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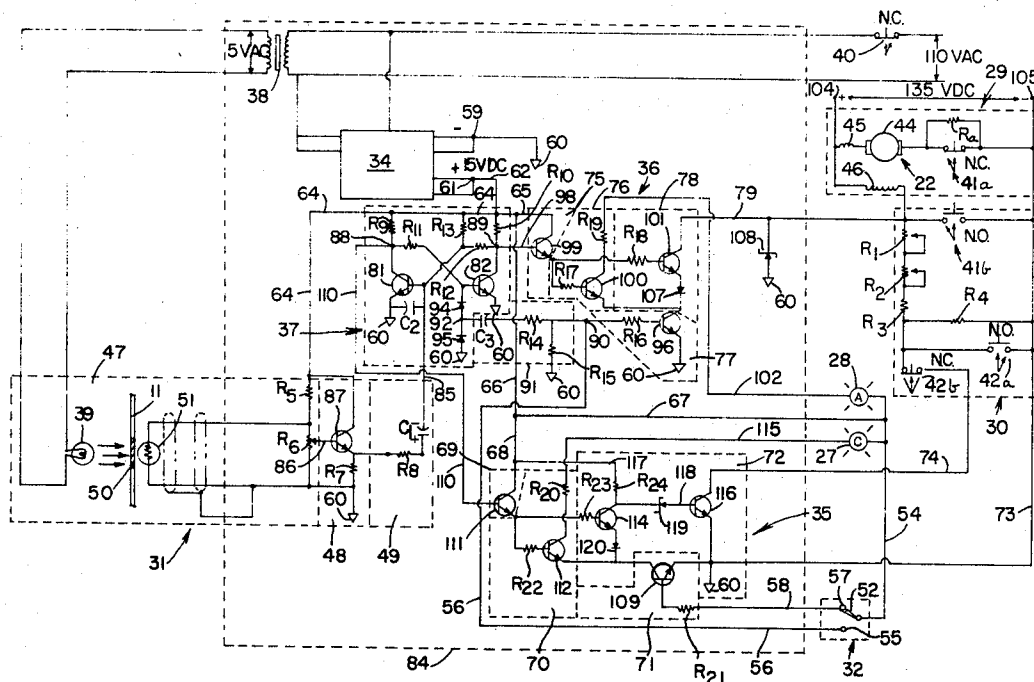
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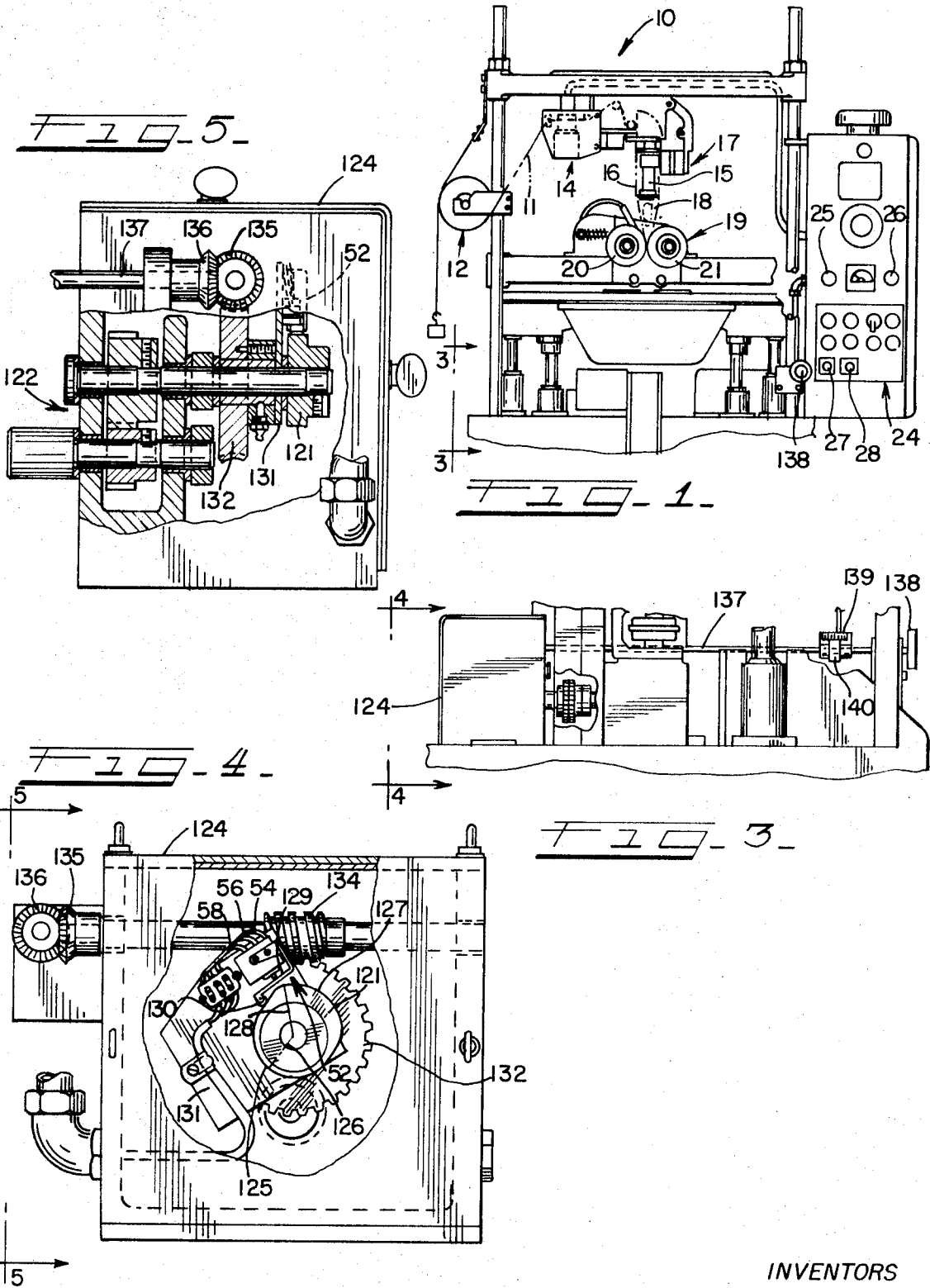
[54] **SPEED CONTROL SYSTEM FOR PACKAGING MACHINES**
 24 Claims, 3 Drawing Figs.

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 [51] Int. Cl. B65b 41/18
 [50] Field of Search 53/51;
 83/74; 226/28; 250/219 DR

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ABSTRACT: A speed control system for regulating the speed of a web feeding mechanism which feeds a web of film having labels thereon through a packaging machine in which individual packages are formed with the label on each package in a desired position in relation to the ends of each package. The package ends are formed by a cutting mechanism which operates at a predetermined frequency, and is driven independently of the web feeding mechanism. The control system of the invention determines the location of the label or other markings on a portion of the web of film which is adjacent the cutting mechanism when the web is cut and regulates the speed of the web feeding mechanism, so that the cutting mechanism will periodically cut the web to form package ends at predetermined locations relative to the labels on the web.





