through switch 214d and line 352 to switch 214c, the latter being actuated to close the circuit to the coil 354 of magnetic switch 356, as indicated in Fig. 23, which operates to close the circuit at contacts 358, 360. The circuit is continued through lines 362, 364, 366 to one terminal of the reversing motor starter 201R, the other terminal being connected to the main line 325 by lines 368, 324 to thus energize the motor to effect a decrease in the volume of the measuring chambers. The contacts 358 forming a part of the holding circuit from line 326 continues the current through line 370 to one terminal of the coil 354, the other terminal being connected by line 372 to cam-operated switch 274, the latter continuing the circuit through lines 330 and switch 332 to the main line 325. The cam-operated switch 274, as previously described, is arranged to be closed but a relatively short time to decrease the volume of the chambers a relatively small amount to correct the overweight condition.

As illustrated in Fig. 24, when the check weighed load effects an increase in pressure beyond P₄ or in the range above forty pounds air pressure for example, indicating that the load is greatly overweight, all of the pneumatically operated switches will be actuated, the current passing through switches 214a, line 340, switch 214b, line 341 and switch 214d to one terminal of the coil 374 of magnetic switch 376, the switch 214c being rendered ineffective by opening of the line at 214d, as illustrated. Energization of coil 374 effects closing of the circuit at contacts 378, 380, and the circuit is continued through lines 362, 364, 366 to the reversing motor starter 201R to effect a decrease in the volume of the measuring chambers. The contacts 378 forming a part of the holding circuit from lines 309, 326 continue the current through lines 382 to one terminal of the coil 374, the other terminal being connected by lines 384, 329 to the cam-operated switch 272, the latter continuing the circuit through lines 330, and switch 332 to the main line 325. The cam-operated switch 272, as previously described, is arranged to be closed a relatively long time to decrease the volume of the chambers a relatively large amount to correct the overweight condition.

In the operation of the present volumetric filling machine, as thus far described, successive measuring chambers 14 are filled as they pass under the filling portion of the hopper 10, the chambers remaining under the filling portion through substantially one-half a revolution of the filling units, during which time the valves 36 are closed and the chambers are filled. When the chambers come into alignment with their respective cartons, the valves 36 are opened by the cam piece 48 to release the

measured loads, the valves remaining open through substantially 180 degrees, whereupon the valves are again closed.

During the travel of the filling units in alignment with their cartons, all of the measured loads except the one associated with the weighing unit 70 are delivered through the funnels 62 directly into their respective cartons 60 disposed therebeneath, the remaining load being released into the weighing receptacle 68.

As illustrated in Figs. 2 and 4, the weighing receptacle 68 is provided with a shutter 400 pivotally mounted at 402 and normally maintained in a closed position by a spring 404. The shutter is also provided with an operating arm 406 having a cam roll 408 arranged to cooperate with a cam piece 410. The shutter 400 remains closed until after the load has been check weighed, whereupon the check weighed load is released into the lower receptacle 72, as diagrammatically indicated in Fig. 19, immediately prior to coming into alignment with the cartons during a succeeding revolution of the filling heads. As shown in Fig. 2, the lower receptacle 72 is also provided with a shutter 412 normally maintained in a closed position by a spring 414 and arranged to be opened by a cam piece 416 cooperating with a roller 418 carried by the shutter arm 420. When the lower receptacle comes into alignment with the cartons, the shutter 412 is opened to release the previously check weighed load into a carton, the shutter being subsequently closed at the point where the cartons are discharged onto the delivery conveyor.

In practice the above operations occur each cycle of the filling machine, and as above described, provision is made for controlling the machine to enable it to perform alternate check weighing and correcting cycles. As herein shown, this may be accomplished by unlocking the weighing beam during a portion of the check weighing cycle, as indicated in Fig. 19, to permit the beam to cooperate with the pneumatic unit 134 to effect operation of the correcting mechanism and to maintain the weighing beam locked during the entire correcting cycle so that no weight indication is permitted during the correcting cycle.

As diagrammatically shown in Fig. 15, the pneumatically actuated scale lock 260, shown in detail in Fig. 7, is connected to an air pipe 422 which is in communication with a passageway 424 formed in the central shaft 34. The lower end of the passageway 424 communicates with an annular chamber 426 in the bushing 165, see Fig. 13, which in turn is connected through the bearing 158 to a pipe 428 leading to the solenoid valve 264. The valve 264 is connected by a pipe 430 to the source of compressed air, as shown.

