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[54] **IMPROVED MULTI-STORY PRESS WITH SIMULTANEOUSLY OPENING AND CLOSING STORIES**

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[63] Continuation of Ser. No. 835,489, June 23, 1969, abandoned.

[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **425/338,** 425/149, 425/168

[51] **Int. Cl.** **B29j 5/08**

[58] **Field of Search** ..... 18/17 P; 425/111, 394, 425/406, 338, 339, 340, 149, 168

[56] **References Cited**

UNITED STATES PATENTS

3,361,056	1/1968	Carlsson et al.	100/200 X
3,451,334	6/1969	Hutter	425/394 X
3,468,243	9/1969	Schneider	425/111 X

FOREIGN PATENTS OR APPLICATIONS

182,455	2/1963	Sweden
65,723	7/1923	Sweden

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[57] **ABSTRACT**

A multi-story press is described which is provided with means for closing and opening the story openings simultaneously or simultaneously in groups, and in which the arrangement is provided with means for preventing the arrangement from being overloaded during the pressing operation and to counteract the influence of the weight of the press plates on the surface pressure in the press. The invention is characterized in that the aforesaid means is provided with members, each of which includes a cylinder and a piston rod which are axially movable in relation to each other, and a frictional arrangement acting therebetween and having a number of friction rings the one or two end surfaces of which are conically countersunk in shape and having a corresponding number of thrust washer plates positioned between the friction rings and two end plates positioned outside the outer friction rings, the one or both end surface of the plates being provided with crowns, which cooperate with the conical end surfaces of the friction rings so that the friction rings are urged towards the cylinder, alternatively are urged in towards the piston rod, when the friction arrangement is compressed longitudinally, and by an arrangement for causing in said members a suitable axial force between the cylinder and one end plate and the friction arrangement, alternatively between the piston rod and the end plate, so that the friction arrangement is compressed against an abutment surface for its other end plate on the piston rod, alternatively against an abutment surface for the second end plate in the cylinder.

