

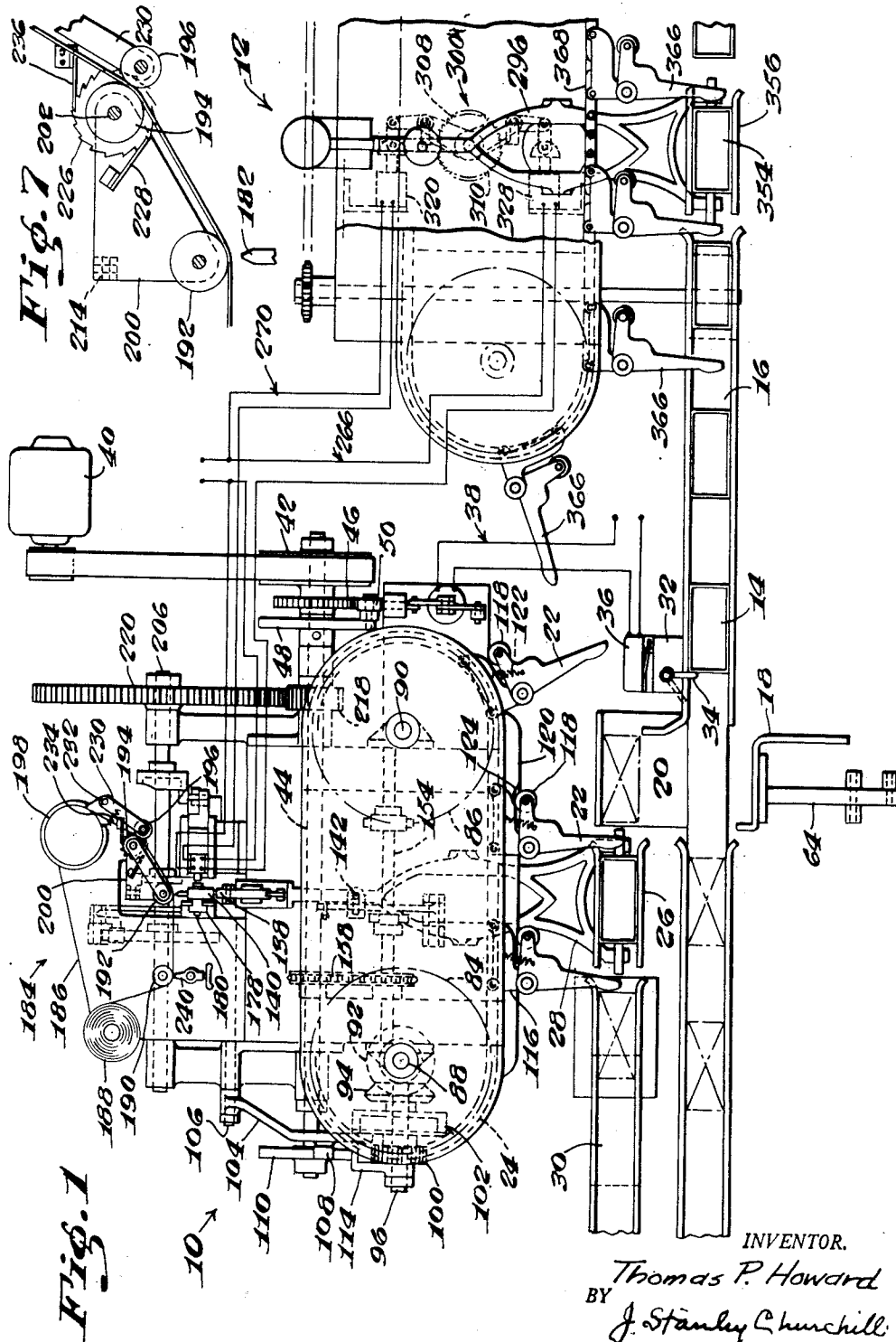
Dec. 21, 1954

T. P. HOWARD  
PACKAGING MACHINE

2,697,580

Filed Oct. 20, 1950

6 Sheets-Sheet 1



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Dec. 21, 1954

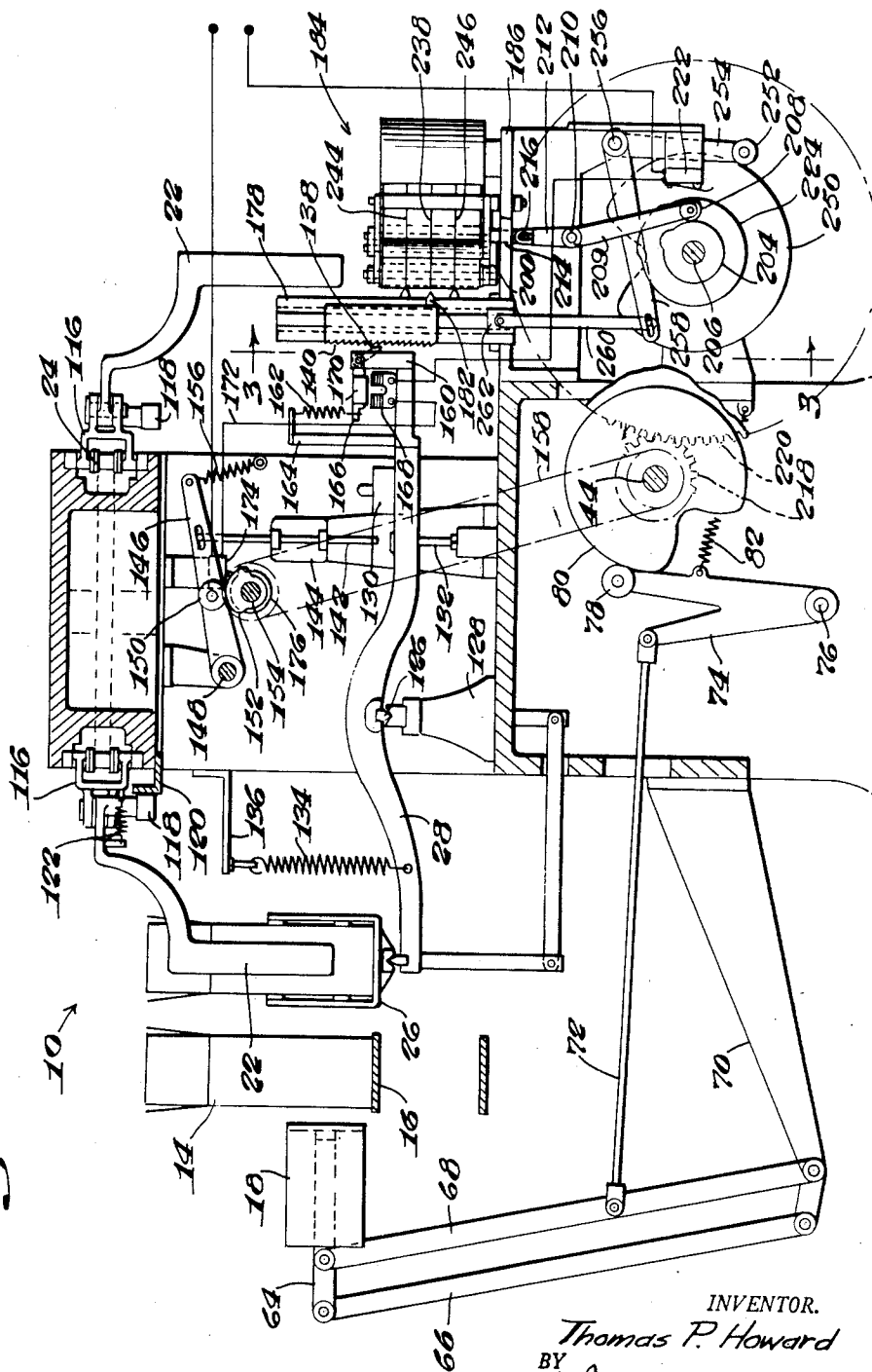
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6 Sheets-Sheet 2

