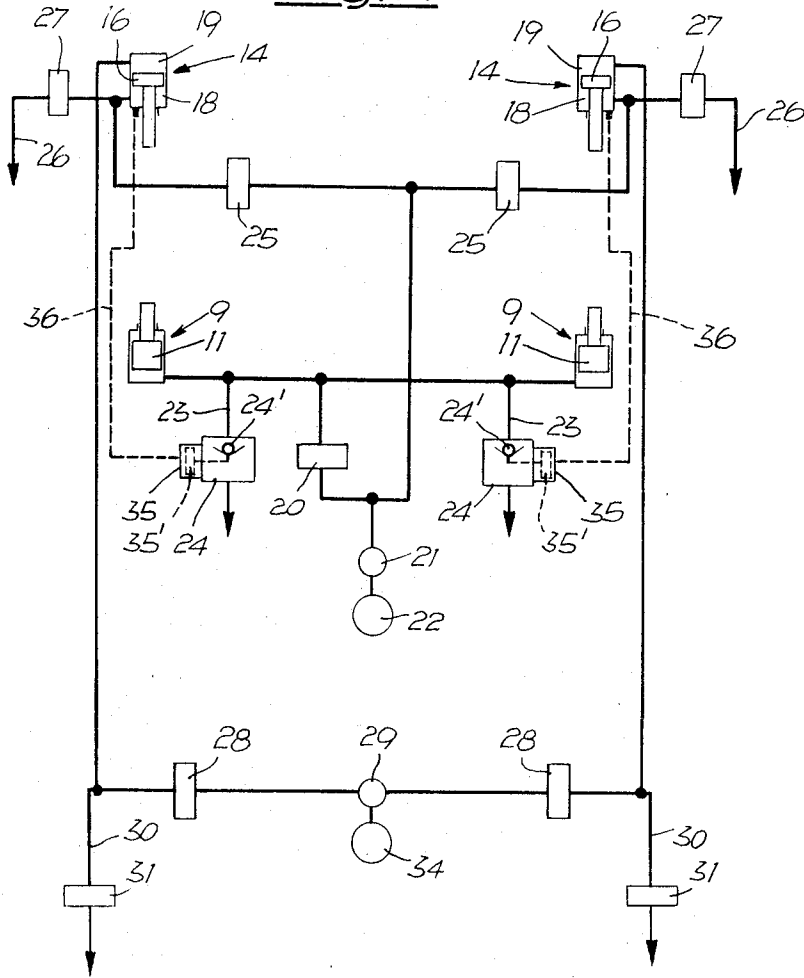


Fig. 2.



CALENDER AND METHOD OF OPERATING THE SAME

The present invention relates to a method and an apparatus for loading the rolls of a calender and for separating them from each other by means of two forces, namely, first by a force which acts upon the highest calender roll and during the operation of the calender exerts a load upon the train of rolls which is necessary in addition to the load as produced by the weight of the individual rolls upon each other, and second by means of a bearing force which acts upon the lowest calender roll and maintains the latter in the operating position until the rolls are to be separated from each other, and which for carrying out the separating operation is reduced to a value which permits the lowest roll to be lowered.

If in a calender of the type in which hard and elastic rolls alternate within the train of rolls the elastic rolls should be protected from being damaged when a web of paper tears while traveling through the train, it is necessary to separate all of the rolls of the train as quickly as possible from each other. According to one calender construction, such a separation has in the past been carried out by means of two hydraulic cylinder and piston units which act upon the two bearings of the highest calender roll so as normally to exert a load upon the train of rolls in addition to the load with which the individual rolls press upon each other due to their own weight. Each of these two hydraulic units is for this purpose provided with a piston which is slidable within a cylinder and divides the same into two cylinder chambers in which a hydraulic fluid may act upon each side of the cylinder. That cylinder chamber of each of these hydraulic units the capacity of which decreases when the piston is shifted in the direction toward the calender rolls so as to exert a load thereon is connected via a control valve to a supply container in which the hydraulic fluid is stored under a high pressure. By means of this supply container it is possible after the web of paper has been torn in the calender to build up the pressure in the mentioned cylinder chamber very quickly to the value which is necessary for lifting the calender rolls. The principal disadvantage of this mechanism is the high cost of the supply container and of the necessary valves.