7 Claims, 3 Drawing Figures

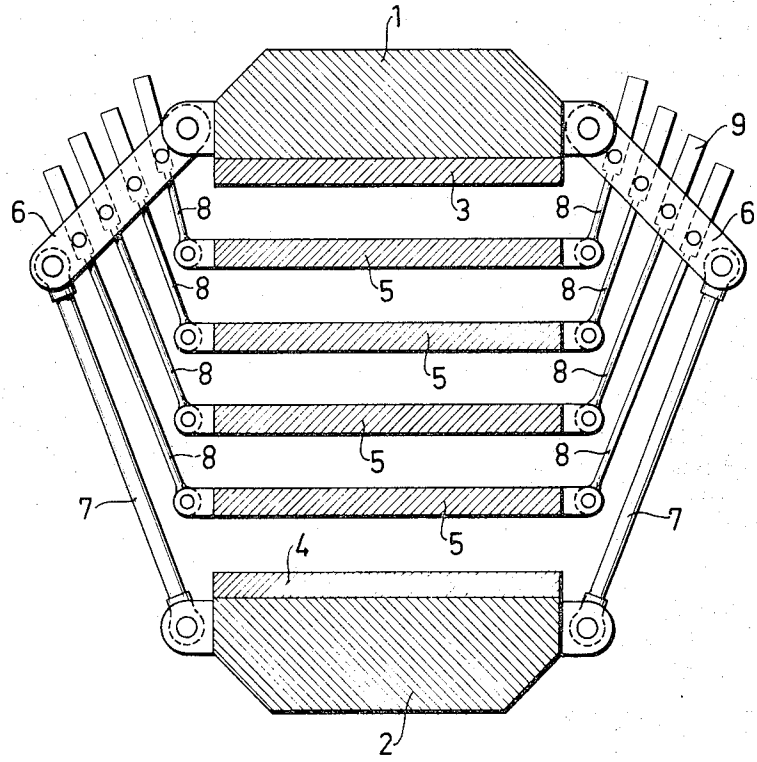


Fig. 1

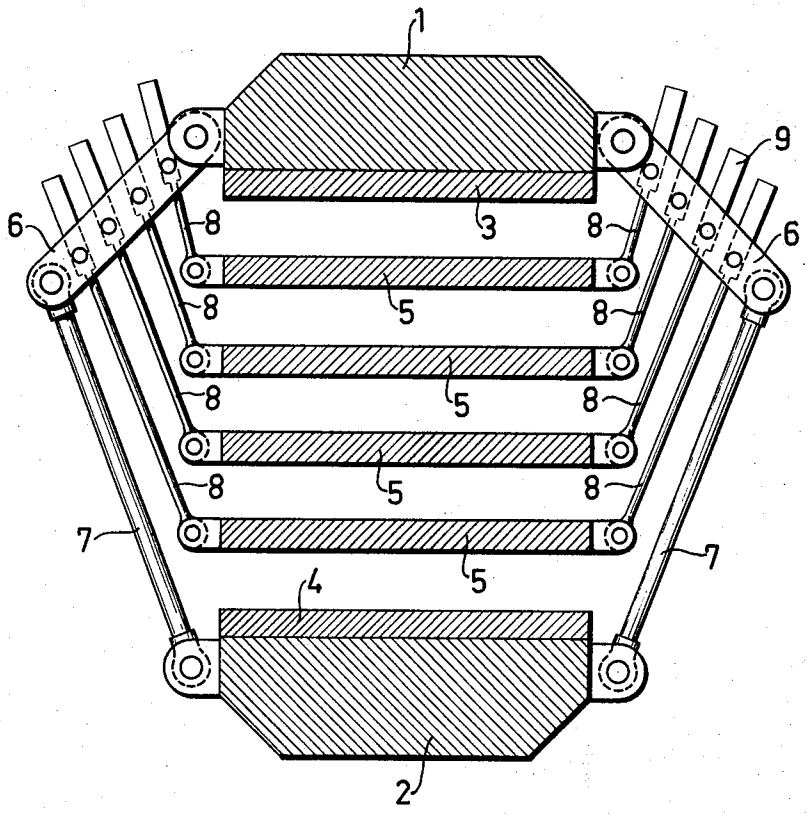


Fig. 2

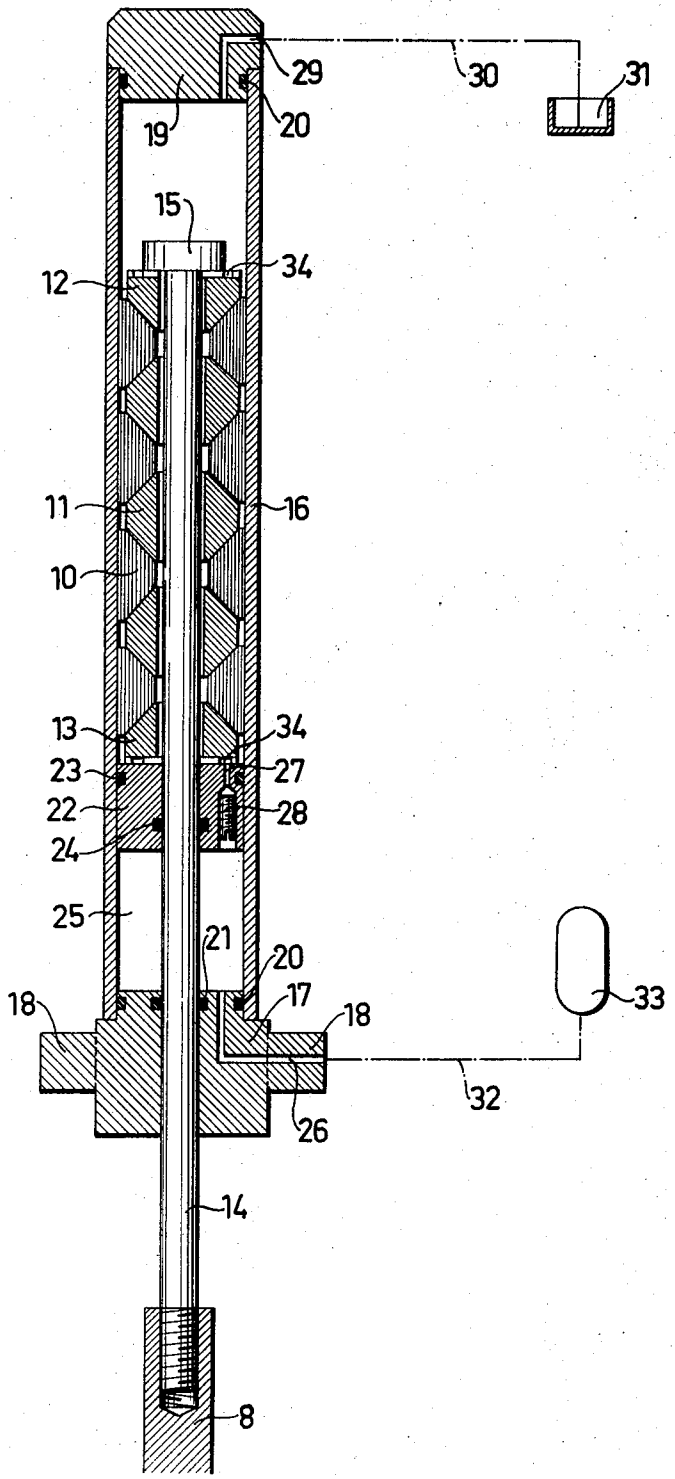
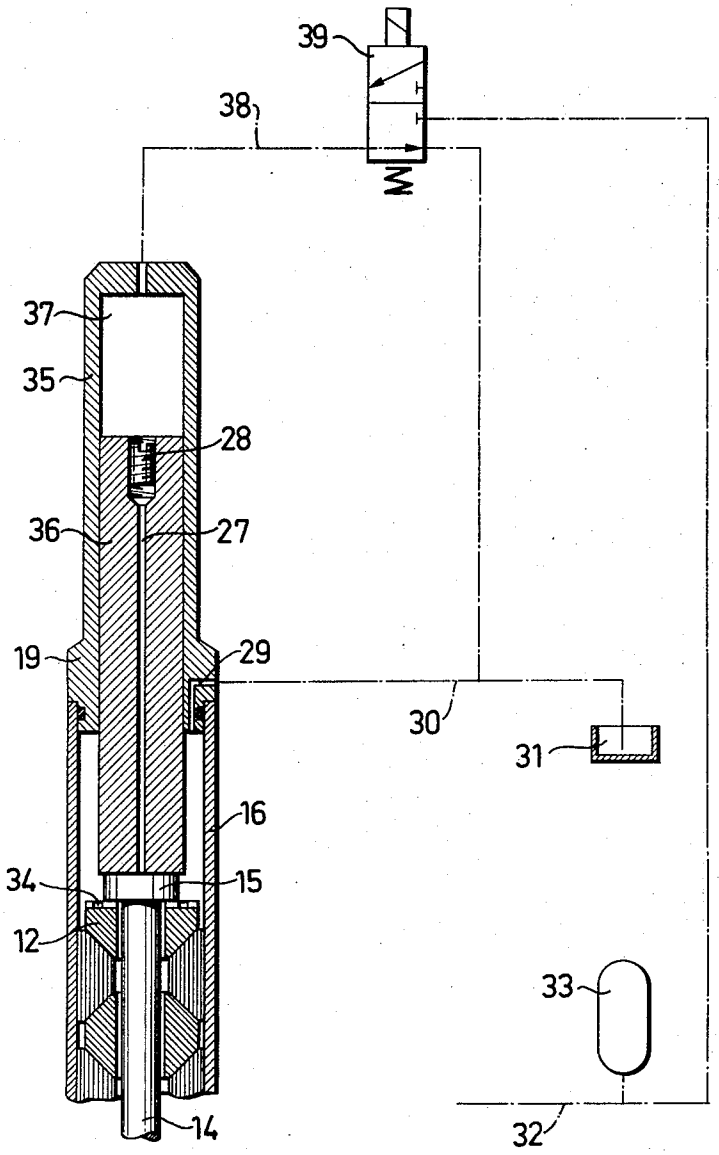

