

March 16, 1954

M. G. JONES

2,672,299

WEB REGISTERING APPARATUS

Filed April 23, 1951

4 Sheets-Sheet 1

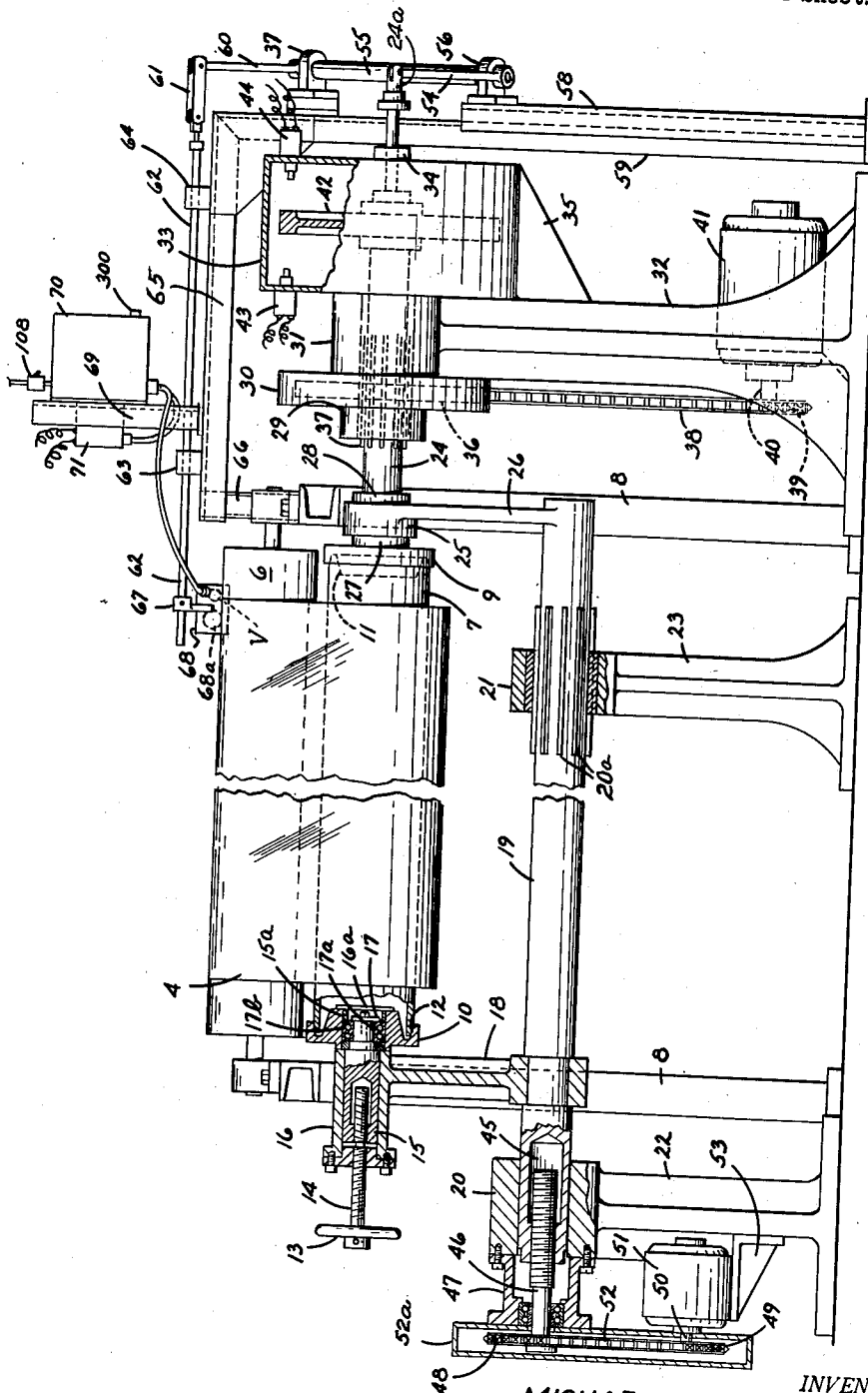


FIG. 1

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4 Sheets-Sheet 2

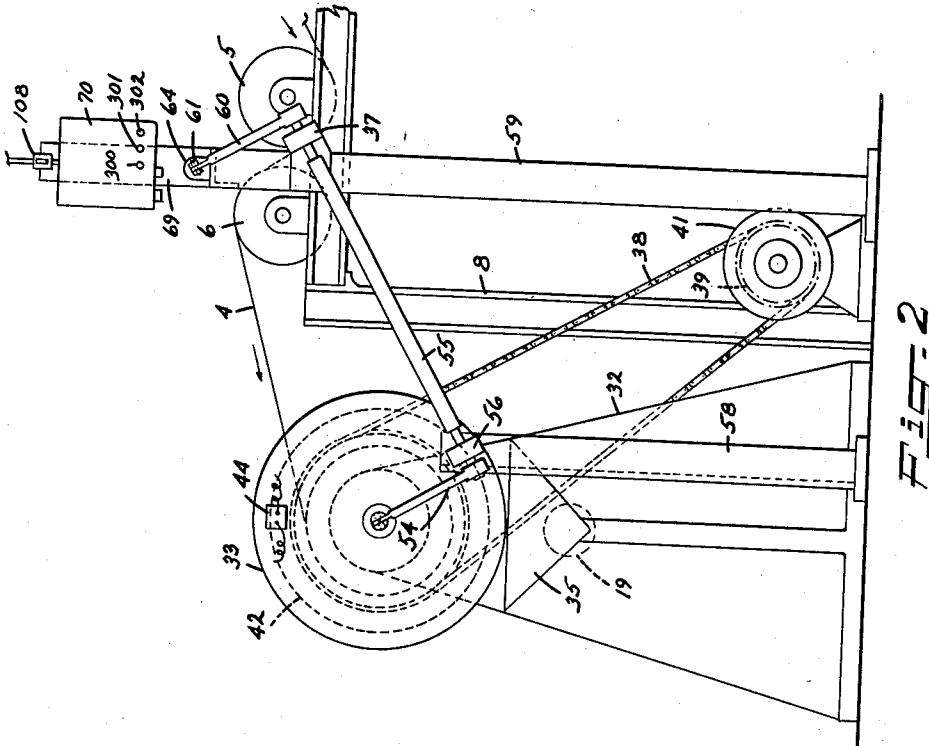


FIG-2

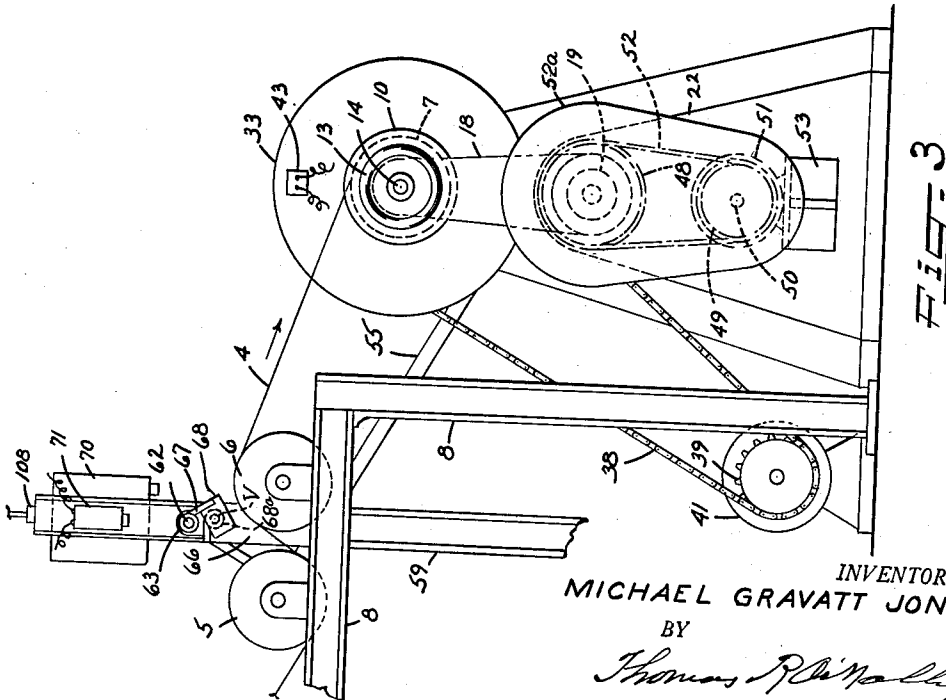


FIG-3

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4 Sheets-Sheet 3

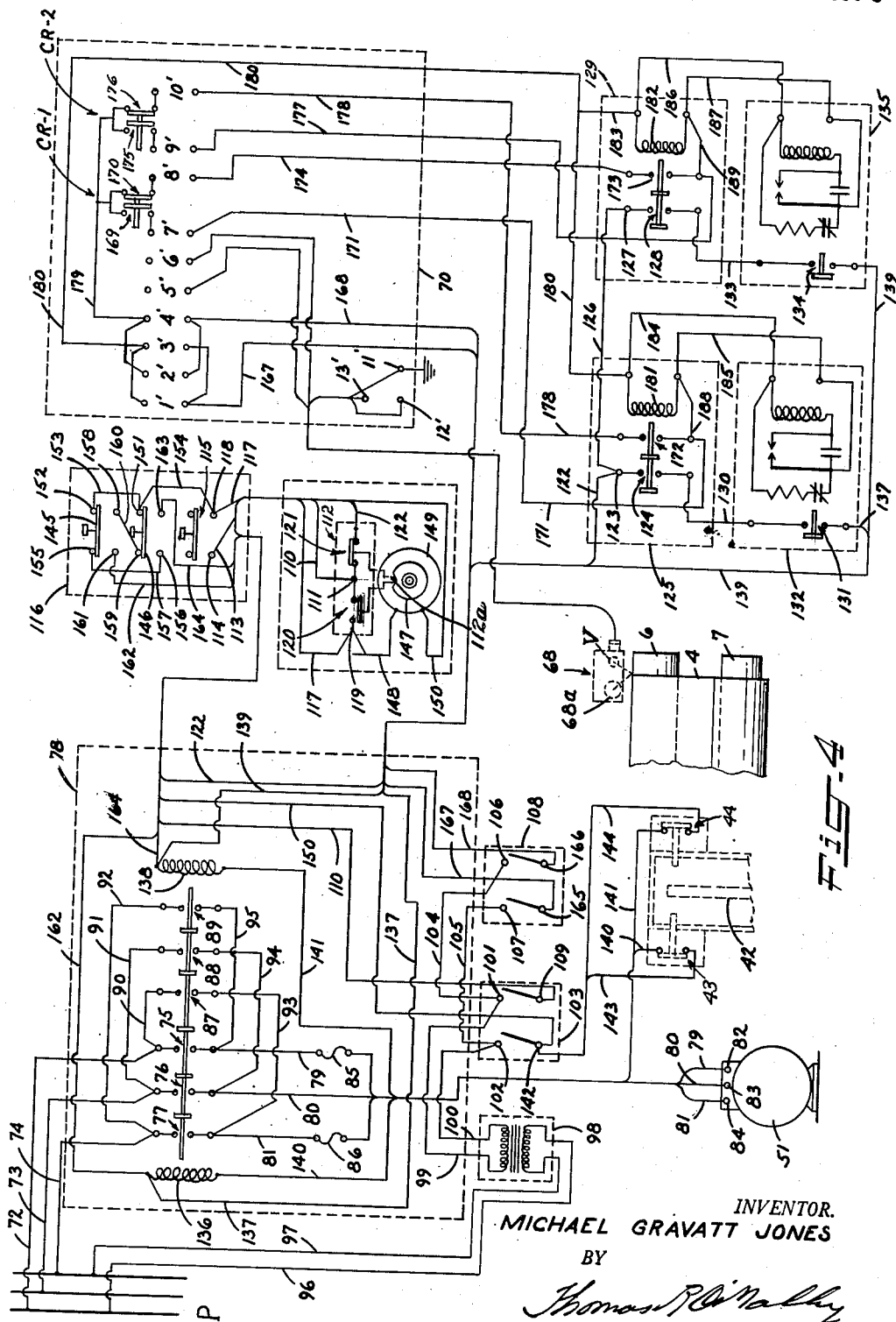


FIG. 4

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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,672,299

WEB REGISTERING APPARATUS

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Application April 23, 1951, Serial No. 222,461

13 Claims. (Cl. 242—76)

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This invention relates to a winding apparatus. More particularly it relates to an apparatus for winding continuous non-porous films, bands, ribbons, or webs into even, smooth rolls. The invention is further particularly concerned with an electronic device or mechanism employed in conjunction or combination with the mechanical winding mechanism for insuring an even and smoothly wound roll as well as an improved wound roll.