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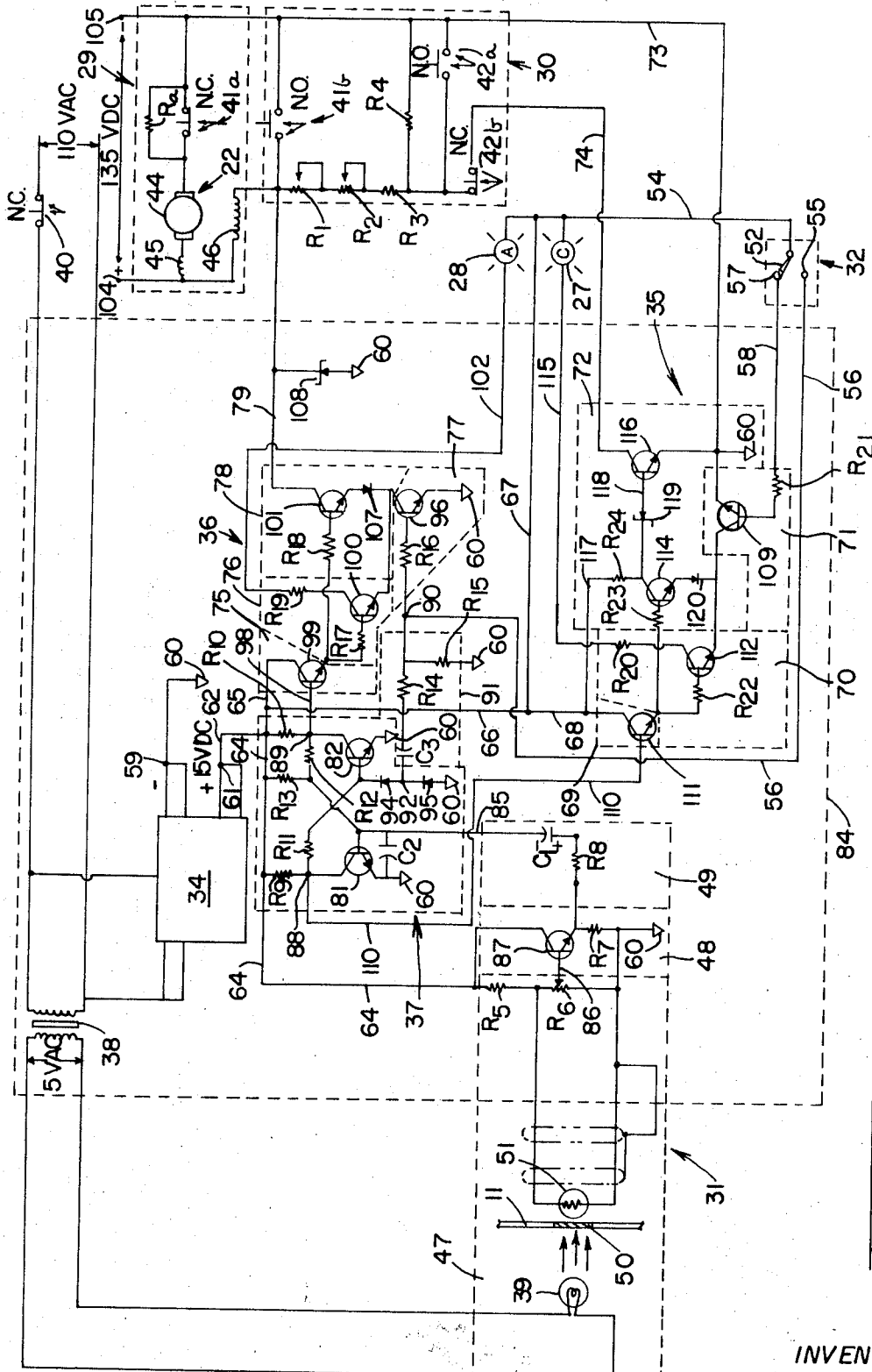


FIG. 2

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SPEED CONTROL SYSTEM FOR PACKAGING MACHINES

BACKGROUND AND DESCRIPTION OF THE INVENTION

This invention relates to an improved speed control system for regulating the speed of one device relative to the speed of another device. More particularly, this invention relates to an improved speed control system for regulating the speed of a web feeding mechanism which feeds a web of film having labels thereon through a packaging machine to a package end forming assembly which operates at a predetermined frequency and is driven independently of the web feeding mechanism to cut the web to form package ends, and the speed of the web feeding mechanism is regulated by the control system so that the label on a portion of the web adjacent the package end forming assembly is in a desired registration relative to the cutting mechanism of the package end forming assembly when the web is cut whereby the label on each package formed will be at a desired location relative to the ends of the package.

The speed control system of this invention is particularly adapted for use in a packaging machine of the type disclosed in the Jensen and Eberman U.S. Pat. No. 2,831,302, issued Apr. 22, 1958. The packaging machine disclosed in this patent is arranged to feed a web of pliable film from a film supply roller to a mandrel where the web is folded over and sealed by a sealing mechanism to form a continuous skin or tube into which a food product is stuffed. The upper end of the mandrel is connected to a source of material, e.g., a meat emulsion, which is fed by the machine through the mandrel to the lower end thereof to fill the tube passing over the lower end of the mandrel. The tube filled with material is fed, by feed rollers, from the lower end of the mandrel past a reciprocating, package end forming assembly which gathers, clips and cuts the tube at predetermined intervals to form package ends. The package end forming assembly is operated at a frequency which is preset and determined by package size and feeding speed, and is driven independently of the feed rollers.

It is desirable that each completed package have a contents-indicating label thereon in a particular position, typically, midway between the ends of each package.

In the meat packaging industry, film is supplied with the labels already affixed to the web of film stock. Therefore, since labels are already on the film when the tube of filled material is formed, it is necessary that the package end forming assembly cut the tube at a proper position between labels so that the label on each completed package is positioned at a particular desired location on each package with respect to the ends of each package.

When the package end forming assembly cuts the tube at the desired positions, the movement of the film is considered properly synchronized with the operation of the package end forming assembly, but if the package end forming assembly cuts the tube too soon or too late, the machine is out of proper synchronization, and labels will not be in the proper position between package ends.

Therefore, whenever there is a variation in the speed at which the tube is moving past the package end forming assembly, or the film is stretched while moving through the packaging machine, the package end forming assembly will not cut the tube at the desired position between labels. Accordingly, it is desirable that means be provided for determining when the movement of the film is out of proper synchronization with the operation of the package end forming assembly and for adjusting the speed of the feed rollers to place the film movement speed back into the desired relation with respect to the operational frequency of the package end forming assembly. One such means for determining whether the film movement is proper, in relation to the operation of the package end forming assembly, and for adjusting the speed of the feed rollers accordingly, is shown and disclosed in the Steinberg U.S. Pat. No. 3,055,246, issued Sept. 26, 1962.

This patent describes a machine in which a scanning head, placed upstream of the package end forming assembly, includes a lamp and a photocell for sensing register marks which are positioned on the film at predetermined intervals, and which bear a particular relationship to the position of the labels previously imprinted on or adhered to the film. The operation of the package end forming assembly, the speed of the feed rollers and the position of the photocell and lamp are then set so that the length of film disposed between the position of the photocell and the position at which the package end forming assembly cuts the filled tube is an integral multiple of the length of an individual package. Typically, the label for each package is located midway between two register marks and the operation of the package machine is set to cut the tube at or on a register mark, whereby when the tube is cut at a register mark, another register mark is simultaneously passing between the lamp and the photocell in the scanning head. The movement of a register mark past the photocell will initiate one signal, while the cutting of the tube by the package end forming assembly will initiate another signal. Both signals are sent to a speed control circuit, and if the control circuit receives the two signals at the same time, the movement of the film is in proper synchronization with the operation of the package end forming assembly and the speed control circuit will not be operated. However, if the signal from the scanning head is received by the control circuit before or after the signal initiated by the cutting of the tube is received, the control circuit will be operated to decrease or increase the speed of the feed rollers.

An object of the present invention is to provide an improved speed control system for maintaining the movement of a web of film in a packaging machine synchronized with the operation of a package end forming assembly.

Another object of the present invention is to provide an improved speed control system for maintaining the movement of a web of film in a packaging machine synchronized with the operation of a package end forming assembly by controlling the speed of a web feeding mechanism which feeds the film to the package end forming assembly.

Another object of the invention is to provide an improved speed control system for controlling the speed of one device relative to the speed of another device.

Another object of the invention is to provide an improved speed control system for a packaging machine of the type described which includes a first signal producing circuit, a second signal producing circuit, a speed increase circuit, a speed decrease circuit and a signal comparing circuit connected to the first and second signal producing circuits and to the speed increase and decrease circuits.

Another object of the invention is to provide an improved control system utilizing components which are easily assembled on a plug-in type printed circuit card.

Another object of the invention is to provide an improved speed control system for a packaging machine which includes a simple means for adjusting the system for different package lengths so that the system is adjustable for any length of package which the machine can handle.

Another object of the invention is to provide an improved speed control system for a packaging machine which includes means for indicating the registration setting of the system for a particular package length.