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Fig.3



IMPROVED MULTI-STORY PRESS WITH SIMULTANEOUSLY OPENING AND CLOSING STORIES

This is a continuation of application Ser. No. 835,489 filed June 23, 1969, now abandoned.

The present day construction of multi-story presses is such that the press plates rest on platens or supports in step-wise array, in the correct position for removal of the pressed goods and charging of the press with fresh goods when the press is fully open. When the press is closed, the press plates are collected one at a time from this position in the press by the vertically movable lower press platen and stacked thereon, and when the press is open the plates are returned singly to their initial positions. The relative speed between any two press plates in each separate story as it opens and closes is thus the same as the speed at which the lower press platen moves.

This conventional design, however, creates serious disadvantages in certain types of pressing operations. When pressing dry, fibrous material, such as particle board, for instance, the material is blown from the press if the stories are closed too rapidly. When pressing different types of boards, e.g., hot pressing of particle board and fibre board, when so-called polishing plates or surface plates are used to impart to the particle or fibre board a desired surface finish, a large quantity of dust and dirt is sucked in between the surface plates and the press plates if the stories are opened rapidly, and in consequence thereof it is necessary to close down the press for cleaning much too often.

Consequently, the speed at which the press platen moves in the aforesaid instances must be restricted to a lower magnitude than would otherwise be used, which means a loss in time and reduced production.

Because the stories are closed one at a time, the period of contact between the pressed goods and the overlying press plate differs in the different stories, which in the case of hot pressing can cause unsuitable variations in the quality of the pressed product, particularly in those cases when the closing speed of the press must be restricted, causing an appreciable time difference between the closing of the individual stories. Since the press plates are stacked one on top of the other the surface pressure decreases during the pressing operation from story to story upwardly in the press by a value which corresponds to the weight of the intermediate press plate. When hot pressing, for instance, soft fibre board shaped according to the wet method, a surface pressure is applied during the latter portion of the pressing period which is of the same magnitude as the difference in surface pressure between the lowermost and the uppermost stories, this difference resulting in wide variations in thickness and uneven quality of the pressed boards.

It is known, for instance, from the U.S. Pat. Nos. 1,939,014, 2,586,474, 2,884,032, 2,913,027, 2,966,183, 3,009,495 and 3,050,777 to reduce the closing and opening speed of the spearate stories in relation to the speed of the movable press platen, thereby to eliminate the aforementioned disadvantages manifest in conventional multi-story presses associated with the fact that the press openings are closed and opened one at a time during the movement of the movable press platen. This is achieved by causing all the movable press plates, including the press plate attached to

the movable press platen, to move contemporaneously towards or away from the press plate attached to the stationary press platen, at speeds which are proportional to or approximately proportional to the distance of respective press plates from the stationary press plate when the press is fully open. The relative movement between the two press plates in one story thus takes place simultaneously and at the same or approximately the same speed in all stories. The closing and opening speeds of the separate stories is equal to or approximately equal to the speed at which the press plate moves divided by the number of stories, and it is possible to use a higher velocity with respect to the movable press platen without risk of ejecting the material to be pressed and without drawing in large quantities of dust and dirt between press plates and surface plates. Furthermore, the material which is pressed is brought into contact with the overlying press plate simultaneously or approximately simultaneously in all stories.

Different arrangements for providing the mentioned simultaneous movement of the press plates are also known; e.g., from the aforementioned patent specifications. Those devices used in this connection include pantographs, levers with lifting rods or arrangements of lines or chains acting between the stationary press platen or press plate and the movable press plate and which are actuated by the movements of the movable press platen and which impart to the individual press plates the desired movement.

It is also known from U.S. Pat. application 713,352, now U.S. Pat. No. 3,518,724 dated July 7, 1970 to close and open the stories groupwise, one group after the other, but simultaneously within each group. When the relative velocity between the two press plates in one story is the same, the velocity of the movable press platen is thus lower, i.e., the times taken to close and open the complete press are shorter, but the arrangements provided to move the press plates are at the same time considerably simplified.