The present invention is applicable to the winding of non-porous films, bands, ribbons, sheets, webs, and the like made from various materials by extrusion, casting, etc., such as regenerated cellulose made from viscose or cuprammonium cellulose, cellulose esters and ethers, for example, nitrocellulose, cellulose acetate, methyl cellulose, ethyl cellulose, benzyl cellulose, hydroxyethyl cellulose, carboxymethyl cellulose, etc. mixed cellulose esters and ethers, resinous materials, such as polyvinyl chloride, vinyl chloride, vinyl acetate, acrylonitrile, etc., and copolymers thereof, rubber and rubber derivatives, synthetic rubbers, etc. For purposes of simplicity, however, the present invention will be shown and described as it is applicable to winding a continuous film of regenerated cellulose made from viscose, more commonly known as cellophane, it being understood that this is done merely in an illustrative sense and the invention should not be limited thereby, but only insofar as the same may be limited by the appended claims.

As is well known, cellophane is usually manufactured by extruding or casting a viscose solution through an elongated slit into a suitable coagulating bath, then regenerating, desulfurizing, bleaching and plasticizing the extruded film by continuously passing it through successive treating baths. The film is then dried by passing it over a plurality of drying rollers and then wound in the form of a roll under slight tension. Obviously such a machine is of considerable length, and the film will shift back and forth on the rollers transverse of the direction of travel during production. Since the roll or core on which the film is wound is normally in fixed position, the edges of the wound roll are highly uneven. This unevenness, in addition to being unsightly, causes difficulty in subsequent operations, such as in the coating of the cellophane.

More important, however, when extruding a viscous film-forming solution through an elongated slit, such as in the case of viscose, the extreme edge portions are thicker than the rest of the film. This thick edge is commonly referred

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to in the art as a "bead." It is the usual desired practice to wind continuous sheet materials with the edge of the sheet continuously winding upon itself and with each succeeding convolution flush with the preceding convolutions. However, when regenerated cellulose and other non-porous films, and the like, are wound in this manner, the bead, being thicker, will cause a greater roll diameter at the edges. This subjects the edges to greater tension than the rest of the film causing the edges to stretch and become floppy. These floppy edges cause great difficulty during the coating operation and in addition a considerable portion of the film close to the edges is stretched during winding and must subsequently be slit or cut off which causes increased waste.

It is an object of the present invention to provide a new apparatus for winding non-porous films, etc. which overcomes the aforementioned difficulties and disadvantages. It is another object of the invention to provide an apparatus for winding non-porous film which will automatically shift as the film shifts transverse of the direction of travel thereof so as to wind a roll having smooth edges and in addition continuously traverses the winding roll carriage back and forth through a predetermined distance so as to prevent the bead from winding upon itself, the traversing distance being of such a length so as not to materially detract from the edge smoothness of the finished wound roll. It is a specific object of the invention to provide a film winding apparatus having in combination therewith a light sensitive electronically controlled means for traversing the roll carriage. Other objects and advantages of the present invention will be apparent from the drawing and description thereof hereinafter.

The objects of the present invention are in general accomplished by winding the film, etc., on a roll or core mounted on a shaft or positioned between rotatable holders which are movable transversely of the direction of travel of the film. Transverse movement of the roll of film is accomplished by a side register reversible motor which is connected to an electronic circuit comprising a photocell or scanning head also mounted for movement transverse of the direction of film travel. The photocell is so mounted that it moves in the same direction and at the same rate as the windup roller shaft or carriage. The scanning head or photocell is mounted above a roll preceding the windup roller and positioned above one edge of the film passing thereover. The photocell is sensitive to both an increase and decrease

of reflected light and by means of the electronic circuit actuates telephone-type relays and thermal relays which in turn actuate the side register motor to move the windup roller carriage.

As hereinafter explained in detail, the scanning head is mounted and so adjusted that the windup carriage will be continuously traversed back and forth through a predetermined distance which may be as great as one inch, but is preferably of the order of $\frac{1}{4}$ to $\frac{1}{2}$ inch. In addition, the electrical system is so hooked up that the photocell will hunt or seek the film so that when the film moves too far to one side the roll carriage will be moved over accordingly so as to insure an even winding at all times. The system is entirely automatic although means are provided for working the apparatus by hand, that is, a hand operated push button station is connected in series with the electric circuit. Limit switches are provided to limit the transverse movement of the windup roll carriage to within reasonable and practical limits and in addition to prevent damage to the roller carriage and apparatus connected thereto.

For a more detailed description of the present invention, reference should be had to the accompanying drawing which is merely intended to be illustrative and not limitative and in which—

Figure 1 is a front elevation view partially in section of the windup apparatus,

Figure 2 is a right side elevation of the apparatus shown in Figure 1,

Figure 3 is a left side elevation of the apparatus shown in Figure 1,

Figure 4 is a diagrammatic view of the electrical system employed in the invention, and

Figure 5 is a diagrammatic view of the electronic circuit housed in the side register control panel shown in Figure 4.

Referring to Figures 1, 2 and 3 of the drawing, a sheet of cellophane 4, coming from the drying section of the casting machine, passes under a guiding roll 5 and then over a scanning roll 6 to windup roller or core 7 mounted for positive rotation. The guiding and scanning rolls are mounted on the machine frame 8 and positively driven at the same rate of speed and by the same means employed for driving the drying rolls (not shown).

