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PRESS FOR PLYWOOD

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Fig. 4

Fig. 5

Fig. 6

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My invention relates to presses for such uses as the manufacture of plywood. It is particularly designed as a hot plate press for manufacture of plywood wherein the binding or adhesive agent is a resin which sets by application of heat and pressure. It is, however, adaptable to the manufacture of other products, as for example combination or molded panels, wherein boards or panels are formed by setting a mass of loose material under heat and pressure, or indeed it is useful in the manufacture of plywood according to present practice, with the usual glues.

Very heavy pressure must be employed in presses which employ as a binder for plywood the resins mentioned. It is not economically possible to provide a press which will operate upon each individual panel, because of the time factor. Such presses, therefore, must receive a considerable number of individual panels, all of which are operated upon at one closing of the press. Because of the pressure involved and the weight and size of the press plates, which must be of a size to accommodate panels of maximum area, say 12 x 15 feet, such presses, with the plates resting one upon another, would produce a tremendous pressure upon the lowermost panel. Because of the manner in which plywood is laid up preparatory to pressing it is not economically possible to dispose the panels on edge, but rather they must be kept flat; therefore the press plates must be superposed horizontally one above another. If too great a pressure is applied to a panel of this sort the wood will be compressed, and it has been found that a pressure of 25,000 pounds per square foot will reduce the thickness of the panel by about 40%, as a result of which the manufacture in effect loses or wastes 40% of its production, and the product is inferior in quality.

Accordingly it is an object of my invention to provide a press of sufficient size and weight to apply the pressure to panels up to the maximum size and to apply heat to these panels, yet in such a way as to avoid such extremes of pressure as will crush or appreciably reduce the thickness of the panels.

One further disadvantage of applying too heavy a weight to the panels is that in addition to the actual shrinkage the panels will not be of uniform thickness, which is disadvantageous, and if they are to be brought to uniform thickness the thickness of the thinnest of the panels must govern, so that all will be uniform; there-
fied form of the press, showing the press partially closed.

The press as illustrated is of the type in which a heavy bed 1 is supported at a fixed elevation above the floor or the ground, and in which a plate 2 is movable upwardly toward the bed 1, under the influence of press-closing means, illustrated by the cylinders 3 with their pistons 30 engaging beneath the plate 2. The structural details of the bed and press, and of the pistons and cylinders, and the manner of control of the latter, are or may be anything which is found suitable or which is conventional, and these details, particularly the controls of the cylinders, have not been illustrated. The bed is shown as formed of heavy structural members 10 extending lengthwise of the press and supported upon columns 11, supported from which structural members 10 are transverse structural members 12, and finally longitudinal structural members 13, beneath which is secured the uppermost of the press plates, which uppermost plate is distinguished by the numeral 41. The plate 2 is similarly formed, and supports the lowermost 25 of the movable press plates, which is distinguished by the numeral 42. Between these plates 41 and 42 are a number of superposed plates. Normally these plates are of the intermedium type typical by the plates 43, but there are preferably provided one or more control plates, of which two are shown in the drawings, designated 44 and 45, which are plates disposed between the upper plate and the lower plate and constructed and arranged to support intermediate plates.

The plates beneath the plates 41, 44 and 45, respectively, may be suspended from these plates, or in succession from each other within the groups of intermediate plates, by means such as are illustrated in Figures 2 and 3, wherein it will be seen that links 5, at each end of the press, extend from each plate to the plate immediately below it, being received over pins or headed studs 56 and 51 in the respective plates. These links 45 may be formed of saw steel, because of its very considerable strength and its flexibility. Each set will support the next lower plate or a series of plates, yet will tend to contract and become round as the press closes, thereby avoiding any danger of becoming disengaged from the studs 56 and 51.

It will now become apparent that the links 5 at the top of the press would be holding a very great weight if all the plates were suspended in succession from those above, for each such plate of a size to take a panel 12x15 feet weighs in the neighborhood of 10,000 pounds, and the press is designed to employ about fifteen such plates, and in addition there would be suspended, to a certain extent at least, the plate 2. Furthermore, if the plate, in moving upward toward the bed, were to pick up the several plates in succession, by the time the last or uppermost plate had closed there would be imposed upon the plywood panel between the two lowest plates a weight in the vicinity of 150,000 pounds, which would be sufficient to materially crush the panels. I have found it necessary, therefore, to provide means to apply a force to the control plates, such as the plates 44 and 45, which force will act in opposition to the force of the pistons 30 tending to close the press, but will eventually be overcome thereby, but which in resisting that force will relieve the suspending links 5 of the weight of all but a few of the plates, and will relieve the lower plies in the press from the great pressure of any considerable number of plates above, transmitting the force created by the weight of the plate groups directly to the plate 2.