Irrespective of whether the stories are all closed simultaneously or whether they are closed simultaneously in groups, it is only in theory that exactly the same relative velocity can be obtained between the press plates in different stories and that contact between the press goods and the overlying press plate can be achieved at exactly the same moment in the stories which are closed simultaneously. Owing to the differnet thickness of the individual press plates and the surface plates etc., and because of variations in the quantity of press goods in the individual stories and the mechanical deficiencies in the arrangements provided to move the press plates, small dissimilarities are obtained in practice between the different stories, both with regard to relative velocity and the point of time when contact between goods and plate occurs. These deviations, however, lack practical significance in the closing and opening movements, and at times small differences in the relative velocity and contact time have been purposely arranged for, for different reasons.

On the other hand, however, the aforementioned difference in thickness, etc., can lead to variations in quality and thickness of the pressed boards, and may cause the arrangements adapted to move the pressed plates in concert to become overloaded and damaged during the actual pressing operation in that a large portion of the pressing force, in extreme cases the whole of the pressing force, is transferred between two press plates

via the aforesaid arrangements instead of through the press goods. Consequently, the known arrangements in a number of cases are either constructed so as to become inoperative during the actual pressing operation or provided with members, springs or hydraulic devices which yield when subjected to a moderate force and prevent large forces from being passed through the arrangement.

For the sake of simplicity the following description will refer only to such instances when the press is arranged so that all stories are closed and opened simultaneously, although it should be understood that the circumstances are the same in the case of presses in which the stories are closed and opened simultaneously in groups.

When the arrangements which cause simultaneous movement of the press plates are provided with yieldable members they are normally also constructed so that the influence of the weight of the press plates on the surface pressure during the pressing operation is counteracted to a greater or less extent by said members. This is significant, particularly when hot pressing fibre board formed in accordance with the wet method, where pressing is normally effected by first applying a high pressure during a relatively short period of time in order to force the majority of the water from the formed, wet fibre mat by the purely mechanical process of high pressure pressing. The pressing pressure is then reduced to a much lower value during the so-called drying process, i.e., while the remainder of the water is vaporized and the fibres in the mat bind together under the influence of the heat in the press. The drop in pressure occurs either in steps or successively over a relatively long transition period, which in certain instances is extended over the whole drying period. Generally, however, the drop in pressure occurs during a minor portion of the drying period and the low drawing pressure is then maintained unchanged until the pressing pressure is completely removed upon completion of the pressing operation and the press is opened. Certain manufacturers advocate that the pressing pressure be increased again for a short period of time before it is completely removed, and maintain that in this way a more uniform board thickness is obtained, while on the other hand other manufacturers consider that this third pressing period is unnecessary and does not influence the result of the pressing operation, or that it is even deleterious and impairs the result.

During high pressure pressing, the fibre mat is compressed to a smallest thickness, to then expand to a larger thickness while the pressing pressure is reduced and contracted to a smaller thickness during the continued drying process. As an example it can be mentioned that when manufacturing ½ inch fibre board the thickness of the fibre mat at the end of the high pressure pressing operation is about 9 mm. It then expands to about 15 mm during the pressure drop, to then contract to approximately the thickness of the finished pressed board, It is therefore necessary that the press plates and the movable press platen are capable of following very considerable variations in board thickness.

The amount by which the boards expand and contract is naturally dependent upon the thickness of the pressed boards. A number of other factors, however, have great influence, such as the quality of the fibre, the pressing temperature, the pressing forces applied and the variations therein as a function of time, how rapidly drying is effected, which in turn is dependent upon how effectively the water is pressed out of the mat during the high pressure pressing operation, etc. For instance, it is possible to obtain approximately the same final result with respect to quality and thickness of the fibre boards by beginning the drying process with a higher content of water in the boards, and during at a higher pressing pressure, which by expelling the water more completely during the high pressure pressing operation as when the water is ejected more completely during the high pressure pressing operation and drying is effected at a lower pressing pressure. In the latter instance, however, the heat economy of the process is improved in that less water need be vaporized and the production capacity is increased in that drying is effected more rapidly.

The pressing pressure applied during the drying period may be selected at different levels according to the desired quality of the fibre boards, i.e., a higher pressure for boards of high density, so-called hard boards, and a lower pressure for boards of low density, so-called soft boards. When manufacturing the softest qualities, the most suitable pressing load during the drying period may even be considerably lower than the pressure which is obtained in a large press of conventional construction in the lowermost stories solely as a result of the weight of the press plates. It is thus highly desirable to counteract and preferably completely eliminate the influence of the weight of the press plates on the surface pressure in the press. This can be achieved with two principally different methods.

In the first method the press plates are actuated during the pressing operation with upwardly directed forces which counteract the force exerted by the weight of the plates. This is the case, for instance, in the arrangements provided for effecting simultaneous movement of the press plates as described in the aforementioned U.S. Pat. Nos. 2,884,032 and 3,009,495, where the yielding members comprise springs which support the weight of the plates when the press is opened. The disadvantage associated with this arrangements is that the spring forces for the individual press plates are changed in an uncontrollable manner during the pressing operation owing to the aforementioned differences in thickness, etc., which lead to uncontrollable variations between the surface pressure, and that the spring arrangements may cause oscillations in the movement of the plates during closing and opening of the press, the oscillations being started by the occurring acceleration forces, friction, etc. Hydraulic arrangements which function according to the first method and which are not encumbered with the said disadvantages are, however, known from, for instance, the U.S. Pat. No. 3,361,056. These arrangements enable practically exactly the same surface pressure to be obtained in all the stories of the press.