Usually and preferably, cellophane and like non-porous film is wound on cores made of pressed fibers, plastic, or similar material of sufficient strength to support several hundred pounds of film wound thereon. The core 7 is supported at its end by the rotatable chucks 9 and 10. The core 7 fits into the annular groove 11 of chuck 9 and into the annular groove 12 of chuck 10. Chuck 10 is movable transversely of the direction of travel of the film by means of the handwheel 13 mounted on the threaded shaft 14 which in turn engages the slidably mounted shaft 15 in the bearing or housing 16. The chuck 10 is rotatably mounted on shaft 15 and moves with it transversely of the film travel by reason of plate 17 bolted to the end of shaft 15 which holds bearing raceway 17a against shaft 15. A ring 15a holds raceway 17b in place, the ring 15a being in turn held in place by the plate 18a bolted to chuck 10. When the hand-wheel 13 is turned in a counterclockwise direction, shaft 15 moves to the right as viewed in Figure 1. In this manner, a core is readily placed in the chuck and held firmly for rotation therewith.

Bearing 19 is mounted on the bracket 18 which in turn is mounted on the shaft 19. Shaft 19 is

non-rotatable but is movable transversely of the direction of travel of the film and is supported in bearings 20 and 21 mounted on the supporting brackets 22 and 23 respectively. Chuck 9 is mounted on shaft 24. Shaft 24 passes through bearing 25 which is mounted on a bracket 26 extending upwardly from shaft 19. Bearing 25 is held in position on shaft 24 by collars 27 and 28 which are keyed to shaft 24. Shaft 24 extends through a sleeve 29, gear-housing 30 and bearing 31 which is mounted on the supporting bracket 32, through the limit switch housing 33 and bearing 34. The housing 33 is mounted on bracket 35 attached to the main supporting bracket 32.

A sprocket 36 is mounted in the housing 30 on a sleeve 37 which in turn is splined to shaft 24. A chain 38 is connected between sprocket 36 and sprocket 39 on shaft 40 of motor 41. The motor 41 rotates shaft 24 and core 7 to wind up the film 4. Collared to shaft 24 in housing 33 is a freely rotatable disc 42. Fastened in the upper walls of housing 33 are limit switches 43 and 44. These switches, as hereinafter more fully explained, control the transverse movement of shaft 24 by reason of disc 42 contacting the same.

Shaft 19 and bearing 20 are splined as at 20a to prevent rotation of shaft 19. However, shaft 19 has a sliding fit with bearing 20. There is a partially threaded opening 45 in the end of shaft 19 into which extends the threaded shaft 46 supported for rotation in bearing 47 which is in turn fastened to bearing 20. Shaft 43 is so mounted as not to be capable of transverse movement. A sprocket 48 is fastened to shaft 46 which in turn is connected to a sprocket 49 on shaft 50 of the reversible motor 51 by a chain 52. Motor 51 is mounted on a bracket 53 to bracket 22. A metal shield 52a covers the sprockets 48 and 49 and the chain 52. When sprocket 48 is rotated in a clockwise direction, shaft 19 is moved to the left, as viewed in Figure 1, until disc 42 contacts limit switch 43 cutting off motor 51. Likewise limit switch 44, when contacted by disc 42 when shaft 19 is moved to the right as viewed in Figure 1, also cuts off motor 51. The limit switches are employed as a safety measure and are only rarely actuated as will be explained hereinafter in connection with the operation of the invention.

Shaft 24 extends through the bearing 34 and is pivotally connected to a link 54 by means of a yoke 24a which is movable axially with shaft 24 but which is free to turn on said shaft. The link 54 is rigidly attached to one end of the shaft 55. Shaft 55 is mounted in bearings 56 and 57 attached to brackets 58 and 59 respectively. On the other end of shaft 55 there is rigidly attached a link 60 which in turn is pivotally connected to a link 61 which is pivotally connected to a slidably mounted rod 62. Rod 62 is mounted in bearings 63 and 64 on bracket 65 which is fastened to brackets 59 and 66, the latter extending upwardly from machine frame 8. Rod 62 extends out over the scanning roll 6 and has a bracket 67 adjustably fastened thereto which supports the photocell or scanning head 68 above the scanning roll 6. This head comprises a light source 68a and a photocell V. It is to be noted that the surface of roll 6 is black and preferably non-light-reflecting. A lacquer or coating composition of some kind containing slate applied to the roll surface is satisfactory. Hence, by means of the linkage just described attached between rod 62 and shaft 24, the photocell or scanning

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head 68 is moved transverse of the film direction simultaneously with and at the same rate of speed and in the same direction as the shaft 24 and core 7 carrying the film windings.

Extending upwardly from bracket 65 is a supporting bracket 69 to which are fastened the side register control panel 70 and the constant voltage transformer 71 both of which are described in detail hereinafter.

While the apparatus in Figures 1, 2 and 3 is shown with only one wind-up roll or core, the invention is equally applicable to a system where a plurality of wind-up rolls or cores are employed arranged on a suitable turret head.

Reference should now be had to Figures 4 and 5 for a description of the electrical and electronic circuits of the present invention. A power source P comprising 440 volts, 3-phase, 60-cycle, is connected by lines 72, 73 and 74 to switches 75, 76 and 77 in the reversible starter 78. Lines 79, 80 and 81 connect switches 75, 76 and 77 to terminals 82, 83 and 84 on the reversible motor 51 which moves the core 7 and shaft 24 back and forth transversely of the direction of film travel. Line 79 has a fuse 85 therein and line 81 a fuse 86 therein. Lines 72, 73 and 74 are connected to switches 87, 88 and 89 respectively by lines 90, 91 and 92, switches 87, 88 and 89 being in turn connected to the terminals of switches 77, 76 and 75 respectively, to which lines 81, 80 and 79 are attached, by lines 93, 94 and 95.

Lines 96 and 97 connect power source P with the transformer 98 which converts 440 volts to 115 volts. Lines 99 and 100 connect transformer 98 with terminals 101 and 102 respectively of switch 103. Lines 104 and 105 connect terminals 101 and 102 with terminals 106 and 107 of switch 108. Switches 103 and 108 are closed during operation of the apparatus. Terminal 109 of switch 103 is connected by line 110 to terminal 111 of the reversing switch 112 which is provided with a cam follower or button 112a. Line 110 has a line 113 connected thereto which is also connected to the terminal 114 of the timer switch 115 in the push-button station 116 which is provided for manual operation of the apparatus. Line 117 connects the terminal 118 of the timer switch with terminal 119 on the normally open side 120 of the reversing switch 112. The normally closed side 121 of switch 112 is connected by line 122 to terminal 123 of switch 124 in relay 125. Line 126 connects terminal 123 to terminal 127 of switch 128 in relay 129.