According to another known calender construction, the additional load to be exerted upon the calender rolls is produced by a pair of hydraulic cylinder and piston units which act up the lowest roll and also have to carry the weight of the entire train of rolls. For separating the rolls from each other, it is only necessary to release the hydraulic fluid from these hydraulic units so that the rolls will then drop downwardly by their own gravity until each of them engages upon adjustable stop members. This calender construction therefore does not require any supply containers in which the hydraulic fluid has to be maintained under pressure. This advantage is, however, opposed by the disadvantage that an accurate and fine adjustment of the additional load to be exerted upon the calender rolls can be effected, if at all, only with considerable difficulties. This is due to the fact that the hydraulic force which is required for producing the additional load upon the calender rolls is very small as compared with the force which is required for overcoming the weight of the rolls when lifting them back to their original positions.

It is an object of the present invention to provide a new method of loading the rolls of a calender and of separating them from each other, which method may be carried out without requiring any expensive means or high operating expenses and which permits the additional hydraulic load which is to be exerted upon the rolls from above to be very accurately and sensitively adjusted and further permits the rolls to be separated more quickly from each other than it has been possible in previous calenders.

The present invention concerns a method as described in the first paragraph of this specification, and for attaining the object as mentioned above, the invention provides that during the normal operation of the calender a force is exerted hydraulically from above upon the calender rolls until it becomes necessary to separate the rolls from each other when the direction of this force is reversed, and that a hydraulic opposing or bearing force acts in the upward direction upon the lowest calender roll but is controlled by simple stop means so as to prevent the lowest roll from being moved upwardly beyond its normal operative position during the normal operation of the calender, while when the rolls are to be separated from each other, this bearing force is reduced or eliminated.

Therefore, during the normal operation of the calender a hydraulic force is exerted from above upon the highest calender roll, while upon the lowest roll a hydraulic opposing or bearing force is exerted which although it at least equals and is preferably greater than the total of the weight of the entire train of calender rolls and of the maximum of the hydraulic force which may be exerted additionally upon the highest roll, is controlled preferably by simple mechanical means in such a manner that it cannot move the lowest roll upwardly beyond its normal operative position. Due to this control of the bearing force, no additional force can be exerted from below upon the rolls during the normal operation of the calender, but the required additional force will only be exerted upon the highest roll and may therefore be very accurately and sensitively controlled. If it becomes necessary to separate the calender rolls quickly from each other, the hydraulic bearing force only needs to be reduced or eliminated so that each of the calender rolls will then drop downwardly to an extent which may be determined by adjustable stops.

It is a further object of the invention to provide a suitable apparatus for carrying out the inventive method as described above. This apparatus basically comprises a vertical train of horizontally extending calender rolls, at least one upper hydraulic cylinder piston unit which acts upon the highest calender roll for exerting a load thereon, and at least one lower hydraulic cylinder and piston unit which acts in the upward direction upon the lowest calender roll with a force which is at least equal to the load which is exerted upon the bearings of the lowest roll. An important feature of the invention consists in providing this apparatus with at least one stop member which prevents the lower hydraulic unit from moving the lowest calender roll upwardly beyond its normal operating position, and it further consists in adjusting the lifting force of the lower hydraulic unit so that during the normal operation of the calender and until it becomes necessary to separate the calender rolls from each other, this force will be at least sufficiently strong to maintain the piston of the lower hy-

draulic unit or the bearing means of the lowest calender roll in engagement with the stop member.

Since during the normal operation of the calender the pressure within the hydraulic unit acting upon the lowest roller only needs to be maintained at such a value that this lowest calender roll will remain in the position which is determined by the stop member, and since because of this stop member even an excessive pressure in this hydraulic unit will not affect the lowest calender roll, there are no means required for controlling this pressure. The considerable expense of such pressure control means is therefore avoided.

For separating the calender rolls from each other, it is only necessary, as has already been indicated, to release the hydraulic fluid from the cylinder of the lower hydraulic unit or units so that the calender rolls can then drop downwardly due to their own weight until each of them engages upon adjustable stop members. Of course, for separating the calender rolls very quickly from each other, it is necessary to make the discharge line through which the hydraulic fluid may flow out of the cylinder of the lower hydraulic unit of such a large diameter that under the downward pressure of the weight of at least the lowest calender roll the piston of this unit will force the fluid very quickly out of the cylinder and move downwardly at a high speed.

Another feature of the invention consists in providing the hydraulic unit which acts upon the highest calender roll with a piston which is hydraulically movable in both directions within its cylinder and permits the additional load which it has to exert upon the calender rolls to be very accurately and sensitively adjusted. Such a hydraulic unit has the advantage that, when the calender rolls are to be separated from each other, the highest roll may in a very simple manner be maintained in the same operating position in which it is located immediately before the separation becomes necessary. Essentially, it is for this purpose only necessary to maintain the lower cylinder chamber of the upper hydraulic unit, that is, the chamber the capacity of which decreases when the piston is moved downwardly to exert a load upon the calender rolls, filled with hydraulic fluid and to prevent any discharge of fluid from this chamber during the separating process. If the highest calender roll remains in its last operating position when the separation of the rolls is started, it is only necessary to design the lower hydraulic unit which acts upon the lowest calender roll so that the stroke of its piston has a length which is equal to the total width of all of the gaps between the rolls when they are separated from each other.

Another feature of the invention consists in accelerating the separating process by connecting the lower cylinder chamber of the upper hydraulic unit to a source of high pressure at the moment when the separation should start. The separating operation may be carried out within the shortest possible length of time if suitable control means are provided which are adapted to open a control valve which is mounted within the discharge line of the lower hydraulic unit and thereby to permit the lowest calender roll to move downwardly from its operating position but not until the pressure in the lower cylinder chamber of the upper hydraulic unit has increased to a strength which is sufficient for starting to lift the highest calender roll. According to one advantageous embodiment of the invention, these control means preferably consist of another

cylinder and piston unit the cylinder of which is connected by a line with the lower cylinder chamber of the upper hydraulic unit and the piston of which is movable in response to the pressure in this lower cylinder chamber and is connected, for example, mechanically, to the mentioned control valve in the discharge line of the lower hydraulic unit. The source of the high pressure which is to be connected to the lower cylinder chamber of the upper hydraulic unit may consist, for example, of a pump which during the normal operation of the calender is connected to the lower hydraulic unit to provide the same with hydraulic fluid and which, when the separating operation should start, is switched over from the lower hydraulic unit to the lower cylinder chamber of the upper hydraulic unit. Thus, while the lower rolls drop downwardly due to their own weight, the piston of the upper hydraulic unit will be moved upwardly and will thereby also draw some of the higher rolls in the upward direction.

Since in a calender the alternate rolls of which are elastic these rolls must be refinished from time to time by turning, the distance between the highest roll and the lowest roll will not remain constant. It is therefore another feature of the invention to make the maximum stroke of the piston of the upper hydraulic unit of a sufficient length so as to permit the differences in the distance between the highest and lowest rolls to be compensated. In order to effect such a compensation and to render it unnecessary to move the piston of this unit always to its upper end position when separating the calender rolls from each other, a limit switch may be provided which may be actuated, for example, by one of the bearing brackets carrying the highest calender roll and which then prevents a further supply of hydraulic fluid to the lower cylinder chamber of the upper unit as soon as the highest calender roll has reached the desired level for the normal operation of the calender.

The features and advantages of the present invention will become further apparent from the following detailed description thereof which is to be read with reference to the accompanying drawings, in which

FIG. 1 shows, diagrammatically and partly broken away and in section, a side or end view of a calender which is designed in accordance with the invention; while

FIG. 2 shows a circuit diagram of the hydraulic mechanism of the calender according to FIG. 1.

In FIG. 1 of the drawings it is assumed that the calender 1 is a so-called super calender in which a vertical train of horizontal calender rolls 2 consists of an alternate succession of elastic rolls and hard rolls. It is, however, to be understood that the invention is equally applicable to a so-called machine calender in which all of the calender rolls 2 are hard rolls.

The opposite ends of each calender roll 2 are rotatably mounted on and between a pair of bearing brackets 3 and all of these brackets 3 are vertically slidable on and guided by a frame 4. Since FIG. 1 is an end view of calender 1, it only shows the brackets 3 and all other elements as hereafter described which are associated with one end of the calender rolls 2. The other end of the calender which cannot be seen in FIG. 1 is therefore provided with elements equal or similar to those as shown.

