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3,476,198

BACON SLICER WEIGHT CONTROL

Filed Oct. 25, 1966

4 Sheets-Sheet 1

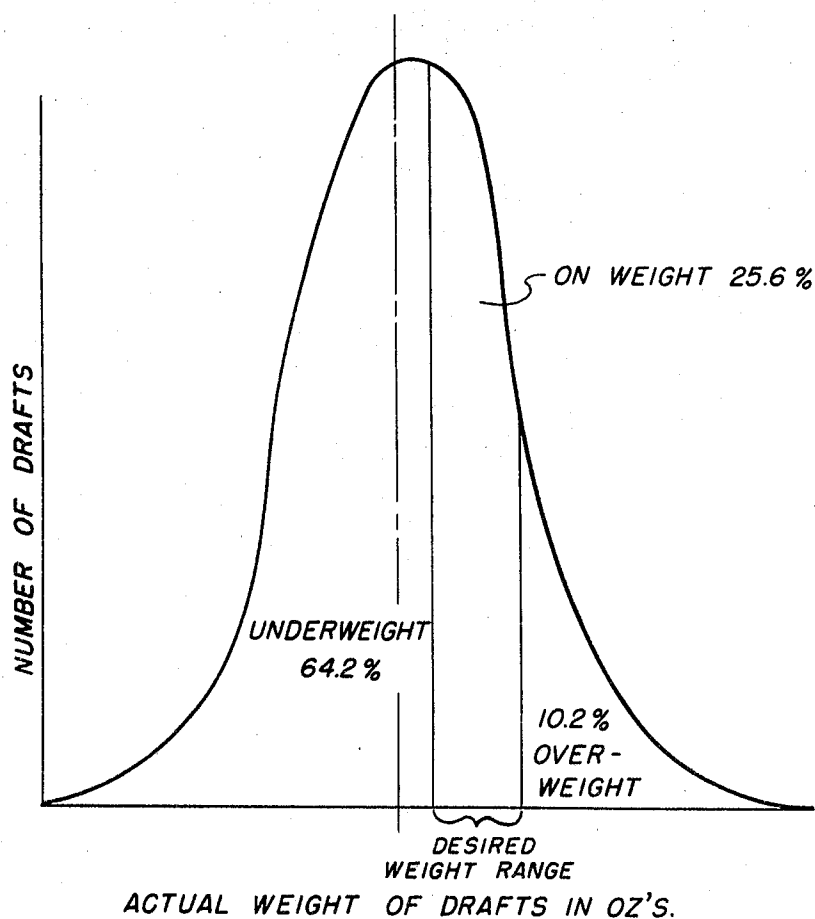


Fig. 1

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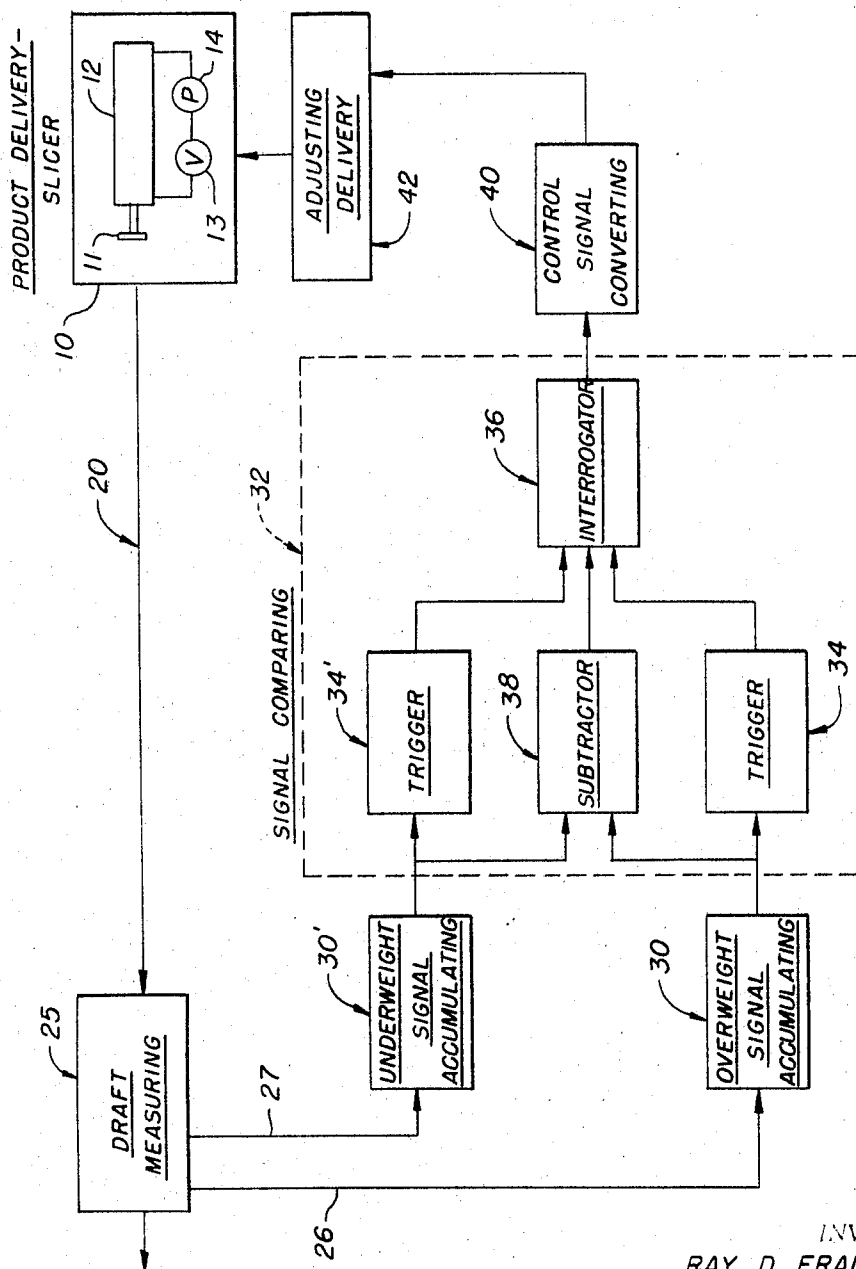