Switch 124 is connected by line 130 to the switch 131 in the thermal relay 132. Switch 128 is connected by line 133 to the switch 134 in the thermal relay 135. Switch 131 is connected to one side of coil 136 in the reversible starter 78, which when energized closes switches 75, 76 and 77, by line 137. Switch 134 in thermal relay 135 is connected to one side of coil 138 in the reversible starter 78, which when energized closes switches 87, 88 and 89, by line 139. The other side of coil 136 is connected by line 140 to limit switch 43 and the other side of coil 138 is connected by line 141 to limit switch 44. Limit switches 43 and 44 are in turn connected to terminal 142 in switch 103 by lines 143 and 144 respectively, and hence to the power source through transformer 98.

In the push button station 116, there is a switch contactor 145 which when shifted (by pushing its push button) from its normal position of rest shown moves the roll or core carriage to the left, as viewed in Figure 1, and a switch contactor 146 which when shifted (by pushing its

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push button) from its normal position of rest shown moves the roll or core carriage to the right. As shown, both switches 145 and 146 are in their normal position of rest wherein both circuits through them are open. When the timer switch 115 is pressed against terminals 114 and 118, the circuit through motor 149 is completed between 99 and 100 through 109, 110, 113, 114, 118, 117, 119, 148, (149), 150, 142, and 102. Operation of motor 149 causes the button 112a of switch 112 to be removed from the indentation on cam 147 thereby closing the normally open switch 120 and opening the normally closed switch 121. Closing of switch 120 completes the circuit from the transformer 98 through line 99, switch 103, line 110, switch 120, line 148 connecting switch 120 with motor 149 which rotates cam 147, line 150 connecting the motor 149 with switch 103, and through line 100 back to the power source through transformer 98. Cam 147 will make one revolution whereupon the indentation comes around to the position shown which will cause switch 120 to reopen and switch 121 to close thus breaking the circuit to the motor 149 and stopping cam 147. While switch 120 is closed the push button station is in condition for initial adjustment by manually shifting either contactor 145 or contactor 146 and by reason of switch 121 being open the automatic system under the control of the photocell is inoperative. The time it takes cam 147 to make one revolution determines the time the system may be operated by hand. Any convenient time may be chosen, one minute, for example, being satisfactory.

There are six terminals in the push button station 116 connected by lead lines as follows: 151 and 152 connected by line 153; line 154 connected to terminals 151 and 118; 155 and 156 connected by line 157; 158 and 159 connected by line 160; terminal 161 is connected by line 162 to the coil 136 in the motor reversing starter 78, and terminal 163 is connected by line 164 to coil 138 in the motor reversing starter 78.

The push buttons 145 and 146 are inoperative unless the timer push button 115 is depressed closing switch 120. When this condition exists then pressing button 145 causes the core carriage to be traversed or shifted to the left, as viewed in Figure 1, by motor 51 by reason of the completion of the circuit from the power source through transformer 98 through line 99, switch 103, line 110, switch 120, line 117, line 154, contactor 145, line 157, contactor 146, line 162, coil 136 (which is energized), line 140, limit switch 43, line 143, switch 103, and line 100 back to the power source 98. The energization of coil 136 closes switches 75, 76, and 77 thus completing the circuit from power source P to motor 51 which moves the core to the left. When button 146 is depressed the core carriage moves to the right, as viewed in Figure 1. The circuit from the power source through transformer 98 and then through switch 120 is the same as above described, then through line 117, line 154, line 153, contactor 145, line 157, contactor 146, line 164, coil 138 (which is energized), line 141, limit switch 44, line 144, switch 103, and line 100 back to the power source 98. The energization of coil 138 closes switches 87, 88, and 89 thus completing the circuit from power source P to motor 51 which moves the core to the right. This circuit, through switches 87 to 89, causes motor 51 to rotate in the opposite direction from that when switches 75 to 77 are closed. This is the manual or hand operated system for moving the windup

core to right or left of the direction of travel of the film. This manual system is advantageous in certain instances, such as at the start of operation or when there is a film break and it is desirable or necessary to center the core with respect to the film. Also the manual system is useful whenever it is necessary to move the core through a great distance quickly. However, the invention is primarily concerned with the automatic system which is in operation when the push button station is inoperative, that is when switch 120 is open and switch 121 is closed, such as is the case when timer button 115 is not depressed. The setup and operation of the automatic windup traversing system is described below.

Terminals 165 and 166 of switch 103 are connected by lines 167 and 168 respectively to terminals 1' and 4' respectively on the side register control panel 70. These lines furnish the power from the transformer 98 to the transformer (shown at the left of Fig. 5) in the panel and thus to the electronic circuit housed therein and described hereinafter. Switch 103 controls the cutting in or out of the automatic electronic system and is located directly above the panel 70 and supported thereon (see Figure 1). A series of terminals 1' to 10' and 11', 12' and 13' are located on panel 70. The photo tube V in the scanning head 68 is connected to terminals 12' and 13', terminal 11' being a ground connection, and the light source or bulb 68a in the scanning head 68 is connected to terminals 5' and 6'. Jumpers are placed across terminals 1' and 3', and 2' and 4'. Terminals 7' and 8' are connected to switches 169 and 170 respectively of relay CR-1 and in addition terminal 7' is connected by lead line 171 to switch 172 in relay 125 and terminal 8' is connected to switch 173 in relay 129 by line 174. Terminals 9' and 10' are connected to switches 175 and 176 respectively of relay CR-2 and in addition terminal 9' is connected by line 177 to switch 173 in relay 129 and terminal 10' is connected by line 178 to switch 172 in relay 125. Line 179 connects terminal 4' with relays CR-1 and CR-2.

