

[54] **METHOD AND APPARATUS FOR EFFECTING THE ACTUATING AND NON-ACTUATION OF A RESPONSIVE INSTRUMENTALITY**

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 [22] Filed: **May 6, 1971**
 [21] Appl. No.: **140,822**

Related U.S. Application Data

[62] Division of Ser. No. 856,005, Sept. 8, 1969, Pat. No. 3,634,741.
 [52] U.S. Cl.146/222, 146/94 R, 146/241
 [51] Int. Cl.B26d
 [58] Field of Search.....146/94, 95, 222, 241

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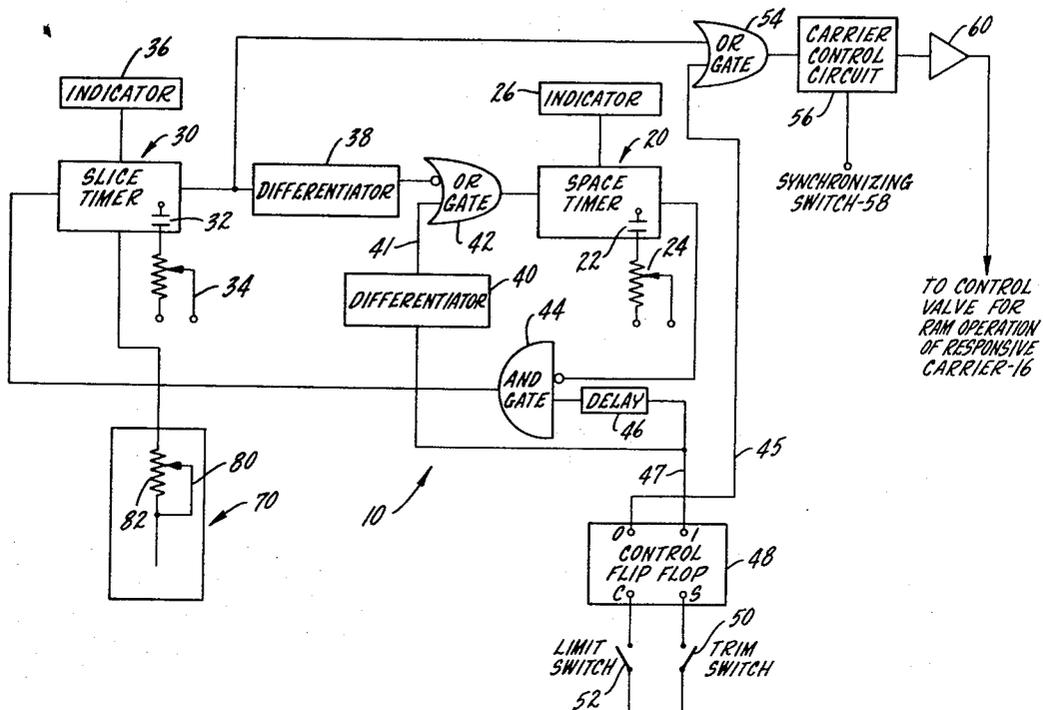
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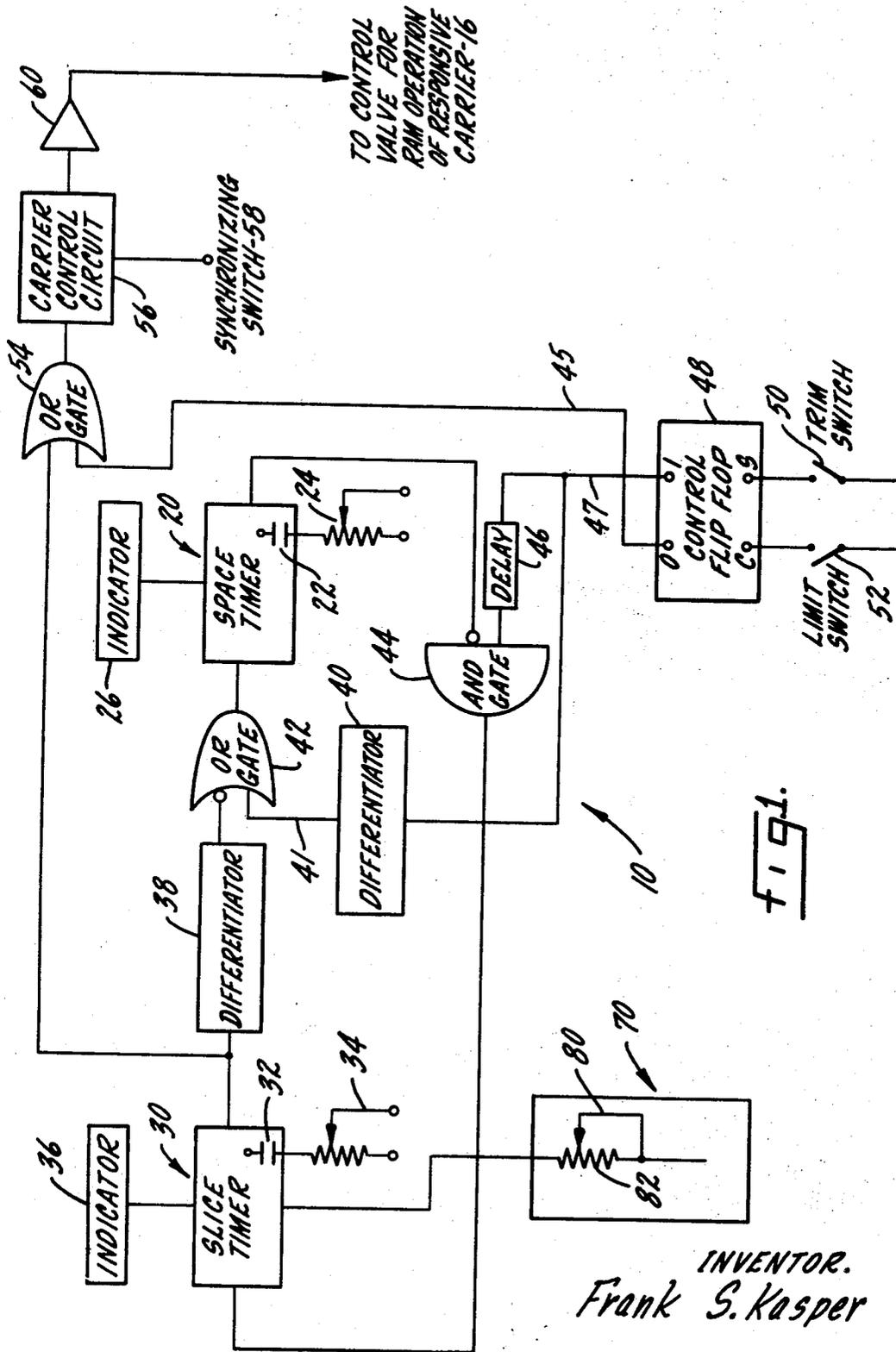
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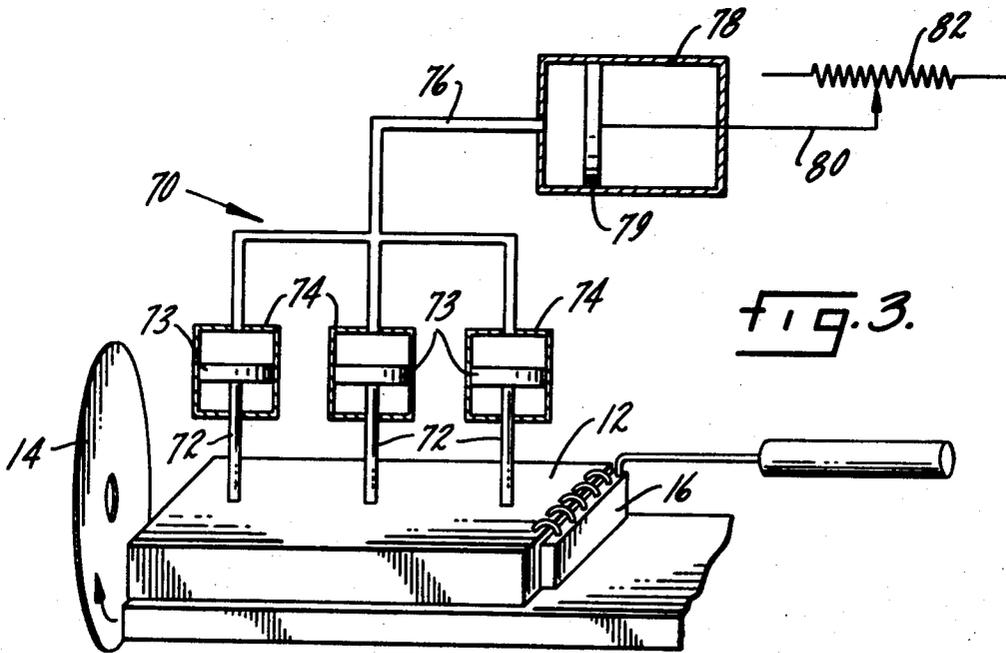
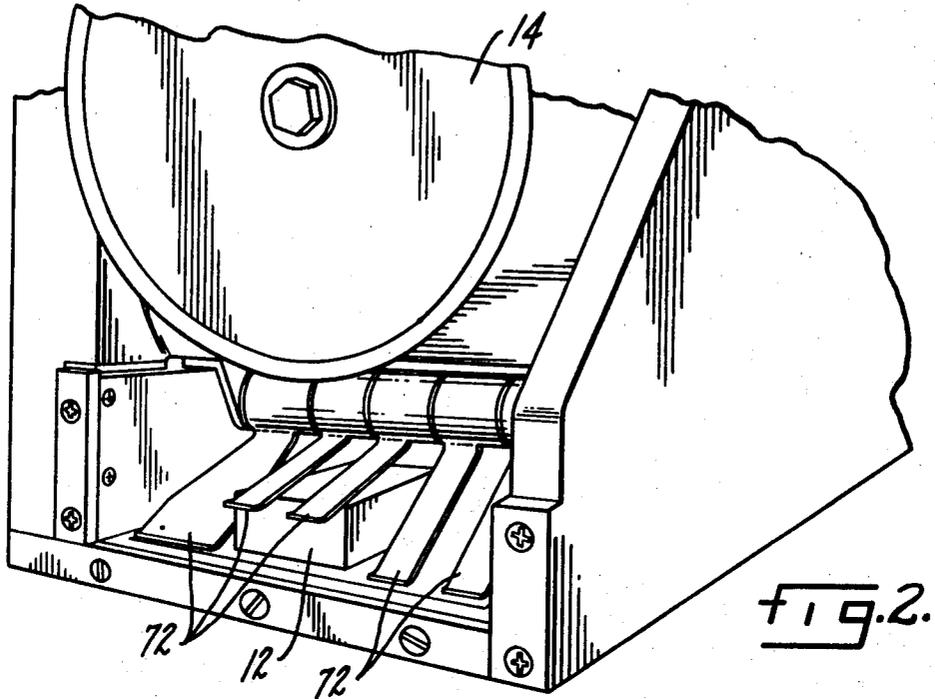
[57] **ABSTRACT**