Another object of the invention is to provide a speed control system for a packaging machine of the type described, which includes a sensing circuit for sensing markings on a web of film passing through the machine, a first signal producing circuit associated with the sensing circuit, a mechanism for cutting the web of film at predetermined intervals, a second signal producing circuit associated with the cutting mechanism for producing a signal each time the web is cut, a speed increase circuit, a speed decrease circuit and a bistable multivibrator circuit for comparing the signals received from the first signal producing circuit with the signals received from the second signal producing circuit and to operate the speed

increase circuit or the speed decrease circuit as indicated by the time of signal reception.

Another object of the invention is to provide a speed control system for a packaging machine of the type described, which includes a bistable multivibrator circuit controlled by first and second signal producing circuits to operate, when indicated, a speed increase circuit or a speed decrease circuit for controlling the speed of a web feeding mechanism to maintain the movement of a web of film synchronized with the operation of a package end forming assembly in the packaging machine.

Another object of the invention is to provide a speed control system for a packaging machine of the type described, wherein electronic switching means are arranged and adapted to compare first signals, initiated by movement of markings on a web of film past a sensing circuit positioned upstream of a package end forming assembly in the machine, with second signals from a signal producing circuit associated with the package end forming assembly and adapted, in an operative mode, to operate a speed increase circuit or a speed decrease circuit which varies resistance connected in series with the shunt field winding of the DC motor operating the web feeding mechanism of the machine.

Another object of the invention is to provide an improved speed control system for regulating the speed of a first device relative to the speed of a second device and wherein the control system includes first and second alternately conducting electronic switching elements, each of which is adapted to apply a control signal to respective first and second control circuits which operate to vary the speed of the first device, each control circuit including first and second switching elements, the first of which is turned on by one of the control signals, a first circuit for producing a signal at a frequency related to the speed of the first device and a second circuit associated with the second device for producing a signal at a frequency related to the speed of the second device, the first signal producing circuit being adapted to turn on the first electronic switching element, the second signal producing circuit being adapted to turn on the second electronic switching element, and the second signal producing circuit also being adapted to turn on the second switching element of the second control circuit during part of the time of one cycle of the second signal to enable said second control circuit to operate when a control signal is applied to the first switching element of the second control circuit, and to turn on the second switching element of the first control circuit during the remainder of the cycle of the second signal to enable the first control circuit to operate when a control signal is applied to the first switching element of the first control circuit.

Additional objects and advantages of the invention will be apparent from the following description, taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a fragmentary front elevational view of a packaging machine embodying the improved speed control system of the present invention;

FIG. 2 is a schematic diagram of the electrical system for operating the web feeding mechanism shown in FIG. 1 and including the improved speed control system of the invention;

FIG. 3 is a fragmentary side elevational view taken along lines 3-3 of FIG. 1;

FIG. 4 is a fragmentary view, with portions broken away, of the gear box assembly shown in FIG. 3, taken along lines 4-4 of FIG. 3; and

FIG. 5 is a fragmentary view, with portions broken away, of the gear box assembly shown in FIG. 4, taken along lines 5-5 of FIG. 4.

Referring to FIG. 1, a packaging machine embodying the speed control system of the present invention is generally indicated at 10. This machine 10 is preferably of the type shown and described in the Jensen and Eberman U.S. Pat. No. 2,831,302, issued Apr. 22, 1958 and only so much of the machine 10 will be herein described as is necessary to an understanding of a preferred embodiment of the control system

of the invention, and a preferred use thereof. It is to be understood that further details of the construction and operation of the machine 10 can be obtained from the Jensen and Eberman patent.

In the machine 10, a web 11 of film is fed from a package film supply roll 12 past a scanning head 14 to a mandrel 15 where the web 11 is folded over into the form of a tube 16 and then the edges of the web are sealed together by a sealing mechanism 17 to complete the formation of the tube 16. As the tube 16 passes over the lower end of the mandrel 15, it is filled with a product 18. The product filled tube is then fed by a web feeding mechanism 19 to a package end forming assembly which gathers, clips and cuts the tube at predetermined intervals. The package end forming assembly clips the tube by applying two metal clips or closures to the tube and then cuts the tube at a point between the two metal clips to complete the formation of one package. The package end forming assembly is operated at a predetermined frequency and driven independently of the web feeding mechanism 19.

Typically, the web feeding mechanism 19 includes two feed rollers 20 and 21, driven by a direct current motor of the shunt field type. The direct current motor is generally indicated schematically at 22 in FIG. 2 and will be more fully described in connection with the description of FIG. 2.

The packaging machine 10 also includes a control panel 24 of known type, which includes various switches, buttons and knobs, for starting, stopping and adjusting various drive mechanisms of the machine 10. Included on the control panel 24 are a coarse adjustment knob 25 and a fine adjustment knob 26 for adjusting the speed of the motor 22 (FIG. 2). Each of these knobs 25 and 26 is connected to a variable resistor to form a rheostat, as will be more fully explained in connection with the description of FIG. 2. Additionally, the control panel 24 has mounted thereon an increase speed indicating lamp 27 and a decrease speed indicating lamp 28. When the speed control system of this invention is operating to increase or decrease the speed of the motor 22 (FIG. 2) the respective increase or decrease speed indicating lamp, 27 or 28, will be turned on to indicate the automatic correction in speed being effected by the speed control system of this invention. When one of the lamps 27 or 28 continues to "blink" on for the same period of time, or for increasingly longer periods of time, this "blinking" will indicate that the movement of the web is out of synchronization with the operation of the package end forming assembly more than can be automatically corrected by the speed control system. If this happens, the knob 25 and/or the knob 26 will have to be adjusted until the speed of the web feeding mechanism 19 is synchronized with the operation of the package end forming assembly, which synchronization is indicated by a "no light" condition.

The electrical system for the web feeding mechanism 19 (FIG. 1) is shown schematically in FIG. 2 and includes: a motor circuit 29; a resistor circuit 30 for controlling the speed of the motor 22; a first signal producing circuit 31; a second signal producing circuit 32; a power supply 34; a motor speed increase circuit 35; a motor speed decrease circuit 36; and a bistable multivibrator circuit 37. In the embodiment of the invention illustrated in FIG. 2, the speed control system generally can be considered as including all the circuits shown except the motor circuit 29 and the resistor circuit 30. However, it is to be understood that, since the resistance in the resistor circuit 30 controls the speed of the motor 22, the resistor circuit 30 also can be considered as part of the speed control system. The function of, and the relationship between, the various circuits will be more fully explained in the following paragraphs.

The power supply 34 is connected to a suitable AC source for example, a 110 volt AC source as indicated. This AC source is also connected to a transformer 38 to provide 5 volts AC power for a lamp 39 in the scanning head 14, the purpose of which will be hereinafter explained. A conventional power control switch 40 is provided in the lead connections to the AC source for disconnecting the power supply 34 and the transformer 38 from the AC source.

A motor starting control, including the switches 41a and 41b, is provided for starting the motor 22. After the motor is running, the switch 41a is normally closed (NC) SHORT circuiting a motor armature starting resistor R_a and switch 41b is normally open (NO) so that the resistor circuit 30 is operatively connected to the motor circuit 29. As shown in FIG. 2, the motor 22 is preferably energized by 135 v. DC, which can be obtained through rectifiers (not shown) from a suitable AC source. The resistor R_a is provided to protect such rectifiers from surge currents when the motor 22 is started.

The switches 42a and 42b, in the resistor circuit 30, are operated in conjunction with the switch 40 to disconnect the speed control system of this invention from the motor circuit 29 and the resistor circuit 30. That is to say, the switches 40, 42a and 42b are actuated together by suitable controls on the control panel 24 (FIG. 1) to open the normally closed switches 40 and 42b and to close the normally open switch 42a to deenergize the speed control system and isolate the control system from the motor circuit 29 and the resistor circuit 30.

The motor control circuit 29 includes, in addition to the resistor R_a , an armature 44, an armature series field winding 45 and a shunt field winding 46 which are conventional and form no part of this invention.