Each bearing bracket 3, with the exception of the bearing brackets 3' of the lowest calender roll 2', is provided on its outer side with a lug 5 containing a ver-

tical bore, and all bores of the lugs 5 on the corresponding brackets 3 are in axial alignment with each other. A threaded spindle 6 which extends through the bores of the corresponding lugs 5 carries a pair of nuts 7 on its upper end which projects from the lug 5'' of the bearing bracket 3'' of the highest calender roll 2''. Each spindle 6 further carries underneath each lug 5 a nut 8, and each of these nuts 8 may be adjusted on the respective spindle 6 to different distances from the associated lug 5.

The two bearing brackets 3' of the lowest calender roll 2' are likewise slidable in a vertical direction on the frame 4, but are not connected to the spindles 6. Each of these brackets 3' is supported on a hydraulic cylinder and piston unit 9, the cylinder 10 of which is mounted in the frame 4 and the vertical axis of which intersects the longitudinal axis of each calender roll 2. The piston 11 in each cylinder 10 carries a short piston rod 12 on which the lowest bearing bracket 3' is supported. The highest position of each piston 11 in which it is located when the calender is in operation is determined by a stop member 13 which in the particular calender as illustrated in FIG. 1 consists of a plate 13 which has a bore in which the piston rod 12 is slidable and which is secured to the cylinder 10 and covers the open end thereof which faces the bearing bracket 3'. The length of the full stroke of each piston 11 is equal to the total width of the gaps between all of the calender rolls 2 when these rolls are lifted from each other. In the particular calender 1 as illustrated in FIG. 1, this length of the stroke of each piston 11 amounts to 40 mm.

Each of the two bearing brackets 3'' of the highest calender roll 2'' is connected to the lower end of a vertical piston rod 15 of a hydraulic cylinder and piston unit 14. The axis of each piston rod 15 intersects the longitudinal axes of the calender rolls. On its upper end, piston rod 15 carries a piston 16 which is slidable within a cylinder 17 and both sides of which may be acted upon hydraulically. Piston 16 has a maximum stroke of such a length as to permit a reduction of the normal distance between the highest calender roll 2'' and the lowest calender roll 2' to be compensated, which reduction is due to the fact that the diameter of any or all elastic rolls of the entire train of calender rolls 2 has been reduced. When each calender roll of the entire train has its maximum diameter and all adjacent rolls engage with each other, piston 16 will still be spaced at a certain distance from the upper end wall of cylinder 17 which in the particular calender as illustrated may amount to about 15 mm. This highest possible position of piston 16 is shown in FIG. 1. If, however, one or more of the elastic rolls have been refinished once or several times, piston 16 will be in a lower position when all adjacent rolls of the entire train engage with each other. In this lowest position, piston 16 will be located at a distance of about 350 mm below its highest position. This is also the extent to which the distance between the highest and lowest calender rolls may be reduced without requiring any readjustment of the position of cylinder 17 on the frame 4. It is evident that insofar as the mentioned dimensions are concerned, their proper relation to each other could not be indicated in FIG. 1.

As illustrated in FIG. 2, the two hydraulic cylinder and piston units 9 are connected via a valve 20 to a pump 21 which is driven by a motor 22. This pump 21

produces a pressure of such a strength that during the normal operation of the calender the piston 11 of each of the two hydraulic units 9 will reliably engage upon the stop member 13 even if the train of calender rolls 2 is pressed downwardly by the two upper hydraulic units 14 with the greatest force which these units can produce. The pressure which may be produced by pump 21 is substantially constant. Therefore, as long as the valve 20 is opened, the pressure of the hydraulic fluid which acts upon the pistons 11 of the two hydraulic units 9 is likewise substantially constant.