The second method involves positively guiding the movements of the press plates during the drying process, i.e., while the goods being pressed expand and contract, so that the two press plates in each story are constantly imparted, within practical limits, the same relative movement, independent of variations in the pressing pressure between the different stories. If the tendency to expand and contract is equally great for the goods being pressed in all the stories the surface pressure is of course also equally great, even in such in-

stances when the tendency of the pressed goods in different stories to expand and contract to different extents if counteracted by variations in the surface pressure between the different stories. The starting position for movements of the press plates during the drying process is obtained because the yielding or resilient members in the arrangements which provide for simultaneous movement of the press plate, which prevents the arrangements from overload during the pressing operation, adjust themselves during the high pressure processing operation, whereafter they remain in the said positions of adjustment during the drying period. A difference in thickness at the end of the high pressure pressing operation between the pressed goods in different stories, which may be caused by different quantities or consistency of the pressed goods in respective stories, will remain with an unchanged absolute magnitude during the drying period and are rediscovered in the finished boards, although these differences in thickness are considerably less than the differences in thickness which for the same, or different reasons may occur during the drying process if the plates are allowed to move freely relative to each other, even though the surface pressure in the different stories is held practically equal. This second method of counteracting the influence of the weight of the press plates is therefore principally superior to the first method.

Arrangements which function according to the said second method are known, for instance, from the aforementioned U.S. Pat. No. 2,918,027 and also from the U.S. Pat. No. 3,361,056, in which FIG. 4 shows a yielding member which together with devices described in said specification are capable of functioning in accordance with the said method. The known arrangements, however, present the disadvantage of being unable to compensate for gaps and clearances appearing in the arrangements during the self-adjustment of the yielding members during the high pressure pressing operation in those instances when the adjustments result in shortening of the members. These clearances are thought to be so great at the beginning of a new pressing operation as to cause unsuitably wide variations in the thickness of the pressed boards; furthermore the clearances increase as a result of wear occurring during the working of the press. The known arrangements are also encumbered with a number of other disadvantages. For instance in the case of the arrangement described in the latter U.S. Pat. each yielding member is a separate hydraulic unit filled with a small quantity of hydraulic fluid which of necessity must not fall below a certain minimum level. It is therefore necessary in a normal pressing operation to constantly inspect 80 to 120 such units for possible leakage, since even a slight leakage will rapidly render the member inoperative. Each unit thus also contains two valves and a piston seal, all of which must be faultlessly sealed against leakage if the arrangement is to function in the aforedescribed manner during the pressing operation. In the Swedish arrangement it has proven difficult to eliminate the springing effect which occurs upon changes in length of the yielding member and which reduces the accuracy of the self-adjustment thereof during the high pressure pressing operation.

The object of the present invention is to eliminate the aforementioned disadvantages associated with known constructions of multi-story presses which are provided with means for closing and opening the story openings simultaneously or simultaneously in groups, and in which the arrangement is provided with means for preventing the arrangement from being overloaded during the pressing operation and to counteract the influence of the weight of the press plates on the surface pressure in the press. This object is achieved by means of the invention which is mainly characterized in that one or more of the members each include a cylinder and a piston rod which are axially movable in relation to each other, and a frictional arrangement acting therebetween and having a number of friction rings the one or two end surfaces of which are conically countersunk in shape and having a corresponding number of thruSt washer plates positioned between the friction rings and two end plates positioned outside the other friction rings, the one or both end surfaces of the plates being provided with crowns, which cooperate with the conical end surfaces of the friction rings so that the friction rings are urged towards the cylinder, alternatively are urged in towards the piston rod, when the friction arrangement is compressed longitudinally, and by an arrangement for causing in said members a suitable axial force between the cylinder and one end plate and the friction arrangement, alternatively between the piston rod and the end plate, so that the friction arrangement is compressed against an abutment surface for its other end plate on the piston rod, alternatively against an abutment surface for the second end plate in the cylinder.

The invention is primarily intended to ensure that the arrangements which cause movement of the press plates fulfill the special requirements which are placed when pressing fibre boards formed in accordance with the wet method although arrangements according to the invention can naturally be used in multi-story presses used for other purposes.

The invention will now be described with reference to the accompanying drawing, where

FIG. 1 is a greatly simplified view in cross section of a multi-story press provided with a known lever arm system for simultaneous movement of the press plate,

FIG. 2 shows in enlarged scale a longitudinal section of one of the members which, in accordance with the invention, is mounted in the arrangement of the multi-story press shown in FIG. 1 for simultaneous movement of the press plates, and

FIG. 3 shows slightly modified embodiment of the member of FIG. 2.

FIG. 1 illustrates by way of example how the invention can suitably be applied in a press using the illustrated type of arrangement for moving the press plates simultaneously. The figure shows only one upper stationary press platen 1 and a lower movable press platen 2 with the press plates 3 and 4 attached to respective platens, and a number of intermediate press plates 5, together with the arrangement adapted to move the press plates 4 and 5 in concert. The remaining components of the press have been neglected since they do not concern the present invention. For the sake of simplicity the figure shows a press having only five stories, although presses used for chip and fibre boards normally have from 20 to 30 stories. The press illustrated in the figure is is its fully open position.