The resistor circuit 30 includes the variable resistors R_1 and R_2 which are connected respectively to the control knobs 25 and 26 (FIG. 1) to form rheostats for manually controlling the current through the shunt field winding 46. Additional current limiting resistors R_3 and R_4 are connected in series with the resistors R_1 and R_2 . The resistors R_1 , R_2 and R_3 are normally connected in series circuit relation with the shunt field winding 46 and, as will be more fully explained hereinafter, are short circuited by the speed decrease circuit 36 connected in shunt relationship with the resistors R_1 , R_2 and R_3 , when a decrease in the speed of the motor 22 is called for. On the other hand, the resistor R_4 is normally short circuited by the speed increase circuit 35 connected in shunt relationship with the resistor R_4 , and this short circuit is opened by the speed increase circuit 35 to increase the resistance in series with the shunt field winding 46, when an increase in the speed of the motor 22 is called for.

The first signal producing circuit 31 includes a photocell circuit 47 mounted in the scanning head 14, an isolating buffer circuit 48, and a signal or pulse forming circuit 49. The photocell circuit 47 can also be referred to as a register mark sensing circuit which senses a register mark or eyespot 50 on the web 11 as the eyespot 50 on the web 11 passes between the lamp 39 and a photocell 51.

As shown, the second signal producing circuit 32 includes a two position limit switch 52 which operates in a first position to connect a lead 54 with a terminal 55 connected to a lead 56 and in a second position to connect the lead 54 with a terminal 57 connected to a lead 58. In FIG. 2, the switch 52 is in the second position.

In one preferred embodiment, the power supply 34 has an output of 15 volts DC as indicated in FIG. 2. The negative terminal 59 of the power supply 34 is connected to a common or ground terminal 60 while the positive terminal 61 of the power supply 34 is connected to a lead 62 which supplies positive voltage through a lead 64 to the multivibrator circuit 37 and the first signal producing circuit 31, through a lead 65 to the speed decrease circuit 36, through a lead 66, a lead 67 and the lead 54 to the limit switch 52 and lamps 27 and 28, and through the lead 66 and a lead 68 to the speed increase circuit 35.

The speed increase circuit 35 includes an isolating buffer circuit 69, a lamp switching circuit 70, a speed increase enabling circuit 71 and a speed increase control circuit 72. Two leads 73 and 74 connect the speed increase control circuit 72 in shunt relationship with resistor R_4 . Normally, the speed increase control circuit 72 provides a short circuit or low resistance path from the lead 74 to the lead 73 to bypass current around the resistor R_4 . When the speed increase circuit 35 is operated this short circuit is opened to increase the resistance in series with the shunt field winding 46 to increase the speed of the motor 22.

The speed decrease circuit 36 includes an isolating buffer circuit 75, a lamp switching circuit 76, a speed decrease enabling circuit 77 and a speed decrease control circuit 78. The speed decrease control circuit 78 is connected by a lead 79 and the common terminal 60 in shunt relationship with the resistors R_1 , R_2 and R_3 . Normally, the speed decrease control circuit 78 between the lead 79 and the common terminal 60 is in an open circuit condition. When the speed decrease circuit 36 is operated, the control circuit 78 is closed to provide a short circuit, low resistance current path between the lead 79 and the common terminal 60 to short circuit the resistors R_1 , R_2 and R_3 to decrease the speed of the motor 22.

The multivibrator circuit 37 includes first and second, alternately conducting, electronic switching elements or components 81 and 82 which, in a preferred embodiment of the invention, are transistors.

In one embodiment of the invention, the circuits 35, 36, 37, 48 and 49 are assembled on a plug-in type printed circuit card and the power supply 34 is of the plug-in type having connections which plug into the printed circuit card. Other plug-in type connections are provided on the card for connecting the photocell circuit 47, the resistor circuit 30, the lamps 27 and 28 and the second signal producing circuit 32 to the printed circuit card. Preferably, the printed circuit card, the power supply 34, and the transformer 38 are mounted in a control box indicated by the broken lines 84 in FIG. 2.

Referring now to FIGS. 1 and 2, the web 11 of the film has a plurality of eyespots 50 (FIG. 2) positioned thereon at spaced apart intervals which correspond or are related to a particular length of package formed by the packaging machine 10. As each one of these eyespots 50 passes the photocell 51 the amount of light from the lamp 39 to the photocell 51 is decreased. This decrease in light will increase the resistance across the photocell 51 which as more fully explained hereinafter, will initiate a signal which will be carried by a lead 85 from the first signal producing circuit 31 to the base of the first transistor 81. At the same time, the second signal producing circuit 32 is applying a positive potential from the lead 54 to either the lead 56 or the lead 58.

The second signal producing circuit 32 is operated by a suitable drive mechanism associated with the package end forming assembly. This drive mechanism moves the limit switch 52 from one of its positions to the other of its positions once, during each cycle of the package end forming mechanism, i.e., once during the time period for producing one package. As a result, the switch 52 will be in contact with terminal 55 for a portion of the time period to produce one package and will be in contact with the terminal 57 during the remainder of the time period for producing one package. As will be explained hereinafter in more detail, when a signal (from the first signal producing circuit 31 initiated by an eyespot 50) is produced at the same time the limit switch 52 is moved from the terminal 55 to the terminal 57, movement of the web 11 will be in synchronization with the operation of the package end forming assembly whereby the tube is constricted, clipped and cut at the desired position with respect to two eyespots 50 on the web 11. Typically, a label has been previously imprinted on the web 11 midway between each two eyespots 50 and the web 11 is cut at or on an eyespot. When the desired registration exists, neither the speed increase circuit 35 nor the speed decrease circuit 36 will be operated and no change in the speed of the motor 22 will be effected.

If an eyespot 50 does not pass the photocell 51 when the limit switch 52 is moved from the terminal 55 to the terminal 57, the speed increase circuit 35 will be operated to increase the speed of the motor 22 until an eyespot 50 passing the photocell 51 initiates a signal. On the other hand, if, while the limit switch 52 is in contact with the terminal 55, an eyespot 50 passes the photocell 51, the speed decrease circuit 36 will be operated to decrease the speed of the motor 22 until the limit switch 52 is moved from the terminal 55 to the terminal 57.

As previously explained, an eyespot passing between the lamp 39 and the photocell 51 will initiate a signal. This is ac-

complished by the fact that the decrease in light to the photocell 51 causes an increase in the resistance across the photocell 51 which is connected in parallel with a control resistor R_5 forming part of a potential divider network with a resistor R_6 . The resistors R_5 and R_6 are connected in series between the common terminal 60 and the lead 64 leading to the positive terminal 61. An adjustable contact 86 connects a portion of the resistance in the resistor R_5 to the base of a conducting transistor 87 in the isolating buffer circuit 48. This transistor 87 is connected as an emitter follower. When the light from the lamp 39 to the photocell 51 is decreased and the resistance of the photocell 51 is increased, a voltage pulse caused by this change in resistance appears between the common terminal 60 and the contact 86. This pulse is applied to the base of the transistor 87 and appears at the emitter of the transistor 87. The pulse at the emitter changes the current flowing through load resistor R_7 to the common terminal 60. The resulting change in voltage across the resistor R_7 is then applied through the signal forming circuit 49 to the base of the transistor 81 in the multivibrator circuit 37.

The signal or pulse forming circuit 49 includes a pulse forming impedance preferably defined by a resistor R_8 and a capacitor C_1 connected in series between the emitter of the transistor 87 and the lead 85 connected to the base of the transistor 81. When the voltage changes across the resistor R_7 , the capacitor C_1 passes a pulse which is generally in the form of a square wave to the base of the transistor 81. The positive going edge of this pulse will turn on the transistor 81.

The resistor R_7 also serves to provide a path to the common terminal 60 for the discharge current from the capacitor C_1 after the transistor 87 stops conducting, while the resistor R_8 and the capacitor C_1 also provide an impedance for any stray signals (e.g., noise) which might be picked up by the first signal producing circuit 31. A capacitor C_2 is connected in the multivibrator circuit 37 between the base of the transistor 81 and the common terminal 60 to provide a low impedance path for such stray signals which are at a frequency well above the frequency range of the pulses produced by the signal producing circuit 31.

