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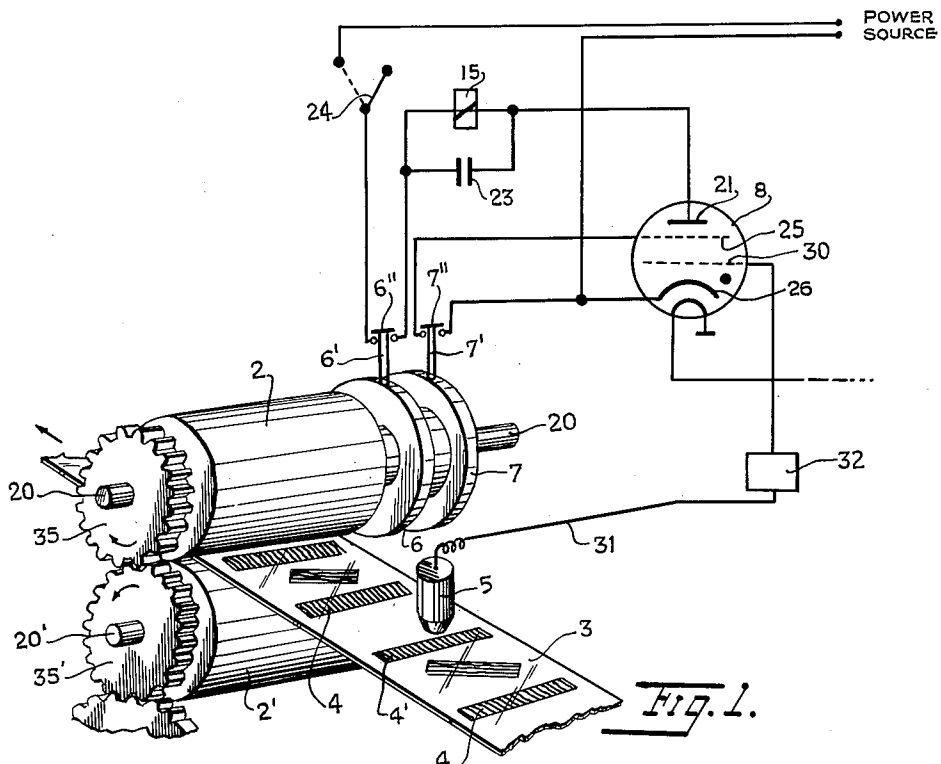
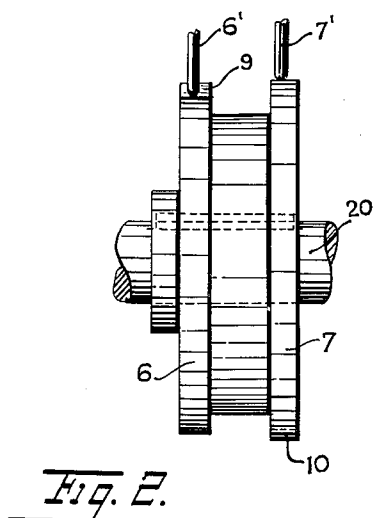
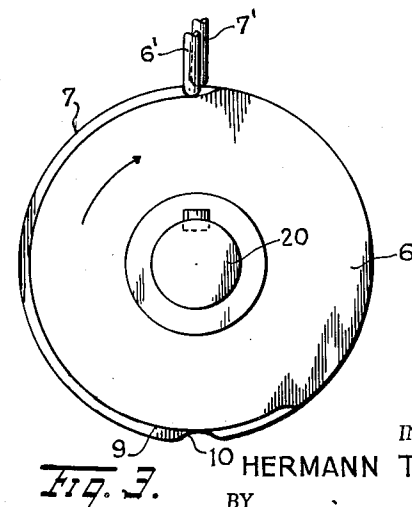
H. THÜRLINGS