There is disclosed a method and an apparatus for alternately effecting the actuation and non-actuation of a responsive instrumentality in a manner such that during actuation of the instrumentality, cooperation can be effected for a variable system condition. The apparatus comprises a first timer having a timing period and a non-timing period, a second timer connected to the first timer also having a timing period and a non-timing period wherein the first timer is adapted to switch to the non-timing period after the timing period is completed and upon switching to the non-timing period actuates the second timer into its timing period. The second timer is connected to the instrumentality to be actuated and the instrumentality is actuated whenever the second timer is in its timing period and is not actuated when the second timer is in its non-timing period. Sensing means are connected to the second timer for continuously sensing a predetermined system condition and wherein the duration of the timing period of the second timer is responsive to the sensing means. Control means are connected in circuit with the instrumentality to be actuated as well as to the first and second timer wherein the control means is adapted to initially place the first timer to its timing period and the second timer into its non-timing period wherein after the timing period of the first timer is completed, the first timer switches to its non-timing period thereby placing the second timer into its timing period and thereby causing the instrumentality to be actuated, this actuation continuing until the second timer switches into its non-timing period whereby the first timer again switches to its timing period thereby effecting the alternate actuation and non-actuation of the instrumentality.

4 Claims, 3 Drawing Figures







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METHOD AND APPARATUS FOR EFFECTING THE ACTUATING AND NON-ACTUATION OF A RESPONSIVE INSTRUMENTALITY

CROSS-REFERENCES TO RELATED APPLICATIONS

This application is a divisional application of application Ser. No. 856,005, filed Sept. 8, 1969, now U.S. Pat. No. 3,634,741, for "Method and Apparatus For Effecting the Actuation and Non-Actuation of a Responsive Instrumentality."