The cylinder chamber of each of these hydraulic units 9 is connected by a line 23 of a relatively large cross-sectional size and a valve 24 in this line to a supply container, not shown, of the hydraulic fluid. When each of these two valves 24 is opened by a control device 35, preferably against the action of springs, the hydraulic fluid will be very quickly discharged from the cylinder chambers of the two hydraulic units 9 to the supply container. These control devices 35 will open the valves 24 when the lower cylinder chambers 18 of the two upper hydraulic units contain a pressure which exceeds a certain minimum which corresponds to the weight of the highest calender roll 2'' the bearing brackets 3'' of which are secured to the piston rod 15. As shown in FIG. 2, each of these control devices may, for example, consist of a cylinder and piston unit the cylinder chamber of which is connected by a line 36 to the lower cylinder chamber 18 of the associated hydraulic unit 14 or to another line leading to the latter, while the piston of this control device acts preferably by mechanical connecting means upon the valve member 24' of valve 24 in the line 23 which is connected to the associated hydraulic unit 9 and lifts this valve member off its seat when the pressure in chamber 18 exceeds the mentioned minimum because pump 21 pumps hydraulic fluid in the chamber 18 and thereby increases the pressure therein.

As further illustrated in FIG. 2, the cylinder chamber 18 of each of the two hydraulic units 14, that is, the cylinder chamber the capacity of which decreases when piston 16 moves downwardly so as to press upon the calender rolls, is connected by a solenoid valve 25 to the pump 21. Each cylinder chamber 18 is further connected to a supply container, not shown, by a discharge line 26 and a solenoid valve 27 which is adapted to be shut off tightly. Each of these valves 27 although adapted to be actuated magnetically like all of the other valves with the possible exception of the valves 24 is provided with a spring-loaded valve plate so as to operate as a pressure relief valve when it is not closed by its magnet. This valve opens automatically at a low pressure which in this particular embodiment of the invention amounts to about 3 atm.

The upper cylinder chamber 19 of each hydraulic unit 14 the capacity of which increases when the piston 16 exerts a pressure upon the calender rolls is connected via a valve 28 to a pump 29 which conveys a lower quantity of hydraulic fluid and produces a lower pressure than pump 21 and is driven by a motor 34. Pump 29 produces a pressure of such a size that the hydraulic units 14 may exert the highest load upon the calender rolls which may be required in addition to their own weight with which they press upon each other.

The hydraulic fluid may be discharged from each cylinder chamber 19 of the hydraulic units 14 into the sup-

ply container through a discharge line 30 which contains a valve 31.

As illustrated in FIG. 1, a limit switch 32 is provided adjacent to one of the bearing brackets 3'' of the highest calender roll 2''. This limit switch 32 which controls the operation of the two valves 25 is vertically adjustable and adapted to be locked in the adjusted position to the frame 4. Switch 32 is provided with a roller 33 which is adapted to trace the position of the bearing bracket 3'' and to actuate the limit switch to open the valves 25 as soon as this bracket 3'' during its upward movement has reached a certain position. This position is, in turn, dependent upon the position to which the limit switch 32 has been adjusted on the frame 4.

The mode of operation of the calender 1 is as follows:

During the operation of the calender a hydraulic pressure is exerted upon the pistons 11 of the two lower hydraulic units 9 so as to maintain them in engagement with the stop members 13. The force which is produced by the two hydraulic units 9 must therefore be stronger than the load acting from above upon piston rods 12 which is the total of the weight of all calender rolls and of the additional load which is exerted upon the latter by the two hydraulic units 14.

In the lower cylinder chambers 18 of the two hydraulic units 14 a low pressure is maintained which insures that during the operation of the calender these two chambers will remain completely filled with hydraulic fluid. These cylinder chambers 18 are filled by opening the valves 25 and 31 for a short time before the calender rolls are loaded by the hydraulic units 14. During this time, the pistons 16 are shifted upwardly as far as possible by the hydraulic fluid which is forced into the chambers 18. Subsequently when the valves 25 are again closed, the hydraulic fluid is forced into the upper chambers 19 of the hydraulic units 14 and shifts the pistons 16 slightly downwardly which thereby force the corresponding amount of hydraulic fluid out of the chambers 18 into the discharge lines 26 since the valves 27 in these lines are then not closed by their magnets. Since these valves 27 are designed so as to act as pressure relief valves, they insure that a pressure of about 3 atm. will be maintained in the chambers 18 and that these chambers will therefore remain filled completely with hydraulic fluid.

The pressure in the upper chamber 19 of each hydraulic unit 14 is adjusted to a value which results in a force which is equal to the total of the desired load which is to be exerted upon the highest roller 2'' and of the opposing force which is produced by the filling of the lower chambers 18 with hydraulic fluid. An accurate adjustment of the pressure in the upper cylinder chambers 19 may be effected without difficulty.

In order to permit the various calender rolls 2, 2' and 2'' to be lifted off each other, the nuts 8 are adjusted on each spindle 6 so that each of them will be spaced from the lower side of the associated lug 5 on the bearing bracket 3 of one calender roll at a distance which is equal to the total of the width of the gaps between this calender roll and the next higher roll and between all of the other higher rolls.

If it becomes necessary to separate the calender rolls from each other, for example, because the paper web has been torn during its travel through the train of rolls, valves 20 and 27 are to be closed and valves 24 to be opened. The inner cross sections of valves 24 and of the lines connecting them with the hydraulic units 9 and

the supply container of the hydraulic fluid are made of such sizes that this fluid may flow within the shortest possible time out of the cylinder chambers of the two hydraulic units 9. This discharge of the hydraulic fluid is further accelerated by the load of the calender rolls acting upon the piston 11. Due to the weight of the lowest calender roll 2', the bearing brackets 3' of the latter and thus also the piston 11 are then lowered until these brackets abut against the two stop members 13. When the lowest calender roll 2' is thus lowered, all of the upper rolls 2 with the exception of the highest roll 2'' will drop due to their own weight until the lugs 5 of each of them abut upon the associated nuts 8.

While the calender rolls 2 move downwardly, the tension which is exerted upon the two spindles 6 increases to the same extent as the number of calender rolls increases which are suspended on the spindles 6. This tension is transmitted by the lugs 5'', the bearing brackets 3'' and the piston rods 15 to the two pistons 16. However, since the valves 25 and 27 are tightly closed, the hydraulic fluid cannot escape from the lower cylinder chambers 18 and the pistons 16 will therefore not move downwardly.

Actually, the pressure in the lower cylinder chambers 18 even increases as soon as the separating action of the calender rolls is started by the actuation of a control switch (not shown) which then opens the valves 25 and simultaneously closes the valves 20 so that pump 21 can not act with its full power upon the lower chamber 18 of the two hydraulic units 14. Due to the dimensions of their pistons 35', the control devices 35 are adapted not to open the valves 24 until the pressure in the lower cylinder chambers 18 has increased to a value which is just sufficient to start an upward movement of the highest roll 2''. During this time in which the pistons 11 of the lower hydraulic units 9 move downwardly, the pistons 16 of the upper hydraulic units 14 move upwardly and thereby lift the highest roll 2'' off the next lower roll 2 and immediately thereafter usually also the latter roll off the following lower roll and so forth when during the upward movement of the spindles 6 together with the bearing brackets 5'' of the highest roller 3'' the nuts 8 on these spindles abut one after another against the associated bracket lugs 5 and then lift the respective roll 2. Since the upper and lower rolls are thus moved in opposite directions and are drawn apart, the entire separation of all of the rolls from each other requires a very short time. The separation would require a longer time if, before the valves 24 are opened, the pressure in the cylinder chambers 18 would not be increased until the force which tends to move the pistons 16 upwardly is sufficient to hold the highest roll 2'' in a fixed position. During the operation of the calender 1, however, the pressure prevailing in the cylinder chambers 18 will not be sufficient to prevent the highest calender roll 2'' from moving downwardly unless this roll is directly supported on the next lower roll 2.

The limit switch 32 causes the two valves 25 to be closed as soon as the highest calender roll 2'' has reached its highest position as desired.

Although my invention has been illustrated and described with reference to the preferred embodiment thereof, I wish to have it understood that it is in no way limited to the details of such embodiment but is capable of numerous modifications within the scope of the appended claims.

Having thus fully disclosed my invention, what I claim is:

1. A method of loading the rolls of a calender for the normal operation thereof and of separating said rolls from each other when necessary comprising the steps of loading the rolls by exerting upon the highest roll a first hydraulic force in the downward direction which is then transmitted to the lower rolls and exerting at the same time upon the lowest roll a second hydraulic force in the upward direction which has a strength at least equal to the total of the weight of all of said rolls and of said first force upon said highest roll, and limiting the upward movement of said lowest roll by said second force during the normal operation of said calender to a fixed operating level of said lowest roll, and separating said rolls from each other when necessary at least by relieving said second force so that at least most of said rolls can drop by gravity for limited distances determined by fixed stops.

2. A method as defined in claim 1, in which for separating said rolls from each other the direction of said first hydraulic force is reversed substantially simultaneously with the relieving of said second force and at least said highest roll is thereby moved upwardly from the lower rolls by said reversed first force.

3. A method as defined in claim 2, in which for separating said rolls from each other the direction of said first hydraulic force is reversed to lift at least said highest roll from the lower rolls shortly before said second force is relieved from said lowest roll.

4. A calender comprising a plurality of substantially horizontal rolls substantially vertically above each other and normally engaging by gravity upon each other, bearing means for each of said rolls slidable in a substantially vertical direction, at least one first hydraulic unit having an upper cylinder and a piston slidable in said cylinder, and having a piston rod connected to said bearing means of the highest of said rolls, first hydraulic pressure supply means connected to said upper cylinder for normally pressing said upper piston from above upon said bearing means of said highest roll, at least one second hydraulic unit having a lower cylinder and a piston slidable in said cylinder between a normal upper end position and a lower end position and connected to said bearing means of the lowest roll, pressure release means for releasing the pressure from said lower cylinder when said rolls are to move downwardly so as to be separated from each other and when said rolls at least due to their gravity then press said lower piston from said upper end position to said lower end position, adjustable stop means associated with said bearing means of at least all lower rolls below said highest roll for limiting the distance of the downward separating movement of each of at least said lower rolls independently of the other rolls, second hydraulic pressure supply means connected to said lower cylinder for hydraulically moving said lower piston only in its upward direction for lifting at least said lower rolls and their bearing means from their separated positions to their normal operating positions, fixed stop means for preventing said lowest roll from being moved upwardly by said lower piston beyond its normal operating posi-

tion, and control means for each of said pressure supply and release means.

5. A calender as defined in claim 4, in which said fixed stop means consist of a stop member which is secured to said lower cylinder and prevents said lower piston from being moved upwardly beyond said upper end position in which said lowest roll is in its normal operating position.

6. A calender as defined in claim 4, in which the length of the stroke of said lower piston is at least equal to the total width of the gaps between all of said rolls when separated to the maximum extent from each other.

7. A calender as defined in claim 4, in which said upper piston is movable hydraulically in both directions in said upper cylinder and divides said upper cylinder into a first cylinder chamber and a second cylinder chamber, said first pressure supply means being adapted to be connected to and disconnected from said first chamber, third hydraulic pressure supply means adapted to be connected to and disconnected from said second chamber, second pressure release means for releasing the pressure from said second chamber when said first pressure supply means are connected to said first chamber, and third pressure release means for releasing the pressure from said first chamber when said third pressure supply means are connected to said second chamber and when substantially at the same time said second pressure supply means are connected to said lower cylinder.

8. A calender as defined in claim 7, in which said first pressure supply means for said first supply comprises a first pump, and said second pressure supply means for said lower cylinder and also said third pressure supply means for said second chamber comprise a second pump, said control means comprising valve means for alternatively connecting said second pump either to said lower cylinder or to said second chamber.

9. A calender as defined in claim 8 in which said first pressure release means for said lower cylinder comprise a release valve, said control means further comprising a control device for opening said valve to release the pressure from said lower cylinder only when the pressure produced by said upper piston in said second chamber exceeds a certain minimum value.

10. A calender as defined in claim 9, in which said control device comprises a cylinder and piston unit having a cylinder connected by a line to said second chamber, and a piston slidable in said cylinder and adapted to open said release valve when the pressure in said second chamber exceeds said minimum value.

11. A calendar as defined in claim 10, in which said second pressure release means comprises a solenoid valve connected by a line to said second chamber and adapted in one operative position to remain closed regardless of the pressure in said second chamber and in its other operative position to be opened when the pressure in said second chamber exceeds a certain value.

12. A calender as defined in claim 7, in which said control means further comprise adjustable means for limiting the upward stroke of said upper piston.

* * * * *