The known arrangement for simultaneously moving the press plates, as illustrated in FIG. 1, comprises a number, preferably four, of lever arm systems posi-

tioned at the side of the press and each having a lever arm **6**, the one end of which is pivotally mounted in an attachment on the upper press platen **1** and the other end of which is pivotally connected with the upper end of a push rod **7**, the lower end of which is pivotally mounted in an attachment on the lower press platen **2**. The press plates **5** are suspended from the lever arm **6** by means of lift rods **8**, the lower ends of which are journalled in attachments on the press plates **5** and which at their upper ends are pivotally journalled in the lever arm **6** at a suitable distance from the fulcrum points thereof at the upper press platen **1**, so that desired movement of the press plates **5** is obtained when the movable lower press platen **2** moves. The upper end of each lift rod **8** comprises a member **9**, the construction of which is more clearly shown in FIG. **2**.

The member **9** includes a friction arrangement having a number of friction rings **10** presenting conically countersunk end surfaces and a corresponding number of thrust plates **11** positioned between the friction rings, and two end plates **12, 13** mounted respectively outside the outer friction rings. The plates **11, 12, 13** are provided with tapered portions which correspond to the conical counter sunk configuration of the friction rings **10**, so that the friction rings are pressed out to a greater diameter when the end plates **12, 13** are urged towards each other. The friction rings **10** may suitably be split or cut away at one positon to prevent them from offering unnecessary resistance to changes in diameter of the rings.

The friction arrangement **10–13** is operative between a piston rod **14** and a cylinder **16**. The piston rod **14** passes freely through centre holes in the friction rings **10** and the plates **11, 12, 13**. The upper end of the rod **14** is provided with a cap **15** or some other suitable form of abutment surface, which bears against the upper end plate **12** in the friction arrangement **10–13**, and its lower end is connected with the actual lifting rod **8**, e.g., fixedly screwed therein. The cylinder **16** is constructed as a straight tube, the lower end of which is closed by a cross-member **17** presenting two trunnions **18**, by means of which the member **9** is journalled in the lever arm **6**, and the upper end of which is closed by an end piece **19**. The piston rod **14** is passed through a central bore in the member **17**. The cylinder **16** with the member **17** snd the end piece **19** are held together in a conventional manner, e.g., by means of tension bolts (not shown) placed outside the cylinder and which are operative between the cross-member and the end piece. Similarly, seals **20, 21** are arranged in a known manner between the cylinder **16** and the member **17** and the end piece **19**, respectively, and at the lead-in of the piston rod **14** through the cross-member **17**. Finally, the cylinder **16** has a free running piston **22**, which is sealed in the cylinder and around the piston rod by seals **23** and **24**. The piston **22** is held urged against the lower end plate **13** in the friction arrangement **10–13** by means of pressure fluid, e.g., the pressure fluid used in the working cylinders of the press. The pressure fluid is passed to the pressure chamber **25** beneath the piston thorugh a bore **26** in the cross member **17**. The pressure fluid may suitably be passed at the end surface of one of the trunnions **18** of the cross-member, which is accessable from its outside the lever arm **6**.

Located in the piston **22** is a bore **27** which presents a pronounced restriction in the form of a screw **28** thread in the threaded portion of the bore and the apex of the threads of which are slightly blunted. Consequently, a small flow of pressure fluid leaks through the bore out from the pressure chamber **25** and fills the remaining cavities within the member **9**. The end plates **12, 13** are provided with grooves **34** adapted to distribute the pressure fluid within and outside the friction arrangement **10–13**. When the cavities have been filled, the surplus pressure fluid is returned through a bore **29** in the end piece **19** and a drain **30** connected thereto to a pressure fluid system tank **31**. Because all cavities in the interior of the member **9** are filled with pressure fluid, which is continuously exchanged, corrosion is prevented, and since the friction rings **10** operate while submersed in pressure fluid the coefficient of friction in the arrangement is maintained constant to the highest possible extent.

In the case of a friction arrangement of the aforedescribed construction, if one of the end plates **12** or **13** is loaded with a greater force F_1 and the other end plate with a smaller opposite force F_2 the friction arrangement slides in the cylinder **16** in the direction of the greater force when the ratio F_1/F_2 exceeds a certain critical value, but is held locked in its position in the cylinder by the friction between the friction rings **10** and the cylinder **16** provided that the ratio F_1/F_2 is less than said critical value. If the insignificant elastic forces in the friction rings **10**, which may occur upon changes in diameter thereof, are ignored, and

the cone angle of the friction rings is said to be 2α
the friction coefficient between friction rings and plate is μ the friction coefficient between friction rings and cylinder is ν
the number of friction rings is n and the critical value of F_1/F_2 is c

than the following relationship is obtained

$$c = [(1-\mu\cdot\nu)\cdot tg\alpha+\mu+\nu/(1+\mu\cdot\nu)\cdot tg\alpha+\mu-\nu]^n$$

When μ and ν are given it is thus possible to obtain any desired value of c by suitable selection of α and n. The arrangement is not self-locking if the individual friction ring is not constructed to be self-locking, i.e., if c does not equal ∞ for $n = 1$, which only occurs if ν is greater than μ and α is chosen small. α is suitably selected at about 45° which means that the values for ν necessary for self-locking are unobtainable. By suitable selection of n it is therefore possible to obtain any desired value of c without risk of self-locking. Since n is an integer it is necessary to adjust α slightly upwards or downwards in order to obtain a certain desired value on c. c, however, is dependent on the magnitude of the coefficients of friction μ and ν, and these vary somewhat, and hence it is not possible to obtain an exact desired value of c. Tests have shown, however, that the amounts by which the coefficients of friction vary are relatively insignificant if the friction rings **10** are completely immersed in pressure fluid.