Turning now to the multivibrator circuit 37, a potential dropping resistor (i.e., a load resistor) R_9 is connected between lead 64 (connected to the positive terminal 61 and an input terminal 88 (i.e., collector) of the transistor 81. The emitter of the transistor 81 is connected to the common terminal 60. Likewise, a potential dropping resistor (i.e., a load resistor) R_{10} is connected between the positive terminal 61 and an input terminal 89 (i.e., collector) of the transistor 82; and the emitter of transistor 82 is connected to the common terminal 60. The input terminal 88 of the first transistor 81 is connected through a base driving or current limiting resistor R_{11} to the base of the transistor 82 while, the input terminal 89 of the transistor 81 is connected through a base driving or current limiting resistor R_{12} to the base of the transistor 81.

When the transistor 81 is conducting, the voltage drop across the collector and emitter terminals of the transistor 81 is very low and most of the 15 volt potential drop is across the resistor R_9 . As a result, the potential at the input terminal 88 of the transistor 81 is at almost 0 volts and this low potential is applied through the resistor R_{11} to the base of the transistor 82 to turn off (render nonconducting) the transistor 82. With the transistor 82 turned off, the input terminal 89 of the transistor 82 is at a potential close to the positive potential at the positive terminal 61. This positive potential is applied through the resistor R_{12} to the base of the transistor 81 and since this positive potential is above the threshold voltage for turning on the transistor 81, it will maintain the transistor 81 turned on (i.e., conducting).

An important feature of the multivibrator circuit 37 is the provision of a control resistor R_{13} connected between the positive terminal 61 and the base of the transistor 81. This control resistor R_{13} forms a potential dividing network with the resistor R_{12} . The potential dividing network, particularly the resistor R_{13} , provides a small voltage to the base of the transistor

81 when the transistor 82 is conducting. In other words, when the transistor 82 is conducting, the voltage drop across the resistor R_{10} also will be across the potential dividing network (formed by the resistors R_{13} and R_{12}) which is in parallel with the resistor R_{10} . The resistor R_{13} is chosen so that: (1) most of the voltage drop across the resistor R_{10} appears across the resistor R_{13} and only a small voltage of somewhere between 0.3 and 0.6 volts appears across the resistor R_{12} ; and, (2) the voltage across the resistor R_{12} is slightly below the threshold voltage needed at the base of the transistor 81 for turning on the transistor 81. Typically, the threshold voltage is about 0.6 volts.

With the voltage at the base of the transistor 81 maintained at a value slightly below the threshold voltage for turning on the transistor 81 when the transistor 82 is conducting, the transistor 81 will be rendered more sensitive to turn on by pulses received from the transistor 87 through the pulse forming circuit 49. This is important, since it allows various types or colors to be utilized for the eyespots 50 on the web 11. For example, it has been found that eyespots colored red and green do not produce as good a signal, when the red or green eyespot passes the photocell 51, as do other colors. However, by inserting the control resistor R_{13} in the multivibrator circuit 37, connected in the manner just described, the transistor 81 can be easily turned on by signals initiated by eyespots having any one of a large variety of colors.

The lead 56 from the terminal 55 is connected at a junction 90 to the speed decrease enabling circuit 77 and to a signal or pulse forming circuit 91 which can be considered as part of the second signal producing circuit 32. The signal forming circuit 91 is similar to the signal forming circuit 49 and includes a resistor R_{14} and a capacitor C_3 connected in series between the junction 90 and the base of the transistor 82. When a positive voltage is first applied to the terminal 55, the capacitor C_3 will initially act as a short circuit and pass a pulse generally in the form of a square wave to the base of the transistor 82. The transistor 82 is turned on by the leading, positive going edge of this pulse. As the transistor 82 starts conducting, the potential at the input terminal 89 goes almost to zero, and this potential is applied through the resistor R_{12} to the base of the transistor 81 to turn off the transistor 81. This potential, however, will be slightly above zero due to the resistor R_{13} , as previously explained. The signal forming circuit 91 also includes a resistor R_{15} which is connected between the junction 90 and the common terminal 60 and which provides a path for the flow of current from the capacitor C_3 to the common terminal 60 when the capacitor C_3 discharges. The capacitor C_3 is connected between the resistor R_{14} and a junction 92. A first unidirectional semiconductor or diode 94 is connected between the junction 92 and the base of the transistor 82 and has a polarity which will allow a positive pulse from the pulse forming circuit 91 to reach the base of the transistor 82 while blocking current flow from the base of the transistor 82 (i.e., from the terminal 88 through the resistor R_{11}) from reaching and charging the capacitor C_3 with a reverse polarity to the charge placed on the capacitor C_3 by the positive potential from the lead 56. A second unidirectional semiconductor or diode 95 is connected between the junction 92 and the common terminal 60 and has a polarity which blocks current flow from the junction 92 to the common terminal 60. When the capacitor C_3 discharges, the junction 92 between the capacitor C_3 and the diodes 94 and 95 will be negative. It is important that the negative potential at the junction 92 is not applied to the base of the transistor 82 since such a negative potential might turn the transistor 82 off. The second diode 95 prevents this from happening, by virtue of the low voltage drop across the diode 95. In other words, when the capacitor C_3 discharges, the current flow will be from the capacitor C_3 through the resistors R_{14} and R_{15} , the common terminal 60, the diode 95 and the junction 92 back to the capacitor C_3 , and the voltage drop across the diode 95 is small whereby the negative potential at the junction 92 is only slightly below the potential at the common terminal 60.

When the limit switch 52 is moved from the terminal 57 to the terminal 55, the pulse from the pulse forming circuit 91 will turn on the transistor 82. The proper biasing voltage to maintain the transistor 82 turned on is obtained from the input terminal 88 of the transistor 81 which has been turned off by the conduction or turning on of the transistor 82. It should be noted that the voltage applied to the junction 90 from the lead 56 is also applied to the base of a transistor 96 in the speed decrease enabling circuit 77 through a base driving resistor R_{16} . This will enable the transistor 96 to conduct. However, the voltage at the input terminal 89 is close to zero, as a result of the conduction of the transistor 82, and no speed decrease control signal is applied from the input terminal 89 through a lead 98 to the base of a transistor 99 in the isolating buffer circuit 75. Now, if at this point in time, an eyespot 50 passes the photocell 51 to produce a signal which turns on the transistor 81, the transistor 82 will be turned off and the potential at the input terminal 89 will approach the positive potential of the positive terminal 61. This positive potential (control signal) will then be applied through the lead 98 to the speed decrease circuit 36 (which has been enabled to conduct as explained above) to operate the speed decrease circuit 36 to short circuit the resistors R_1 , R_2 and R_3 to decrease the speed of the motor 22.

The transistor 99 of the isolating buffer circuit 75 is connected as an emitter follower which isolates the speed decrease circuit 36 from the multivibrator circuit 37 to prevent the speed decrease circuit 36 from reacting on the multivibrator circuit 37. The transistor 99 also can be considered as a control switching element of the speed decrease circuit 36, while the transistor 96 is the enable switching element of the speed decrease circuit 36. It is to be noted that both switching elements 96 and 99 must be turned on to operate the speed decrease circuit 36.

When both of the switching elements 96 and 99 have been turned on, the transistor 99 applies current from its emitter through a base driving resistor R_{17} to the base of a transistor 100 in the lamp switching circuit 76 and through a base driving resistor R_{18} to the base of a transistor 101 in the speed decrease control circuit 78.

The positive potential applied to the base of the transistor 100 will turn on the transistor 100 to turn on the decrease speed indicating lamp 28. The circuit for the lamp 28 is from the positive potential on the lead 54, through the lamp 28, a lead 102, a lamp current limiting resistor R_{19} , the transistor 100, the transistor 96 to the common terminal 60; and this circuit is conducting current through the lamp 28 when the transistors 96 and 100 are turned on. The resistor R_{19} protects the lamp 28 from high currents and thereby prolongs the life of the lamp 28. A similar resistor R_{20} is provided in the lamp switching circuit 70 of the speed increase circuit 35 for the same purpose as will be explained hereinafter.