Thus each of the control plates 44 and 45 may be provided with lugs 46 and 47, respectively, and there may be supported upon the plate 2 cylin-ders 6 and 7, the pistons 64 and 74, respectively, of which engage the lugs 46 and 47. A fluid pressure medium—steam or compressed air—is supplied to the cylinders by the respective supply pipes 61 and 71, and the pressure in such cylinders is maintained constant within certain limits, at a value to create a force inferior to that exerted by the pistons 30 in closing the press, by suitable means such as the valves 62 and 72, and the force developed in these pistons may be so regulated, having proper regard to the pressure of the medium within the cylinders and the area of the pistons, as to produce upward force on the lugs 46 and 47 sufficient to support the plates suspended from or supported by these control plates 44 and 45, respectively.

I have illustrated a press having sixteen plates in all and divided into three groups. The total number of plates may, of course, be varied, as may the number within each group, but for clarity of description I shall confine my discussion of the operation of the press to one having sixteen plates, divided into three groups, of the type illustrated.

In my sixteen-plate press there are two control plates, numbered 44 and 45, supported on the pistons 60 and 70, respectively. In each of the spaces, between the stated control plates, between control plate 44 and the uppermost plate 41, and between control plate 45 and the lowermost plate 42, are mounted four intermediate plates 43. As a preliminary step to the operation of the press the valves 62 and 72 are regulated so that a pressure is maintained within the cylinders 6 and 7 sufficient to cause the pistons 60 and 70 to exert a pressure of approximately 12,500 pounds, assuming that the weight of one plate is 10,000 pounds. This pressure is maintained so that the force exercised by the four pistons 60 will aggregate 50,000 pounds, which is the weight of the control plate 44 and four intermediate plates. Similarly the combined force exerted by the pistons 70 should be approximately 50,000 pounds, or the weight of the control plate 45 and four intermediate plates. Also the individual valves 62 and 72 should be regulated so that the pressure in each of the four cylinders 6 and in each of the four cylinders 7, respectively, is equal, so that the force exerted on the control plates 44 and 45 will be distributed evenly.

Now in describing a typical closing operation of the press we shall assume that the combined force exerted by the pistons 60 is slightly in excess of 50,000 pounds, and that exerted by the pistons 70 is likewise slightly in excess of 50,000 pounds. With the press in the open position, therefore, the upper set of four intermediate plates 43, between plates 41 and 44, will be suspended one from the other, and the uppermost plate 42 will be suspended from the plate 41. The uppermost links 5 will therefore support a weight of 40,000 pounds, the next lower set of links will support a weight of 30,000 pounds, the next lower set 20,000 pounds, the next lower set 10,000 pounds, and the next lower set, interconnected by the plate 44 and the plate 43 immediately above it, will be substantially untensioned. The reason that this last mentioned set of links will be substantially unten-
stated is that the plate 44 and the four plates 43 there beneath are supported by the pistons 60. Therefore the links interconnecting the plate 44 with the plate 43 immediately there beneath will support a weight of 40,000 pounds, the next lower set of links 30,000 pounds, the next lower set 20,000 pounds, the next lower set 10,000 pounds, and again the set of links interconnecting the plate 44 with intermediate plate 43 next there below will be substantially unstressed. Again the reason for the lack of tension in the last mentioned set of links is that the pistons 70 support the plate 45 and the four intermediate plates 43 suspended therefrom. The reaction of the force of 50,000 pounds is exerted on the members 41 by these pistons. Again the weight supported by the links below plate 45 will decrease successively as in the sets of plates therebelow, until the links interconnecting plate 42 and the plate immediately therebelow will be substantially unstressed, since plate 42 is supported directly from the plate 2.