3,028,064

CONTROL DEVICE FOR WEB FEEDING MECHANISM

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2 Sheets-Sheet 1



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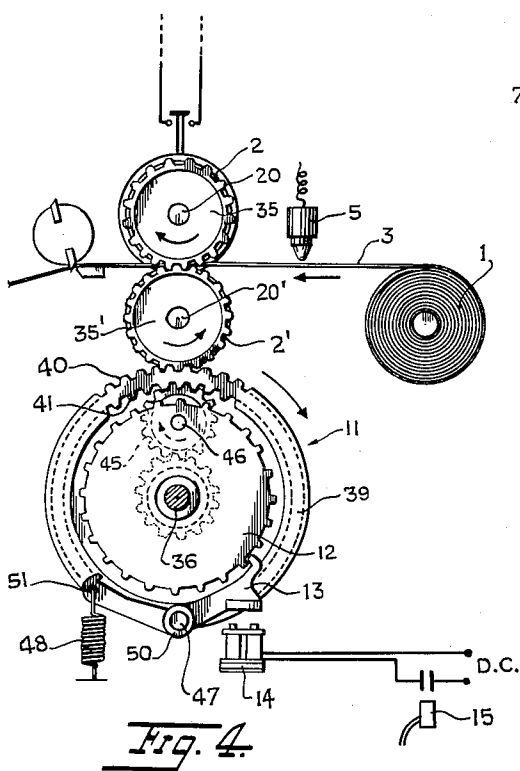
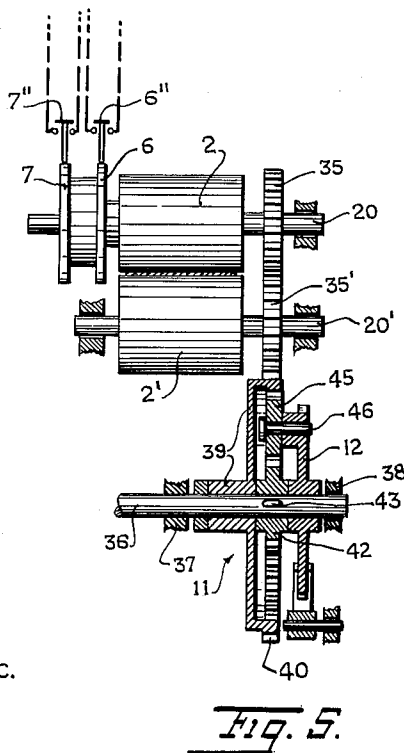
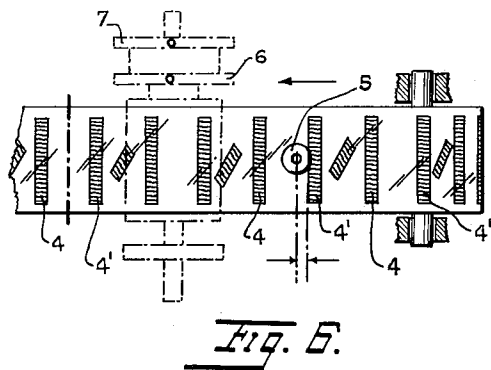
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CONTROL DEVICE FOR WEB FEEDING MECHANISM

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2 Sheets-Sheet 2



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CONTROL DEVICE FOR WEB FEEDING MECHANISM

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This invention relates to the feeding of web material such as the feeding of a web of paper or other wrapping material in packaging machines. More particularly, the invention relates to control means responsive to markings on the web for introducing a delay into the driving mechanism which drives the web feed rollers.

In packaging and other machines in which a web of paper is fed to a paper-manipulating apparatus, it is important that the repeated decoration or design imprinted on the web appear symmetrically with respect to the edges of the final product. Thus, for example, if the final product is a packaged article, the web should be fed to the wrapping apparatus in such manner that the imprinted design appears in the center of the package. This result cannot be achieved solely by proper synchronization of the feed rollers and the wrapping apparatus, no matter how accurate the synchronization may be. One reason for the failure of such synchronization to produce the desired result is that the tensile stresses produced in the web vary from time to time, thereby causing variations in the length of the web.

In conventional machines, in order to insure that the design imprinted on a web appears symmetrically on the final product, the feeding of the web is controlled by a selenium or other photoelectric device which senses selected markings on the web and transmits a signal in accordance therewith. If the markings pass the photoelectric device at time sequences which indicate that the design on the web will appear as desired on the final product, the signal transmitted by the device will have no effect. If on the other hand, a single marking passes the photoelectric device out of proper time sequence, the signal transmitted effects a corrective speed change in the mechanism which drives the web feed rollers thus compensating for the undesirable shift of the design.