Fig. 2

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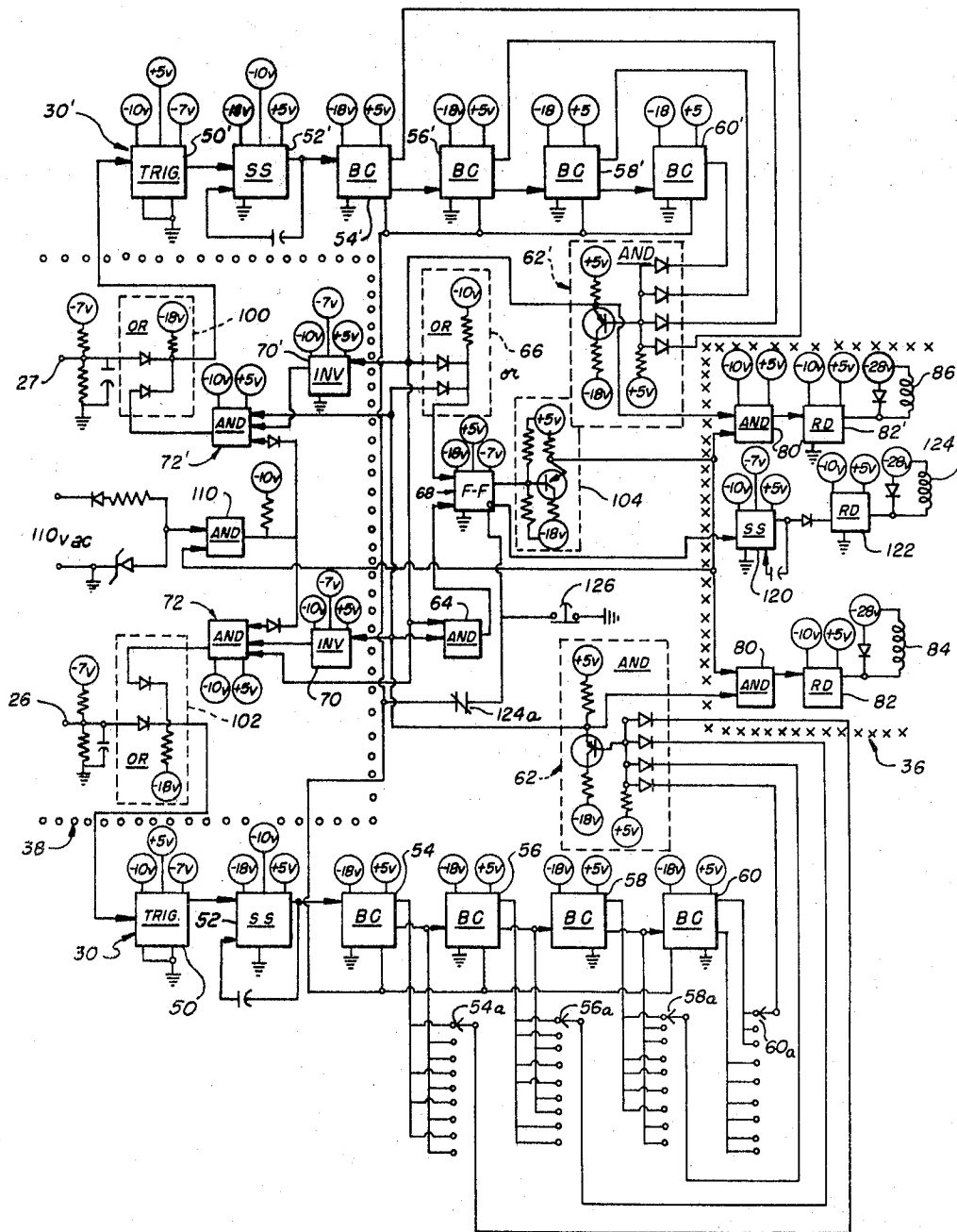