The closing action is accomplished entirely by pressure being exerted on the pistons 30 within the cylinders 3, the pressure in the cylinders 6 and 7 remaining constant throughout the closing and opening operations. Since in open position, the upper set of four intermediate plates 43 is supported from the plate 45 the pressure exerted by the pistons 30 will be 110,000 pounds, made up of (1) the pressure exerted by the cylinders 6 equal to the weight of the plate 44 and the four plates 43 suspended therefrom and transmitted through pistons 60; (2) the pressure of the cylinders 7 which is equivalent to the weight of the plate 45 and the four plates 43 suspended therefrom, transmitted through the pistons 70, and (3) the weight of the plate 42 plus, in addition to this 50,000 pounds, the weight of the cylinders 6 and 7 and the pistons 60 and 70 and the plate 2. When the press is closed the only additional weight borne by the pistons 30 is that of the upper set of four intermediate plates, which is 40,000 pounds plus the pressure exerted on the least pressed panel.

When the press is to be closed the pressure in the cylinders 3 is increased, and the plate 2 starts to rise. The plate 44 and the plates 43 suspended therefrom, supported as they are directly from the plate 2 through the pistons 50 and cylinders 6, will be carried bodily upward. Likewise the plate 45 and the plates 43 suspended therefrom, supported directly from the plate 2 through the pistons 70 and cylinders 7, will be carried bodily upward, as will the plate 42, which is mounted directly on the plate 2. The upper set of plates 43, it will be remembered, is suspended when the press is open from the plate 43, and hence the position of these plates will be unaffected by upward movement of the pistons 30. As a result the first space to close is that between the plate 44 and the plate 43 next thereabove. Now as the upward movement of the plate continues, the plate 44 will begin to assume the weight of the plate 43 next thereabove through the medium of the interposed panel. If the plate 44 were to take the whole weight of this next above plate 43, the total force on the plate 44 including the four plates 43 suspended therefrom would be 60,000 pounds, but the force exerted by the pistons 60 is only slightly in excess of 50,000 pounds. Hence although the space above the plate 44 is now closed, before the weight of the plate 43 next thereabove would be assumed, the resistance of the pistons 60 would be overcome, and they would remain stationary for an interval while the plate 44 raised the cylinders 6 with respect thereto.

Since the pistons 60, the plate 44, and the plates 43 suspended therefrom are all now stationary, although the plate continues to move upward, the pistons 70, which still remain in their fully extended position, will raise the plate 45 to close the space between it and the momentarily stationary plate 43 next thereabove. When this gap is closed the plate 45 would tend to assume the weight of this plate 43, but if this were accomplished the total force on the plate 45, including the weight of the four plates 43 suspended therefrom, would be 60,000 pounds, which would exceed the critical force of 50,000 pounds, or slightly more, for which the set of pistons 70 is set. Hence upon continued upward movement of the plate 45, the pistons 70 would remain stationary and cylinders 7 would move upward relatively thereto, while cylinders 6 would continue to move upward relatively to pistons 60.

At this stage all of the plates 41, 44 and 45 and the plates 43 suspended therefrom are stationary, but the plate 42 mounted directly on the plate 2 is still moving upward, so that the space between it and the plate 43 next thereabove will be closed, and this plate will assume the weight of the lowest plate 43.

With the weight of the lowest plate 43 removed from suspension by the plate 45, the latter plate will assume the weight of the plate 43 next thereabove, in turn relieving the plate 44 from the suspended weight of this plate 43. Likewise, when thus relieved the plate 44 will assume the weight of the plate 43 next thereabove, for two plates 43 will be supported directly upon the plate 2, and only three plates 43 will be suspended from the plate 43.

Upon further upward movement of the plate the space second above plate 44 will now be closed, and in turn the space second above plate 45 will be closed. The closing process then continues in this fashion until all the plates are moved into the position shown in Figure 3. In this position the plate 44 will no longer support any plate 45 therebelow, but will support the plate 43 thereabove. Similarly the plate 45 will no longer support any plate 43 therebelow, but will support the plates 43 between the plate 44 and plate 45.

The intermediate plates 43 below plate 45 will be supported directly by the plate 2, while no plate will be suspended from plate 41.

If the pressure in the cylinders 6 and 7 is set at a value so that the pistons will support a weight slightly under 50,000 pounds, then the first space to close will be that immediately above plate 42, the second space to close will be that immediately above plate 43, and the third space to close will be that immediately above plate 44.

The succeeding spaces to be closed will be those second above plate 42, second above plate 43, and second above plate 44, respectively, and this closing action will continue until the same closed position is reached.