Specifically, in the usual arrangement of parts, the web feed roller drive includes an epicyclic gear train, the planetary gear of which is mounted on a rotatable ratchet wheel which is normally held against rotation by a pawl. An electromagnetic device is provided for actuating the pawl in order to release the ratchet wheel for rotation through a small predetermined angles, thus introducing the above-mentioned corrective speed change into the drive gears. The electromagnetic device is in turn controlled through a relay by the photoelectric device. Ordinarily, the feed rollers are driven slightly more rapidly than is necessary to take up the greatest possible elongation produced in the web by the tensile stresses, and the inaccuracy caused thereby is tolerable within a small range. As soon as the cumulative inaccuracy or error becomes excessive, however, a marking on the web will pass the photoelectric device out of proper time sequence. Consequently, the latter will transmit a signal for energizing the electromagnetic device while actuates the pawl, thus releasing the planetary gear-carrying ratchet wheel whereby an additional rotation will be superimposed upon the uniform rotation of the drive gears thus serving to slow down or otherwise adjust the motion of the feed rollers for a short interval.

In the conventional mechanism, which has just been described, there is provided between the photoelectric

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device and the relay which actuates the electromagnetic device, an amplifier having a thyatron connected to its output terminal. The signals transmitted by the photoelectric device are amplified and fed to the control grid of the thyatron. In addition, a periodically operated switch means is provided for opening and closing the plate circuit of the thyatron in order to determine the point of time at which the tube can possibly fire and the duration of the plate current flow once firing occurs. The screen grid and cathode circuits of the tube are completed when the main switch of the apparatus is closed, and remain completed throughout the operation of the machine. Hence it may be seen that when a signal from the photoelectric device coincides with a time interval when the plate circuit is completed, the thyatron will fire, and the relay which is disposed in the plate circuit and which energizes the electromagnetic device, will be activated.

With the increase in operating speeds of modern packaging machinery, the above described control device, as well as other known control devices, have proved unsatisfactory. In particular, difficulties have arisen due to the fact that the relay is located in the plate circuit, hence when the periodically operated switch is closed, the potential is applied to the plate through the relay coil. This results in a delay between the time that the switch is closed and the time that the plate reaches firing potential. Such a delay cannot be tolerated in high speed machinery.

It is the object of the present invention to alleviate this and other difficulties, and toward this end an improved control device is provided in which the thyatron may be conditioned instantaneously to fire at any selected moment, thus eliminating the undesirable time delay of former devices. In accordance with this invention, a switch is provided in the screen grid circuit of the thyatron as well as in the plate circuit. As a result, the plate circuit may be completed some time before it is desired that the tube be conditioned to fire, thus giving the plate ample time to reach firing potential. Then, at the earliest instant that it is desirable for the tube to fire, the screen grid circuit is completed. By this time, the plate has reached firing potential and the tube is conditioned to fire. If then the control grid is charged, as usual, by a signal from the photoelectric device, the thyatron will fire instantaneously.

Other objects and advantages of the present invention will be apparent from the more detailed description which follows.

In the drawings:

FIG. 1 is a perspective view showing the present control device including a schematic representation of the electric circuitry;

FIG. 2 is a front elevational view showing the switch actuating means of the invention;

FIG. 3 is an end elevational view of FIG. 2;

FIG. 4 is an end elevational view of illustrative driving gears for the web feed rollers;

FIG. 5 is a front elevational view of FIG. 4 with parts shown in section; and

FIG. 6 is a plan view of the web.

Referring now to the drawings, particularly FIGS. 1 and 4, a web 3 of paper or other suitable wrapping material is withdrawn from a supply roll 1 by a pair of feed rollers 2 and 2' mounted on the rotatable shafts 20 and 20' respectively. The web 3 has imprinted thereon a continuously repeated decoration or design, for example advertising material. The printed indicia includes markings such as colored stripes alternatively designated 4 and 4' extending transversely of the web. The alternate stripes

4' are designed to be sensed by a photoelectric device 5 as the web passes.