In operation the valve 264 is normally open so that the locking unit 260 is in operative position to lock the weighing unit, the solenoid being energized to close the valve and permit retraction of the spring-pressed plunger 262 and thus effect unlocking of the weighing beam upon closing of the switch 266 by cam 268, as above described. Since the cam shaft 270 makes one-half a revolution for each revolution of the filling units, the valve 264 is closed only during the check weighing portion of the weighing cycle, the weighing unit remaining locked during the filling operation and during the entire correcting cycle, as diagrammatically indicated in the cam chart, Fig. 14, and in the timing charts, Figs. 19 and 20. As shown in Fig. 18, the circuit to the scale lock solenoid 264 includes the line 432 to the cam-operated switch 266, and line 434 to one terminal of the solenoid, the other terminal being connected by lines 436, 330 and switch 332 to the return line 325.

As diagrammatically indicated in Fig. 15, the air line 248 is connected by a pipe 438 to a pressure indicator dial 440 and to recording mechanism, indicated generally at 442, which includes a chart 444 arranged to be rotated during the operation of the machine, and a stylus

unit 446 arranged to be moved laterally by the pressure supplied in the pipe 438 and arranged to be actuated to mark the chart when the check weighing unit indicates the weight of the load. As shown in Fig. 18, the chart motor 448 is included in a circuit from line 432 and includes a switch 450 and line 452 to one terminal of the motor, the other terminal being connected by a line 454, switch 456 and line 458 to the return line 330. The stylus 446 may be actuated by a solenoid 460 arranged to be actuated by a cam-operated switch 462 in a circuit including lines 464 and 466 in parallel with the chart motor circuit, the cam 468 for operating the stylus switch 462 being mounted on the cam shaft 270, as shown in Figs. 1 and 2. As indicated in Fig. 18, the stylus circuit includes a temperature control rheostat 470 and a transformer 472 in parallel with the stylus solenoid circuit. In practice when it is desired to manually effect operation of the correcting mechanism, the automatic correcting mechanism may be rendered inoperative by opening the circuit at switch 306 and closing the circuit at the manual correction switch 304, switches 474 and 476 being arranged for manual operation to close the circuits to the motor starter 201I or 201R to effect either an increase or a decrease in the measured loads.

From the above description it will be seen that the present filling machine is adapted to selectively correct the volume of the filling chambers in accordance with the weight of a check weighed load whereby to effect a relatively small volume change when the load is only slightly over or under a predetermined weight without prescribed ranges, and to effect a larger volume change when the check weighed load is greatly over or underweight within predetermined ranges from the predetermined weight. In the drawings the notations relative to "single correction" and "double correction" are intended to indicate a small correction and a larger correction respectively and not necessarily that one correction is double that of the other, since the cams determining the correcting interval may be designed to make different corrections in any desired number of ranges.

As above described, in practice a predetermined weight of relatively dense or compact material will be of less volume than the same weight of relatively loose and less compact material so that height of the material in the containers may vary. In order to provide more or less uniformly filled containers, the container may be made of a size such as to receive the smaller volume of the denser material to a height within a short distance from the top of the container, and provision is made for settling the larger volume of less dense material in the container and for varying the settling operation in accordance with the density thereof so that the level of the material in successive containers may be substantially uniform.

In the illustrated embodiment of the invention the filled containers are arranged to be vibrated or tapped as they are advanced through the machine, and as shown in Figs. 1 and 2, and in detail in Fig. 26, the settling mechanism may comprise vertically reciprocated tapping means indicated generally at 500 wherein a separate curved portion 501 of the container bottom supporting rail 96 may be vibrated to shake the filled containers as they pass thereover to settle the material therein. The rail 501 is connected to the upper end of a rod 502 supported for vertical reciprocation in a bearing formed in the machine frame and is further provided with guide pins 503 adjacent the ends of the rail arranged to slide in bearing members 504, see Fig. 26. The lower end of the rod 502 may be connected by links 505 to an arm 506 pivotally mounted at 507. An eccentric 508 fast on a shaft 509 is arranged to engage the underside of the arm 506 to rock the arm upwardly, and a spring 510 connected to the arm is arranged to urge the same downwardly. The eccentric 508 may be continuously rotated by a chain and sprocket drive 512 from the main drive shaft 86. A second eccentric 514 also engageable with the under-

13

side of the arm 506 is normally stationary and is arranged to be rotatably adjusted to vary the distance between the rotary eccentric 508 and the underside of the arm 506 to vary the effective throw thereof and consequently the amplitude of vibration imparted to the tapping rail 501.

Provision is made for automatically adjusting the second eccentric 514 in order to vary or modify the amplitude of vibration of the rail 501 in a manner substantially proportionate to the degree of density of the material whereby to effect no contact of the eccentric 508 with the arm 506 when the material is of maximum density, and varying rates of throw of the eccentric when the material is of lesser and different densities. As illustrated in Fig. 9, this may be accomplished through connections to the adjusting screw 200 which is rotated to adjust the volume of the measuring chambers 14 in accordance with the density of the material as determined by the check weighing apparatus, as above described. As herein shown, an extended end of the screw 200 may be connected through a gear reduction train, indicated at 516, to a vertical shaft 518 connected by bevel gears 520 to a horizontal shaft 522. The shaft 522 is connected by bevel gears 524 to a second horizontal shaft 526 on which the adjustable eccentric 514 is mounted. Thus, in the operation of the device when the screw 200 is adjusted in one direction to increase the volume of the chambers 14, indicating that the material is of lesser density, the eccentric 514 will be adjusted to increase the throw of the eccentric 508 and the amplitude of vibration of the tapping rail 501 at a rate substantially proportionate to the density of the material, and conversely when the screw 200 is rotated in the other direction to decrease the volume of the chambers, indicating that the material is more dense, the eccentric 514 will be adjusted to shorten the throw of the eccentric 508 correspondingly, extreme density of the material effecting adjustment of the eccentric 514 to a position to hold the arm 506 away from the eccentric 508 so that no tapping is effected.

Referring now to Fig. 27, a modified form of settling mechanism therein illustrated includes an electric vibratory motor 528 arranged to effect vibration of a thin flexible strap 530 secured at one end to the machine frame and connected by the links 505 to the vertically reciprocal rod 502. Provision is made for increasing or decreasing the amplitude of vibration of the motor 528 through connections to the adjusting screw 200. As herein illustrated, a variable voltage transformer 532 in circuit with the vibratory motor is arranged to cooperate with a contact 534 carried by a nut 536 mounted on a threaded extension 538 of the adjusting screw 200. In operation movement of the contact 534 relative to the transformer 532, as effected by rotation of the adjusting screw 200 to change the volume of the chambers 14 in response to the check weighing apparatus, will vary the voltage to the vibratory motor, thus varying the amplitude of vibration in accordance with the density of the material delivered into the containers. Adjustment of the screw 200 to reduce the volume to a predetermined minimum, indicating relatively great density of the material, will effect movement of the contact 534 to a position of minimum voltage wherein no vibration will be effected.

Another modified form of settling mechanism, as illustrated in Fig. 28, includes a pneumatically operated motor 540 controlled by a valve unit 542 arranged to be adjusted through connections from the adjusting screw 200 to increase or decrease the effective air pressure delivered to the motor 540 in accordance with the density of the material and thus vary the rate of reciprocation of the air motor accordingly. As herein shown, the pneumatically operated motor 540 includes a piston 543 slidably mounted in a cylinder 544, the piston being connected to the lower end of the tapping rod 502. The piston 543 is urged downwardly against a shoulder 546

14

in the cylinder by a spring 548, and the piston is urged upwardly by the air under pressure entering the chamber 550 beneath the piston. As herein shown, the air enters the chamber through passageways 552 and grooved portion 554 which communicates with an inlet 555 connected by a pipe 556 to the valve unit 542. When the piston 543 is urged upwardly by the air pressure, the grooved portion 554 leaves the inlet 555 and comes into communication with an air outlet 558 formed in the cylinder to release the air to the atmosphere whereupon the spring forces the piston down and the cycle is repeated. The valve unit 542 may comprise a block 560 having a chamber 561 provided with an inlet 562 connected to a source of compressed air by a pipe 563, the chamber outlet 564 being connected by the pipe 556 to the motor 540. The inlet 562 is provided with a conical valve seat arranged to cooperate with a correspondingly shaped stem 565 having a threaded portion engaged in the upper end of the block and connected through the reduction gear train 516 to an extended portion of the adjusting screw 200, as shown. Thus, in operation rotation of the screw 200 in a direction to reduce the volume of the measuring chambers 14, indicating that the material is relatively dense, will effect movement of the stem 565 toward the valve seat to reduce the air inlet and thus effect operation of the tapping mechanism at a relatively slow rate, and conversely, rotation of the screw 200 in the other direction, indicating that the material is less dense, will effect movement of the stem to increase the air inlet and thus effect operation of the tapping mechanism at a faster rate, to the end that successive containers will be filled to a substantially uniform level irrespective of the density of the material. Rotation of the screw 200 to reduce the volume to a predetermined minimum, indicating relatively great density of the material will effect movement of the stem 565 to close the valve whereby to discontinue the settling operation.

Referring now to Fig. 29, in a still further modified form of tapping settling mechanism, the height level of the material in the container may be ascertained by photo-electric means, which may be arranged in a circuit with a plurality of solenoid operated air valves connected to a pneumatically operated vibrating motor, the air valves having different size valve openings and the photo-cells being arranged to selectively open one of the solenoid valves to effect appropriate settling operation in accordance with the filling height. Since the filling height is a measure of the volume of the adjustable measuring chambers 14 and thus also a measure of the density of the material, the embodiment illustrated in Fig. 29 may be employed to vary the tapping operation in accordance with variations in the density of the material as determined by the height of the material in the container.

As diagrammatically shown in Fig. 29, the filling level of the material in a container may be determined by one of a plurality of photo-electric cells 570, 571, 572 arranged to be selectively energized by light reflected from the upper surface of the material at different levels. The light source may comprise a lamp 573 provided with a lens 574 for concentrating the light on the material, and the reflected light may pass through lens 575 to its respective photo-cell. Thus, as illustrated, light reflected from a relatively high level will energize the photo-cell 570; light reflected from an intermediate level will energize the photo-cell 571; and light reflected from a still lower level will energize the photo-cell 572.

The photo-cells 570, 571, 572 are connected in an electrical circuit to individual amplifying units 576, 577, 578 which in turn are connected to individual solenoids 580, 581, 582 respectively of solenoid operated air valves 583, 584, 585. Each solenoid operated air valve 583, 584, 585 comprises a block provided with an air chamber 586 having an inlet connected by a pipe 587 to a regulated source of compressed air, and having outlets 588 connected by a pipe 589 to a pneumatically operated vibrat-

ing motor 540, similar to the motor shown in Fig. 28, and which is provided with a piston connected to the lower end of the tapping rod 502.

Each value inlet is provided with a conical valve seat arranged to cooperate with a similar shaped stem or needle 590 comprising the armatures of the solenoids 580, 581, 582. Each inlet comprises a restricted opening for modulating the air pressure delivered to its respective air chamber 586 whereby to vary the tapping or settling operation, and as herein shown, the valve unit 583 is provided with a relatively large inlet opening 591; the valve unit 584 is provided with an intermediate size inlet opening 592; and the valve unit 585 is provided with a relatively small restricted inlet or valve opening 593.

The photo-electric level detecting or determining device is preferably disposed at a point to detect the level of the material in a container prior to arrival of the container at the tapping station and during the continuous movement of the containers through the machine. In operation it is desired to provide a substantially uniform filling level in successive containers irrespective of the density of the material in successive weighed loads by settling the loosely packed or less dense material until it settles to a more or less uniform level. Thus, it will be observed that the various levels herein illustrated have been exaggerated for clearness of description and illustration. Thus, assuming that the lower level, indicated at 594, is the desired level of the material, which actually would be only a short distance from the top of the container, it will be seen that none of the photo-cells will be energized when the light strikes such lower level, thus indicating that the material is of such density as not to require settling, and in such event none of the normally closed valve units 583, 584, 585 will be opened.

Thus, in the operation of the device illustrated in Fig. 29 when the material in the weighed load is relatively loose so as to fill the container to a point relatively near the top of the container, as indicated by the level at 595, the light will be reflected to energize the photo-cell 570 to effect opening of the valve unit 583 having a large inlet opening 591 arranged to effect maximum frequency of vibration of the air motor 540 to settle the loosely packed material to a point approximating the desired level 594. Similarly, intermediate lower levels of the material, as indicated at 596 and 597 will individually energize its photo-cell 571 or 572 to effect opening of its respective valve unit 584 or 585 having progressively smaller inlet openings 592, 593 to effect proportionately less vibrating movement of the tapping rail 501 to reduce the height of the material to a point near the desired level 594.

From the above description of the various embodiments of the invention it will be seen that different filling levels of uniform weight loads as caused by differences in density of different batches of material being weighed are avoided, and that substantially uniform filling levels are maintained by settling the material an amount proportionate to the density as determined by differences in volume or filling level of the weighed load so that when the containers are opened by the consumer they will be found to be filled to a uniform level. As above described, in practice, the size of the container may be regulated by the volume of a weighed load of maximum density plus an additional volume to maintain a reasonable clearance between the top of the container and the filling level, all loads of less density being settled to a point corresponding to the level of the maximum density load.

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 volumetric filling machine, in combination, load measuring means, means for check weighing a measured

load, means responsive to the check weighing means for adjusting the load measuring means to vary the volume when the measured load deviates from a predetermined weight in accordance with variations in the density of the material being handled, means for depositing the load in a container, means for agitating the container to settle the material therein, and control means for modifying the agitating operation in accordance with variations in volume of said predetermined weight as caused by the variations in density of the material.