Terminal 3' is connected by line 180 to the coil 181 in relay 125 and to the coil 182 in relay 129 by line 189 and line 183 attached thereto. Coil 181 is connected by lines 184 and 185 to the thermal relay 132 and coil 182 is connected by lines 186 and 187 to the thermal relay 135. A line 188 is connected between coil 181 and line 171 in relay 125 and a line 189 is connected between coil 182 and line 177 in relay 129. It can readily be seen that relays 125 and 132 comprise a unit which is actuated by relay CR-1 and relays 129 and 135 a unit actuated by relay CR-2. Relay CR-1 is actuated by a light-decrease, as hereinafter explained in detail, and by actuating relays 125 and 132 causes the core carriage to be moved to the left, as viewed in Figure 1. Relay CR-2 is actuated by a light increase and by actuating relays 129 and 135 causes the core carriage to be moved to the right.

Reference should be had to Figure 5 for a description of the electronic circuit housed in the panel 70. Lines 167 and 168, connected to terminals 1' and 4', conduct 115 volt A. C. to the primary side of transformer T-1 and to the primary side of transformer 71 which conducts the proper current to the light source 68a. A full wave high vacuum rectifier V-2 and a filter K are employed to insure a steady, non-fluctuating D. C. flow. There are also employed two twin triode

amplifier tubes V-3 and V-4 and a detector amplifier triode V-5. Line 190 connects the power source with the cathodes of tubes V-3, V-4 and V-5. The filaments of Tube V-3 are connected to transformer T-1 by lines 191 and 192. The filaments of tube V-4 are connected to transformers T-1 by lines 193 and 194, and the filament of tube V-5 is connected to transformer T-1 by lines 195 and 196 joined to lines 193 and 194 respectively. Line 197 is connected between the power source and coil 198 of relay CR-1 and coil 199 of relay CR-2, coil 198 being connected to plate 200 of tube V-4 and coil 199 being connected to plate 201 of tube V-4. Line 202 is connected between line 197 and the plate of tube V-5. Lines 203 and 204 are connected between line 197 and plates 205 and 206 respectively of tube V-3. Lines 207 and 208 are connected between lines 203 and 204 respectively, and the grids of tube V-4.

Line 209 connects line 197 with the potentiometer or "dead zone control" C. Line 210 connects potentiometer C with potentiometer or balance control D. Line 211 is connected by line 211 to terminal 13'. Line 212 connects potentiometer D with terminal 11'. The arm of the potentiometer C is connected by line 213 to the grid of tube V-5 and the arm of potentiometer D is connected by line 214 to one of the grids of tube V-3. The arm of the multiple-point rotary switch or sensitivity control E is connected by line 215 to the other grid of tube V-3. The arm of the sensitivity control E is also connected by line 216 to terminal 12'. Line 217 connects the contact points of switch E with the filaments of tube V-3.

As previously pointed out, the present invention is designed to continuously traverse a windup roll of cellophane through a predetermined distance to prevent the bead from winding upon itself and at the same time follow the film as it deviates from the desired path to insure an evenly wound roll. Photoelectric means are employed to correct for the lateral deviation of the film and also to traverse the windup roll or core carriage continuously. The phototube is responsive to both increase and decrease in light reaching the same and functions to pick up or drop out telephone-type relays CR-1 and CR-2.

The beam of light is of sufficient size so as to produce a dead zone equal in width to the distance through which the roll or core carriage is to be traversed. The dead zone is the center portion of the light beam and when the edge of the film is resting therein neither relay should be picked up or energized. However, due to the wiring system employed in the present invention the relay picked up prior to the film edge entering the dead zone stays picked up until the film edge passes through the dead zone and the same is true in the reverse directions. In this way, there is a continual traversing since one relay must stay locked in until the film edge passes through the dead zone to pick up the other relay. The dead zone may be of any desired width but preferably is from $\frac{3}{8}$ to $\frac{1}{2}$ inch in width this being sufficient for all practical purposes. The term "dead zone" as used herein may be defined as an increment or decrement of light impulse directed to the photoelectric cell which increment or decrement as the case may be is insufficient to energize the high light impulse relay or the low light impulse relay.

The motor 51 may be geared to move the core carriage at any rate of speed. However, speeds up to one foot per minute are sufficient. The

traversing speed will, of course, depend upon the distance through which the core is to be continually traversed and in addition upon the R. P. M. of the film forming or treating machine, i. e. the speed with which the film is to be wound. For example, when winding thirty-gram cellophane at a speed in the range of 50 to 80 R. P. M. the traversing distance may be equal to $\frac{3}{8}$ inch and the traversing speed approximately 3 inches per minute.

In the following description of operation of the invention, all references to direction, etc., such as right and left, are made with respect to the apparatus as it is shown in Figure 1, since it will be apparent to those skilled in the art that the entire system could be reversed, that is, the scanning head, etc., could be mounted above the other side or end of the scanning roll.

At the start of operation, switches 103 and 108 are open while the machine is being threaded. After the film has started to wind up on core 7, the scanning head 68 is positioned a little to one side or the other of the film edge. This may be done by adjusting the scanning head along the rod or shaft 62 or by closing switch 103 and operating the push button station 116, hereinbefore described. Then switches 103 and 108 are closed and for purposes of description assume that the scanning head is positioned above the film so that an increased amount of light, due to the reflective properties of cellophane, is being received thereby.

When the phototube V receives an increased amount of light it passes more current which gives a more positive bias on the grid of tube V-3 attached to line 215. As plate 205 goes negative the grid of tube V-4 attached to line 237 goes negative and the grid attached to line 263 goes positive by an equal amount. When the latter grid of tube V-4 is sufficiently positive sufficient current passes through plate 201 so that relay CR-2 picks up. The left hand section of tube V-4 being negative it does not conduct and relay CR-1 remains dropped out. When there is a decrease in light reaching the phototube the system just described works in reverse and relay CR-1 picks up and relay CR-2 remains dropped out.

When the current flows through plate 201, coil 199 is energized which causes the normally closed switch 176 to open and the normally open switch 175 to close. This completes the circuit through line 180, 183, coil 182, line 189, line 177, switch 175 and line 179, the terminals 3' and 4' being connected to the power source. Coil 182, being energized, closes switches 173, and 128 thus completing the circuit through line 174 and switch 170 in relay CR-1, the purpose of which is explained hereinafter. At the same time, the circuit is completed to the thermal relay 135 through lines 186 and 187. The thermal relay is so chosen that it takes five seconds for the bi-metallic member therein to heat up and cause switch 134 in the thermal relay 135 to close. When switches 128 and 134 are closed a circuit is completed from the power source 98, through line 99, switch 103, line 110, switch 121, line 122, switch 128 in relay 129, switch 134 in thermal relay 135, line 139, coil 138 in the reversing starter 78, line 141, right limit switch 44, line 144, switch 103 and line 100 back to the power source. This energizes coil 138 which closes switches 87, 88 and 89 in the reversing starter 78 completing the circuit from power source P to the reversible motor 51. This causes the motor 51 to rotate

sprocket 49 in a counter-clockwise direction moving the core 7 to the right. The scanning head 68 is likewise moved to the right. As the light beam passes off the film and the film edge hits the dead zone relay CR-2 drops out, i. e. switch 175 opens and switch 176 closes. However, and this is an important feature of the invention, the circuit through relays 129 and 135 is not broken and the core 7 is still moved to the right. This is so because the circuit is still complete through line 180, coil 182, line 189, switch 173, line 174 and the normally closed switch 170 of relay CR-1, and line 179 all of which make up a holding circuit. In other words, relay CR-1 is tied into relay CR-2 and vice versa. Therefore, the motor 51 continues to move the core and scanning head to the right until the film edge passes through the dead zone and there is a decrease in light picked up by the phototube.

When the phototube V receives a decrease in light, relay CR-1 picks up due to the energization of coil 198 which causes the normally open switch 169 to close and the normally closed switch 170 to open. When switch 170 opens it breaks the holding circuit to relays 129 and 135 dropping them out. Switches 128 and 134 open breaking the circuit to the coil 138 in the reversing starter 78. Switches 87, 88 and 89 open breaking the circuit to motor 51 which stops thus stopping the rightward movement of core 7 and scanning head 78. When switch 169 closes it completes the circuit through line 180, coil 181 in relay 125, line 188, line 171, switch 169 and line 179. Coil 181, being energized, closes switches 172 and 124. Therefore a circuit is completed through switch 172, line 178, switch 176 in relay CR-2 and line 179. At the same time, the circuit is completed to the thermal relay 132. After five seconds, switch 131 in the thermal relay is closed thus completing the circuit from the power source 98, line 99, switch 103, line 110, switch 121, line 122, switch 124, line 130, switch 131, line 137, coil 136 in the reversing starter 78, line 140, left limit switch 43, line 143, switch 103 and line 100 back to the power source. Coil 136 is thus energized closing switches 75, 76 and 77 in the reversible starter 78 completing the circuit from power source P to the reversible motor 51. This causes the motor 51 to rotate sprocket 49 in a clockwise direction moving the core 7 and the scanning head to the left. As the light beam again comes into contact with the film and the edge hits or contacts the dead zone relay CR-1 drops out, i. e. switch 169 opens and switch 170 closes. Here again, as in the case of relay CR-2, the circuit through relays 125 and 132 is not broken and core 7 is still moved to the left, because coil 181 stays energized and switches 172 and 124 remain closed by reason of the completed holding circuit through line 180, coil 181, line 188, switch 172, line 178, and the normally closed switch 176 of relay CR-2, and line 179. Relay CR-2 is tied into relay CR-1 and holds relays 125 and 132 in until the film edge passes through the dead zone and phototube V picks up an increase in light when CR-2 picks up and switch 176 opens breaking the circuit through relays 125 and 132 and thus stopping motor 51. The five second delay in starting motor 51 is advisable to prevent overheating of the same.

Thus it can be seen that the roll or core traverse is equal to the width of the dead zone since in either direction the film edge must pass through the dead zone before there is a change in the direction of rotation of the reversible mo-

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tor 51. If, while the core is being traversed in one direction, the film should shift in the same direction, the particular relay CR-1 or CR-2, will remain cut in and the scanning head will follow the film, and likewise the core, until the film edge is caught-up with and passes through the dead zone giving a change in light reaching phototube V. Thus it can be seen that not only is the core or roll, upon which the film is being wound continually traversed so as to prevent the bead from winding upon itself, but also the core or roll is moved to follow the film as it may deviate from a straight line as it comes from the forming or treating machine. There is thus insured an evenly wound roll with the elimination of floppy edges.

It is to be noted that in Figure 5 there is shown dead zone, balance and sensitivity controls C, D, and E respectively which are represented by the knobs 300, 301, and 302 respectively on the face of panel 70 (see Figure 2). The sensitivity control E, as previously pointed out, is a rotary switch having a plurality of contacts clockwise rotation of which increases the sensitivity of the system such that less movement of the film edge is required to operate the relays CR-1 and CR-2. Clockwise rotation of the balance control tends to drop out relay CR-2 and pick up relay CR-1. Clockwise rotation of the dead zone control will widen the dead zone thus in addition to choosing a beam of light having a certain width dead zone, the width of that dead zone can be additionally controlled from the panel 70 housing the electronic circuit.

In order to adjust the balance control, the film is moved completely into the scanning area thus allowing a maximum amount of light to reach the phototube V which causes relay CR-2 to pick up. The balance control 301 is then turned in a counter-clockwise direction until CR-2 drops out and the position of the pointer is noted. Then the material is removed from the scanning area which causes relay CR-1 to pick up. The balance control 301 is turned in a clockwise direction until relay CR-1 drops out and the position of the pointer is noted. The correct balance point is midway between the two positions noted as indicated. Each time the sensitivity control is changed, the balance control must be readjusted.

The purpose of the limit switches 43 and 44, connected in series with the circuits hereinbefore described, is to limit the transverse movement of the roll carriage, either right or left, and thus prevent possible damage to the equipment. Should the film deviate too far from a straight line while coming through the forming or treating machine, and the like, so that one or the other of the limit switches 43 or 44 is contacted by disc 42 and the circuit broken before the scanning head has caught up with the film edge, suitable readjustment of the film along the machine, prior to reaching the windup apparatus, must be made. This phenomenon very rarely occurs however and is easily taken care of by conventional means, not the subject of this invention.