On the shaft 20 of the feed roller 2, there is mounted for rotation with the shaft a pair of switch-actuating cams 6 and 7. Above the cam 6 is a switch 6'' (FIG. 1) having a depending follower 6' which contacts the surface of the cam 6. Above the cam 7 is a switch 7'' having a depending follower 7' which contacts the surface of the cam 7. The contours of the cams 6 and 7 may be seen in FIG. 3. Both cams are substantially circular. The cam 6 has a long recess 9 extending more than 180° around its periphery, and the cam 7 has a short recess 10 in its periphery intermediate the ends of the recess 9 in the cam 6.

When the followers 6' and 7' ride on the non-recessed portions of the cams 6 and 7, both switches 6'' and 7'' are open, as shown in FIG. 1. When the follower 6' enters the recess 9, the switch 6'' closes, and when the follower 7' enters the recess 10, the switch 7'' closes.

Mounted on the end of the shaft 20 opposite from the cams 6 and 7, and on the corresponding end of the shaft 20', is a pair of meshing spur gears 35 and 35' by means of which the feed rollers are driven. A mechanism which may be employed to drive the feed rollers is shown in FIGS. 4 and 5. A rotatable drive shaft 36 journaled in the bearings 37 and 38 carries the epicyclic gearing indicated generally by the reference numeral 11. The gearing 11 includes a ring gear 39, rotatably mounted on the shaft 36. It has external teeth 40 meshing with the spur gear 35', and internal teeth 41. A sun gear 42 is keyed to the shaft 36, as at 43, for rotation therewith. Alongside the sun gear 42 is a ratchet or escapement wheel 12 rotatably mounted on the shaft 36. Radially outward of the shaft 36, the ratchet wheel 12 carries a pin 46 upon which a planetary gear 45 is rotatably mounted in meshing engagement with both the internal teeth 41 of the ring gear 39, and the sun gear 42.

The ratchet wheel 12 is normally held against rotation by the pawl 13 of the escapement lever 50, as shown in FIG. 4. In this condition, the rotation of the drive shaft 36 is transmitted through the sun gear 42, the planetary gear 45, and the ring gear 39 to the feed rollers 2 and 2'.

An electromagnet 14 is located adjacent the pawl 13, and when it is energized it attracts the pawl 13 and pivots the escapement lever 50 about its support 47 against the action of the spring 48. In this position the pawl 13 releases the ratchet wheel 12 and the pawl 51, which is normally held out of the path of the ratchet wheel teeth, moves into the path of the teeth. Consequently, upon further rotation of the sun gear 42, the ratchet wheel 12 is now free to pivot through an angle about equal to the angle between two adjacent teeth thereof, whereupon the planetary gear 45 moves through an equal angle thus introducing a small delay into the movement of the driving gears. Upon deenergization of the electromagnet 14, the escapement lever 50 swings back to its original position and the pawl 13 engages the tooth next adjacent to the tooth which it formerly engaged.

The means for controlling the operation of the electromagnet 14 will now be described, with reference to FIG. 1. The control means include a thyatron 8, having a plate 21, a screen grid 25, a control grid 30, and a cathode 26. The plate circuit of the thyatron includes the main on-off switch 24, the switch 6'', and the relay coil 15, which when energized serves to activate the electromagnet 14. The screen grid circuit includes the switch 7''. The cathode 36 remains constantly charged in the usual way.

The control grid 30 is charged intermittently by the signals transmitted by the photoelectric device 5 as the stripes 4' pass by. The signals from the device 5 are directed through an amplifier 32 before they reach the control grid 30.

When the switches 24 and 6'' in the plate circuit are closed, a firing potential is applied to the plate 21 through

the relay coil 15. However, due to the build-up of a magnetic field around the coil 15, there is a time delay between the time that the circuit is completed and the time that the plate 21 reaches firing potential. When the switch 7'' closes, a potential necessary to allow the thyatron to fire is applied to the screen grid 25. Finally, when a signal is transmitted by the photoelectric device 5 through the amplifier 32, a potential capable of causing the thyatron to fire is applied to the control grid 30. Note that it is only when the plate 21 and the grids 25 and 30 are charged concurrently that the thyatron will fire, whereupon the relay coil 15 will be energized.