BACKGROUND OF THE INVENTION

The present invention relates to a method and apparatus for controlling the alternate actuation and non-actuation of a movable instrument.

One industry which has a great need for an invention such as that disclosed in the instant disclosure is the meat industry. For many years bacon and other meats have been sliced on high-speed slicing machines and segregated into correct weight groups by manual or automatic techniques. One automatic technique includes the counting out of a given number of slices to the approximate desired weight. A second technique is to slice the bacon onto a scale until the correct weight is reached and then stop slicing for a short, predetermined time interval. Recently, even more sophisticated techniques have been developed wherein the amount of sliced bacon is weighted and where there is a slight discrepancy in the weight, small amounts of bacon are added to make up the desired weight.

In the meat cutting field, it has, therefore, been the general practice to employ various types of weighing devices which weigh the sliced meat to determine whether or not a proper amount has been sliced. After determining this weight, more or less meat is added to the sliced pile. Although such devices have served the purpose, they have not proved entirely satisfactory under all conditions of service.

SUMMARY OF THE INVENTION

The present invention contemplates a unique timer control system utilizing two timer controls, a slice timer and a space timer. The slice timer times for a predetermined period of time so that the desired approximate weight of sliced material is reached. The time duration of the slice timer contains a manual control whereby the operator may make small adjustments if the weight tendency of the sliced material is over or under the weight. After the slice timer times out, the space timer is triggered. The space timer provides a gap between groups of sliced material. The adjustment of the space timer may be altered by another manual control. After the space timer times out, the output of the space timer is fed through a gating circuit which triggers the slice timer again and the cycle is repeated. The output of the slice timer feeds a control circuit which operates a control valve for starting and stopping the feed of the product to be sliced which is normally placed on a movable carrier means and which is fed into a rotatable blade for slicing.

When the slice timer is operative in its timing period, a valve is energized causing the movable carrier to feed the product into the rotating knife blade. The two timers then alternately operate to cause a slicing period

and a non-slicing period of the product. The slice timer normally triggers the space timer which in turn triggers the slice timer again. To accurately control the amount of product being sliced, a sensing means is placed in contact with the unsliced product. This sensing means measures the cross-sectional area of the uncut product and based upon this measurement, changes the timing period of the slice timer thereby allowing for a longer or shorter timing period. This timing period is inversely related to the cross-sectional area of the product to be sliced. In this manner, the proper amount of sliced product may be obtained very economically without the use of any weighing device on the output of the slicer.

It is therefore, an object of the present invention to provide an improved method of and apparatus for controlling the operation of a system instrumentality in a reliable and efficient manner.

Another object is the provision of a method of and apparatus for accurately slicing a product into preselected and predetermined weight groups without the use of a weighing scale.

A further object is the provision of a method of and an apparatus for the automatic slicing of bacon into preselected and predetermined weight groups without the use of weighing scales.

Still another object is to provide a method and an apparatus which has the necessary versatility to be adapted for a variety of applications at relatively low cost and without substantial modification in the basic functional characteristics thereof.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings and which like reference numerals designate like parts throughout the several views.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of a timer control circuit which constitutes the preferred embodiment of the invention.

FIG. 2 is a perspective view of the sensor circuit utilized in conjunction with the timer control circuit.

FIG. 3 is a schematic view of the sensor circuit shown in FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Broadly, there is disclosed a method for automatically slicing a product and collecting the sliced product in weight groups of preselected magnitude in the absence of weighing. The invention achieves these weight groups of essentially identical weight, automatically, even though the product is sliced. First the product to be sliced is placed in contact with the slicing instrument thereby initiating the start of a slicing period. Secondly, the cross-sectional area of the product to be sliced is continuously sensed. Based on the varying cross-sectional area of the product, the timing period of a slicing cycle is varied. The timing cycle of the slicing period is determined by the preselected amount of the sliced product required and by the cross-sectional area of the unsliced product. Thirdly, a non-

slicing period is then timed. The non-slicing period is initiated when the slicing period is terminated and finally, the slicing period is automatically reinitiated when the non-slicing period is terminated thereby causing an automatic sequential operation of slicing and non-slicing of the product.