The member **9** in the press of FIG. **1** may be constructed, for instance, for $c = 3$. The pressure chamber **25** is connected directly through a conduit **32** (FIG. **2**) to the low pressure accumulator **33** of the press, and the member **9** is dimensioned so that the piston **22** at full accumulator pressure actuates the lower end plate **13** with an upwardly directed force F_{up}, which corresponds approximately to the force in the pull rod **8**, which is created by the weight G of he press plate **5**, including plates and press goods, and which via the piston

rod **14** actuates the upper end plate **12** with a downwardly directed force F_G.

The member **9** functions in the following manner.

When the press is stationary in the open position the downwardly directing force F_{down} acting on the end plate **12** is equal to F_G, i.e., approximately equal to F_{up}, and the friction arrangement **10–13** holds the member **9** locked in the adjusted position. Upon closing of the press, the force F_{down} increases owing to the acceleration forces on the press plate **5,** but provided that the acceleration forces are less than about 2G no sliding will take place in the member **9,** since $F_{down} < 3F_{up}$. Normally the acceleration forces acting on the lower press plates **5** are also considerably less than 2G. Subsequent to the short acceleration period, F_{down} is decreased to the value F_G, and consequently no sliding in the member **9** takes place during closing of the press, although F_{up} is slightly reduced owing to the fact that the accumulator pressure decreases.

When the press has been closed and the high pressure pressing operation begins, the member **9** yields and adjust itself with respect to any occurring differences in thickness of the press boards and plates, different quantity of press goods in the various stories etc. The member **9** can thus either be extended by drawing the friction arrangement **10–13** downwards in the cylinder by an attaction force $F_{down} = 3 \cdot F_{up}$ in the lift rod **8,** or is shortened by moving the friction arrangement **10–13** upwards in the cylinder by the piston **22,** a traction force of $F_{down} = \frac{1}{3} \cdot F_{up}$ being simultaneously caused in the lifting rod **8.** Setting of the adjustment of the length of the yielding members **9** in the lifting rods **8** thus constantly takes place while the lifting rods are subjected to traction forces, whereby the influence of clearances in their bearings etc. is eliminated, irrespective whether the members **9** are extended or shortened during adjustment.

During the subsequent drying period, the members **9** maintain their adjusted positions provided that the differences in surface pressure between two adjacent stories does not result in an upwardly directed force on the press plate **5** corresponding to an upwardly directed force in the pull rod of more than $F_G - \frac{1}{3} \cdot F_{up}$, or a downwardly directed force on the press plate however which corresponds to more than $3 \cdot F_{up} - F_G$.

It is considered a pure advantage that the accumulator pressure of the press decreases while the press is closed, since this decreases the large force $3 \cdot F_{up} - F_G$ which occurs in the members **9** during the adjustment during the high pressure pressing operation, and also increases the smaller force $F_G - \frac{1}{3} \cdot F_{up}$, which counteracts the change in length of the members during the drying period, i.e., at least during the first portion of the drying period before the accumulator has time to be charged to full pressure.

The adjusted length of members **9** is also naturally maintained while the press is open.

The lift rods need not be provided with extra devices for setting the length thereof when assembling the press, and the conventional, space consuming step-like stands upon which the press plates **5** are placed in conventional multi-story presses when the press is open can be omitted. Subsequent to assembling the press it is only necessary manually to position ready pressed boards in all the stories and close the press once, in order that the press plates **5** adopt their correct positions when the press is open, so that the press can be charged by means of the normal press charging arrangements. The small movements in positions of the press plates which later occur during operation of the press lack practical significance for charging operations.

If, against expectation, it should be found that the differences in surface pressures between different stories during any period of the drying operation are so great that the setting of the members **9** is changed thereby, i.e., primarily that a portion of the members **9** are shortened during the drying period, this can be prevented by the modification of members **9** illustrated in FIG. **3.** In this embodiment, the end piece **19** is in the form of a second cylinder **35** having a second free running piston **36,** which bears against the cap **15** on the piston rod **14.** A pressure chamber **37** above the piston **36** is connected through a conduit **38** to a three-path valve **39,** by means of which it can either be connected to the tank **31** of the pressure fluid system or with the accumulator **33.** Normally the pressure chamber **37** is connected with the tank **31,** and the extra cylinder piston arrangement **35–36** does not then influence the function of the member **9.** During the drying operation, the valve **39,** however, is switched so that the pressure chamber is connected with the accumulator **33.** The piston **36** then exerts a force F_3 on the piston rod **14,** which contributes towards preventing a shortening of the member **9.** The cylinder-piston arrangement **35–36** is suitably dimensioned so that approximately $F_3 = \frac{2}{3} \cdot F_G$ is obtained, whereby the resistances of the member **9** against the change in length during the drying operation are of equal magnitude, irrespective whether differences in the surface pressure shorten or extend the member. The piston **36** is also provided with leakage means **27, 28** of the same type as the piston **22.**

The resistance of the member **9** against change in length can be further increased by subjecting both pressure chamber **25** and **37** to a higher pressure during the drying period.

In the arrangement of FIG. **3,** the clearance in the lift rods **8** is naturally of importance if the surface pressure in an underlying story becomes so much higher than the surface pressure in the overlying story and the surface pressure difference corresponds to more than the weight G of the intermediate press plate **5** and a pressure force arises in the lift rods **8** connected to said press plate. The influence of the clearance, however, is eliminated owing to the fact that the board in the underlying story contracts during the continued drying period to a greater extent than the board in the overlying story, as a result of the difference in surface pressure.