The positive potential applied to the base of the transistor 101 will turn on the transistor 101 enabling it to conduct. The transistor 101 is connected in series with the transistor 96 between the lead 79 and the common terminal 60. When both of the transistors 96 and 101 are turned on, current will flow from a positive terminal 104 of the DC supply voltage for the motor 22 through the shunt field winding 46, the lead 79, the transistors 101 and 96 to the common terminal 60, which is connected to a negative terminal 105 of the DC supply voltage for the motor 22 by the lead 73. The low resistance current path through the transistors 101 and 96 short circuits the resistors R_1 , R_2 and R_3 to increase the current through the shunt field winding 46 to decrease the speed of the motor 22.

The emitters of transistors 100 and 101 are both connected to the collector of the transistor 96. As a result, when the transistor 96 is turned off and the transistors 99 and 100 are turned on, a leakage current could flow from the lead 54 through the lamp 28, the resistor R_{19} through the collector and emitter of the transistor 100 through the emitter and collector of the transistor 101, the lead 79, and the resistor circuit 30 to the common terminal 60. To prevent this from happening, a

current blocking diode 107 is placed in the connection between the emitter of the transistor 101 and the collector of the transistor 96 connected to the emitter of the transistor 100.

To protect the speed decrease control circuit 78 from transient voltages which are generated by the inductance of the shunt field winding 46 when resistors are switched into or out of the resistor circuit 30, a Zener diode 108 is connected between the lead 79 and the common terminal 60 and has a breakdown voltage below the upper limit for collector voltage on the transistor 101.

When the limit switch 52 is moved from the terminal 57 to the terminal 55, 15 volts from the power supply 34 is applied to the junction 90 as previously explained. If no eyespot 50 passes the photocell 51, the transistor 81 will not be turned on and the transistor 82 will continue to conduct. Also, the speed decrease circuit 36 will not have been actuated. Then, when the limit switch 52 is moved from the terminal 55 to the terminal 57, the positive potential on the lead 54 is applied through the limit switch 52, the terminal 57 and the lead 58 through a base driving resistor R_{21} to the base of a transistor 109 in the speed increase enabling circuit 71. Also, since the transistor 81 is not conducting at this time, the positive potential (control signal) at the input terminal 89 of the transistor 81 is applied through a lead 110 to the base of a transistor 111 in the isolating buffer circuit 69. When the transistors 109 and 111 are both turned on, the speed increase circuit 35 is operated to increase the speed of the motor 22.

The isolating buffer circuit 89 is essentially the same as the isolating buffer circuit 75 and the transistor 111 is connected as an emitter follower to prevent the speed increase circuit 35 from reacting on the multivibrator circuit 37. Also, the transistor 111 can be considered as a control switching element while the transistor 109 is the enabling switching element. Both of the switching elements 109 and 111 must be turned on to operate the speed increase circuit 35. With the transistors 109 and 111 turned on current flows from the leads 66 and 68 through the transistor 111 and from the emitter of transistor 111 through a base driving resistor R_{22} to the base of a transistor 112 in the lamp switching circuit 70 and through a base driving resistor R_{23} to the base of a transistor 114 in the speed increase control circuit 72.

The circuit for the lamp 27 is from the positive potential on the lead 54 through the lamp 27, a lead 115, the resistor R_{20} , and the transistors 112 and 109 to the common terminal 60.

The speed increase control circuit 72 includes a second, normally conducting transistor 116 in addition to the transistor 114. A positive turn on voltage is applied from the leads 66 and 68 to a lead 117 through a resistor R_{24} and a lead 118 to the base of the transistor 116. A Zener diode 119 is placed in the lead 118 and has a low breakdown voltage to permit the voltage from the leads 66, 68 and 117 to turn on the transistor 116 when the transistor 114 is not conducting. The Zener diode 119 is provided to prevent any voltage, which may develop across the transistors 109 and 114 at the collector of the transistor 114 when the transistors 109 and 114 are conducting, and which may be above the threshold voltage for turning on the transistor 116, from reaching the base of the transistor 116 to turn on the transistor 116.

When the speed increase circuit 35 is not operating, the transistor 116 is turned on, and is conducting current from the lead 74 to the negative terminal 105. This current path through the transistor 116 has a very low resistance whereby the resistor R_4 is essentially short circuited by the conducting transistor 116. However, when the speed increase circuit 35 is operated and the transistor 114 is turned on as well as the transistor 109, a larger current flows through the resistor R_{24} and the transistors 114 and 109 to the common terminal 60. This larger current causes a voltage drop across the resistor R_{24} , such that the voltage at the junction between the resistor R_{24} , the collector of the transistor 114, and the lead 118 is below the breakdown voltage for the Zener diode 119 connected in the lead 118 to the base of the transistor 116. As a

result, no turn on voltage or current will be applied to the base of the transistor 116 and the transistor 116 will be turned off. The current path through the transistor 116 then will be open circuited placing the resistor R_4 in series with the shunt field winding 46 of the motor 22 to decrease the current through the shunt field winding 46 and thereby increase the speed of the motor 22.

It is to be noted that the resistor R_{24} serves two functions. When the speed increase circuit 35 is not operating, the resistor R_{24} functions as the base driving resistor for the transistor 116, and when the speed increase circuit 35 is operated, the resistor R_{24} functions as a load resistor for the transistor 114 and as a potential dropping device to reduce the voltage applied to the lead 118 below the breakdown voltage of the Zener diode 119 to turn off the transistor 116.

To prevent leakage current from the emitter of transistor 112 from flowing through the emitter and collector of the transistor 114, through Zener diode 119 across the base and emitter of the transistor 116 to the common terminal 60 when the transistors 111 and 112 are turned on and the transistor 109 is turned off, a current limiting diode 120, similar to the diode 107, is connected between the emitter of the transistor 114 and the collector of the transistor 109 connected to the emitter of the transistor 112.

Once the speed increase circuit 35 is operated by the turning on of the transistors 109 and 111, the speed increase circuit 35 will continue to operate until an eyespot 50 passes the photocell 51 which will turn on the transistor 81, reduce the potential at the input terminal 88 and thereby turn off the transistor 111.

As previously explained, when an eyespot 50 passes the photocell 51 at the time the limit switch 52 is moving from terminal 55 to terminal 57, movement of the web 11 will be in synchronization with the operation of the package end forming assembly associated with the limit switch 52, and the speed increase circuit 35 will not be operated. Then, when the limit switch 52 moves from the terminal 57 to the terminal 55 during the remainder of one cycle of operation of the package end forming assembly, the speed decrease 36 will not be operated and only will be operated if an eyespot 50 passes the photocell 51 while the limit switch 52 is connected to the terminal 55. In this way, the control system maintains the eyespot (or label) on the portion of the tube 16 which is adjacent the package end forming assembly and which is a predetermined distance along the web 11 from the lamp 39 and the photocell 51, in the proper desired registration relative to the package end forming assembly when the tube 16 is cut.

One preferred form of the limit switch 52 is illustrated in FIG. 4 with the leads 54, 56 and 58 leading from the switch 52 to the control box 84 (FIG. 2) containing the speed control system. Preferably, the control box 84 (FIG. 2) is mounted behind the control panel 24 (FIG. 1). The mechanism for operating the limit switch 52 includes an eccentric cam 121 which is connected by a suitable gear mechanism, generally indicated at 122 in FIG. 5, to a drive mechanism associated with the package end forming assembly. The gear mechanism 122 and the cam 121 are preferably mounted in a gear box 124. The gear mechanism 122 is arranged and adapted to rotate the cam 121 360° for each package produced by the machine 10, i.e., one complete revolution for each reciprocation of the package end forming assembly. As best shown in FIG. 4, the cam 121 has a first cam surface 125 which has a first radius 126 and a second cam surface 127 which has a second radius 128 which is greater than the first radius 126 of the first cam surface 125. Both of the radii 126 and 128 extend from a center coincident with the axis of rotation of the cam 121. The limit switch 52 includes a movable contact arm 129 which has a roller 130 at one end arranged to ride on the surfaces 125 and 127 of the cam 121. When the roller 130 is engaging the cam surface 125, the limit switch 52 will be making contact with the terminal 57 to apply 15 volts DC from the lead 54 to the lead 58 thereby enabling the speed increase circuit 35, and when the roller 130 is engaging the cam surface 127 the limit switch

52 will be making contact with the terminal 55 to apply 15 volts enabling the from the lead 54 to the lead 56 thereby enabling the speed decrease circuit 36 and, at the instant contact is made with the terminal 55, sending a signal to turn on the transistor 82.

In one preferred embodiment of the invention a satisfactory operation of the control system is obtained when the percentage of the circumference of the cam 121 covered by the cam surface 127 is 30 percent and the percentage of the circumference of the cam covered by the cam surface 125 is 70 percent. With this relationship, the terminal 55 will be energized for 30 percent of the time period for producing one package while the terminal 57 will be energized for 70 percent of the time period for producing one package. It is to be appreciated, of course, that the proportion of the circumference occupied by cam surface 125 with respect to the proportion occupied by the cam surface 127 is dependent upon the dynamics of a particular packaging machine 10, and for other packaging machines or for other uses of the control system, a different relationship between the cam surfaces 125 and 127, other than 70-30, may be more appropriate.

In the illustrated embodiment, and as best shown in FIGS. 4 and 5, the limit switch 52 is mounted on a plate 131 which is rotatably adjustable through an angle of 370°, for reasons which will be explained hereinafter. The plate 131 is connected to a gear 132 which is in meshing engagement with a worm gear 134. The worm gear 134 is connected through two bevel gears 135 and 136 to a control shaft 137. As best seen in FIG. 3, the control shaft 137 extends from the gear box 124 to a control knob 138 which, as shown in FIG. 1, is positioned adjacent the control panel 124.

As explained previously, the limit switch is set for a particular length of package and in this respect the length of the web 11 between the photocell 51 and the point where the tube 16 is cut by the package end forming assembly is usually or preferably equal to an integral multiple of package lengths. However, it may be desired to make packages having a different length. If so, the predetermined frequency of operation of the package end forming assembly and the point during the cycle of operation of the package end forming assembly at which the limit switch 52 is moved from the terminal 57 to the terminal 55 will have to be adjusted. The readjustment of the limit switch 52 is accomplished by rotating the control knob 138.

Of course, it is to be understood, that it may be desirable to cut the tube 16 at a point other than at or on an eyespot 50. If so, the position of the limit switch 52 relative to the cam 121 can be set for any point in time during one cycle of operation of the package end forming assembly by virtue of the 370° adjustment of the limit switch mounting plate 131. In this way, the synchronization of the movement of the web 11 with the operation of the package end forming assembly can be set so that the tube 16 is cut at any desired point between two eyespots 50 and for any length of package which the machine 10 can handle.

Thus, the operation of the control system can be adjusted so that the tube 16 is cut periodically at a point closer to one label on the web 11 than to an adjacent label and all the packages formed by the machine 10 with this particular setting of the knob 138 will have a label thereon at a particular desired location on each package closer to one end of each package.

To facilitate adjustment of the registration, for different lengths of packages and for different label positions an indicating means is provided in the form of a scale 139 positioned adjacent the control shaft 131, as best shown in FIG. 3. A marker 140, which is moved relative to the scale 139 when the knob 138 is rotated, is situated on the shaft 137. Once a particular synchronization or registration position is obtained for a particular package length or for a particular label position, the relationship between marker 140 and the scale 139 is noted. Then, after the limit switch 52 is adjusted, by turning the knob 138, for another package length or a different label

position, one can easily readjust the position of the limit switch 52 to the synchronization or registration position for the particular package previously formed by the machine by aligning the marker 140 relative to the scale 139 at the particular position, previously noted.

Although the invention has been described with particular reference to its use with a packaging machine, it is to be understood that the control system of this invention (1) can be utilized in different environments, particularly where a shunt wound DC motor performing some function must be synchronized with another independently driven or controlled machine or function, and (2) can be modified without departing from the principles of the invention, e.g., the lamp switching circuits can be omitted. Moreover, other pulse forming devices can be used in place of the photocell 51 and the limit switch 52 for producing the input signals. Also, the supply voltages used and the DC motor size are only limited by the choice and availability of the circuit components used and can be varied as desired. Therefore, the scope of this invention is to be limited only as required by the following claims.

We claim:

1. In a packaging machine of the type where a web of pliable film is utilized in packaging a product, the improvement comprising a control system for regulating the speed of a web feeding means to maintain the movement of said web in synchronization with the operation of a package end forming assembly, said control system comprising: first and second electronic switch means, each switch means having an input terminal connected through a voltage dropping means to the positive terminal of a voltage source, and each switch means being adapted to alternately conduct current from said positive terminal of said source to a negative terminal of said source, said first and second electronic switch means being interconnected in such a way that the turning on of one of said switch means will turn off the other of said switch means, a two position switch means operable through a cycle dependent upon the time period for producing one package, said two position switch means being adapted, in a first position to apply a single, turn on signal for a completed package exiting from said machine to said second electronic switch means and to enable a speed decrease means to operate for a portion of said time period between packages, and in a second position to enable a speed increase means to operate for the remainder of the time period between packages, said input terminal of said first electronic switch means being connected to a control switching element in said speed increase means and said input terminal of said second electronic switch means being connected to a control switching element in said speed decrease means, means for sensing a register mark on said web of film, and means associated with said sensing means for applying a turn on signal to said first electronic switch mean when a register mark is sensed by said sensing means whereby, when said two position switch means is in said first position and said first electronic switch means is turned on, said second electronic switch means is turned off and the potential at said input terminal of said second electronic switch means is applied to said control switching element in said enabled speed decrease means to operate said speed decrease means to decrease the speed of said web feeding means, and when said two position switch is moved to said second position before said first electronic switch means is turned on, the potential at said input terminal of said first electronic switch is applied to said control switching element in said enabled speed increase means to operate said speed increase means to increase the speed of said web feeding means.

2. A control system for a packaging machine, in which a web of film with markings thereon at spaced intervals is fed by a web feeding means to a package end forming assembly which is driven independently of said web feeding means to cut said film at a predetermined frequency and at predetermined intervals, for regulating the speed of said web feeding means relative to the frequency of operation of said package end forming assembly, said system comprising first and second

alternately conducting electronic switch means which are adapted to conduct current from a positive terminal of a voltage source to a negative terminal of a said source and which are interconnected in such a way that conduction of one of said electronic switch means will turn off the other of said electronic switch means, each of said electronic switch means being adapted, when not conducting, to apply a control signal to respective first and second speed control circuits for varying the speed of said web feeding means, each speed control circuit including first and second switching elements, the first of which is turned on by the control signal from one of said electronic switch means, a first signal producing means producing a first signal at a frequency related to the speed of said web feeding means, and a second signal producing means associated with said package end forming assembly and adapted to produce a second signal at a frequency related to the frequency of operation of said package end forming assembly, said first signal producing means being adapted to turn on said first electronic switch means, and said second signal producing means being adapted to apply said second signal to said second electronic switch means to turn on said second electronic switch means and being adapted, during part of one cycle of operation of said package end forming assembly, to turn on said second switching element of said second control circuit enabling said second control circuit to operate when the control signal from one of said electronic switch means is applied to said first switching element of said second control circuit, and, during the remainder of said one cycle of operation of said package end forming assembly, to turn on the second switching element of said first control circuit to enable it to operate when the control signal from the other electronic switch means is applied to said first switching element of said first control circuit.

3. The control system of claim 2 in which said first electronic switch means includes a control electrode which is connected to said first signal producing means and to a voltage dividing network associated with said second electronic switch means, said voltage dividing network being adapted to apply a small potential to said control electrode of said first electronic means when said second electronic switch means is conducting and said first electronic switch means is not conducting, said small potential being of a value slightly below the threshold potential for turning on said first electronic switch means whereby said first electronic switch means is very sensitive to signals from said first signal producing means.

4. The control system of claim 2 in which said first signal producing means includes a resistor and a capacitor connected in series with a control electrode of said first electronic switch means.

5. The control system of claim 2 in which said second signal producing means includes a resistor and a capacitor connected in series with a control electrode of said second electronic switch means.

6. The control system of claim 5 in which an impedance means is connected between one side of said capacitor and the negative terminal of said source, said impedance means being adapted to permit said second signal to be applied to said control electrode of said second electronic switch means and thereafter to provide a path for the flow of discharge current from said capacitor when said capacitor discharges.

7. The control system of claim 6 in which a unidirectional circuit element is connected between said control electrode of said second electronic switch means and said negative terminal of said source and provides a current path for said discharge current from said capacitor and also, by reason of a low voltage drop across said unidirectional circuit element, limits the negative potential which can be applied to said control electrode when said capacitor discharges.

8. The control system of claim 5 in which a unidirectional circuit element is connected between said control electrode of said second electronic switch means and said series connected resistor and capacitor, said first electronic switch means being adapted to apply a positive, turn on voltage to the control

electrode of said second electronic switch means and said unidirectional circuit element prevents this voltage from said first electronic switch means from being applied to said resistor and said capacitor.

9. The control circuit of claim 2 in which said second control circuit includes a normally nonconducting circuit element which is rendered conducting when said second control circuit is operated.

10. The control circuit of claim 9 in which said web feeding means includes a DC motor having shunt field winding, said circuit element is connected in parallel with a resistor in series with said field winding, and, when said second control circuit is operated, said circuit element is rendered conducting to short circuit said resistor to decrease the speed of said motor.

11. The control systems of claim 2 in which said first control circuit includes a normally conducting circuit element.

12. The control system of claim 11 in which said web feeding mean includes a DC motor having a shunt field winding, said circuit element is connected in parallel with a resistor in series with said field winding, said resistor being normally short circuited by said normally conducting circuit element, and, when said first control circuit is operated, said circuit element is rendered nonconducting to open circuit the short circuit across said resistor to increase the speed of said motor.

13. The control system of claim 2 in which at least one of said first and second control circuits includes an indicating lamp and an indicating lamp switch means, said indicating lamp switch means being adapted to conduct current to energize said indicating lamp when the respective control circuit is operated to vary the speed of said web feeding means and said indicating lamp serves to indicate one direction in which the speed of said web feeding means is being varied.

14. The control system of claim 2 in which said second signal producing means includes means for adjusting the point in time when said second signal is produced so that said system can be used to regulate the position at which aid web is periodically cut relative to the position of said markings on said web.

15. The control system of claim 2 in which said second signal producing means comprises a limit switch which is in a first position during part of the time period for producing one package and is in a second position for the remainder of said time period, said second signal producing means produces said second signal when said limit switch is moved from said second position to said first position, and means are provided for adjusting the point in time when said limit switch is moved to said first position to produce said second signal relative to the time when said first signal is produced and through a complete cycle of said first signal.

16. The control system of claim 15 in which said limit switch is actuated by an eccentric cam which makes one revolution for each package produced by said machine, and said adjustment means includes a limit switch mounting plate which is rotatable about the axis of rotation of said eccentric cam and through an angle of at least 370°, and means for rotating said mounting plate to change the point in time at which said limit switch is moved by said cam from second position to said first position.

17. The control system of claim 14 in which means are provided for indicating the adjustment position of said adjustment means for one package length, whereby, after said adjustment means has been adjusted for a second package length, said adjustment means can be easily readjusted to said first mentioned adjustment position.

18. A speed control system for maintaining the movement of a web of film in a packaging machine in synchronization with the operation of a package end forming assembly, said system comprising means for sensing the speed of said web, said sensing means being situated at a point adjacent the path of movement of said web and upstream of said package end forming assembly and being adapted to sense eyespots positioned on said web at predetermined intervals as each eyespot passes said sensing means, a web feeding mechanism for feed-

ing said web to said package end forming assembly, said package end forming assembly being operated at a predetermined frequency and independently of the speed of said web feeding mechanism, a control circuit, a first signal producing means associated with said sensing means and adapted to produce a signal and apply said signal to said control circuit when an eyespot on said web passes said sensing means, a second signal producing means associated with said package end forming assembly and adapted to send a signal to said control circuit upon each cycle of operation of said package end forming assembly, said control circuit including a signal comparing circuit, a speed increase circuit and a speed decrease circuit, said first signal producing means being connected to said signal comparing circuit, said second signal producing means being connected to, and applying a signal to, said speed decrease circuit during part of the cycle of operation of said end forming assembly and, being connected to, and applying a signal to, said speed increase circuit during the remainder of the cycle of operation of said package end forming assembly, and said comparing circuit being adapted to cause operation of said speed decrease circuit to decrease the speed of said web feeding mechanism if a signal from said first signal producing means is received by said comparing circuit before said signal applied by said second signal producing means to said speed decrease circuit is terminated and applied to said speed increase circuit, and being adapted to cause operation of said speed increase circuit to increase the speed of said web feeding mechanism when said second signal producing means applies a signal to said speed increase circuit before said signal comparing circuit receives a signal from said first signal producing means.

19. The speed control system of claim 18 in which said speed increase circuit and said speed decrease circuit both include an enabling switching element and a control switching element, said second signal producing means being connected to said enabling switching element of said speed decrease circuit during part of the cycle of operation of said package end forming assembly and being connected to said enabling switching element of said speed increase circuit during the remaining portion of the cycle of operation of said package end forming assembly, said signal comparing circuit having a first connection to said control switching element of said speed increase circuit and a second connection to said control switching element of said speed decrease circuit and being adapted to turn on said control switching element in said speed decrease circuit when a signal is received by said signal comparing circuit from said first signal producing means, and said second signal producing means, when initially connected to said speed decrease circuit also being connected to, and applying a signal pulse to, said signal comparing circuit to cause said signal comparing circuit to turn on said control switching element in said speed increase circuit until a signal is received by said signal comparing circuit from said first signal producing means.

20. The speed control system of claim 18 in which said signal comparing circuit is a flip-flop circuit.

21. An electronic control system for controlling the speed of a web feeding mechanism of a packaging machine relative to the frequency of operation of a web processing mechanism of said packaging machine, said web processing mechanism being operated at a predetermined frequency and independently of the speed of said web feeding mechanism, said system comprising means for sensing the speed of said web at a point adjacent the path of movement of said web and upstream of said web processing mechanism, a trigger control circuit, first signal producing means associated with said sensing means and adapted to produce a signal and apply said signal to said trigger control circuit when a marking on said web passes said sensing means, a second signal producing means associated with said web processing mechanism and adapted to send signal to said trigger control circuit upon each cycle of operation of said web processing mechanism, a speed increase circuit connected to said trigger control circuit, and a

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speed decrease circuit connected to said trigger control circuit, said trigger control circuit being adapted to trigger said speed decrease circuit to decrease the speed of said web feeding mechanism when a signal from said first signal producing means is received by said trigger control circuit within a predetermined time period after a signal is received by said trigger control circuit from said second signal producing means, and, if no signal is received by said trigger control circuit from said first signal producing means during said predetermined time period, said trigger control circuit being adapted to trigger said speed increase circuit to increase the speed of said web feeding mechanism after said predetermined time period and until said trigger control circuit receives a signal from said first signal producing means.

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22. The electronic control system of claim 21 in which said second signal producing means is connected to said speed decrease circuit during part of the cycle of operation of said web processing means and is connected to said speed increase circuit during the remainder of the cycle of operation of said web processing means.

23. The electronic control system of claim 21 in which said trigger control circuit is a flip-flop circuit.

24. The electronic control system of claim 21 in which said trigger control circuit includes means for controlling the sensitivity of said trigger control circuit to signals received from said first signal producing means.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,583,128 Dated June 8, 1971

Inventor(s) Lloyd Dale Johnson and Robert Edward Wulf

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 6, line 31, change "he" to --the--.

Column 7, line 48, change "a" to --an--.

Column 7, line 54, change "diving" to --driving--.

Column 8, line 49, change "firs" to --first--.

Column 8, line 62, change "when" to --When--.

Column 9, line 45, change "he" to --the--.

Column 12, line 2, delete "enabling the" and insert --DC--.

Column 14, line 56, change "an" to --and--.

Column 15, line 37, change "aid" to --said--.

Column 16, line 62, change "paid" to --said--.

Column 16, line 73, after "send" insert --a--.

Signed and sealed this 7th day of December 1971.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Acting Commissioner of Patents