Oct. 2, 1934. J. A. HEPPERLEN 1,975,577

CONTROL SYSTEM

Filed July 21, 1930

Fig. 1.

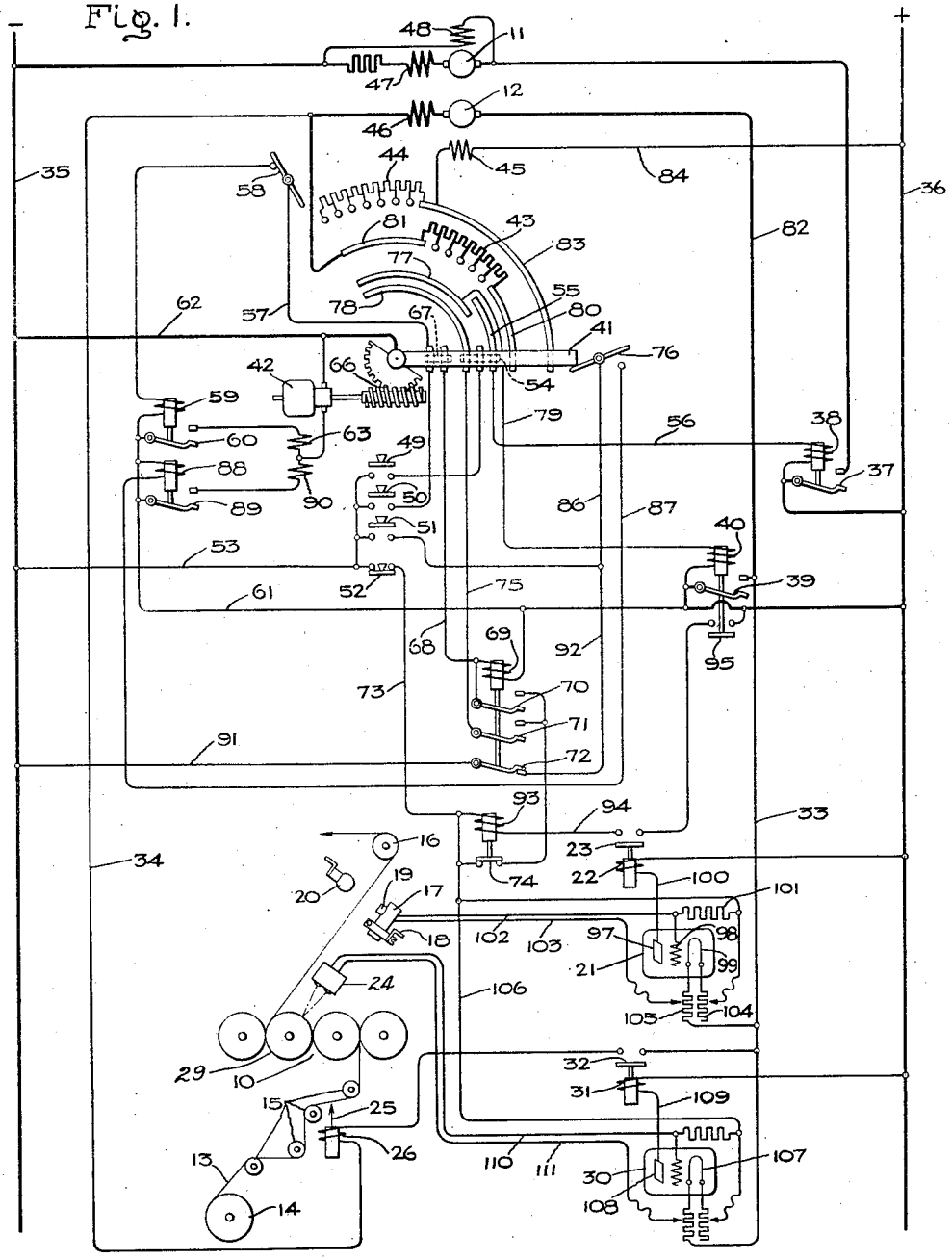
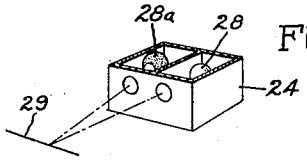


Fig. 2.



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1,975,577

CONTROL SYSTEM

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Application July 21, 1930, Serial No. 469,493

14 Claims. (Cl. 164—47)

My invention relates to control systems for apparatus employing a predetermined material or web, such as printing presses and the like, and has for its object a simple, reliable and inexpensive system for carrying out certain control operations in dependence upon a function of the web, for example, the breakage and wrapping of the web around one of the press cylinders.

In the operation of modern high speed printing presses it is important that some means be provided for detecting a break in the paper or web and for immediately stopping the press or severing the web back of the plate or type cylinder, or both, in the event that the broken end of the web tends to wrap around the cylinders with consequent delay and in some cases damage to the press especially in springing the cylinder shaft.

In my copending application, Serial No. 440,199, filed Mar. 31, 1930, of which this invention is an improvement, I have described and claimed a control system for apparatus employing a web in which light sensitive devices are provided for detecting a break in the web and for stopping the apparatus or severing the web or both. In this earlier application the light sensitive device is shielded from light by the web and upon breakage of the web is exposed to the light and thereby caused to initiate the desired control operations.

The specific system disclosed in my aforesaid application, while entirely operative and useful, has the disadvantage in common with other similar devices that the desired control operations are carried out immediately in all cases upon a break in the web. In many instances, however, the web when broken does not wrap around the press cylinders and under these conditions there is no immediate necessity for severing it, sufficient protection being given by simply shutting down the press. The delay incident to rethreading the web through the press, which has to be done when the web is severed, is thus avoided. It will be understood that a considerable length of paper is fed into the press while it is slowing down and coming to a stop. If this paper does not wrap around the press cylinders, no harm is done but if it starts to wrap around the cylinders, it should be immediately severed at some point in front of the press cylinder so that no more paper will be fed into them with resulting damage to the press.

In accordance with my present invention, therefore, I provide means dependent upon the winding of the web around the press cylinders for actuating the severing means so that the paper is severed only in the event that it wraps around the cylinders. In carrying out my invention in one form, I provide light sensitive control means for the severing means arranged to receive reflected light from a surface of a press cylinder. Under normal conditions this reflected light from the relatively dark surface of the cylinder is not strong enough to produce operation of the light sensitive device, but when the paper wraps around the cylinder the increase in the amount of light reflected to the light sensitive device from the relatively good reflecting surface of the paper causes the light sensitive device to operate and sever the paper.

For a more complete understanding of my invention, reference should be had to the accompanying drawing: Fig. 1 of which is a diagrammatic representation of a simplified printing press control system embodying my invention.

Fig. 2 is a detached view of the photo-electric control device.

Referring to the drawing, I have shown my invention in one form in connection with an electric motor driven printing press comprising a plurality of press cylinders 10 shown as two couples constituting a duplicate printing press unit each couple comprising a type cylinder and impression cylinder. These cylinders are driven by suitable driving means comprising a start and inching electric motor 11 and a main high speed electric driving motor 12. The paper or web 13 is fed to the cylinders from a roll 14 over guide rollers 15. After passing through the two couples of the press, the web passes over a guide roller 16 and thence to a folder not shown.

In accordance with my present invention I provide a paper break detector associated with the length of paper between the cylinders and the guide roller 16 comprising a light sensitive device or photo electric cell device 17 mounted on a support 18 secured to the press. This photo electric cell device is arranged substantially as described and claimed in my aforesaid copending application, it being provided with an orifice or opening 19 adjacent the web in position to receive light, in case the web breaks, from the source of light 20 shown as an incandescent lamp mounted on the opposite side of the web. In the present system, however, this photo electric device performs only the function of stopping the press so that in all cases when the web breaks, the press is stopped as soon as practicable. As will be explained more in detail hereinafter, the photo electric device controls an electric discharge de-

vice 21 which in turn energizes an operating coil 22. This coil when energized upon the breaking of the web closes a switch 23 in a control circuit for the press driving motors whereby the press is brought to rest as will be described more in detail hereinafter.

In accordance with my present invention I have provided a second photo electric control device 24 which serves the sole purpose of operating the paper severing device 25 arranged to sever the paper between the roll 14 and the press at a point closely adjacent the press. As shown the severing device 25 consists of a knife or bar which is moved into engagement with the web upon the energization of an operating coil 26. The photo electric device 24 is suitably mounted on the press and is provided with an orifice adjacent a surface of one of the press cylinders, which surface is uncovered under normal conditions but covered by the paper when the paper wraps around the cylinder. Preferably the photo electric device is mounted to receive reflected light from the normally uncovered surface of a cylinder around which the paper will wrap, if at all, when broken. Usually the paper wraps around the impression cylinder when a wrap occurs. As shown the photo electric device 24 is in such position that it receives light from a suitable source 28 (Fig. 2), such as an incandescent lamp, solely by reflection from the surface of the impression cylinder 29. Since this surface is normally jet black in color, or at least a poor reflector of light, the light reflected to the photo electric device is not sufficient under normal condition to operate it. However, in case the paper breaks and wraps around the cylinder 29, covering the surface of the cylinder from which light is reflected, the increase in light due to the relatively good reflecting surface of the paper causes the photo electric device to operate and in turn operate the web severing device 25. As indicated in Fig. 2 the lamp 28 and the photo electric cell 28*a* may be mounted in separate compartments in a casing, constituting the device 24, the casing being provided with suitable apertures, through one of which light is transmitted to the surface of the cylinder 29 from which it is reflected, when covered by paper, back through the other orifice to the photo electric cell.

The photo electric device 24 controls an electric discharge device 30 which in turn controls energization of the operating coil 31. This coil when energized closes the switch 32 in the circuit with the operating coil 26 whereby the operating coil is connected through the conductors 33 and 34 across the armature of the main driving motor 12.

Referring now to other elements of the system, it will be understood that any suitable control means for the driving motors 11 and 12 may be provided. The control means disclosed with which the paper break detector control mechanism is associated will now be described in detail.

The two motors 11 and 12 are energized from a suitable direct current source of supply connected to supply mains 35 and 36, the connections for the start and inch motor 11 being controlled by means of the contactor switch 37 operated by a coil 38 while the circuit for the main motor 12 is opened and closed by a contactor switch 39 operated by a coil 40. These two switches are further controlled by a switch arm 41 which is driven by a pilot motor 42. This switch arm further controls the amount of resistance 43 in the circuit with the armature of the motor 12 and also the amount of resistance 44 in circuit with the field winding 45 of this motor whereby the speed of the main motor may be varied. The main motor is also provided with a series field winding 46 while the start and inching motor 11 is provided with a series field 47 and shunt field winding 48. Furthermore, the control of the motors is effected by means of an "inching" push button 49, a "fast" push button 50 and a "slow" push button 51. A "stop" push button 52 is also provided.

In the operation of the system when the inching button 49 is pressed the circuit is closed from the supply main 35 through the conductor 53, the push button, a contact bar 54, carried on the arm 41 but insulated therefrom to a conducting segment 55, and thence through a conductor 56 and coil 38 to the supply main 36. This closes the switch 37 whereby the inching motor is started and continues to run as long as the button 49 is held depressed. When it is desired to start the press for a run, the fast button 50 is pressed whereupon a control circuit is closed from the main 35 through conductor 53, the button, conductor 57, limit switch 58 which is closed, the operating coil 59 of a switch 60 in the circuit of the pilot motor 42 and thence through conductor 61 to the supply main 36. This starts the motor 42, its circuit leading from the main 35 through conductor 62, the motor armature, its series field 63, the switch 60, and conductor 61 to the main 36. The motor 42 then operates through its worm gearing connection 66 to turn the arm 41 in a counter-clockwise direction.

At the same time the fast button 50 closes a circuit through the conducting bar 67, secured to the arm 41 but insulated therefrom, to a conductor 68 and through an operating coil 69 and the conductor 61 to the main 36. This coil 69 closes the switches 70 and 71 and opens a switch 72, the switch 70 closing a circuit in parallel to the fast button 50 which may now be released. This circuit leads from the conductor 53 through the stop switch 52, conductor 73, switch 74, which is normally closed, and switch 70 to the conductor 68. The closing of the switch 71 closes a circuit from the supply main 35, as just traced, through the conductor 75, the contact bar 54, the segment 55 and conductor 56 for the operating coil 38 whereby the motor 11 is started to initiate the operation of the press at low speed. At this time the opening of the normally closed switch 72 has no effect on the control.

At the beginning of the movement of the arm 41 by the motor 42, the limit switch 76 is released and closes in accordance with its bias although this does not have any immediate effect upon the control. This slow speed operation of the press is continued until the arm 41 has been turned in a counter-clockwise direction to such a position that the contact bar 54 engages with the conducting segment 77 whereupon a control circuit is established from the segment 78 through the contact bar 54 to the segment 77 and thence through the conductor 79 and the operating coil 40 to the main supply main 36 whereby the switch 39 is closed to start the main motor 12. This circuit for the main motor may be traced from the conductor 62 through the contact arm 41 to the conducting segment 80, resistance 43, the segment 81, the armature of the motor, conductor 82 and switch 39 to the supply main 36. A branch circuit leads from the arm 41 through the conducting seg-

ment 83, the shunt field winding 45 and conductor 84 to the supply main 36.

The main motor is thus operated at low speed with the entire amount of resistance 43 in its armature circuit and with its shunt field winding fully energized. Immediately after the energization of the main motor, the contact bar 54 moves off the end of the segment 55 whereby the coil 38 is deenergized and the circuit of the starting motor 11 opened.

Upon continued movement of the arm 41 by the pilot motor 42, the resistance 43 is gradually cut out and the field resistance 44 is gradually cut in whereby the main motor is accelerated to full speed, whereupon the contact arm engages the limit switch 58 and opens it to deenergize the pilot motor 42.

With the main motor operating at full speed, when it is desired to slow down the press, the slow button 51 is pressed thereby closing a control circuit through the conductor 53, the push button, conductor 86, limit switch 76, conductor 87, operating coil 88 for switch 89 and conductor 61 to the supply main 36, whereby the switch 89 is closed and the pilot motor 42 is started for the opposite direction of rotation, that is, to move the arm 41 in a clockwise direction. For this direction of rotation, it will be observed that the series field winding 90 of the pilot motor is energized. The slow button 51 must be held depressed to continue this operation of the pilot motor 42 and, if it is released, the pilot motor is deenergized and the main driving motor continues to drive the press at a speed corresponding with the position of the arm 41. If the slow button is held pressed long enough, it will be observed that the contact arm 41 will deenergize the main motor and restart the starting motor 11, these control operations being the reverse of those described during the starting of the press.

If at any time it is desired to stop the press, the stop button 52 is depressed whereby the circuit previously traced for the operating coil 40 or the operating coil 38, as the case may be, is opened, and also the circuit for the operating coil 69 whereupon the switches 37, 39, 70 and 71 drop open, while at the same time the switch 72 is closed. The switch 72 closes a circuit for the coil 88 of switch 89 whereby the pilot motor 42 is started in a direction to return the arm 41 to the starting position shown in the drawing. This circuit leads from the supply main 35 through the conductor 91, switch 72, conductor 92, conductor 86, limit switch 76, which is in the closed position, conductor 87, coil 88 and conductor 61 to the supply main 36. The pilot motor is finally stopped by the opening of the limit switch 76 by the arm 41.

The connections between the driving motor and the web break detector control means operated by the photo electric cell 17 will now be described. In order that this control means may effect the stopping of the motor, a circuit is provided from the conductor 73 through the operating coil 93 of the switch 74, conductor 94, the normally open relay switch 23, and relay switch 95, actuated by switch 39 so as to be closed when switch 39 is closed, to the supply main 36. Thus when the switch 39 is closed, whereby the press is driven at high speed by the main motor 12 and the relay switch 95 is thereby closed, the closing of the relay switch 23 energizes the coil 93 thereby opening the switch 74 to deenergize the main motor, the switch 74, as previously observed, being in series with the stop button 52. The closing of this relay switch 23 is effected by the operating coil 22 which is in the output of the circuit of the electric discharge device 21.

Preferably, the electric discharge device 21 is of the grid controlled arc rectifier type which is characterized by a large power output controllable by a small amount of grid energy. This device may comprise three electrodes, that is, a plate or anode 97, a grid 98 and a filament or cathode 99 in a sealed envelope containing a small quantity of an inert gas, such as mercury vapor, whereby the device becomes an arc rectifier, the arc formation between the cathode and anode being controlled by the grid. It will be understood that when the grid is sufficiently positive with respect to the anode, the arc will start but when the grid is more negative than a certain critical voltage value, the arc is prevented from starting by the grid. The output circuit of the discharge device 21 may be traced from the negative supply main 35, conductor 53, switch 52, conductor 73 to the cathode, thence through the discharge device to the plate, conductor 100 and the coil 22 to the positive supply main 36. The grid 98 is connected through a resistor 101 to the conductor 73, leading to the negative supply main 35, whereby the grid is normally maintained sufficiently negative with respect to the anode to prevent starting of the arc. As shown, the photo electric cell has its terminals connected by conductors 102 and 103 to the grid and cathode of the discharge device, the cathode of the photo electric cell preferably being connected to the grid. Adjustable resistances 104 and 105 are connected in the heating circuit for the cathode 99, which circuit leads from the conductor 73 through the resistor 104, the cathode, the resistance 105, conductor 33 and switch 39 to the supply main 36.

The electric discharge device 30 preferably is of the same type as the discharge device 21. It is shown as being of the same type as the discharge device 21, and its connections and operation are also the same as for the discharge device 21. It will be noted that the output circuit of the discharge device 30 leads from the negative supply main 35 through conductor 53, switch 52, conductor 73, conductor 106 to the cathode 107 thence through the discharge device to the plate 108, conductor 109 and coil 31 to the positive supply main 36. The photo electric control device 24 is connected in the grid circuit of the discharge device 30 by means of the conductors 110 and 111. The remaining connections will be understood from the previous description in connection with the discharge device 21.

In the operation of the system the two photo electric control devices are darkened as long as the paper web is intact so that the resistances of the photo electric cells are very high and consequently the grids of the discharge devices are sufficiently negative to prevent the formation of arcs. In the event of a break in the paper, however, the photo electric control device 17 is illuminated from the light source 20 since it will be no longer interposed between them as a light shield whereupon its resistance is very greatly decreased and the grid voltage of the discharge device 21 is thereby made more positive with respect to the anode voltage. In other words, the grid will be connected under these conditions through the conductor 102, the photo electric cell, conductor 103, a portion of resistance 105 and conductor 33 to the positive supply main 36. The

arc then starts in the discharge device whereby the coil 22 is energized and closes the relay switch 23. This energizes the coil 93 which thereupon opens the relay switch 74 to stop the press. It will be understood that the switch 74 is in the same holding circuit in series with the stop button 52.

As long as the broken end of the paper does not wrap around the cylinder 29 the photo electric device 24 will remain dark and therefore the paper will not be severed. On the relatively few occasions when the broken end wraps around the cylinder 29, sufficient light will be reflected to the photo electric device 24 to gradually decrease its resistance and thereby make the grid voltage of the discharge device 30 more positive, enough so that the arc will start. This energizes the coil 31 in the plate circuit of the discharge device which closes the switch 32 and thereby connects the operating coil 26 of the severing device across the terminals of the high speed motor 12. By thus connecting the coil 26 across the terminals of the main motor, it will be observed that the paper severing device operates in any event only when the press is being driven by the main motor, that is, at high speeds. The severing means is thus responsive to a condition of operation of the motor.

It will also be observed that the opening of the switch 39 to stop the motor 12 also interrupts the connection of the heating circuits for the cathodes of the electric discharge devices with the supply main 36 although the cathodes remain energized from the motor voltage for an appreciable length of time thus holding the web severing device in the severing position for a desired interval. When the motor comes to rest, however, the cathodes are deenergized whereby the arcs are stopped.

While I have shown a particular embodiment of my invention, it will be understood, of course, that I do not wish to be limited thereto since many modifications may be made, and I, therefore, contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. The combination in apparatus provided with a web of material, of means for feeding the web, a member provided with a surface covered by the web when the web breaks, said surface and said web having different light reflecting characteristics, a source of light for directing a beam of light on said surface, a light sensitive device arranged to receive light reflected from said surface and responsive to the difference in the amount of light reflected from said surface and from the web when it covers said surface, a member movable to sever the web to prevent further feeding of the web, and means controlled by said light sensitive device for operating said member to sever the web when the web covers said surface.

2. In a control system for apparatus with which a web is provided, means for feeding the web, a member around which the web tends to wrap under certain abnormal conditions and thereby vary the light reflecting characteristics of a surface of said member, light sensitive means arranged to receive reflected light from said surface responsive to the variations in said reflected light due to the wrapping of said web around said member, a member movable into engagement with said web for carrying out a predetermined cutting operation on said web and actuating means for said member controlled by said light sensitive means.

3. In a control system for apparatus with which a web is provided, a roll for feeding said web around which the web wraps under certain abnormal conditions, said roll being provided with a normally bare reflecting surface covered by said web under said abnormal conditions whereby the light reflecting characteristics of said roll are varied, a light sensitive device arranged to receive reflected light from said surface responsive to variations in said reflected light due to said abnormal conditions, a member movable into engagement with said web for carrying out a predetermined cutting operation on said web and actuating means for said member controlled by said light sensitive means.

4. The combination with a printing press provided with at least one cylinder and in which a paper web is used, of a light sensitive device arranged to receive reflected light from a surface of said cylinder around which said paper tends to wrap when broken and thereby vary the amount of reflected light received by said light sensitive device, and means controlled by said light sensitive device for cutting said web.

5. Web severing apparatus for a printing press, or the like, provided with at least one cylinder and in which a paper web is used, comprising light sensitive means arranged to receive reflected light from said cylinder and responsive to a variation in said reflected light caused by the web wrapping around said cylinder and web severing means controlled by said light sensitive device.

6. Web severing apparatus for a printing press, or the like, provided with at least one cylinder in which a paper web is used, comprising light sensitive means arranged to receive reflected light from said cylinder and responsive to a variation in said reflected light caused by the web wrapping around said cylinder, an electric discharge device controlled by said light sensitive means and web severing means controlled by said discharge device.

7. The combination with a printing press, or the like, provided with at least one cylinder and in which a web is used, of a motor for driving said press, web severing means, electrical means for operating said web severing means and means responsive to the wrapping of the web around said cylinder for connecting said operating means across predetermined points of the circuit of said motor.

8. The combination with a printing press, or the like, provided with at least one cylinder and in which a web is used, of a motor for driving said press, web severing means, and means jointly responsive to the wrapping of the web around said cylinder and the energization of said motor for controlling said severing means.

9. The combination with a printing press, or the like, provided with at least one cylinder and in which a web is used, of low and high speed driving motors for said press, means for independently controlling the operation of said motors to drive the press at low and high speeds, web severing means and means responsive to the wrapping of the web around said cylinder for connecting said severing means across a predetermined portion of the circuit of said high speed motor.

10. The combination with a printing press, or the like, provided with at least one cylinder and in which a web is used, of a driving motor therefor, means responsve to the continuity of the web for deenergizing said motor, severing means for said web, and means responsive to the wrapping of the web around said cylinder for operating said severing means.

11. The combination with a printing press, or the like, provided with at least one cylinder and in which a web is used, of low and high speed driving motors for said press, means for independently controlling said motors including a switch in the circuit of said high speed motor, means jointly responsive to the continuity of the web and the operation of said high speed motor for opening said switch, severing means for said web, and means jointly responsive to the wrapping of the web around said cylinder and the operation of said high speed motor for operating said severing means.

12. The combination with a printing press, or the like, in which a web is used, of a driving motor therefor, a switch for said motor, a web severing device, a switch for controlling said severing device, an electric discharge device provided with a cathode circuit for controlling each of said switches, means operated by said web for operating said discharge devices, a source of electrical supply for said motor and connections between the cathode circuits of said discharge devices and said source including said switches.

13. The combination with a printing press and the like, provided with at least one cylinder and in which a web is used, of driving means for said press, a severing device for the web, means responsive to the continuity of the web for controlling said driving means and means responsive to the wrapping of the web around said cylinder for operating said severing means.

14. The combination with a printing press and the like provided with at least one cylinder and in which a web is used, of a driving motor for said press, means for starting said driving motor, means responsive to the continuity of the web for stopping said driving motor, severing means for said web, and means responsive to the wrapping of the web around said cylinder for operating said severing means.

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