This method of automatically slicing the product and collecting the sliced product into preselected measured weight groups will be more clearly understood when taken in conjunction with an apparatus for carrying out the method as shown in FIGS. 1-3.

Referring now to the drawings wherein like reference characters designate like or corresponding parts throughout the several views, there is shown in FIG. 1, which illustrates a preferred embodiment, a timer control circuit 10 which is used to control the alternate actuation and non-actuation of a carrier means 16 (shown in FIGS. 2 and 3). In a preferred embodiment, the timer control circuit 10 is utilized with a meat cutting machine. The timer control alternatively feeds a reciprocal meat carrier towards a constantly rotating blade and then removes the meat carrier from the constantly rotating blade.

Referring momentarily to FIG. 3, a conventional meat cutting machine comprises a constantly rotating knife blade 14 and a responsive carrier means 16 upon which is carried the product 12 to be sliced. One such meat cutting machine is the ANCO Model No. 827, manufactured by the ANCO Company of Chicago, Ill. This slicing machine is described in a manual entitled "Hydraulic Bacon Slicer Operating Instructions For the ANCO Model No. 827 Slicer Machine."

Referring now to FIG. 1, it can be seen that the heart of the timer control system comprises two timers, a space timer 20 and a slice timer 30. Each timer has two periods associated with it, a timing period and an ambient non-timing period. Also, each timer has an indicator 26 and 36, respectively, associated with it, so that an observer or operator can determine which timer is timing. One such timing control which may be utilized is described in U.S. Pat. No. 3,350,688 issued on Oct. 31, 1967, to Frank S. Kasper et al.; however, other timing devices may be employed.

Briefly, the operation of the timer control circuit 10 is used to actuate a control valve which in turn moves a carrier means 16 into contact with the rotating knife 14. In operation, the slice timer 30 will time for a predetermined period of time so that the desired approximate weight of sliced product is reached. This assumes that the rotating knife is rotating in a constant RPM so that reproducible results can be obtained. The time duration of slice timer 30 is controlled by a manual potentiometer 34 whereby the operator can make small adjustments if the weight tendency of the sliced product is over or underweight. After the slice timer times out, space timer 20 is triggered. Space timer 20 provides a gap between the groups of product being sliced. When space timer 20 is triggered, the carrier means 16 is stopped so that no further product is sliced. The timing period of space timer 20 may be adjusted by another manual potentiometer 24. After the space timer timing period times out, the output of the space timer 20 is fed through an AND gate 44 which triggers the slice timer 30 again and the cycle is repeated.

The output of slice timer 30 feeds a carrier control circuit 56 which operates a control valve for responsively feeding the carrier means 16, having the product 12 upon it, towards the rotating knife blade 14. When the slice timer 30 is operative, a valve (not shown) is energized causing the product to be fed into the knife. A synchronizing switch 58 indicative of the position of the knife blade is electrically connected to the carrier control circuit 56. This provides a means for insuring that the first slice is of proper thickness and that the last slice is of proper thickness as desired.

The sequencing of the cycling of slice timer 30 and space timer 20 can be interrupted by a gate control circuit which is under the control of a gating means, control flip-flop circuit 48. The slice timer 30 will normally trigger the space timer 20 which in turn triggers the slice timer 30 again providing that the gate control circuit is appropriately energized.

The gate control circuit broadly comprises an OR gate 42 connected between slice timer 30 and space timer 20 and an AND gate 44 connected between space timer 20 and slice timer 30. Lastly, an OR gate 54 is included between slice timer 30 and carrier control circuit 56. It can thusly be seen that the control gate circuit comprises three logic means, OR gates 42 and 54 and AND gate 44 which thus control the operation of slice timer 30 and space timer 20. Control flip-flop 48 which acts as a gating means and which operates OR gate 54 and AND gate 44, receives inputs from trim switch 50 and limit switch 52. In operation, slice timer 30 and space timer 20 continue cycling until limit switch 52 activates control flip-flop circuit 48 which in turn energizes gate 54 and the cycling stops. Control flip-flop 48 also provides an input to carrier control circuit 56 through OR gate 54 which operates the control valve which in turn activates the carrier means so that the slicer may be operated. When the carrier means has been loaded with an unsliced product and it is desired to start the slicer machine in operation, trim switch 50 is closed which in turn operates control flip-flop 48 to produce a signal to the input of AND gate 44 through a delay circuit 46 which causes timers 20 and 30 to begin their sequential operation.