2. In a volumetric filling machine, in combination, load measuring means, means for check weighing a measured load, mean responsive to the check weighing means for adjusting the load measuring means to vary the volume when the measured load deviates from a predetermined weight in accordance with variations in the density of the material being handled, means for depositing the load in a container, means for agitating the container to settle the material therein, and control means for modifying the agitating operation in accordance with variations in the density of the material as detected by said check weighing means whereby to effect settling of loads of different densities to substantially the same level in the container.

3. In a volumetric filling machine, in combination, load measuring means, means for check weighing a measured load, means responsive to the check weighing means for adjusting the load measuring means to vary the volume when the measured load deviates from a predetermined weight in accordance with variations in the density of the material being handled, means for depositing the load in a container, means for agitating the container to settle the material therein, and control means operatively connected to said volume adjusting means for modifying the agitating operation in accordance with variations in volume of said predetermined weight as caused by the variations in density of the material whereby to effect settling of loads of different densities to substantially the same level in the container.

4. In a volumetric filling machine, in combination, load measuring means, means for check weighing a measured load, means responsive to the check weighing means for adjusting the load measuring means to vary the volume when the measured load deviates from a predetermined weight in accordance with variations in density of the material being handled, means for depositing the load in a container means for determining the height of the material in the container, means for agitating the container to settle the material therein, and means controlled by variations in the height of the material in the container for modifying the agitating operation whereby to effect settling of loads of different densities to substantially the same height in the container.

5. In a volumetric filling machine, in combination, load forming means including a plurality of adjustable measuring chambers, check weighing means associated with one of said chambers arranged to receive and check weigh the load, means responsive to the check weighing means for varying the volume of said measuring chambers when the measured load deviates from a predetermined weight in accordance with variations in the density of the material being handled, said volume varying means including a volume adjusting member, means for delivering the measured loads into containers, means for agitating the containers to settle the material therein, and control means responsive to the movement of said adjusting member for modifying the agitating operation in accordance with variations in volume of said predetermined weight whereby to effect settling of loads of different densities to substantially the same height in the containers.

6. A volumetric filling machine as defined in claim 5 wherein the agitating means includes a vibratory rail, means for vibrating said rail and connections between

the volume adjusting member and said vibrating means for varying the vibratory movement.

7. A volumetric filling machine as defined in claim 5 wherein the agitating means includes a mechanically vibrated arm, and connections between said arm and said volume adjusting member for varying the amplitude of vibration of said arm.

8. A volumetric filling machine as defined in claim 5 wherein the agitating means includes a pivoted vibratory arm, and an eccentric for vibrating said arm, stop means engageable with said arm for limiting the movement thereof in one direction, and connections between said stop means and said volume adjusting member for changing the position of said stop means relative to the arm to vary the amplitude of vibration of said arm.

9. A volumetric filling machine as defined in claim 5 wherein the agitating means includes a vibratory motor, an electrical circuit for said motor, a variable transformer connected in said circuit arranged to vary the voltage to said vibratory motor, and connections between said volume adjusting member and said variable transformer for automatically varying the voltage whereby to vary the frequency of vibration of said motor.

10. A volumetric filling machine as defined in claim 5 wherein the agitating means includes a pneumatically operated vibrator and a compressed air line to said vibrator, an adjustable air valve in said line arranged to vary the air pressure to said vibrator, and connections between said volume adjusting member and said valve for automatically varying the air pressure whereby to vary the frequency of vibration of said pneumatically operated vibrator.

11. In a volumetric filling machine, in combination, load forming means including a plurality of adjustable measuring chambers, check weighing means associated

with one of said chambers arranged to receive and check weigh the load, means responsive to the check weighing means for varying the volume of said measuring chambers when the measured load deviates from a predetermined weight in accordance with variations in the density of the material being handled, means for delivering the measured loads into containers, means for agitating the containers to settle the material therein, means for detecting the height of the material in successive containers to determine the volume thereof, and means controlled by said detecting means for modifying the settling operation in accordance with variations in density of the material as indicated by the volume whereby to effect settling of loads of different densities to substantially the same height in the containers.

12. A volumetric filling machine as defined in claim 11 wherein the height detecting means includes photoelectric means arranged to detect variations in height of the material in successive containers during the continuous movement thereof through the machine.

13. A volumetric filling machine as defined in claim 12 wherein the agitating means includes pneumatically operated vibrating means, and a plurality of solenoid operated air valves operatively connected to said vibrating means, said air valves having different size valve openings and arranged to be selectively actuated by said photoelectric means for varying the agitating operation.

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