Fig. 2



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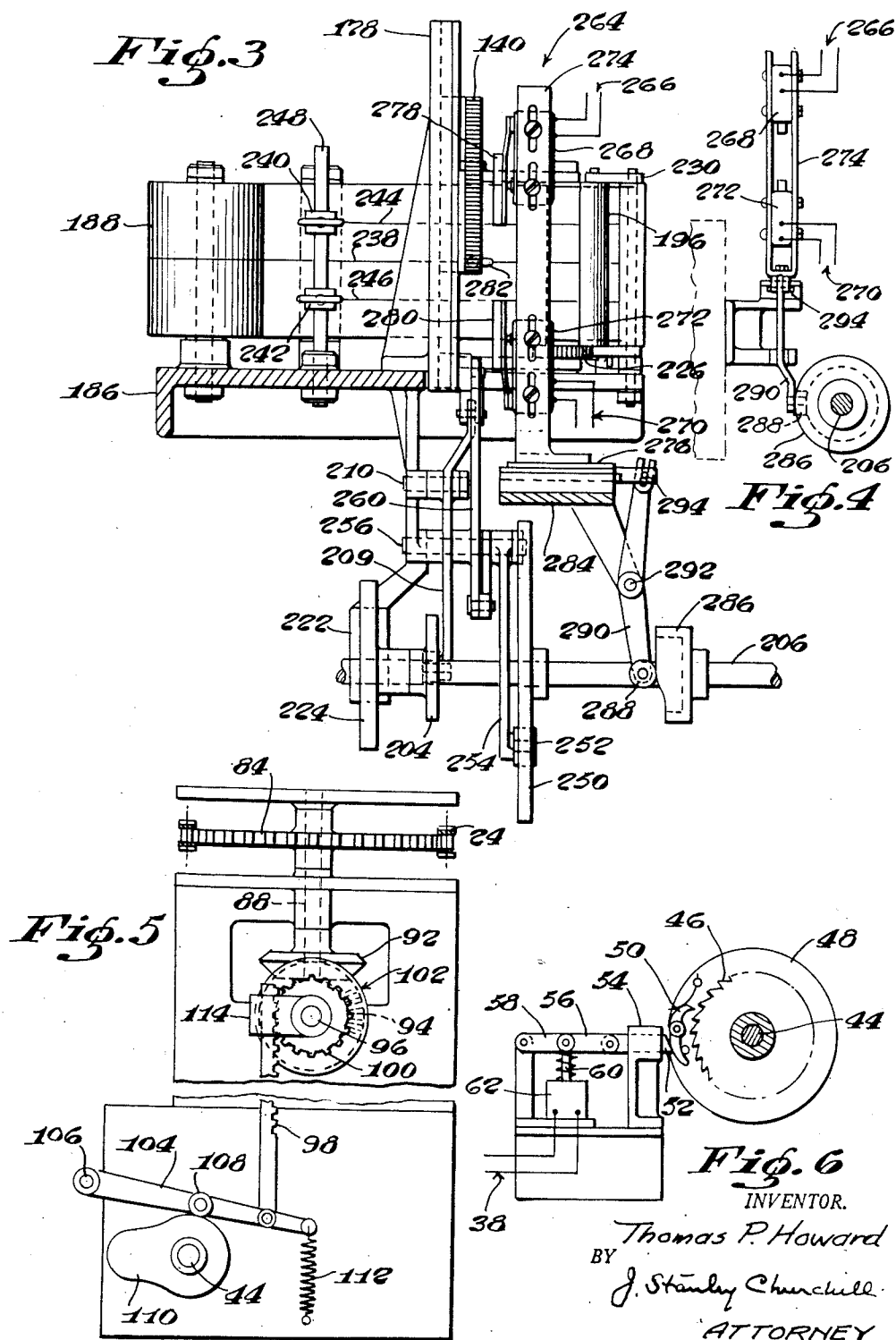
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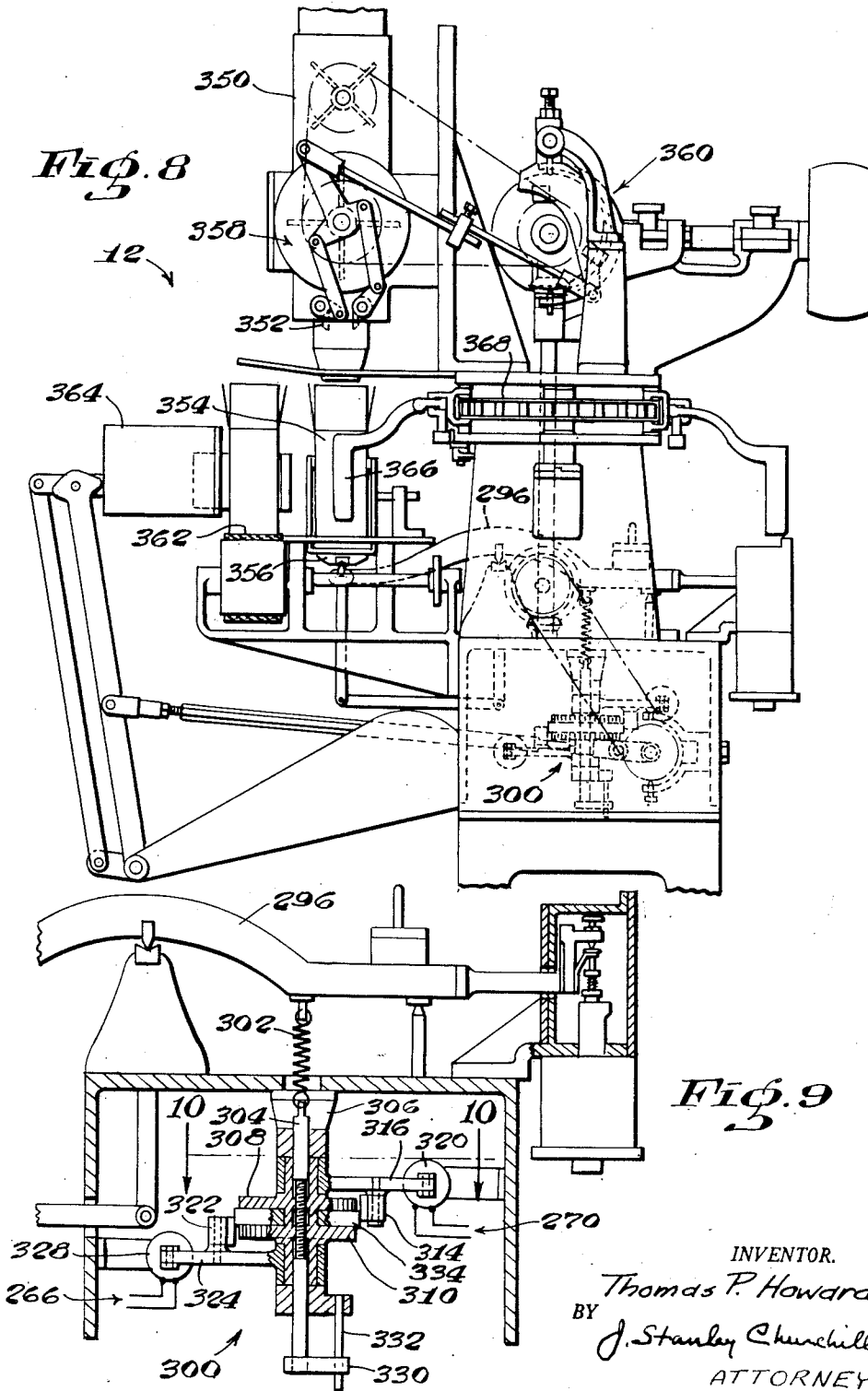
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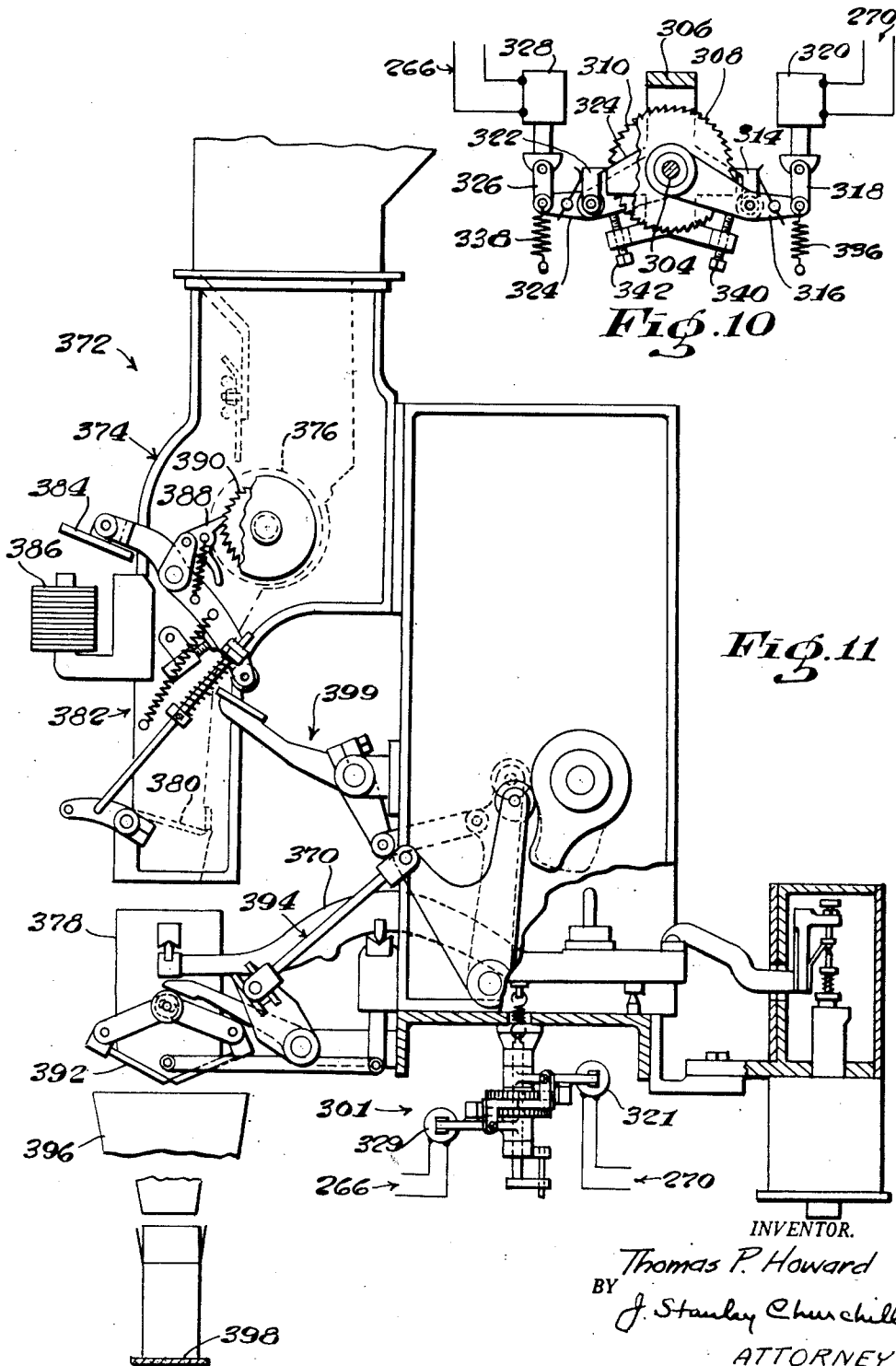
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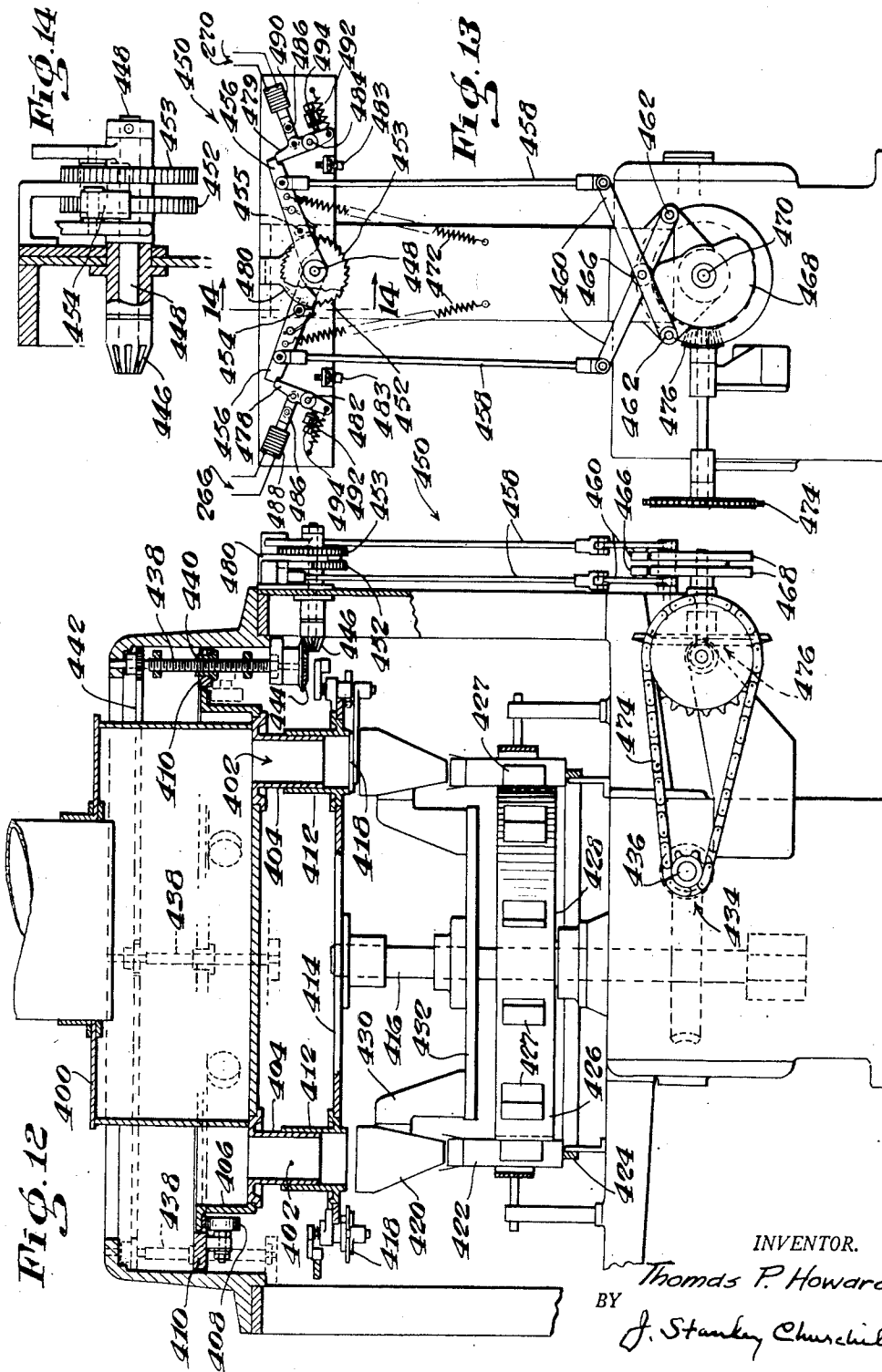
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T. P. HOWARD  
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2,697,580

## PACKAGING MACHINE

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Application October 20, 1950, Serial No. 191,111

17 Claims. (Cl. 249—2)

This invention relates to packaging machines.

One object of the invention is to provide novel and highly efficient check-weighing apparatus in which provision is made for determining the deviation in the weight of an article from a predetermined weight and for ascertaining the average algebraic deviation of a plurality or group of the weighed articles from a predetermined weight and also for indicating the average algebraic deviation from such predetermined weight of the group thus check weighed.

A further object of the invention is to provide a novel packaging machine embodying load-forming mechanism for producing either a measured load or a weighed load and also embodying check-weighing apparatus of novel structure having provision for ascertaining the average algebraic deviation of a plurality or group of loads formed by the load-forming mechanism from a predetermined weight, and in which provision is made for thereafter automatically increasing or decreasing by a definite increment the weight of the load formed by the load-forming mechanism in the event that the average algebraic deviation thus determined varies beyond predetermined amounts.

A still further object of the invention is to provide a novel machine for producing successive articles and for check weighing the same, and wherein provision is made for ascertaining the average algebraic deviation of a plurality or group of such articles from a predetermined weight and for thereafter automatically controlling the machine to increase or decrease the weight of succeeding articles being formed by the machine in the event that the aforesaid average algebraic deviation thus determined varies beyond predetermined amounts.

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

In the drawings, Fig. 1 is a plan view of a novel packaging machine embodying gross-weight weighing mechanism for forming weighing loads in succeeding cartons and a check-weighing mechanism of novel construction and operation operatively connected to the gross-weight weighing mechanism to effect corrections in the formation of the weighing loads in response to determinations of average algebraic deviations beyond definite amounts from a predetermined weight of a plurality of weighed loads; Fig. 2 is a side elevation, partly in cross section, of the check-weighing mechanism shown in Fig. 1; Fig. 3 is a front elevation, partly in cross section, of the totalizing, recording, and detecting mechanism as viewed from the line 3—3 of Fig. 2; Fig. 4 is a side elevation of the detecting mechanism shown in Fig. 3; Fig. 5 is a side elevation of the carrier-driving mechanism as viewed from the left in Fig. 1; Fig. 6 is a side elevation of a portion of the driving mechanism as viewed from the right in Fig. 1; Fig. 7 is an enlarged plan view detail, partly in cross section, of a portion of the recording and paper-advancing mechanism; Fig. 8 is a side elevation of portions of the packaging machine shown in Fig. 1 embodying the correcting mechanism referred to; Fig. 9 is a cross-sectional view of the correcting mechanism embodied in the machine shown in Figs. 1 and 3; Fig. 10 is a plan view of the correcting mechanism shown in Fig. 9; Fig. 11 is a side elevation of a sufficient portion of a net-weight weighing machine embodying the mechanism for correcting the operation thereof in response to determinations of the

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average algebraic deviations beyond definite amounts from a predetermined weight of a plurality of weighed loads; Fig. 12 is a cross-sectional view of a sufficient portion of a volumetric filling machine to enable the invention to be understood and wherein the machine is provided with correcting mechanism of the general type of the correcting mechanism embodied in the machines of Figs. 8 and 11; Fig. 13 is a side elevation of the volume-correcting mechanism shown in Fig. 12; and Fig. 14 is a detail view, partly in cross section, of the correcting mechanism as seen from the line 14—14 of Fig. 13.

Referring to the drawings, the invention in one of its aspects contemplates novel check-weighing apparatus which is highly useful for any of the industrial purposes for which present check-weighing apparatus is or may be used. In another of its aspects the invention contemplates a packaging machine for packaging flowable solid material and other commodities in containers, such as cartons, and in this aspect of the invention such packaging machine embodies gross-weight weighing apparatus operatively connected to check-weighing mechanism, or net-weight weighing apparatus operatively connected to check-weighing mechanism, or a volumetric filling apparatus operatively connected to check-weighing mechanism, and provision is made in all of the three embodiments of the invention described for controlling the operation of the packaging machine to correct the formation of the weighed or measured loads in response to determinations of the average algebraic deviations beyond definite amounts from a predetermined weight of a plurality or group of the check-weighed loads.

Reference is made to U. S. patent to Howard No. 2,116,895 for a complete disclosure of the gross-weight weighing apparatus shown in Figs. 1 to 8. Reference is also made to the U. S. patent to Howard No. 2,364,902 for a more complete disclosure of the net-weight weighing machine illustrated in Fig. 11; and reference is also made to the U. S. patent to Delamere et al. No. 1,527,030 for a complete disclosure of the volumetric filling machine shown in Fig. 12, and only sufficient portions of such patented machines have been herein illustrated as will enable the present invention to be understood, reference being made to such patents for a more complete disclosure thereof.

The present check-weighing apparatus of itself is, as above set forth, useful for any of the purposes for which prior check-weighing apparatus has or may be used. In Figs. 1 and 8 I have illustrated a packaging machine wherein the check-weighing apparatus is operatively connected to and arranged to control the load-forming mechanism of a gross-weight weighing machine of the type illustrated in the Howard Patent No. 2,116,895, but it will be understood that the check-weighing apparatus may be used alone or for controlling other machines, as for example, the net-weight weighing machine shown in Fig. 11 and the volumetric filling machine shown in Fig. 12.

The nearest check-weighing apparatus is characterized by weighing mechanism which may comprise any usual or preferred type of weighing mechanism and which embodies means for determining, either directly or indirectly, the variation or deviation of an individual load or article being check weighed from a predetermined weight. The check-weighing apparatus further embodies means for ascertaining the average algebraic deviation of a plurality of the weighed loads or articles and for indicating, and preferably graphically recording, the amount of the average algebraic deviation of a group or plurality of such loads or articles.

The determination of the average algebraic deviation of the weights of a plurality of loads or particles being check weighed may be determined in various ways, as for example, each load or article may be check weighed, the deviations algebraically totalized, and the total divided by the number of articles or loads to give the average algebraic deviation. Another method involves the addition of the individual weights of the articles or loads making up the group, the division of this total by the number of articles in this group and the subtraction of the predetermined weight therefrom to give the average algebraic deviation. Another method involves the check weighing of each article of the group, the totalization of the weights,

the division of the total by the number of articles in the group, and the subtraction of the predetermined weight therefrom to give the average algebraic deviation. Another method involves the weighing of all of the articles or loads in the group, the subtraction therefrom of the product of the number of articles times the predetermined weight, and then the division of this amount by the number of articles in the group, to give the average algebraic deviation.

When the present check-weighing apparatus is embodied in or operatively connected to a machine whose operation it is desired to control, as for example, a filling machine of either the weighing or measuring type, provision is made for controlling the operation of such machine in response to the average algebraic deviation of successive groups or samples comprising a plurality of the products or loads produced by such machine. In practice the samples or groups should be uniformly taken at regular intervals over a day's run, and it is preferred that the number of individual articles or loads being produced by the machine to be controlled making up each sample group should at least equal three and preferably be five or more.

Experience has shown that this method of sampling and of controlling the operation of a machine, and particularly a packaging machine, possesses important commercial utility over prior attempts which have been made to control the operation of such machines by check weighing individual articles or loads produced and then attempting to continuously correct the machine in response to each deviation of an individual load or article from a predetermined weight. In many such instances the attempted corrections result in further increase in the deviations instead of in their reduction.

Referring now to Figs. 1 and 2, 10 represents the present check-weighing apparatus, and 12 represents a packaging machine illustrated in Fig. 1 as comprising a gross-weight weighing machine, from which the filled packages 14 may be delivered to the check-weighing apparatus by a continuously moving conveyer belt 16. The packages delivered from the weighing machine 12 are arranged to be transferred by a package pusher 18 from the delivery belt 16 onto a receiving plate 20 and into the path of intermittently movable carrier arms 22, a plurality of which are mounted on a carrier chain 24 forming a part of the check-weighing apparatus. In operation, the package on the receiving plate 20 is moved onto the scale pan 26 of the check-weigher scale beam 28, the preceding package on the scale pan being thereby moved onto a continuously moving discharge conveyer 30 to be delivered from the machine.

While the present check-weighing machine may be arranged to check weigh successive packages delivered from the weighing machine, in practice it is preferred to transfer alternate packages from the delivery belt into the check-weighing apparatus.

The mechanism for controlling the transfer of alternate packages from the delivery belt 16 onto the receiving plate 20 may include a commercially available counter 32 mounted adjacent one side of the conveyer and having an arm 34 arranged to be engaged by the packages moved therepast. The counter 32 is designed to be actuated to close a micro-switch 36 when the arm 34 is engaged by alternate packages. The micro-switch 36 forms part of a circuit 38 for initiating a cycle of operation of the check-weighing apparatus thus effecting transfer of alternate packages into the check weigher, the intermediate packages being permitted to continue their progress along the conveyer belt past the package pusher 18 and out of the machine as indicated in Fig. 1. It will be apparent that in practice the counter 32 may be arranged to be actuated to initiate a cycle of operation and effect the transfer of a package into the check weigher upon engagement of the arm 34 by any sequence of packages, such as every third or every fifth package passing along the conveyer, including successive packages as desired.

As illustrated in Fig. 1, the check weigher 10 may be driven from a motor 40 belted to a pulley 42 loosely mounted on a main cam shaft 44, the pulley being formed integrally with a ratchet 46 forming the driving member of a one-revolution clutch. The driven member of the clutch comprises a pawl-carrier disk 48 fast on the cam shaft and provided with a spring-pressed pawl 50 arranged

to cooperate with the ratchet to effect rotation of the cam shaft 44 when the pawl stop is withdrawn. Provision is made for controlling the operation of the one-revolution clutch to initiate a cycle of operation of the check-weighing apparatus when the counter-operated micro-switch circuit 38 is closed and to discontinue driving engagement of the clutch at the end of one revolution. As shown in Fig. 6 a pawl stop 52 slidably mounted in a bracket 54 is arranged to normally engage the tail of the pawl 50 to maintain the same out of driving engagement with the ratchet 46. The pawl stop is connected by toggle links 56, 58 to the armature 60 of an electromagnet 62 connected in the micro-switch circuit 38. In operation, when the micro-switch 36 is closed by the counter 32, the electromagnet is energized to withdraw the pawl stop 52 and permit driving engagement of the spring-pressed pawl with its ratchet. Immediately thereafter the spring returns the pawl stop into the path of the pawl to disengage the same from the ratchet and discontinue rotation of the cam shaft at the end of one revolution.

Upon initiation of a cycle of operation of the cam shaft 44, the package pusher 18 is arranged to be operated to transfer a package from the belt 16 onto the receiving plate 20, and as shown in Fig. 2, the package pusher is mounted on a bar 64 supported by parallel links 66, 68 which are rockingly supported at their lower ends in a bracket 70 attached to the machine frame and arranged to impart a substantially straight-line movement to the pusher. One of the links 68 is connected by a rod 72 to one arm of a cam lever 74 pivotally mounted at 76, the second arm being provided with a cam roll 78 cooperating with a package-pusher cam 80 fast on the shaft 44. A spring 82 is connected to the lever 74 to hold the cam roll against its cam.

The package-carrier chain 24 is then moved to advance the packages one station of operation. As herein shown, the carrier chain is arranged to run around sprockets 84, 86 mounted on vertical shafts 88, 90 respectively, journaled in the machine frame at each end of the machine. One of the shafts 88 is provided with a bevel gear 92 arranged to mesh with a bevel gear 94 fast on a horizontal shaft 96, see Fig. 5. Provision is made for intermittently rotating the horizontal shaft 96 to effect advancement of the carriers through cam-operated connections including a gear rack 98 arranged to mesh with a pinion 100 loosely mounted on the shaft 96 and formed integrally with the drawing member of a unidirectional clutch of conventional design, indicated generally at 102, the driven member of the clutch being fast on the shaft 96. The rack 98 is connected at its lower end to a cam lever 104 which is rockingly mounted at 106 and is provided with a cam roll 108 for cooperation with a cam 110 fast on the cam shaft 44. A spring 112 connected to the outer end of the lever 104 is arranged to hold the roll against its cam and to effect downward movement of the rack. A retaining member 114 loosely carried on the outer end of the shaft 96 is arranged to retain the rack in engagement with its pinion. In operation, when the rack 98 is moved in one direction the driving and driven members of the unidirectional clutch 102 are in driving engagement to effect rotation of the shaft 96 and advancement of the packages, and when the rack is moved in the opposite direction the clutch members are disengaged to prevent reverse rotation of the shaft during the return of the rack to its initial position. It will be observed that the carrier arms 22 are pivotally mounted on carrier members 116 attached to the carrier chain 24, each carrier being provided with a roller 118 arranged to engage a stationary cam piece 120 in order to maintain the arms 22 extended substantially at right angles to the chain during the movement of the carriers. The carriers are urged to rock in a counterclockwise direction, viewing Fig. 1, by a spring 122 connected between the carrier 22 and its supporting member 116. In order to permit each carrier arm to be retracted or to rock away from the package at the check-weighing station when the chain comes to rest, the cam piece 120 may be provided with a low spot 124, thus preventing interference with the weighing operation.

From the description thus far it will be observed that alternate of successive filled packages delivered from a packaging machine are arranged to initiate a cycle of operation of the check weigher and that such alternate packages are transferred into the check weigher and

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moved onto the scale pan 26 of the check-weighing scale beam 28. As illustrated in Fig. 2, the check-weighing scale beam is mounted to rock on the usual knife edges 126 supported in a bracket 128 attached to the machine frame and is provided with an adjustable counterweight 130. The counterweight end of the scale beam is arranged to rest against a fixed stop 132.

The sensitivity of the weighing element of the check-weighing apparatus will be selected in accordance with the maximum and minimum weight limits of the articles to be check weighed, and in practice the maximum and minimum weight limits of the loads produced by the weighing or filling machine with which the present check-weighing apparatus is to be used are first determined experimentally under normal running conditions. Thereafter the scale beam of the check-weighing apparatus is adjusted by the adjustable counterweight so that the scale beam is in balance and just ready to move off the solid stop 132 when the minimum weight limit is applied to the scale pan 26. Any weight in excess of the minimum will then depress the scale beam an amount proportional to such excess. As herein shown a coil spring 134 connected between the weighing end of the scale beam 28 and a bracket 136 attached to the machine frame serves as an additional counterweight, and the extension of the coil spring is proportional to the excess of the load being weighed over the minimum weight limit.

Provision is made as will be described for totalizing the weight in excess of the minimum weight limit of each of the N packages in the group or plurality of packages comprising the sample being check weighed. This totalized figure will thus be N times the average weight of the group, and by utilizing a graph paper having a scale per ounce equal to N times the displacement per ounce of the totalizing device, it is possible to read directly in ounces the totalized displacement as the average weight of the group of N packages.

It will be understood that the scale beam may be counterweighted so as to be depressed by either an underweight or overweight package, and that in both events the extent of the depression of the scale beam serves as a measure of the weight of the load.

Referring now particularly to Fig. 2, a pawl 138 carried by the counterweight end of the scale beam is arranged to cooperate with a frictionally held and vertically displaceable rack 140 during the return movement of the scale beam after each check-weighing operation. The scale beam is arranged to be returned to its initial position against the fixed stop 132 by a cam-operated locking rod 142 mounted for vertical reciprocation in a bracket 144 attached to the machine frame. The upper end of the rod 142 is bent at right angles and engaged in a slotted opening formed in a cam lever 146 pivotally mounted at 148 and provided with a cam roll 150 for cooperation with a cam 152 fast on a cam shaft 154. A spring 156 connected to the outer end of the lever 146 is arranged to hold the roll against its cam. The cam shaft 154 is arranged to be driven by a chain and sprocket drive 158 connected to the cam shaft 44. In operation the scale beam is maintained in its locked position during the advance of a package onto the scale pan whereupon the scale beam is unlocked to perform the check-weighing operation. After a predetermined time, sufficient to rock the scale beam and complete the check-weighing operation, the pawl 138, which is normally disengaged from the indicating rack 140, is arranged to be engaged therewith whereupon the scale beam is again locked to return the beam to its initial position and to effect movement of the rack 140 a distance proportionate to the rocking movement of the beam which is in turn proportioned to the deviation from the counterweight of the weight of the article being check weighed.

As illustrated in Fig. 2, the pawl 138 is pivotally mounted in a bracket 160 attached to the counterweight end of the scale beam 28 and is normally arranged to be maintained in an inoperative position by a spring 162 connected between a spring stud 164 and an arm 166 extended from the pawl. The pawl is arranged to be moved into engagement with the rack by an electromagnet 168 having an armature 170 mounted on the pawl arm 166. The electromagnet 168 forms part of a circuit 172 including a micro-switch 174 which is arranged to be closed by a cam 176 to energize the electromagnet. The cam 176 is mounted on the shaft 154 and is designed to close the

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circuit after a predetermined time in the cycle of operation sufficient to permit rocking of the scale beam in response to the load being check weighed.

Provision is made in the illustrated embodiment of the invention for totalizing successive increments of movement of the scale beam in returning to its position against the stop 132 after each check-weighing operation of the individual loads comprising the group sample. In this manner the total excess of the group over the minimum weight limit for which the scale beam has been adjusted as above set forth is indicated by the extent of movement of the vertically movable rack 140. In practice the stylus 182 carried by the rack will be correlated with respect to the particular scale upon the graph paper with which the stylus cooperates so that the final position resulting from its successive increments of movement corresponding to the individual excesses in the weight of each member of the group over the minimum weight limit will be proportionate to the total algebraic deviation, if any, under or over the predetermined weight for which the packaging machine has been set. For example, if the minimum weight limit is selected at 15 ounces for a predetermined weight of load of 16 ounces and the maximum limit is set at 17 ounces, then if the packaging machine is operating perfectly, the return movement of the scale beam at the end of each check-weighing operation will effect movement of the rack 140 so that the stylus 182 will at the end of the check-weighing of the group sample be disposed at the zero or central line 238 on the recording graph, and if the algebraic average of the totalized weights is less than 16 ounces, then the stylus will be disposed between the minimum limit corresponding to the line 244 and the zero line 238. The stylus will be proportionately moved to dispose it between the zero line and the maximum limit in the event that the algebraic average weight exceeds 16 ounces.

At the completion of N cycles of operation of the check weigher, that is at the end of the check weighing of each sample group, provision is made for making a graphic record on a chart or roll of paper from which the average algebraic deviation of the group may be read and for resetting the rack and stylus back to their initial positions from which the next group may be totalized.

To establish the plus and minus control limits to be used for either automatic or manual correction of the packaging or other machine when package group weights exceed these limits, it is preferred to first run the packaging machine under normal conditions with the recording device in operation, and after sufficient groups have been recorded to establish normal machine performance, to then locate the control limits by inspection and set the two limit pens on these limits so they will continuously thereafter trace the control limit lines on the graph paper. As shown in Fig. 2, these limits may be represented by the lines 244 and 246. These lines should generally be located so that the control limits are just slightly more accurate than the normal machine performance. Such location will prove advantageous even though it results in a few false corrections for group weights which lie in the extreme upper and lower normal range.

In accordance with one aspect of the present invention, the packaging or other machine may be controlled to correct its load-forming operation in response to the indicated average algebraic deviations of the sample groups of packages check weighed. As herein shown, however, provision is made for automatically increasing or decreasing preferably by a definite increment the weight of load formed by the load-forming mechanism in the event that such average algebraic deviation varies beyond a predetermined amount, herein shown as defined by the limit lines 244 and 246 on the graph paper.

As herein shown, the vertically displaceable rack 140 is mounted to be moved in a bracket 178 attached to the machine frame, the bracket being provided with a friction member 180 arranged to retain the rack in the position to which it is moved. The rack is initially disposed in a predetermined elevated position in the bracket and is provided with a recording stylus 182 against which the recording paper is pressed at the completion of the predetermined number of check-weighing cycles.

As illustrated in Fig. 1, the recording mechanism indicated generally at 184 is supported in a bracket 186 forming a part of the machine frame, and includes a supply roll 188 of recording paper, preferably pressure-sensitive

paper, which is guided over idler rolls 190, 192 between a paper-advancing roll 194 and a pressure roll 196, and then into a coil box 198 to be rewound. The idler roll 192 is supported by a triangular plate 200, see Fig. 7, pivotally mounted at 202 in the bracket 186, and in operation the plate 200 is arranged to be rocked to press the surface of the pressure-sensitive paper against the recording stylus 182 to form a mark. As shown in Fig. 2, the plate 200 is rocked by a cam 204 fast on a cam shaft 206 and connections including a cam roll 208 carried by a lever 209 pivotally mounted at 210. A second arm 212 of the lever is connected to a depending extension 214 of the plate 200 by a pin and slot connection 216.

The cam shaft 206 may be driven from the main cam shaft 44 through a pinion 218 and gear 220 arranged to drive the cam shaft 206 at a reduced rate of speed proportional to the predetermined cycles of operation of the check weigher plus an additional cycle of operation during which time the check weigher is arranged to be inoperative to effect movement of the rack 140. In other words, assuming that five packages comprise the sample group and are to be check weighed before the recording mechanism is to operate, the main cam shaft 44 will make six revolutions during one revolution of the cam shaft 206, and the recording cam 204 is designed to operate to perform the marking operation during the sixth cycle of the check-weighing operation.

The mechanism for rendering the check weigher inoperative to move the rack 140 during the sixth cycle, as shown in Fig. 2, may comprise a normally closed micro-switch 222 included in the circuit 172 for the pawl electromagnet 168, the normally closed switch 222 being arranged to be opened by a cam 224 on the shaft 206 whereby to prevent energization of the electromagnet during the sixth cycle of operation of the check weigher.

Provision is made for advancing the strip of pressure-sensitive paper a relatively small increment each time the plate 200 is rocked to produce a mark, and as herein shown, a ratchet 226, formed integrally with the paper-advancing roller 194, is arranged to be engaged by the end of a flat spring 228 carried by the plate 200. The paper is maintained against the advancing roller by the pressure roll 196 which is carried between upper and lower arms 230 pivoted on a stud 232 mounted in the frame 186. The roller 196 is urged against the paper and the advancing roll by a spring 234, and a second flat spring 236 mounted on the frame 186 is arranged to engage the ratchet to prevent reverse rotation thereof.

As above stated the recording paper may be provided with the central line 238 graphically representing the position where a mark will be made by the recording stylus 182 when the algebraic average of the group of packages check weighed conforms to the predetermined weight. In practice the permissible limits of deviations over or under such predetermined weight may be graphically represented by limit line pens 240, 242 supported adjacent the idler roll 190 and engageable with the paper as it is drawn therepast to mark the upper and lower limit lines 244, 246 respectively. The pens 240, 242 may be adjustably mounted on a supporting rod 248 to designate the limits of deviation permissible for a particular product being check weighed, such deviation coming within commercially acceptable tolerances of a predetermined weight. In operation the rack 140 is initially disposed in an elevated position to dispose the recording stylus 182 carried thereby in a position above the upper limit or underweight limit line 244. As shown in Fig. 2, provision is made for resetting the rack 140 to such elevated position after the recording and correcting operations by means of a resetting cam 250 fast on the cam shaft 206. The cam 250 is arranged to cooperate with a roller 252 carried by one arm 254 of a lever pivotally mounted at 256, the second arm 258 of the lever being connected by a link 260 to a block 262 slidably carried by the rack bracket 178 and engageable with the lower end of the frictionally held rack to move it upwardly to a predetermined initial position.

In operation in the event that successive packages being check weighed are of a predetermined weight, successive return movements of the beam against the stop 132 will be uniform to advance the rack so that the recording stylus 182 will be in alignment with the central line 238 of the recording paper at the end of the selected number of cycles of operation corresponding to the number of loads in the sample group. Any intermediate position of the rack between the upper and lower limit lines 244, 246 in-

dicating permissible variations in weight. Any position of the stylus 182 above or below the permissible limit lines 244, 246 indicate that the packaging machine should be corrected.

Referring now to Figs. 1 and 3, when the rack 140 is moved to a position above or below the normal limit lines 244, 246 indicating an abnormal underweight or an overweight condition respectively, provision is made for detecting such position and for automatically correcting the operation of the packaging machine preferably so that the load-forming mechanism will produce increased or decreased loads.

As illustrated in Fig. 3, the detecting mechanism indicated generally at 264 may include an underweight circuit 266 having a normally open micro-switch 268, and an overweight circuit 270 having a normally open micro-switch 272, each micro-switch being adjustably mounted in a bracket 274 mounted on a slide member 276 arranged to move the micro-switches laterally toward and from the rack 140 during the recording and detecting cycle of operation. As herein shown, the micro-switches are provided with switch arms 278, 280 respectively arranged to engage a lug 282 on the rack to effect closing of the respective switch during the detecting operation. The slide member 276 is mounted in a bracket 284 and is arranged to be reciprocated through connections including a barrel cam 286 fast on the cam shaft 206, and a cooperating cam roller 288 carried by a lever 290 pivotally mounted at 292. The upper end of the lever is connected to the slide member 276 by a pin and slot connection 294.

Referring now to Figs. 1 and 8, in which the check weigher 10 is illustrated as operatively connected to a gross-weight weighing machine, indicated generally at 12, in order to correct the operation of the load-forming mechanism thereof when the average algebraic deviation of a sample group of loads check weighed varies beyond a predetermined amount from the predetermined weight, provision is made for either increasing or decreasing by a definite increment the effective counterweight of the scale beam 296 of the weighing machine through correcting mechanism indicated generally at 300 arranged to be actuated by the detecting mechanism 264. As illustrated in detail in Figs. 9 and 10, the correcting mechanism includes a coil spring 302 connected between the counterweight end of the scale beam 296 and the upper end of a threaded stud 304 supported for vertical axial adjustment in a bracket 306 attached to the frame of the gross-weight weighing machine. The threaded portion of the stud 304 is arranged to cooperate with a dual ratchet member having integral opposed ratchets 308, 310 supported between upper and lower bearing members of the bracket 306 and which is arranged to be rotated in one direction to effect extension of the spring 302, thereby increasing the effective counterweight when the check-weighing machine detects an underweight condition, and to be rotated in the opposite direction to effect contraction of the spring 302 and reduction of the effective counterweight when the check-weighing machine detects an overweight condition.

As best shown in Fig. 10, the upper ratchet 308 is arranged to be rotated a relatively small increment in a counterclockwise direction to contract the spring 302 by a spring-pressed pawl 314 carried by an arm 316 loosely journaled on an extended hub portion of the dual ratchet member, the outer end of the arm 316 being connected by a link 318 to a solenoid 320 connected in the overweight circuit 270 of the detecting mechanism 264, and the lower opposed ratchet 310 is arranged to be rotated in a clockwise direction to extend the spring 302 by a spring-pressed pawl 322 carried by an arm 324 loosely journaled on a depending hub portion of the dual ratchet member, the outer end of the arm 324 being connected by a link 326 to a solenoid 328 connected in the underweight circuit 266 of the detecting mechanism. The dual ratchet member is prevented from vertical axial displacement by engagement with the upper and lower bearing portions of the bracket 306, and the lower end of the spring stud 304 may be provided with a lateral extension 330 having an opening arranged to receive a guide pin 332 depending from the bracket 306 to prevent rotation of the stud. The pawls 314, 322 are normally maintained out of engagement with their respective ratchets by a shield member 334 extending from the bracket 306, and springs 336, 338 connected to the arms 316, 324 are arranged to retain the latter

against limiting stops 340, 342 respectively to prevent engagement of the pawls with their respective ratchets until one or the other of the solenoids 320, 328 is energized by closing of the appropriate microswitch 272, or 268 in the detecting circuit.

From the description thus far, it will be seen that the gross-weight weighing machine 12 may be controlled from the check-weighing machine in the manner described, thereby maintaining the weight deviations of the packages produced within commercially acceptable weight variations. The weighing machine shown in Figs. 1 and 8 may comprise a weighing machine known in the trade as a two-scale weigher and which may be of the same general type as illustrated and described in the patent to Howard No. 2,116,895, to which reference may be had for a complete description thereof. For the purposes of the present invention, only sufficient portions of the complete weighing machine have been herein illustrated as appear to be necessary for a complete understanding of the present invention. In general the illustrated weighing machine includes a feed hopper 350 provided with shutters 352 arranged to be opened to feed a stream of material into a carton 354 supported on the scale pan 356 of the scale beam 296, and in operation the shutters are arranged to be closed when the carton has received its weight through linkage indicated generally at 358 connected to cam-operated mechanism 360 arranged to be controlled by the scale beam. The machine is arranged to be operated in successive cycles, a complete cycle comprising a package-weighing cycle, and a package-moving cycle, and as herein shown the cartons may be delivered to the machine on a continuously moving inlet belt 362, successive cartons being transferred by a pusher 364 into the path of carrier fingers 366 carried on a chain 368 arranged to be intermittently operated to advance the cartons one station of operation each cycle, the filled and weighed package being removed from the scale pan 356 and transferred to the delivery conveyer 16, as shown in Fig. 1, to be delivered to the check-weighing machine 10. The above generally described mechanisms may comprise the mechanisms illustrated in the Howard patent above referred to.

Referring now to Fig. 11, similar correcting mechanism 301, arranged to be actuated by the check-weighing machine 10, may be embodied in a net-weight weighing machine indicated generally at 372 to cooperate with the scale beam 370 thereof. Such machine may comprise the weighing machine illustrated and described in the Howard Patent No. 2,364,902 to which reference may be had for a complete description thereof. In general the illustrated net-weight weighing machine includes a feed hopper 374 having a rotatable feed drum 376 arranged to feed material into a receptacle 378 carried by the weighing end of the scale beam 370. The hopper 374 is provided with a gate 380 at its lower end arranged to be held open during the weighing operation through linkage 382 including an armature 284 arranged to cooperate with a normally energized electromagnet 386 to hold the gate open. The electromagnet 386 forms part of a circuit arranged to be controlled by the scale beam 370, and in operation when the scale beam makes its weight, the electromagnet is de-energized to permit closing of the gate as shown. Simultaneously therewith, a pawl 388 carried by the linkage 382 is engaged with a ratchet 390 to discontinue rotation of the feed drum. Thereafter, the shutters 392 of the receptacle 378 are opened through cam-operated linkage 394 to release the weighed load which is guided through a funnel 396 into a carton supported therebeneath on a belt 398. The filled carton is then advanced along the belt 398 to be discharged onto the delivery belt 16 and delivered into the check-weighing machine as described. In the continued operation of the net-weight weighing machine, the shutters 392 are closed, and the gate 380 may be opened and the feed drum released by cam-operated resetting mechanism indicated generally at 399 which may and preferably will comprise the mechanism shown in the Howard Patent No. 2,364,902. As illustrated in Fig. 11, the correcting mechanism 301 may be similar in construction and mode of operation to the correcting mechanism 300 above described, the underweight and overweight solenoids 329, 321 being connected in the appropriate circuits 266, 270 of the check-weigher detecting mechanism.

Referring now to Fig. 12, in a modified form of the invention provision is made for correcting the volume of the measuring chambers of a volumetric filler in ac-

cordance with abnormal average algebraic deviations from a normal weight of the filled packages produced thereby as indicated by the detecting mechanism of the check weigher 10. As herein shown, the illustrated filling machine may comprise a rotary volumetric filler of the general type illustrated and described in the U. S. patent to Delamere et al. No. 1,527,030 and which may comprise a hopper 400 containing a supply of the material, and a series of telescopically adjustable measuring chambers 402 cooperating therewith. The upper portion 404 of the measuring chambers may be supported by an annular flanged member 406 arranged to ride on rollers 408 carried by an adjustably supported ring 410. The lower portions 412 of the measuring chambers may be supported on a disk 414 fast on the upper end of a continuously rotated central shaft 416, the telescoping connection imparting rotary movement to the upper portion 404 of the chambers. As herein shown, the chambers 402 are provided with cam-operated shutters 418, and in the operation of the machine successive chambers are filled as they pass under the hopper 400 during one portion of the revolution of the chambers during which time the shutters 418 are closed, and during another portion of the revolution the chambers 402 pass out from under the hopper and the shutters are opened to release the measured load which is guided through a funnel 420 and into a carton 422 being moved along in alignment therewith. The cartons may be advanced along rails 424 by a flexible metal belt 426 having a series of blocks 427 attached thereto and between which the cartons are engaged. The belt 426 may cooperate with a driving pulley 428 fast on the central shaft 416, and the funnels 420 are supported in alignment with the measuring chambers 402 by brackets 430 attached to a disk 432 also fast on the central shaft. As herein shown, the central shaft 416 may be driven through a worm-gear drive 434 connected to a drive shaft 436 which may be rotated by any usual or preferred means, such as an electric motor. In the operation of the filling machine, the cartons may be delivered to the machine from a supply thereof, and when provided with their measured loads, the filled cartons may be discharged from the machine and delivered to the check weigher 10 to check the weight thereof.

Provision is made in the modified form of the invention for automatically adjusting the upper portion 404 of the measuring chambers 402 relative to the lower portion 412 in order to vary the measured load when the average algebraic deviations of a group of the filled cartons are found to vary abnormally beyond commercially acceptable limits, as detected by the check weigher 10, and as herein shown, the adjusting mechanism may include a plurality of screws 438 rotatably mounted in the machine frame and arranged to cooperate with a nut 440 secured in the supporting ring 410. The screws 438 may be connected to rotate together by a chain and sprocket drive 442, and one of the screws may be provided with a bevel gear 444 arranged to mesh with a bevel gear 446 fast on a shaft 448 forming a part of the correcting mechanism indicated generally at 450. In operation rotation of the screws 438 in one direction will effect elevation of the upper portion 404 of the measuring chambers to increase the volume of subsequent loads delivered to the cartons, and rotation of the screws in the opposite direction will cause the upper portion of the chambers to be lowered into the lower portion to decrease the volume of the chambers.

As illustrated in Figs. 13 and 14, the correcting mechanism 450, adapted to be controlled in the manner described by the check-weighing machine 10, may include a pair of integral opposed ratchets 452, 453 fast on the shaft 448 and arranged to be engaged by similar spring-pressed pawls 454, 455 to effect rotation of the shaft 448 and adjustment of the chambers 402 when permitted to do so by the check-weighing machine. The pawls 454, 455 are carried by similar arms 456 pivotally mounted on the shaft 448, each arm being connected by a similar link 458 to cam levers 460 pivotally mounted at 462. Each lever 460 is provided with a roller 466 arranged to cooperate with similar cams 468 fast on a cam shaft 470, the arms 456 being provided with springs 472 arranged to urge the linkage downwardly to permit the roller to follow its cam. The cam shaft 470 is arranged to be rotated from the drive shaft 436 through a chain and sprocket drive 474 and bevel gears 476.

The pawl carrying arms 456 are normally maintained in an elevated or locked position, as shown, by solenoid-operated latch members 478, 479 arranged to engage the ends of the arms, and the pawls are prevented from engaging their respective ratchets by a shield member 480 supported from the machine frame. As herein shown, the latch members 478, 479 are pivotally mounted at 482, 484 and are connected by similar links 486 to their respective solenoids 488, 490. Springs 492 cooperating with adjustable stops 494 are arranged to hold the latch members 478, 479 in latched engagement with their respective arms 456, and in operation when one or the other of the arms is released by its solenoid the arm is rocked downwardly by its spring 472 permitting the roller 466 to follow its cam 468, the pawl riding off the shield 480 and engaging with its ratchet to effect rocking of the shaft 448 and adjustment of the measuring chambers 402 as described. The downward rocking movement of the arms 456 may be adjustably limited by stop screws 483.

In practice one of the solenoids 488 may be connected in the underweight circuit 266 and is arranged to be energized to effect release of the latch 478 when the micro-switch 268 of the detecting mechanism 264 is closed, and the other solenoid 490 may be connected in the overweight circuit 270 and is arranged to be energized when the micro-switch 272 of the detecting mechanism is closed, thus effecting automatic adjustment of the measuring chambers 402 through definite increments when the detecting mechanism of the check weigher detects an abnormal average algebraic deviation of a group of packages check weighed beyond commercially acceptable limits.

From the description thus far, it will be observed that the packaging machine for forming the successive loads will in accordance with the present invention be corrected to automatically increase or decrease the weight of the load formed by the load-forming mechanism in the event that the algebraic average deviation of a group of weighed loads varies beyond a predetermined amount from the predetermined weight. By controlling the load-forming mechanism from the algebraic average deviation as described, the effect of one abnormal weight of a load beyond or outside of the tolerance in throwing the entire packaging machine out of normal operation may be avoided. The utility of the present invention as compared with prior-art methods of check weighing and of controlling the packaging machine may be illustrated by assuming that a weighing machine normally operates with an accuracy of plus or minus one-quarter of an ounce. In prior-art methods of correction if the check weigher made a single determination that was more than one-quarter of an ounce above the correct weight, then correction was made to decrease the load by one-eighth of an ounce. Assuming that in the operation of the packaging machine the next package to be check weighed was in fact a quarter of an ounce light, then application of the correction of an eighth of an ounce would cause the package to be three-eighths of an ounce light. In other words, the correction based on the single overweight beyond the tolerance in many instances has heretofore resulted in decreasing the accuracy of the weighing machine and operated in fact to enlarge the tolerance from plus or minus one-quarter of an ounce to plus or minus three-eighths of an ounce. By utilizing the algebraic average deviation from a predetermined weight of a group of packages, this condition is avoided, and as a result the operation of the weighing machine may be controlled much more efficiently.

Having thus described the invention, what is claimed is:

1. A check-weighing machine having, in combination, check-weighing mechanism including means for determining the variation in the weight of an article from a predetermined weight, means operatively connected with and controlled by said variation-determining means for ascertaining the amount of the average algebraic deviation of a plurality of the weighed articles from the aforesaid predetermined weight, and indicating means for indicating the amount of such average algebraic deviation.

2. A check-weighing machine having, in combination, check-weighing mechanism including means for determining the variation in the weight of an article from a predetermined weight, means operatively connected with and controlled by said variation-determining means for ascertaining the amount of the average algebraic deviation

of a plurality of the weighed articles from the aforesaid predetermined weight, and means for recording such average algebraic deviations on a graph.

3. A check-weighing machine having, in combination, check-weighing mechanism including a weighing element arranged to be moved in proportion to the load being weighed by said weighing element, a member mounted for linear movement, connections between the weighing element and said movable member for moving the member through successive cumulative increments responsive to the excess of each check-weighed load in a predetermined group above a predetermined minimum limit, and calibrated means cooperating with said movable member for indicating the average algebraic deviation of the members of the group check weigher.

4. A check-weighing machine having, in combination, check-weighing mechanism including an element arranged to be moved in proportion to the load being check weighed, means arranged to be moved by said weighing element during each of a number of check weighings an amount proportionate to the excess of each check-weighed load above a selected minimum, and graphic recording means for recording the position to which said member has been moved after a predetermined number of check weighings.

5. A check-weighing machine as defined in claim 4 wherein the graphic recording means is calibrated to graphically record the average algebraic deviation of a plurality of the check-weighed articles.

6. A check-weighing machine having, in combination, check-weighing mechanism including a weighing element having load-supporting means upon which the article to be check weighed may be placed, adjustable means cooperating with the weighing element for regulating the minimum weight limit above which loads supplied to the load-supporting member cause movement of the weighing element in proportion to the excesses of the weighed loads above such minimum limit, and means rendered operative by such movements of the weighing element for determining the variation in the weights of the articles being check weighed from a predetermined weight, means connected with and controlled by said variation-determining means for ascertaining the amount of the average algebraic deviation of a plurality of said check-weighed articles from the aforesaid predetermined weight, and indicating means for indicating such algebraic deviation.

7. A check-weighing machine as defined in claim 6 wherein an adjustable spring is utilized to adjustably determine the minimum weight limit.

8. The combination with load-forming mechanism for forming successive loads, of check-weighing mechanism including means for determining the variation of a plurality of check-weighed loads from a predetermined weight, means operatively connected with and controlled by said variation-determining means for ascertaining the amount of the algebraic average deviation of a plurality of the weighed loads from the aforesaid predetermined weight, and means for thereafter automatically increasing or decreasing the weight of a load formed by the load-forming mechanism in the event that the above average deviation varies beyond predetermined amounts.

9. The combination with a volumetric load-measuring mechanism for forming successive loads, of check-weighing mechanism including means for determining the variation of a plurality of check-weighed loads from a predetermined weight, means operatively connected with and controlled by said variation-determining means for ascertaining the amount of the algebraic average deviation of a plurality of the measured loads from the aforesaid weight, and means for thereafter automatically increasing or decreasing the volume of a measured load formed by the load-measuring mechanism in the event that the above average deviation varies beyond predetermined amounts.

10. The combination with load-forming mechanism for forming successive loads, of check-weighing mechanism including means for determining the variation of a plurality of check-weighed loads from a predetermined weight, means operatively connected with and controlled by said variation-determining means for ascertaining the amount of the algebraic average deviation of a plurality of the weighed loads from the aforesaid predetermined weight, and means for thereafter automatically increasing or decreasing by a definite increment the weight of a load formed by the load-forming mechanism in the event that

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the above average deviation varies beyond predetermined amounts.

11. The combination with a packaging machine having load-forming mechanism for forming successive loads, of check-weighing mechanism including a weighing element 5 movable in proportion to excesses in the weighed loads above a predetermined minimum limit, a member arranged to be moved in proportion to such excesses, means rendered operative in response to the position of said movable member at the end of a predetermined number 10 of check-weighing operations for increasing or decreasing by a definite increment the weight of the loads thereafter produced by the load-forming mechanism accordingly as the position of said movable member is above or below predetermined positions corresponding to permissible 15 tolerances.

12. A check-weighing machine as defined in claim 1 wherein provision is made for automatically resetting said averaging and said indicating means after the amount of the average algebraic deviation of said plurality of the 20 articles has been determined.

13. A check-weighing machine as defined in claim 2 wherein provision is made for automatically resetting said averaging and said indicating means after the amount of the average algebraic deviation of said plurality of the 25 articles has been determined.

14. A check-weighing machine as defined in claim 2 including means for automatically drawing limit lines on said graph.

15. A check-weighing machine as defined in claim 13 30 including means for automatically drawing limit lines on said graph.

16. A check-weighing machine having, in combination check-weighing mechanism including means for determining the amount of the variation in the weight of an article 35 from a predetermined weight, and means operatively connected with and controlled by said variation-determining means for ascertaining the amount of the average alge-

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braic deviation of a plurality of the weighed articles from the aforesaid predetermined weight.

17. In combination, a load forming apparatus having adjustable load forming means, and a check-weighing machine including means for determining the amount of the variation in the weight of successive loads from a load of a desired predetermined weight, means operatively connected with and controlled by said variation-determining means for ascertaining the amount of the average algebraic deviation of a plurality of the weighed loads from the aforesaid predetermined weight, and means for automatically adjusting said load forming means in accordance with the amount of the average algebraic deviation from the aforesaid predetermined weight.

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