A last feature provided by timer control circuit 10 is a sensor means 70 which senses the cross-sectional area of the product to be sliced. Basically, sensor 70 adjusts the duration of the timer period of slice timer 30 in inverse relationship to the cross-sectional area of the product to be sliced. Broadly, referring to FIGS. 2 and 3 as well as FIG. 1, sensor 70 comprises a potentiometer 82. The setting of this potentiometer is varied by the movement of a plurality of sensing fingers 72 shown in FIG. 3. While only three sensing fingers 72 are shown, it will be recognized that any number can be used and the greater the number of fingers, the greater the accuracy of the sensing means.

Now, referring to FIG. 1, the operation of timer control circuit 10 will be explained in more detail. The operation of timer control system 10 is initiated when the operator adjusts the product carrier means 16 (shown in FIG. 3) so that the product to be sliced is manually fed into rotating knife 14 until several slices are cut. This manual slicing evens the edge of the product so that a fixed reference edge may be established. The carrier means in the ANCO slicer con-

sists of a set of fingers or grippers (shown in FIG. 3) which dig into the end of the product and firmly push the product into the knife. These grippers are connected to a rod and piston which are hydraulically operated. However, it will be recognized by one skilled in the art that any means may be used to move the product into the knife. At this time, the operator closes trim switch 50 which causes an output signal on lead 47. This signal passes through differentiator 40 along lead 41, through OR gate 42, to space timer 20. This initiates the timing period of space timer 20. No further slicing occurs at this point, thereby allowing the manually sliced portion of the product to be removed. While space timer 20 is in its timing period, an indication is given by indicator 26. Indicator 26 may be a simple light bulb or any other conventional indicating means. The time duration of space timer 20 is determined and set by manual potentiometer 24 which is connected to the timing capacitor 22 of the timer control circuit. As mentioned above, one such timer control circuit is disclosed in U.S. Pat. No. 3,350,688. In this patent, the timing capacitor which is connected to the potentiometer would be capacitor 54 of the patent.

When space timer 20 is in its ambient non-timing period, or, in other words, its idle condition, it produces a low output. This low output from space timer 20 is applied to an input of AND gate 44.

When control flip-flop 48 is set by the actuation of trim switch 50, space timer 20 is triggered through differentiator 40 and OR gate 42. This causes space timer 20 to move into its timing cycle and thus, a high output signal occurs on the output of space timer 20. This high output signal is then applied to the circled input of AND gate 44. Another high input signal is applied to the other side of AND gate 44 by the control flip-flop 48 through delay circuit 46. Delay circuit 46 may be any conventional delay circuit such as an RC circuit. If delay network 46 were not in the timer circuit, a possibility would exist that there would be an output at AND gate 44 since the upper input of AND gate 44 is changing from a low to a high input. If this occurred, then the slice timer 30 would also be triggered at this time and both timers would then time simultaneously, rather than alternately as is required.

Continuing with the explanation of the operation of timer control circuit 10, the control flip-flop circuit 48 is energized when trim switch 50 is closed by the operator. This energizes one input of AND gate 44 after being delayed by delay circuit 46 as explained above. When this occurs, the output from space timer 20 will be permitted to pass through AND gate 44 when the space timer completes its timing period and thereby produces a low output. This then causes slice timer 30 to switch from its ambient non-timing period to its timing period. Indicator 36 then indicates to the operator that slice timer 30 is in its timing period. When slice timer 30 is in its timing period, the product to be sliced which is on the carrier 16 is then brought into engagement with the rotating knife blade 14 and slicing begins. When slice timer 30 furnishes its timing period, its associated indicator 36 is extinguished and space timer 20 is then triggered via differentiator 38 and OR gate 42. Specifically, when slice timer 30 completes its timing period, its output goes from high to low. Differentiator 38 then produces a differentiated pulse to

the circle input of OR gate 42. This causes a high output signal at the output of OR gate 42 which then triggers the space timer 20 into its timing period from its ambient non-timing period. This cycle is continued, space-slice-space, etc., until limit switch 52 is closed. It will be noted that differentiators 38 and 40 at the input of OR gate 42 are utilized so that the OR gate is responsive to an instantaneous signal rather than being continuously responsive.