The invention is naturally not restricted to the described arrangement illustrated in the drawing but can be varied within the scope of the following claims.

For instance, the friction arrangement **10–13** can alternatively be constructed so that the friction rings **10** are urged in against the piston rod **14** instead of out towards the cylinder **16** when the end plates **12, 13** are urged towards each other. In this instance obviously other constructive changes must be made in the member **9** in order that it shall function in the desired manner. The piston rod **14** can be connected to the lever arm **6** and the cylinder **16** to the actual lift rod **8,** the upper thrust washer **12** can be caused to bear against an abutment in the cylinder **16** and the pressure chamber **25** is formed between the piston **22** and the lower

end of the piston rod **14** formed as a piston in the cylinder **16.** This embodiment, however, is less suitable than that shown in FIG. **2** for several reasons.

The friction rings **10** may also of course be provided with a conical and a planar end surface, the plate **11, 12, 13** naturally being given a corresponding shape. The aforementioned formula with regard to *c* will then be slightly different, but in principle the friction arrangement functions in the described manner.

The force F_{up} on the lower end plate **13** in the friction arrangement **10–13** may also be created in another suitable manner e.g., by means of a spring acting between the end plate **13** and the cross member **17,** and it is then unnecessary to use any form of pressure fluid or the like in the member **9.** If pressure fluid is used it is not necessary to take the fluid from he pressure fluid system of the press, but that a suitable separate pressure fluid system can be arranged for the members **9.**

Yielding members **9** of principally the described construction may, of course, be positioned anywhere in the lift rods **8** in a press haVing the lever arm arrangement **6 – 8** illustrated in FIG. **1** for moving the press plates **4, 5** in concert, and may also to advantage be used in arrangements for simultaneous movement of the press plates of another type, even in arrangements using lines or change, since the members **9** constantly produce a traction force which holds the lines or change extended so that adjustment is made even to members which require shortening during the high pressure pressing despite of the fact that the lines or chains cannot exert any shortening force on the members **9.**

Neither need the members **9** be dimensioned or constructed as described in the illustrated example, but that forces and force-conditions can be selected and the construction of details changed in accordance with those best suited to prevailing circumstances.

Finally, it may also be necessary for some reason or other to provide the arrangement **6 – 8** which moves the press plates **4, 5** with members **9** of a different construction at one or more of the press plates **5,** e.g., at the lowermost.

I claim:

1. A multi-story press comprising a stationary press plate, a plurality of movable press plates, means for selectively moving said plurality of movable press plates when closing and opening said press relative to said stationary press plate, said moving means each including relative to said stationary press plate, said moving means each including a cylinder and a piston rod which are axially movable in relation to each other, said moving means including overloading and counteracting means formed by a plurality of yieldable frictional elements disposed between said cylinder and said piston rod and in external telescopic relationship to said piston rod, a first of said friction elements being a number of friction rings each having axial end surfaces which are conically countersunk in shape, a second of said friction elements being a plurality of thrust washers each having axial end surfaces complementary contoured to and seated against an associated one of the end surfaces of the friction rings, a third group of said friction elements being two end plates positioned axially outboard of the outermost friction rings with at least one end surface of each having a surface complementary to and seated within and against the conical end surface of the outer friction rings, and means for forcibly axially compressing the friction elements.

2. The press of claim **1** wherein said compressing means is a piston in external telescopic axially movable relationship to said rod internally of said cylinder.

3. The press of claim **1** wherein said compressing means is a piston in external telescopic axially movable relationship to said rod internally of said cylinder and means for applying hydraulic pressure to move said piston toward one of said end plates with means operative to restrain movement of the other of said end plates thereby compressing said friction elements to hold said rod immovable relative to said cylinder.

4. The press of claim **3** including a second hydraulic pressure actuated piston in axial relationship to said restraining means, and means for applying hydraulic pressure to said second piston to move said second piston toward said restraining means.

5. The press of claim **4** wherein means are provided for adjusting said hydraulic pressure so that different pressures can be set during different periods of the pressing operation.

6. The press of claim **4** wherein said overloading and counteracting means are provided with means permitting continued hydraulic leakage through said friction elements whereby the interior of said cylinder is continually filled with fluid under pressure.

7. The press of claim **4** wherein at least one of said pistons has means for permitting the bleeding of hydraulic fluid therethrough.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 3,840,314

DATED : October 8, 1974

INVENTOR(S) : Nils E. E. BOOK

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 47, "differnet" should read -- different --;

Column 3, line 59, the comma (,) after "board" should be a period (.);

Column 5, line 11 "processing" should read -- pressing --;
Column 5, line 30, "U.S. Pat. No. 2,918,027" should read -- U.S. Pat. No. 2,913,027 --;

Column 6, line 13, "thruSt" should read -- thrust --;
Column 6, line 48, after "shows" insert -- a --;
Column 6, line 64, "is is" should read -- is in --;

Column 7, line 46, "snd" should read -- and --;
Column 7, line 61, "thorugh" should read -- through --;

Column 8, line 66, "of he" should read -- of the --;

Column 11, line 16, "from he" should read -- from the --;
Column 11, line 22, "haVing" should read -- having --;
Column 11, line 49, claim 1, delete the entire line;

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,840,314 Dated October 8, 1974

Inventor(s) Nils E. E. Book

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 12, line 1, claim 1, delete "means each including".

Signed and Sealed this

twelfth Day of *July 1977*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks