Aug. 18, 1936. J. J. CAVAGNARO 2,051,434

ACCUMULATOR SYSTEM FOR CALENDERS

Filed June 18, 1934 2 Sheets-Sheet 1

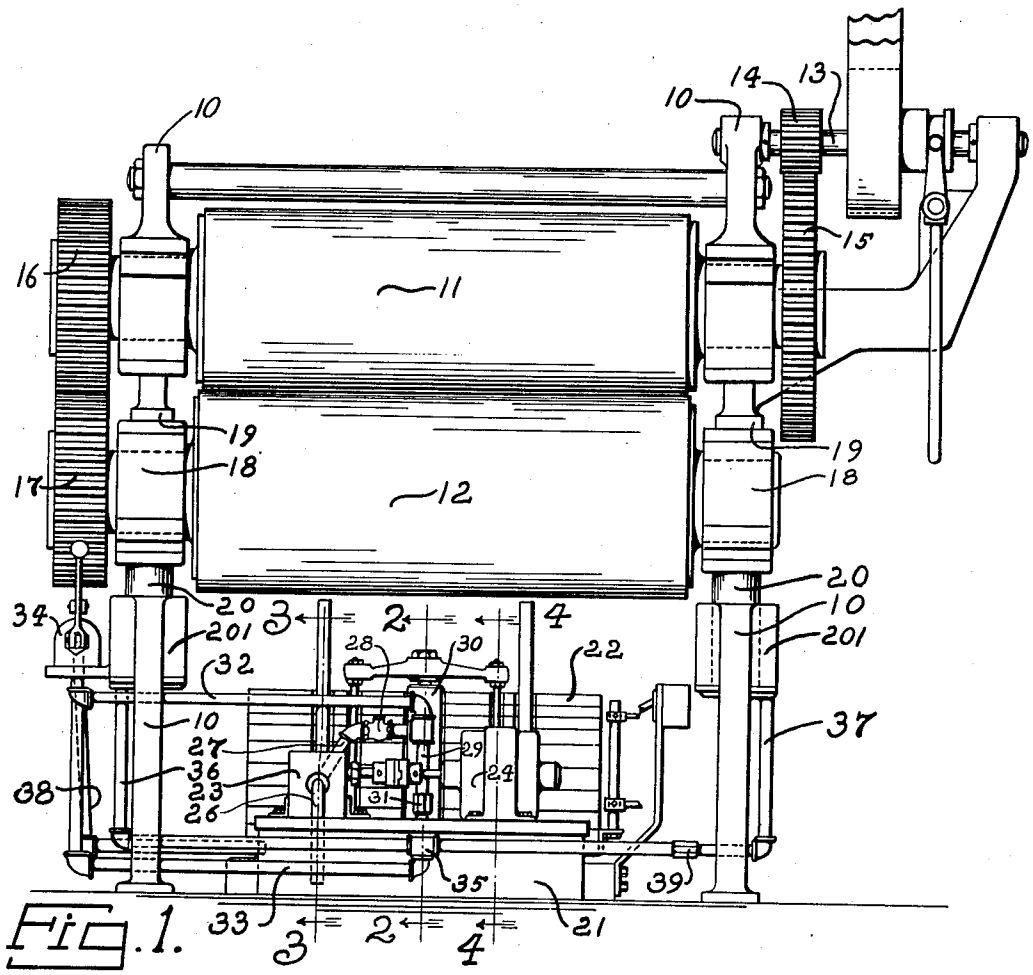


Fig. 1.

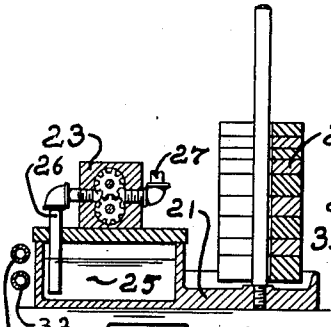


Fig. 3.

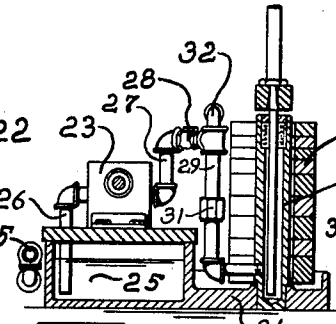


Fig. 2.

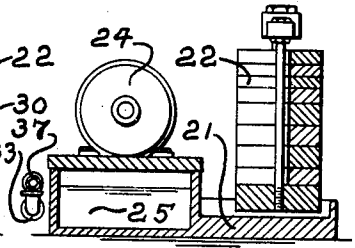


Fig. 4.

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ACCUMULATOR SYSTEM FOR CALENDERS

Filed June 18, 1934 2 Sheets-Sheet 2

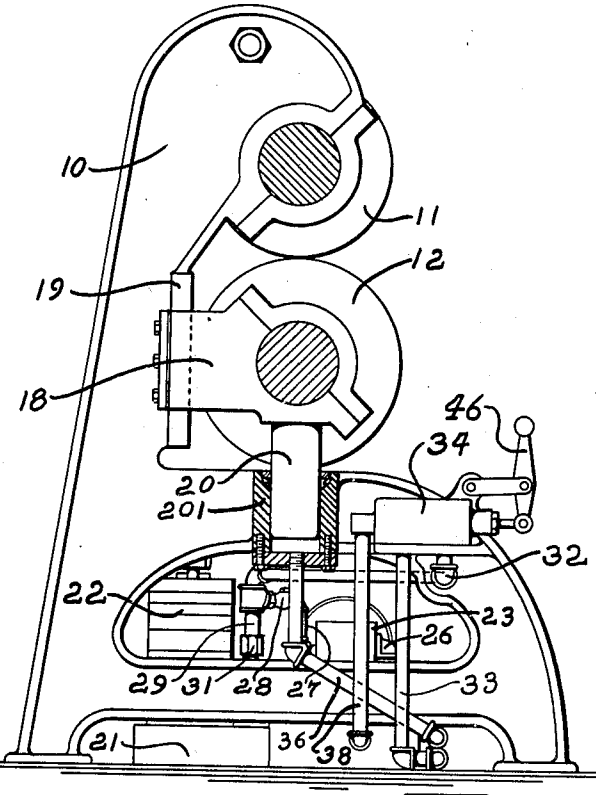


Fig. 5.

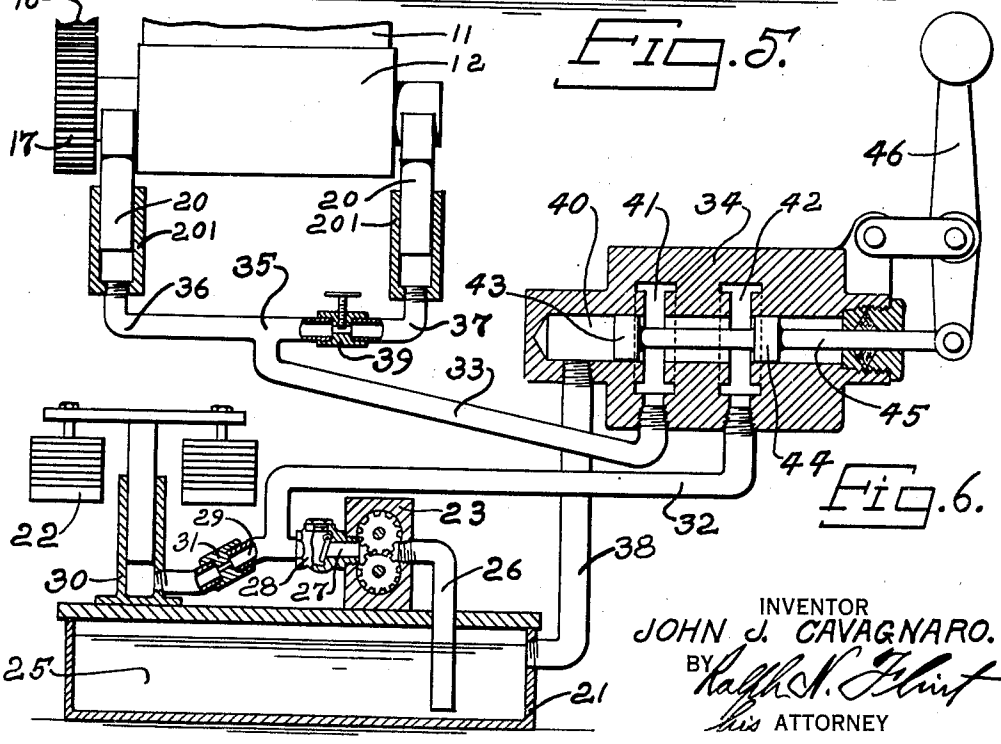


Fig. 6.

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UNITED STATES PATENT OFFICE

2,051,434

ACCUMULATOR SYSTEM FOR CALENDERS

John J. Cavagnaro, Ridgewood, N. J.

Application June 18, 1934, Serial No. 731,119

4 Claims. (Cl. 92—71)

My invention relates to calenders comprising rolls arranged one above another, and which may be either smooth to impart a smooth surface to the web operated upon, or embossed to impress a pattern or figure upon a web of wall or other paper, leather or artificial leather, or textile fabric passing between them; and particularly to an accumulator system for use with such rolls and the purpose of which is to force them together, or rather to press a movable lower roll against an upper one which rotates about a fixed axis when the machine is in operation.

In such machines it is frequently necessary to permit the lower roll to move downward and away from the fixed upper roll as when the machine is not in operation and a web to be operated upon is introduced between the rolls, at starting, or when a seam in the web approaches the rolls, or under other circumstances; and after the movable roll has been lowered it is desirable that it be returned into cooperative relationship with the upper roll as quickly as possible, to thereby secure a maximum rate of operation of the machine. The movable roll is lowered and lifted by hydraulic cylinders and ram devices at its two ends which are supplied with pressure liquid from the accumulator system; and heretofore the lifting of the lower roll to close the gap between them has been a slow operation because the draining of the cylinders to permit the roll to drop commonly exhausts all or most of the operating liquid from the system, and the pump which restores liquid to the system has ordinarily been of the reciprocating type having a constant rate of discharge and designed rather to supply a small volume of liquid to the system to maintain a high static pressure therein, than to fill the comparatively large roll lifting cylinders from which the liquid is exhausted more or less frequently to permit the rolls to separate. The lifting of the roll was thus ordinarily dependent solely upon the volume of the pumping chamber and unless the pump was inordinately large (or the capacity of the accumulator itself much greater than that necessary for maintaining the required pressure, so that the closing could be effected by liquid derived from the accumulator system) the gap closing operation proceeded slowly; as it could proceed no faster than the pump discharged constant and unvarying increments of fluid, corresponding with the volume of its pumping chamber, into the accumulator system.

Incidentally the pressure necessary to lift the movable roll is small as compared with the pressure necessary to lift the accumulator weights and establish the requisite pressure between the rolls when the machine is in operation, whereas the discharge from the pump is dependent only upon its volumetric capacity; so that in machines of the class herein contemplated the pump operates against what is practically a negligible head during the roll lifting period and until pressure begins to build up in the accumulator system.

The principal object of my invention is therefore to provide an accumulator system for calender rolls of the class described wherein the lower roll after being dropped may be lifted and brought into contact with the fixed upper roll (with a web between them) in the shortest possible time; this being accomplished by using a high speed rotary pump to supply fluid under low pressure to the roll lifting cylinders to close the gap, and thereafter under high pressure to the accumulator system to build up the static pressure necessary to press the rolls together. The pump used as will hereinafter appear discharges a large volume of liquid at comparatively low pressure during the lifting of the lower roll and secures a rapid closing of the gap between the rolls, whereas after the gap is closed the pump discharges a much less volume of liquid at a greatly increased pressure to thereby build up the static pressure necessary to press the rolls against one another after the gap is closed and when the machine is in operation.

A further object of my invention is to provide an accumulator system wherein the rate at which the two ends of the movable roll are lifted to close the gap may be regulated and controlled, to thereby insure that the ends of the roll being lifted shall come into contact with the upper fixed roll at the same instant, and that both ends of the two rolls shall be subjected to uniform and equal wear.

With the above and other objects of invention in view my invention consists in the improved accumulator system for applying pressure to calender, embossing, and similar rolls illustrated in the accompanying drawings, described in the following specification, and particularly claimed; and in such variations and modifications thereof, within the scope of the concluding claims, as will be obvious to those skilled in the art to which my invention relates.

In the drawings wherein the preferred form of my invention is illustrated:

Figure 1 is a view showing a calender having two rolls such as are commonly used for emboss-

ing paper, leather and similar fabrics, the same having an accumulator system in accordance with my invention.

Figure 2 is a sectional view upon a central plane indicated by the line 2—2, Figure 1, showing accumulator features only.

Figure 3 is a similar sectional view upon a plane indicated by the line 3—3, Figure 1.

Figure 4 is a similar sectional view upon a plane indicated by the line 4—4, Figure 1.

Figure 5 is a view showing the calender as seen from a position to the left of Figure 1, the driving gears for the rolls being omitted and certain of the parts being shown in section to afford a better understanding thereof.

Figure 6 is a schematic view illustrating the accumulator system, the various parts being all in one plane so that the functional relationship between them may be the more readily appreciated and understood.

Referring now to the drawings, the numerals 10 designate side frames or housings of the calender herein described; and 11, 12 are two rolls the ends of which are rotatable in bearings carried by said frames. The upper roll is stationary, that is it is not movable except about its axis; whereas the lower roll 12 is movable downward and away from the upper roll to the extent of ⅛ inch (⅛") or thereabouts, to permit a web to be operated upon to be introduced between the rolls or for other purposes as hereinbefore explained. The roll 11 is driven from a drive shaft 13 through gears 14, 15; and gears 16, 17 drive the lower roll from the upper as will be understood. The bearings 18 for the lower roll are slidable upon guides 19 carried by the frame members 10 so that said roll is movable, vertically; and the roll is lifted into contact with the upper roll (with the web operated upon between them) by plungers 20 movable in cylinders 201 to which a fluid under comparatively low pressure is supplied directly from the pump during the lifting of the lower roll to close the gap between the rolls. After the gap has been closed fluid within the accumulator system and under a much higher static pressure acts to force the lower roll against the upper when the machine is in operation.

The numeral 21 designates a base whereby the accumulator 22, the rotary pump 23 and the electric motor 24 for driving the same, are supported; the base having a reservoir 25 for containing the pressure liquid, which is ordinarily a suitable oil. The pump draws its supply of liquid from the reservoir through a pipe 26, and forces the same through a pipe 27 and past a check valve 28. A conduit 29 leads from just beyond the check valve to the lower end of the cylinder 30 of the accumulator; and included in this conduit is a restriction member or choke 31 having a passage of small area to restrain the flow of pressure liquid from the accumulator cylinder as will hereinafter appear. The passage through this choke may be on the order of $\frac{1}{16}$ inch ($\frac{1}{16}$") in diameter.

Leading also from the pump discharge pipe 27 beyond the check valve 28 is a conduit system 32, 33 in which a controlling valve 34 is included, and which conduit 33 divides at 35; one branch 36 leading to one of the roll lifting cylinders 201 and the other branch 37 leading to the other cylinder. A waste pipe 38 leads from the controlling valve 34 back to the reservoir 25 through which fluid may be exhausted from the roll lifting cylinders 201 to permit the rams 20 to descend and the lower roll 12 to drop away from the upper roll, and the two to separate as hereinbefore explained. The branch 37 which leads to the lifting cylinder 201 for the end of the roll 12 opposite the end which has the driving gear 17, has therein a second restriction or choke 39 the purpose of which is to secure uniform lifting of the two ends of the roll and insure that the rolls will contact with one another at the same instant throughout their whole lengths. The choke 39 should be adjustable, but the choke 31 may be of fixed area and need not be adjustable; although it also may be made adjustable to vary the area of the liquid passage therethrough if desired.

The rotary pump 23 is preferably of the type having intermeshing gears for pumping the pressure liquid, and it is driven directly by the motor 24 at high speed, commonly 1750 R. P. M. When the rolls are separated the pump will operate with little or no slippage (leakage back through the gears) and discharge the maximum possible quantity of liquid at a comparatively low pressure, for example at around 120 pounds per square inch, directly into the cylinders 201 to thereby lift the lower roll; there being no flow through the choke 31 and into the accumulator cylinder 30 during the lifting of the lower roll because it is full of liquid and the pressure must rise to around 1500 pounds per square inch in order to lift the accumulator weights and build up the required static pressure within the accumulator system.

The large volume of liquid thus supplied to the roll lifting cylinders at a pressure not necessarily greater than that required to lift the lower roll and close the gap, but very much less than that necessary within the accumulator system for lifting the accumulator weight and establishing a static pressure for forcing the rolls together when the machine is in operation, will close the gap in an extremely short time, say in from one to three seconds or thereabouts; the liquid for lifting the lower roll coming directly from the pump and not from the accumulator cylinder because of the restraining action of the choke 31 upon liquid tending to flow from the accumulator cylinder as will be understood. After the lower roll comes into contact with the upper no more liquid can enter the lifting cylinders and the pressure (which up to this time has been comparatively low as explained) rises and the liquid flows through the choke 31 and into the accumulator cylinder 30, thus lifting the accumulator weights and establishing a static pressure in the accumulator system which as stated may be around 1500 pounds per square inch; and which pressure obviously acts to press the rolls together when the machine is in operation.

The available power of the motor 24 must obviously be sufficient to establish this maximum pressure in the liquid within the accumulator system. Ordinarily the motor used will operate at much less than its rated capacity, but at its maximum pumping (fluid discharging) efficiency, during the discharge at low pressure and the closing of the gap; and at a considerable overload but with much less pumping efficiency after the gap has been closed and the pump is forcing liquid at high pressure into the accumulator cylinder. Obviously slippage (that is, leakage back past the intermeshing pump gears) is very much greater when the pump is discharging at high pressure than it is when the pressure dis-

charged against is low; and the pump continues to operate against the high pressure within the accumulator system, but at greatly reduced capacity as measured by the volume of liquid discharged, until the accumulator weights have been lifted to a predetermined extent at which time (unless meanwhile the pressure liquid has been permitted to exhaust from the lifting cylinders to allow the lower roll to drop) a switch operated by a trip which moves with the weights is actuated to interrupt the supply of current to the motor 24. Ordinarily, however, and especially if it is necessary to drop the lower roll frequently, the motor may run all the time that the machine is in operation.

The controlling valve (which may be located anywhere about the machine) comprises a suitable casing having an internal valve chamber 40, and annular ports 41, 42. The valve member itself comprises two pistons 43, 44 fast upon a rod 45, which extends to outside the casing and is operated by an operating lever 46.

In the position shown both ports are open and fluid at low pressure discharged by the pump flows through the conduits 32, 33 and into the lifting cylinders 201 until the lower roll is lifted into contact with the upper roll to close the gap, after which and as hereinbefore explained the pressure increases and fluid under much higher pressure flows through the choke 31 and into the accumulator cylinder to build up the static pressure required to press the rolls together when the machine is in operation.

When the pistons 43, 44 are moved to the right beyond the port 41 the flow to the lifting cylinders is interrupted, and fluid flows from the cylinders through conduit 33, port 41 and the waste pipe 38 to the reservoir 25, thus permitting the lower roll to drop; during which movement, however there will be no flow from the accumulator cylinder (or practically none) because the only flow, disregarding leakage, which could occur would be back through the pump and that is prevented by the check valve 28.

In a third position the piston 43 is over and closes the port 41 and in this position no flow can occur either to the lifting cylinders or to waste through the pipe 38, and the existing condition of static pressure within the accumulator system is maintained. This is the position into which the piston should be returned immediately when the lower roll has dropped far enough to provide the desired gap as otherwise, the cylinders being still in open communication with the reservoir 25 through the conduit 33 the port 41 and waste pipe 38, more fluid than that necessary to provide the desired gap will flow from the cylinders, and indeed they may be left empty; and the choke 31 serves an additional purpose in case the cylinders or the conduit system becomes for any reason empty or partly empty, or if air pockets are formed therein, because in that event and when a supply passage to the lifting cylinders is again established by moving the pistons 43, 44 into the position shown it (the choke 31) will prevent a surge of the fluid from the accumulator cylinder and at high static pressure through the control valve and into the lifting cylinders, with consequent sudden dropping of the accumulator weights into their lowermost position. In fact the capacity of the lifting cylinders is commonly so large that if the waste passage 38 is left open after being opened to permit the lower roll to drop, the quantity of high pressure liquid within the accumulator cylinder will be nowhere near enough to fill the cylinders and close the gap, and the high static pressure within the system will disappear until reestablished after the pump has lifted the lower roll and closed the gap.

As explained, the purpose of the choke 39 is to secure uniform lifting of both ends of the lower roll 12. This roll necessarily has a gear 17 at one end to drive it so that that end is much heavier than the one which has no such gear; and if the flow of liquid to both lifting cylinders is equally free and unconstrained the lighter end will be lifted the more quickly, and will contact with the upper roll sooner, and contact with more violence, than the heavy end thereof, thus subjecting the lighter end to more wear than the heavier end and often to serious injury. With the choke 39, however, the flow to the cylinder at the lighter end of the roll can be restrained and regulated so that its two ends will rise uniformly, and contact along the entire lengths of the rolls can be made to occur at the same instant. This choke will not interfere with the lowering of the lower roll to form the gap and the lifting of the lower roll, because the gap does not have to be especially uniform as regards width, and because a condition of equalized static pressure will be established between the two lifting cylinders immediately upon the closing of the port 41 by the piston 43; so that the conditions at the beginning of upward movements of the lower roll are always the same.

Having thus described and explained my invention I claim and desire to secure by Letters Patent:

1. In combination with a calender having a fixed upper roll, a lower roll beneath said fixed roll and movable downwardly therefrom to provide a gap between the two, and cooperating lifting cylinders and plungers at the ends of said lower roll and adapted to lift the same to close said gap and force said lower roll against said fixed roll; an accumulator cylinder; a conduit system connecting said accumulator cylinder and said lifting cylinders; a rotary pump the outlet from which discharges into said conduit system and which pump is adapted to discharge a large volume of liquid at low pressure into said system to lift said lower roll into contact with said fixed roll, and to thereafter discharge a lesser volume of liquid at high pressure into said system to produce a condition of high static pressure therein; an electric motor directly connected with said rotary pump to drive the same; and valve means for controlling the flow of liquid into said lifting cylinders to lift said lower roll, and out therefrom to permit said lower roll to move downward to thereby form a gap between the rolls.

2. In combination with a calender having a fixed upper roll, a lower roll beneath said fixed roll and movable downwardly therefrom to provide a gap between the two, a driving gear at one end of said lower roll, and cooperating lifting cylinders and plungers at the two ends of said lower roll and adapted to lift the same to close said gap and force said lower roll against said fixed roll; a conduit system through which liquid under pressure is supplied to said lifting cylinders; a valve device for controlling the flow of liquid under pressure into and out from said lifting cylinders; and a choke device

included in said conduit system for restraining the flow of liquid under pressure to the lifting cylinder for the end of said lower roll which is opposite the end thereof having the driving gear.

3. In combination with a calender having a fixed upper roll, a lower roll beneath said fixed roll and movable downwardly therefrom to provide a gap between the two, and cooperating lifting cylinders and plungers at the ends of said lower roll and adapted to lift the same to close said gap and force said lower roll against said fixed roll; an accumulator cylinder; a conduit system connecting said accumulator cylinder and said lifting cylinders; a choke device included in said conduit system and located adjacent said accumulator cylinder for restraining the flow of liquid from said accumulator cylinder; a rotary pump the outlet from which discharges into said conduit system between said choke device and said lifting cylinders and which pump is adapted to discharge a large volume of liquid at low pressure into said system to lift said lower roll into contact with said fixed roll, and to thereafter discharge a lesser volume of liquid at high pressure into said system to produce a condition of high static pressure therein; an electric motor directly connected with said rotary pump to drive the same; and valve means for controlling the flow of liquid into said lifting cylinders to lift said lower roll, and out therefrom to permit said lower roll to move downward to thereby form a gap between the rolls.

4. In combination with a calender having a fixed upper roll, a lower roll beneath said fixed roll and movable downwardly therefrom to provide a gap between the two, and cooperating lifting cylinders and plungers at the ends of said lower roll and adapted to lift the same to close said gap and force said lower roll against said fixed roll; an accumulator cylinder; a conduit system connecting said accumulator cylinder and said lifting cylinders; a choke device included in said conduit system for restraining the flow of liquid from said accumulator cylinder; a rotary pump the outlet from which discharges into said conduit system and which pump is adapted to discharge a large volume of liquid at low pressure into said system to lift said lower roll into contact with said fixed roll, and to thereafter discharge a lesser volume of liquid at high pressure into said system to produce a condition of high static pressure therein; an electric motor connected with said rotary pump to drive the same; and valve means for controlling the flow of liquid into said lifting cylinders to lift said lower roll, and out therefrom to permit said lower roll to move downward to thereby form a gap between the rolls.

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