Fig. 3A

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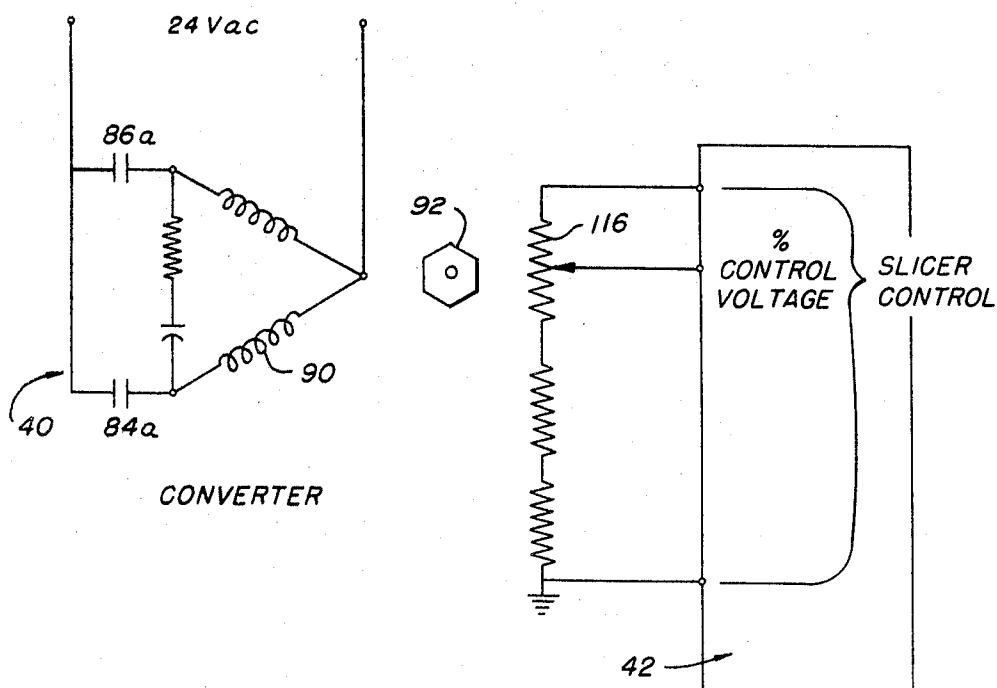


Fig. 3B

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BACON SLICER WEIGHT CONTROL

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U.S. Cl. 177—50

14 Claims

ABSTRACT OF THE DISCLOSURE

Items for packages of product are assembled in groups approximating a desired measure, with some overmeasure and undermeasure groups being produced. A desired ratio of overmeasure to undermeasure groups is established and the assembly of groups is adjusted to produce that ratio which will result in sufficient undermeasure groups being produced to take up the excess items assembled in produced overmeasure groups and also excess items obtained from incomplete groups and the like.

The present invention is directed to the art of assembling accurate weight packages of products; and more particularly involves an improved method and apparatus for controlling offweight drafts of sliced product such as sliced bacon.

Industry involves many instances where multiple units or items must be assembled into a product of accurate measure. Packaging involves this concept. Many package assembly practices are automatically controlled and often result in the production of a significant proportion of off-weight packages along with a quantity of packages falling within a desired weight range. Usually the off-weight portion will include both underweight and overweight packages. Both of the latter categories must be further attended to remove excess product from the overweight packages and add product to the underweight packages. Where this occurs it is of advantage, from the standpoint of production economy, to reduce the number of correcting manipulations to a minimum and to also provide for utilization of all of the product removed from the overweight packages.

The art of packaging sliced bacon is an example of the above type of operation. Heretofore numerous inventions and improvements have been made in bacon slicer and take-off conveyor apparatus aiming to increase the proportion of packages or drafts of sliced product falling within the on-weight range. However, for the most part the most efficient of these apparatus will result in only about 25 to 30 percent of on-weight packages. The remaining off-weight packages will be distributed between underweights and overweights approximately according to a distribution curve such as that shown in FIGURE 1. Further it is understood that the prior art apparatus is adjustable to establish a desired on-weight range and thus it is possible to shift the actual on-weight range, under the distribution curve, and to adjust the ratio of underweight to overweight packages.

In the production of packaged sliced bacon it is the usual procedure that slabs of bacon (bellies) are sliced, and the slicer shingles out approximately the desired quantity of slices in separate drafts onto a take-off conveyor. The take-off conveyor carries each draft past a check-weighing scale that signals, and sometimes diverts, underweight and overweight quantities. Attendants must collect and separate the latter and then manually adjust the weight of each draft to bring it into the on-weight range. Thereafter the drafts are wrapped, etc., to complete the packages.

In the production of bacon packages there is one further complicating factor. That is, the usual bacon slab will

2

not necessarily produce a whole number of drafts of slices. Normally the terminal portion of a bacon slab results in a partial draft amounting to considerably less than that required for an on-weight package. In practice the slicer operator diverts the latter "non-draft" slicers to the attendants for use as make-up for the underweight drafts.

Thus the attendants hope to utilize, during the course of the day, both the excess slices taken from the overweight drafts and the last mentioned "non-draft" slices as make weight added to the underweight drafts. However, it is unusual to find that the available and needed slices balance, and normal operation most often either accumulates a large surplus of excess slices, or results in the frequent need for complete drafts to be diverted for additional make-up. In both instances the economy of production is seriously affected.

Accordingly, it is an object of this invention to control the nature of off-weight product in package assembly operation so as to better utilize normal excess product.

It is another object of the present invention to provide an improved method and apparatus for controlling the ratio of undermeasure to overmeasure production so as to most efficiently utilize excess product when correcting package measure.

It is still another object of the present invention to provide an improved method and apparatus for controlling the ratio of underweight to overweight bacon drafts so as to most efficiently utilize both excess slices taken from the overweight drafts and "non-draft" slices produced at the slicing operation.

Basically the improved method of the present invention contemplates the detection of both overmeasure and undermeasure packages, and the production of separate signals for each of such packages detected. The latter signals are accumulated during the passage of at least a minimum number of packages against a desired and established ratio of undermeasure to overmeasure packages. Periodically, where the accumulation of such signals indicates that the actual ratio of undermeasure to overmeasure packages departs from the desired and established ratio, the delivery of product to subsequent packages is adjusted to either increase or decrease the average amount of product per package so as to tend to drive the actual ratio toward the desired ratio.

An apparatus devised for carrying out the foregoing method includes a means for interrupting the delivery of product to packages, and a means for detecting the measure of product within each package. The latter means or an associated means is adapted to produce separate signals for each undermeasure and overmeasure package, and each type of signal is delivered to an accumulating means which is periodically interrogated to produce a further signal that in turn is applied to an adjusting means connected to the means for interrupting product delivery.

Further objects and advantages of the present invention will become apparent upon reading the following detailed description in conjunction with the drawings wherein:

FIGURE 1 is a graph showing a distribution curve plotting number of drafts or packages against the normal distribution of product measure;

FIGURE 2 is a schematic diagram showing the apparatus components for initially assembling packages, weighing the packages, and controlling the product delivery in accordance with the actual ratio of undermeasure and overmeasure packages produced; and

FIGURES 3A and 3B are wiring diagrams of parts of a preferred embodiment of a portion of the control component shown in FIGURE 2, that part of the embodiment shown in FIGURE 3B being actuated and driven in accordance with conditions placed upon the part of the embodiment shown in FIGURE 3A.

The present invention may be applied to a packaging operation after certain operating characteristics of the packaging system have been determined. For instance, a chart such as that shown in FIGURE 1 should be first made to show the relationship of packages to the normal distribution of product measure. The ability or efficiency of the system to produce packages within the acceptable measure range must also be determined. Thereafter it becomes a recognizable mathematical problem to determine the optimum ratio of undermeasure packages to overmeasure packages by equating the total excess measure (including both overweight and normal "non-draft" slices) to the total undermeasure.

In the instant application of the invention to bacon packaging the foregoing is applied to determinations of overweight and underweight packages, and in addition the average amount of "non-draft" slices (ends of slabs) is taken into consideration in forming an off-weight balance. That is, total underweight is equated to total excess weight plus average "non-draft" weight. From this information the desired ratio of underweight to overweight packages may be established.

On establishing the desired ratio a bacon slicing machine is set up so as to initially produce packages according to the desired ratio. The usual slicing machine regulates draft size by interrupting the feed of the bacon slab into a slicer blade at intervals calculated to distinguish the desired drafts. Some machines achieve draft separation through control of take-off conveyor speed rather than bacon feed. However, in either instance the machines usually are controlled by either (1) counting a number of slices judged to complete a draft, (2) estimating a volume of sliced product judged to equal a draft, or (3) roughly weighing the slices as they are delivered from the slicing machine.

The present invention is applicable to any method of initial draft control. All may be considered to be equivalent techniques for interrupting the delivery of product units in a package assembling operation.

Thus the present method requires that successive units of product are delivered in a regular fashion and interrupted periodically to form initial drafts of the approximate measure desired to complete a package. The initial draft is then moved away from the delivery station and measured to detect both undermeasure and overmeasure packages.

A distinct signal is produced for each undermeasure draft and similarly another distinct signal is separately produced for each overmeasure draft. Packages falling within the acceptable measure range are not further considered.

The foregoing signals are then accumulated separately toward a maximum number that may occur in the count of either undermeasure or overmeasure packages. The respective target numbers for each count may be the same or different but are related to one another as the established ratio desired for the production of off-weight packages. Upon either the count of overmeasure or of undermeasure packages reaching the respective set number limits, a comparison is made of the quantity of each type of signal accumulated, and if both sets of accumulated signals do not concurrently equal the respective set number limits, which indicates that the actual ratio of undermeasure to overmeasure packages does not equal the desired ratio, then an algebraic subtraction is made to determine the degree and direction in which the actual ratio differs from the desired ratio.

A control signal is accordingly produced that is a function of the result of the aforementioned algebraic subtraction. Finally, the control signal is applied to the means for interrupting the delivery of product units so as to adjust the average measure of the initial packages in a direction that should result in correction of the actual ratio of undermeasure to overmeasure packages.

Apparatus for carrying out the foregoing method is

shown in FIGURE 2, wherein the product delivery means generally 10 is a bacon slicing machine, in an actual embodiment, having a feed ram 11 operated horizontally by a hydraulic cylinder 12 which is controlled by a valve 13 and pump 14. Delivery of bacon slices is interrupted to form drafts by periodically closing the valve 13.

The delivery means generally 10 deposits the product upon a continuously moving take-off conveyor generally 20 that extends past a draft detecting and measuring means generally 25. In an operating embodiment bacon slices are shingled in drafts of multiple slices upon separate cards carried on the take-off conveyor; and are weighed on a check-weighing scale.

The detecting and measuring means must be capable of distinguishing between undermeasure and overmeasure packages and includes means to produce separate signals for each, delivering an overweight signal to a wire 26 and an underweight signal to a wire 27, respectively.

The overweight signals are delivered to an accumulating means generally 30, whereas the underweight signals are delivered to a second accumulating means generally 30'. In each accumulating means the signals are collected against the previously mentioned set number limits established according to the characteristics of the system. Preferably one or both of the accumulating means includes an adjustment so that the number limit may be varied.

Each accumulating means generally 30, 30' is connected to a comparing means generally 32. The latter actually includes separate pre-set count trigger circuits generally 34, 34', which in turn are connected to an interrogator circuit generally 36. Each of the respective accumulating means 30, 30' is also connected to a common algebraic subtractor circuit generally 38 which is also connected to the interrogator circuit generally 36. From the interrogator circuit 36 the comparing means generally 32 is in turn connected to a control signal means generally 40. The latter function to convert a signal generated in the algebraic subtractor circuit 38 to a control signal that is operable upon an adjusting means generally 42 that is connected to regulate the product delivery interrupting means. For instance, the adjusting means 42 may be connected to the mechanism controlling valve 13 in the bacon slicer.

Knowledge of the foregoing method and functional apparatus component may enable persons skilled in the art to utilize either mechanical or hydraulic control elements as well as electrical. However, an electrical control apparatus is preferred. An embodiment of the preferred control mechanism is shown in FIGURES 3A and 3B.

The preferred electrical control apparatus is designed with solid state circuitry which, insofar as practical, includes pre-assembled modules that are available on the commercial market. Those and other parts of the circuit are connected to suitable low voltage electrical sources, not shown, as is indicated in FIGURE 3A. Essentially the preferred circuitry comprises a plurality of binary counters, triggers (not to be confused with the pre-set count triggers 34 and 34') and single shot modules which function to insure clear and distinct signals, "and" gates, "or" gates, "flip-flop" modules, inverters and relay drivers.

In FIGURE 3A the lower and upper horizontal banks of modules function as the first and second accumulating means generally 30 and 30'. The circuitry between these banks corresponds substantially to the comparing means generally 32; and specifically the elements functioning as the algebraic subtractor generally 38 are shown within the dotted line to the left of the figure, and the elements corresponding to the interrogator generally 36 are shown within the X'd line to the right of the figure. The circuit elements remaining in the central portion of FIGURE 3A function as the pre-set count triggers 34 and 34' (utilizing certain common components as subsequently explained). Finally in FIGURE 3B the basic circuit of the control signal means generally 40 is shown, together with the adjusting means generally 42 which is diagrammatically represented.

Returning to FIGURE 3A, each bank of modules representing the accumulating means 30, 30', includes a trigger module 50 connected to impart a signal to a single shot module 52, which in turn is connected to deliver a signal to a plurality of series connected binary counters 54, 56, 58, and 60. Each binary counter 54 thru 60 is connected to deliver a signal to the next succeeding counter and also connected to an "and" gate 62. In FIGURE 3A the "and" gates 62, 62' are shown within a broken perimeter to include a plurality of parallel connected diodes and a series connected transistor. "And" gates 62, 62' were assembled specifically for this circuit due to the fact that commercially available modules were not available to accept the number of separate signals required and have the required input impedance. The circuitry illustrated thus includes an emitter follower (amplifier) in the form of the transistor shown. These "and" gates 62, 62' function separately in the respective pre-set count triggers 34, 34', which additionally include an "and" gate module 64, and "or" gate 66, and a "flip-flop" module 68. Each of the "and" gates 62, 62' are connected to deliver a signal to both of the "and" gate module 64 and the "or" gate 66. In turn both of the latter are connected to deliver signals to the "flip-flop" module 68.

The "and" gates 62, 62' are also connected to respective inverter modules 70 and 70'. The latter are the first elements of the algebraic subtractor generally 38; and are in turn connected separately to respective "and" gate modules 72, 72'. Specifically it will be noted that each of the "and" gates 62, 62' are connected to both of the last mentioned "and" gate modules 72, 72'. Specifically "and" gate 62 is connected through inverter 70 to the "and" gate 72, and is also connected directly to the "and" gate 72'; whereas the "and" gate 62' is connected through inverter 70' to "and" gate 72', and is also connected directly to the "and" gate 72.

The "and" gate 62 is further connected to deliver a signal to another "and" gate module 80 in the interrogator component generally 36. Similarly the "and" gate 62' is connected to deliver a signal to a similar "and" gate module 80'. In turn each of the last mentioned "and" gates 80, 80' are connected to signal relay driver modules 82, 82', which in turn are connected to energize relay coils 84, 86, respectively.

The relay coils 84, 86 are associated with separate relay contacts 84a and 86a shown in FIGURE 3B as part of the control signal means generally 40. Both sets of relay contacts 84a, 86a are connected between a source of electrical power, such as 24 volts alternating current, and the windings 90 of a synchronous motor, the shaft of which is designated by the reference character 92.

In operation the preferred control apparatus illustrated in FIGURES 3A and 3B operate substantially as follows. Each signal representing an underweight package is received in the binary counters 54-60' via wire 27 and an "or" gate 100. Similarly each signal representing an overweight package is received in the binary counters 54-60 through wire 26 and an "or" gate 102. An "or" gate is designed to transmit or produce an output signal upon receiving an input signal from any of a plurality of sources. It will be noted that "or" gate 100 is connected to receive signals from both wire 27 and the "and" gate 72'; similarly the "or" gate 102 is connected to receive input signals from both the wire 26 and the "and" gate 72.

At any rate each signal representing an underweight package is received in the second accumulating means generally 30', and after a sufficient number of signals has been received each binary counter 54'-60' will transmit a signal to the "and" gate 62'. Any number of binary counters may be utilized and interconnected between themselves and the "and" gate 62' so as to require substantially any number of signals to be received before the latter will transmit an output signal. It should be understood that an "and" gate, as distinguished from an "or" gate, produces

an output signal only upon receipt of all of a plurality of input signals.

In the present application for bacon packaging the established number against which the underweight signals are measured in the second accumulating means generally 30' is the quantity of fifteen. The illustrated circuit of binary counters 54'-60' and "and" gate 62' will produce an output signal upon the receipt of the fifteenth underweight signal via wire 27. The output signal is delivered simultaneously to the "or" gate 66 and the "and" gate 64, which together with the "and" gate 62' and the "flip-flop" 68 make up the pre-set count trigger 34'. The "or" gate 66 immediately transmits an output signal to one side of the "flip-flop" module 68, causing still another signal to be delivered through an emitter follower (amplifier) 104 to both "and" gates 80, 80' of the interrogator generally 36.

At the same instant the "and" gate 62' also delivers a signal to the interrogator "and" gate 80', thus fulfilling the requirements for the latter to deliver a signal to the relay driver 82', with the result that relay coil 86 is energized and contacts 86a are closed to turn the motor shaft 92 in a counterclockwise direction.

The extent to which the motor shaft 92 of the control signal means generally 40 will turn depends upon the time increment, if any, between energizing of relay coil 86 and the production of an output signal by "and" gate 62. It has been shown that the "and" gate 80' will produce an output signal essentially when the required number of underweight signals have been received in the binary counters of the second accumulating means generally 30'. The similar event will occur at "and" gate 80 when a sufficient number of overweight signals have been received in the binary counters 54-60 of the first accumulating means 30 as will be further explained. It is not possible for both an underweight and an overweight signal to occur simultaneously, so at least one count difference is always present at time of interrogation. When only one count difference exists, the time difference between energizing of the proper relay coil and the output from the "and" gate at the end of the other counting chain is so small that the correction signal is negligible.

To further explain the first accumulating means generally 30, for the overweight signals, it will be seen that such signals are received via wire 26 through the "or" gate 102 into the binary counters 54-60. When a sufficient number of signals have been received, the "and" gate 62 will produce a signal that is delivered to both the "and" gate 80, in the interrogator generally 36, and to the "or" gate 66. The latter again will result in a signal being delivered to the "flip-flop" module 68 and hence through amplifier 104 to both the interrogator "and" gates 80, 80'. In essence the "flip-flop" module 68 will produce an output signal for both of the latter "and" gates 80, 80' when either of the "and" gates 62, 62' produce an output signal.

It will be noted with reference to the first accumulating means 30, in FIGURE 3A, that each binary counter 54, 56, 58, and 60 is connected to a multi-contact switch 54a, 56a, 58a and 60a, respectively. Each of the latter provides alternate paths to the "and" gate 62. This circuitry may be distinguished from the second accumulating means 30' wherein each similar connection of binary counters 54'-60' is directly to the "and" gate 62'. By appropriate manipulating of the switches 54a, 56a, 58a, 60a any number less than the maximum available number limit may be selected to provide sufficient input signals to satisfy the "and" gate 62. Thus the latter switches provide a means to vary the ratio of underweight to overweight packages that will be maintained by the apparatus.

With further reference to the "and" gate 62, it will be seen that its output signal is also delivered to the inverter 70 and additionally delivered direct to the "and" gate 72'. Similarly the output signal of the "and" gate 62' is de-

livered to the inverter 70' and also directly to the "and" gate 72. An inverter functions to provide an output signal opposite to that of the input signal received. In effect if an input signal is absent the inverter will produce an output signal; whereas if an input signal is present the inverter will produce no output signal.

On the occasion that the "and" gate 62 produces an output signal the inverter 70 will not deliver an output signal to the subtractor "and" gate 72. Thus the latter "and" gate cannot in turn produce an output signal when the required number of overweight signals have been received in the first accumulating means 30. Similarly the subtractor "and" gate 72' cannot produce an output signal where the inverter 70' does not deliver a signal thereto, which condition will occur only upon the required number of underweight signals being received in the second accumulating means 30'.

If the required number of overweight signals are received in the accumulating means 30 prior to the required number of underweight signals being received in the second accumulating means 30', two of three necessary conditions will be met to produce an output signal at the subtractor "and" gate 72'. The third required condition will be provided upon the occasion that an output signal is available from a final "and" gate 110. The latter requires two input signals, one being in "pulse form" and constantly supplied from a 110 volt alternating current source and the other provided through the "flip-flop" module 68 and amplifier 104.

When the three conditions are being met at the subtractor "and" gate 72' a 60 pulse per second signal (stemming from the 110 volt A.C. source) will be delivered to the "or" gate 100. Recalling that this condition is met only when the second accumulating means 30' has not received a sufficient number of signals, the pulsing signal thus impressed will rapidly complete the requirements of the binary counters 54'-60' and result in an output signal being produced at the "and" gate 62'.

Recalling further that to produce the foregoing conditions the required number of overweight package signals would have already been received in the first accumulating means 30 and the consequent energizing of the relay coil 84. Thus the relay contacts 84A have been closed for a brief period of time causing energizing of the motor coil 90 and the motor shaft 92 to be turned clockwise. The extent to which the motor shaft will turn clockwise will be limited solely by the length of time necessary for the binary counters 54'-60' of the second accumulating means 30' to be brought up to the required number count. Thus the degree of shaft turn will be directly proportional to the imbalance of the underweight packages in the desired ratio of underweight to overweight.

Further analysis of the circuit shown in FIGURE 3A teaches that should the required number of underweight signals be first received in the second accumulating means 30' a similar correcting signal will be delivered from the subtractor "and" gate 110 through "and" gate 72 and the "or" gate 102 to complete the requirements of the binary counters 54'-60' in the first accumulating means 30. The latter condition will result in a counterwise movement of the motor shaft 92 proportionate to the imbalance of overweight package signals in the desired ratio.

In either instance, movement of the synchronous motor shaft 92 alters the position of a variable potentiometer 116 which is connected across the adjusting means 42 and alters the electrical condition in the latter in accordance with the displacement of the potentiometer.

Finally, on the occasion that the signal requirements in both the first and second accumulating means 30, 30' have been met, and both "and" gates 62, 62' produce output signals, both of the latter signals are simultaneously impressed on the "and" gate 64 with the result that a different signal is delivered to the "flip-flop" module 68. The latter signal changes the condition of the flip-flop module 68 to deliver a signal directly to a single shot

module 120 and thence to a third relay driver 122. The latter results in energizing of a relay coil 124, in turn opening of a pair of associated contacts 124A. The latter action breaks a grounding circuit common to all of the binary counters 54-60, 54'-60', in both first and second accumulating means, which causes them to be reset to receive a new cycle of signals. Resetting of the binary counters can also be accomplished manually by push button 126.

It will thus be apparent from the foregoing that the apparatus of this invention will automatically continue to analyze the relationship of undermeasure packages to overmeasure packages and periodically adjust the product delivery means so as to result in a desired ratio of undermeasure to overmeasure product.

Obviously many modifications and variations of the invention as hereinbefore set forth may be made without departing from the spirit and scope thereof, and therefore only such limitations should be imposed as are indicated.

I claim:

1. An improved method for assembling packages of multi-unit product, said method comprising: delivering a succession of said product units; interrupting the delivery of said units periodically on an established basis to form successive drafts of product each amounting to approximately a desired measure with some drafts purposely undermeasure; measuring each successive draft to separately identify overmeasure and undermeasure drafts; producing separate signals for each of said overmeasure and undermeasure drafts; accumulating said separate signals against an established ratio of undermeasure to overmeasure drafts; and periodically adjusting the basis for interrupting the delivery of said units so as to continue to produce some undermeasure drafts and to force the accumulated signals thereafter to approach said established ratio.

2. The improved method of claim 1 wherein said separate signals are accumulated against first and second number limits, respectively, said first and second numbers being established in a desired ratio of undermeasure to overmeasure drafts previously determined to be adequate to work off excess units.

3. The improved method of claim 2 including the step of comparing the quantity of each of said accumulated signals upon the quantity of either one of said signals equaling the respective first and second number limits; and producing a control signal from said comparison, said control signal being a function of both the magnitude and direction of departure of said signals from said established ratio.

4. The improved method of claim 3 wherein said control signal is applied to adjust the basis for interrupting the delivery of said units so as to force the accumulated signals thereafter into closer conformity with said established ratio.

5. The method of claim 1 wherein the product is sliced bacon, and the delivery of bacon slices is interrupted by controlling the feed of a bacon slab into a slicer blade.

6. The method of claim 5 wherein the measuring of each draft of bacon slices is accomplished by weighing.

7. An improved apparatus for assembling packages of multi-unit product, said apparatus comprising: product delivery means for providing a succession of product units; interrupting means associated with said delivery means for grouping said product units into drafts on an established basis; draft measuring means to detect overmeasure and undermeasure drafts produced by said interrupting means; signal producing means associated with said measuring means for producing separate signals according to each overmeasure and undermeasure draft; accumulating means connected to receive said signals from said signal producing means; and adjusting means connected between said accumulating means and said interrupting means and operable in accordance with the

difference between said accumulated signals and an established ratio of undermeasure to overmeasure drafts.

8. The apparatus of claim 7 wherein the accumulating means and the adjusting means are comprised of first and second accumulating means for each of said undermeasure and overmeasure signals, respectively; comparing means associated with both of said accumulating means for measuring said signals against an established ratio; a control signal means associated with said comparing means for producing a further signal proportional to the difference between said accumulated signals and said established ratio; and an adjusting means connected between said control signal means and said interrupting means.

9. The apparatus of claim 8 wherein the product delivery means is a bacon slicer.

10. The apparatus of claim 9 wherein the first and second accumulating means are counters.

11. The apparatus of claim 9 wherein the first and second accumulating means are a plurality of binary counters.

12. The apparatus of claim 8 wherein the comparing means includes pre-set count trigger means connected to each of said first and second accumulator means; an interrogator means connected to both of said triggers; and an algebraic subtractor mechanism connected to each of said first and second accumulating means and to said interrogator means.

13. The apparatus of claim 8 wherein the control sig-

nal means is a digital to analog converter connected between said comparing means and said adjusting means.

14. An electrical apparatus for controlling the assembly of off-weight drafts of product to be used in combination with apparatus for separately detecting and signaling both underweight and overweight drafts, said apparatus comprising: a first bank of binary counters; a second bank of binary counters; a first pre-set count trigger connected to said first bank of binary counters, a second pre-set count trigger connected to said second binary counters; an interrogator connected to each of said first and second pre-set count triggers; an algebraic subtractor connector to both first and second banks of said binary counters and to said interrogator; and a converter connected to receive a signal from said interrogator.

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