Numerous advantages of the present invention, not hereinbefore specifically pointed out, will be apparent from the description and drawing of the invention.

Various changes may be made in the drawing and description of the present invention without departing from the spirit and scope thereof as defined in the appended claims.

I claim:

1. An apparatus for winding non-porous film comprising in combination, a film wind-up roll mounted for rotation and reciprocable movement transverse of the direction of film travel, roller means mounted transverse of the direction of film travel and preceding the wind-up roll along the path of the film, adjustably mounted photoelectric means positioned above the roller means, lever means connecting the photoelectric means with the wind-up roll shaft for simultaneous transverse movement therewith, means for moving the wind-up roll transverse of the film travel, relay means for actuating the moving means, an electronic circuit connecting the photoelectric means with the relay means, and electrical means connected to the relay means to move the wind-up roll back and forth through a predetermined distance.

2. An apparatus as defined in claim 1 wherein the electrical means comprises thermal relay means.

3. An apparatus as defined in claim 2 wherein there are limit switch means positioned adjacent the wind-up roll shaft, said limit switch means being connected in series with the relay means and limiting the travel of the wind-up roll shaft in both directions.

4. An apparatus for winding non-porous film comprising in combination, a film wind-up roll mounted for rotation and reciprocable movement transverse of the direction of film travel, roller means mounted transverse of the direction of film travel and preceding the wind-up roll along the path of the film, an electronic circuit comprising adjustably mounted photoelectric means positioned above the roller means, lever means connecting the photoelectric means with the wind-up roll shaft for simultaneous transverse movement therewith, reversible motor means for moving the wind-up roll transverse of the film travel, reversible starter means connected to the motor means, light increase responsive and light decrease responsive relay means connected to and actuated by the electronic circuit, second relay means connected to each of the first-named relay means, and electrical means connecting the second relay means with the starter means.

5. An apparatus as defined in claim 4 wherein the electrical means comprises thermal relay means.

6. An apparatus as defined in claim 5 wherein there are limit switch means positioned adjacent the wind-up roll shaft, said limit switch means being connected in series with the second relay means and limiting the travel of the wind-up roll shaft in both directions.

7. An apparatus for winding non-porous film comprising in combination, a film wind-up roll mounted for rotation and reciprocable movement transverse of the direction of film travel, roller means mounted transverse of the direction of film travel and preceding the windup roll along the path of the film, adjustably mounted photoelectric means positioned above the roller means, lever means connecting the photoelectric means with the windup roll shaft for simultaneous transverse movement therewith, reversible motor means adjacent the windup roll for moving the same transverse of the direction of film travel, reversible starter means connected to the motor means, an electronic circuit connected to the photoelectric means comprising a light increase responsive relay, a light decrease responsive relay,

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each of said relays having a normally open and a normally closed switch therein, a set of relays connected to each mentioned relay, the normally closed switch of the light increase responsive relay being connected to the set of relays connected to the light decrease responsive relay and the normally closed switch of the light decrease responsive relay being connected to the set of relays connected to the light increase responsive relay, and electrical means connecting each set of relays with the starter means.

8. An apparatus as defined in claim 7 wherein each set of relays comprises a thermal relay.

9. An apparatus as defined in claim 8 wherein there is a limit switch connected in series with each thermal relay, said limit switches being positioned adjacent the windup roll shaft.

10. An apparatus as defined in claim 9 wherein there is a freely rotatable disc collared to the windup roll shaft and positioned so as to contact the limit switches to limit the travel of the windup roll shaft in both directions.

11. An apparatus for winding film comprising in combination, a film wind-up roll mounted for rotation and reciprocable movement transverse of the direction of film travel, roller means mounted transverse of the direction of film travel and preceding the wind-up roll along the path of the film, adjustably mounted photoelectric means positioned adjacent an edge of the path of the film near the wind-up roll, lever means connecting the photoelectric means with the wind-up roll shaft for simultaneous transverse movement therewith, means for reciprocating the wind-up roll transverse of the film travel, relay means for actuating the reciprocating means, an electronic circuit connecting the photoelectric means with the relay means, and electrical means connected to the relay means to continuously actuate the reciprocating means to reciprocate the wind-up roll back and forth through a predetermined distance.

12. An apparatus for winding a film or web comprising a film wind-up core mounted for rotation and axial reciprocable movement transverse to the direction of film travel, means for rotating the core, means for reciprocating the wind-up core axially, an electronic circuit comprising light-responsive photoelectric means positioned adjacent an edge of the path of the film to the wind-up core, a support for the photoelectric means, a light source on said support for casting a beam of light adjacent the edge of the film for influencing the photoelectric means, means connecting the support with the core for

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reciprocating the support in a direction transverse of the film edge simultaneously with the axial reciprocation of the core, said electronic circuit including two relays each of which is energized by the photoelectric means upon an appreciable change in light impulse to the photoelectric means, adjustable control means for predetermining the change in light impulse required to energize the respective relays, means actuated by the energization of said relays for reversing the reciprocating means, and a holding circuit associated with each relay for continuing to operate the reciprocating means in the same direction until sufficient change in light impulse is received by the photoelectric means to energize the other relay.

13. An apparatus for winding a film or web comprising a film wind-up core mounted for rotation and axial reciprocable movement transverse to the direction of film travel, means for rotating the core, means for reciprocating the wind-up core axially, an electronic circuit comprising light-responsive photoelectric means positioned adjacent an edge of the path of the film to the wind-up core, a support for the photoelectric means, a light source on said support for casting a beam of light adjacent the edge of the film for influencing the photoelectric means, means connecting the support with the core for reciprocating the support in a direction transverse of the film edge simultaneously with the axial reciprocation of the core, a first relay in said electronic circuit energizable when light impulse to the photoelectric cell has increased above a predetermined value, a second relay in said electronic circuit energizable when light impulse to the photoelectric cell has decreased below a predetermined value, means in said circuit for controlling the difference between said predetermined values, means actuated by the energization of said relays for reversing the reciprocating means, and a holding circuit for maintaining reciprocating movement of the core.

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