The timing period of slice timer 30 is determined by a potentiometer 34 connected to the timing capacitor of the timing circuit and by sensor 70. The potentiometer 34 is a manual potentiometer which sets the nominal timing period of slice timer 30. The combination of the average setting of fingers 72 of sensor 70 (FIGS. 2 and 3) determines the average cross-sectional area of the product to be sliced. These fingers control the setting of potentiometer 82 of sensor 70 which also effects the slice timer time period duration as will be explained below. The output of slice timer 30 controls the carrier control circuit 56 through OR gate 54. The carrier control circuit 56 accepts an input from OR gate 54 and from the synchronizing switch 58 so as to provide an output signal to power amplifier 60 at the correct time to synchronize the starting of the movement of the carrier means with the knife position to produce an acceptable first and last slice. The purpose of power amplifier 60 is simply to amplify the output from the carrier control circuit 56 and provide the power necessary to operate the control valve which operates the carrier means 16. When the product has been completely sliced, a limit switch 52 is operated which ends the timing cycle and turns off the timer control circuit 10.

Limit switch 52 operates control flip-flop circuit 48 so as to produce a high output on lead 45 and a low output on lead 47. With a low signal on lead 47 which feeds one input of AND gate 44, AND gate 44 will then have a low output, hence, no start signal will occur to trigger slice timer 30; therefore, the cycling is stopped. The high output of flip-flop 48 on lead 45 is then applied to one input lead of OR gate 54. The output of OR gate 54 then energizes carrier control circuit 56. This causes the control valve to move into a run position causing the carrier to retract and permitting only manual operation of the slicer. To start the cycle all over again, trim switch 50 is then actuated as previously described and the space-slice-space-slice alternate cycle is again begun.

As mentioned above, sensor 70 is utilized to control the time duration of slice timer 30 in an inverse relation to the cross-sectional area of the product to be sliced.

Referring now to FIGS. 2 and 3, the operation of sensor 70 will be explained. Conventional meat slicer machines such as the ANCO Model 827 described above, contain hold-down fingers 72 which are used to hold the product to be sliced in position while being sliced and when the product is almost completely sliced, the last little piece is not pulled into the rotating knife. These hold-down fingers 72 may be modified as will now be described to act as a sensor means to determine the cross-sectional area of the product to be sliced. One each of the sensor fingers 72 may be connected to a small cylinder piston 73 as will be recognized by one skilled in the art, any suitable connecting

means may be utilized. Each small cylinder 74 in which the pistons 73 as confined is coupled to a large cylinder 78 by a tube 76. As the sensing fingers under spring tension move up and down following the contour of the product to be sliced, the associated pistons 73 in each of the small cylinders 74 also move up and down. Oil or any other suitable fluid or gas is then moved in or out of the large cylinder 78 thereby moving piston 79 which moves arm 80. Wiper arm 80 is connected to a potentiometer 82 so that wiper arm 80 may act as a potentiometer wiper thereby changing the resistance setting and, hence, changing the timing period of slice timer 30. The movement of piston 79 of cylinder 78 is indicative of the average cross-sectional area of the product to be sliced. This can easily be seen by the following calculation:

$$V = AD$$

$$v_1 = a_1 d_1$$

$$v_2 = a_2 d_2$$

$$v_3 = a_3 d_3$$

where:

V = the incremental change in volume of cylinder 78 when piston 79 moves

v = the incremental change in volume of each small cylinder 74 when each piston 73 moves

A = area of piston head 79

a = area of each small piston head 73

D = displacement of piston head 79

d = displacement of each small piston head 73

therefore:

$$V = v_1 + v_2 + v_3$$

$$AD = a_1 d_1 + a_2 d_2 + a_3 d_3$$

assume that:

$$A = 3a_1 = 3a_2 = 3a_3$$

then:

$$3AD = ad_1 + ad_2 + ad_3$$

therefore:

$$D = (d_1 + d_2 + d_3)/3$$

Therefore, it can be seen that the displacement of piston cylinder 79 of the large cylinder 78 can be made to follow the average of the small piston motions represented by d_1 , d_2 and d_3 . When this motion is coupled to potentiometer 82, an electronic signal is generated equal to the average position of the small pistons 73 (i.e., the position of the fingers 72). Thus, the cross-sectional area of the product to be sliced may always be determined.

It should be understood, however, that while only three sensing fingers have been shown, any number of sensing fingers and any numbers of master cylinders may be utilized. It will be recognized that the greater the number of fingers, the more accurate the sensing will be. Furthermore, it will be recognized by one skilled in the art that each sensing fingers 72 may be connected individually to its own potentiometer and that these potentiometers could then be connected in series to achieve an equivalent result to the use of a master cylinder and a single potentiometer. It is also interesting to note that the movement of the sensing fingers is made continuously as the product is being sliced. This means that the charging current into the timing capacitor 32 of slice timer 30 is continuously varying as the product is being cut so that the averaging technique of accounting for the cross-sectional area as well as the length of the product to be sliced gives an accurate in-

dications of the amount of product being sliced so that slice product groups of equal weight may be formed. Therefore, the time period of slice timer 30 is inversely related to the charging current and this means that the variation of the sectional volume will be taken into account by the variation in the charging current as the product is being sliced.

It will be recognized by one skilled in the art that while the preferred embodiment was directed to a machine for slicing a product, it need not be limited as such. It will be recognized that timer control circuit 10 may be utilized in any environment wherein it is necessary to effect the actuation and non-actuation of a responsive instrumentality and wherein a varying system condition must be accounted for during at least a portion of the actuated period of the instrumentality. Both space timer 20 and slice timer 30 may be individually set so that their relative periods of timing and non-timing may be alternated.

It should be understood, of course, that the foregoing disclosure relates only to a preferred embodiment of the apparatus and of the method of the invention and that numerous modifications or alterations may be made therein without departing from the spirit and the scope of the invention as set forth in the appended claims.

What is claimed is:

1. A timer control circuit in combination with a meat slicing machine having a rotatable cutting blade and a movable meat carrier to feed said meat to the blade for cutting, the improvement comprising:

first timer means having a first condition and a second condition, said first condition representing a timing period and said second condition representing an ambient non-timing period wherein said first timer means is adapted to switch to said second condition after said timing period is completed;

a second timer means connected in circuit with said first timer means and said movable meat carrier, having a first condition and a second condition, said first condition representing a timing period and said second condition representing an ambient non-timing period wherein said second timer means is placed in said first condition when said first timer means switches from said first condition to said second condition and wherein said meat on said movable meat carrier is placed in engagement with said blade thereby slicing said meat whenever said second timer means is in said timing period and said meat on said meat carrier is placed out of engagement from said blade when said second timer is in said second condition;

sensing means connected to said second timer means for continuously sensing the cross-sectional area of said unsliced meat and wherein the duration of said timing period of said second timer means is responsive to said sensing means; and

control means connected in circuit to said first timer means, said second timer means and said movable meat carrier wherein said control means is adapted to place said first timer means into said timing period and said second timer means into said second condition wherein after said timing cycle of said first timer means is completed, said second

time means switches to said first condition, thereby causing said meat to be sliced and wherein after said timing cycle of said second timer means is completed said first timer means switches to said first condition thereby ending said slicing action until said second timer means again switches to said first condition.

2. The combination of claim 1 wherein said control means further comprises means to synchronize said engagement of said meat with the position of said rotatable blade.

3. The combination of claim 2 wherein said synchronizing means comprises:

an OR gate connected in circuit with said second timer means;

a synchronizing switch connected between said rotatable knife blade and the output of said OR gate wherein said synchronizing means provides a signal to said movable meat carrier so as to synchronize the starting movement of said carrier with the position of said rotatable blade.

4. A method for automatically slicing a product and

collecting said sliced product into preselected measured weight groups comprising the steps of:

placing said product to be sliced in contact with a slicing instrument thereby initiating the start of a slicing period;

continuously sensing the cross-sectional area of said product to be sliced prior to said slicing of said product;

timing said slicing period wherein the duration of said slicing period is variable and is determined by the preselected amount of said product required and by said cross-sectional area of said unsliced product;

timing a non-slicing period wherein said non-slicing period is initiated when said slicing period is terminated; and

automatically reinitiating said slicing period when said non-slicing period is terminated thereby causing an automatic sequential operation of slicing and non-slicing of said product.

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