In operation, the cams 6 and 7 are relatively angularly positioned as shown, for example, in FIG. 3. In this way, as the cams rotate in the direction indicated by the arrow, the follower 6' drops into the recess 9 about 180° before the recess 10 reaches the follower 7'. Therefore, the switch 6'' closes and, assuming that the main switch 24 has been thrown to its closed position (shown in dotted line in FIG. 1), a charge will gradually build up on the plate 21. By the time the follower 7' drops into the recess 10, the charge on the plate 21 will have reached firing potential. At this point, the switch 7'' closes, thus applying a firing potential to the screen grid 25. During the short interval that the switch 7'' is closed, which may be called the "control period," the thyatron is conditioned to fire, but will do so only if a proper potential is applied to the control grid 30. The operation of the mechanism is so timed that normally a signal is transmitted to the control grid immediately after the follower 7' leaves the recess 10 and the switch 7'' has opened, hence the tube 8 does not fire. When, however, a stripe 4' passes beneath the device 5 at a time earlier than normal, indicating that a delay in the rotation of the feeding rollers 2 and 2' is desirable, the control grid 30 will be charged during the control period of the thyatron, i.e., during the interval that the switch 7'' is closed and the screen grid 25 is at firing potential. As a result, the thyatron will fire and energize the relay coil 15, whereupon the electromagnet 14 will be energized and a time delay introduced into the driving gears as previously described.

Note that even after the follower 7' leaves the recess 10, the thyatron 8 will continue to conduct a current until the follower 6' leaves the recess 9 thus maintaining the relay coil 15 in energized condition. In addition, even after the tube ceases to conduct a current, the relay coil 15 will remain energized for a short period as the capacitor 23 discharges across it. Consequently, the electromagnet 14 will remain energized long enough to insure that the pawl 13 is out of operative position for a time sufficient to permit the contemplated amount of rotation of the ratchet wheel 12. Furthermore, it may be seen that by altering the relative angular positions of the cams 6 and 7, the duration of firing of the thyatron may be varied.

It will be seen therefore, that the present invention provides a control apparatus wherein, in spite of any delay encountered between the closing of the switch 6'' and the attainment by the plate 21 of firing potential, the control period in which the thyatron is conditioned to fire is sensitively and accurately determined by means of the switch 7'' in the screen grid circuit.

It will be understood that many of the details herein described and illustrated may be modified by those skilled in the art without necessarily departing from the spirit and scope of the invention. For example, the functions of the screen grid 25 and control grid 30 may be interchanged so that the switch 7'' controls the application of potential to the control grid, in order to condition the thyatron for firing, rather than to the screen grid 25. Except as expressed in the appended claims, therefore, it is intended that these details be interpreted as being illustrative only.

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What is claimed is:

1. In a web feeding apparatus having feeding rollers, means for driving said rollers, and electrically operable means for introducing a speed change into said driving means: control means comprising a thyatron having a plate, a screen grid and a control grid, a circuit for applying a firing and current-sustaining electrical potential to said plate for a period coinciding with a predetermined interval of feeding roller rotation, relay means arranged in said plate circuit, said relay means when energized serving to operate said speed change means, a circuit for applying an electrical potential to one of said grids for a control period during which said thyatron is conditioned to fire, said control period beginning long enough after the commencement of said predetermined interval to permit the charge on said plate to reach firing potential and ending at the latest coincident with the termination of said predetermined interval, means separately responsive to successive individual markings on the web for transmitting to the other of said grids a signal capable of firing said thyatron, whereby upon coincidence of said signal and said control period said thyatron will fire and energize said relay means, the duration of firing of said thyatron extending from the beginning of said control period to the end of said predetermined interval of potential application to said plate, and means for varying the duration of firing of said thyatron without affecting the length of said control period.

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2. Apparatus according to claim 1 including switch means in each of said circuits, said switch means being responsive to feeding roller rotation for determining the period of potential application to said plate and the control period of potential application to said one of said grids.

3. Apparatus according to claim 2 including a cam for operating each of said switches, said cams being rotatable with said feeding rollers and serving to open and close said switches in timed relation to the rotation of said feeding rollers.

4. Apparatus according to claim 3 wherein the cam for operating said switch in said plate circuit is so contoured that said plate circuit switch is closed throughout a relatively large angle of rotation of the cam, and the cam for operating said switch in said grid circuit is so contoured that said grid circuit switch is closed throughout a relatively small angle of rotation, said cams being angularly adjustable with respect to one another in order to vary the duration of firing of said thyatron but said cams always being adjusted so that said grid circuit switch is closed only when said plate circuit switch is closed.

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