In opening, precisely the reverse operation occurs. The spaces above plates 44 and 45 will remain closed as long as no weight is added to these plates. Therefore the first space to open will be that immediately below plate 44. With the added weight of the plate 44 the plate 43 the space immediately below plate 44 will start to open, and when the weight of this plate begins to be suspended from 44 the space immediately below plate 41 will begin to open, and the spaces will continue to open in succession.
until the press has reached the full open position shown in Figure 2. Of course, if the cylinder pressures are such that the forces supplied by the two sets of platen are slightly under 66,000 pounds, then the first space to open will be that immediately below plate 41, then that immediately below plate 44, then that immediately below plate 45, and so on. Thus opening and closing of the press is accomplished in a short time with a minimum of shock and with only sufficient pressure to produce the setting of the binder, but insufficient to affect the wood of the plies. The minimum pressure, of course, is applied to the panel in the space last to close, and the maximum pressure will be on the panels resting on the plates 42, 45 and 44, which will be approximately 40,000 pounds in excess of the minimum pressure, which is the weight of the press plates supported by these panels above the control plate.

In order to supply steam to the interior chambers of these plates I provide each of them with an inlet connection as illustrated at 6 by way of example. The steam supply may come from a source such as the header 80, and between the header 80 and the several inlets 8 are connections formed of pipes, including particularly the length 81 which may in turn be connected to the inlet 6 by a riser 82, the length 81, which is connected rigidly to the header, being of such length with respect to the required movement of its connected inlet 8 and the limit of elasticity of the pipe itself, of which it is formed, that in flexing its end through this amount of movement the limit of elasticity will not be reached. In consequence, the pipe, though rigidly connected throughout, will flex without being damaged; there is no packing joint required, and the difficulties of a flexible steam hose are eliminated.

Whereas in the form shown in Figures 4 and 5 the two cylinders 6 and 7 are both shown supported from the platen 2, in Figure 6 the same results are achieved by a modification of that arrangement, in which the shorter cylinder 7, which supports the plate 45, in turn supports the cylinder 66, the piston 87 of which supports in turn the plate 44. In this form, of course, the force exerted by the piston 70 will be approximately twice as great as the force exerted by the piston 67, since the lower piston must support not only the lower set of plates supported by or from plate 45, but through the piston 67, must support also the set of plates supported by or from plate 44. The same results are achieved, the piston 67 first yielding, and then the piston 70 yielding, the two thereafter yielding alternately until the last space, that immediately below plate 45, is closed.

What I claim as my invention is:

1. A press for the purposes described comprising a bed, a platen, and a plurality of independently movable superposed plates therebetween, means to move the platen towards the bed, to contract the several plates for pressing the work therebetween, and means movable with the platen and supporting an intermediate plate therefrom, and operable to transmit a contracting force to plates between such intermediate plate and the bed, and said means being contractable under the force of the platen-moving means in contracting the plates between such intermediate plate and the platen, a second like means movable with the platen and similarly supporting a different plate intermediate the first intermediate plate and the bed, and similarly contractable.

3. A press for the purposes described comprising an upper and a lower pressure member, a plurality of superposed plates therebetween, means to move the lower member towards the upper member, to contract the several plates for pressing the work therebetween, a cylinder and piston movable therein independent of said moving means, both supported upon and for movement with the lower member, and supporting a plate intermediate the upper and lower members, and means to control the pressure of a fluid medium within the cylinder supported upon the lower member, to transmit a contracting force to plates above said intermediate plate, but to maintain the pressure of the fluid medium in said cylinder inferior to that of the moving means, whereby the cylinder and piston will yield during contraction of plates below said intermediate plate.

4. A press for the purpose described comprising an upper and a lower pressure member, a plurality of superposed press plates therebetween, moving means to effect approach of the two pressure members to contract the several plates for pressing the work therebetween, and means to apply a force in one direction to an intermediate block, the reaction thereof, acting in opposition to but being inferior to the force of the moving means, to partially support the weight of said intermediate plate and plates thereaboe during contraction of the press plates.

5. A press for the purpose described comprising an upper bed and a lower platen, a plurality of superposed press plates therebetween, means to suspend each plate in succession from the bed above, means to effect approach of the platen towards the bed to contract the several plates for pressing the work therebetween, and means reacting from the platen to apply a yieldable force to an intermediate plate sufficient to support the weight of such intermediate plate and plates suspended therefrom.

6. A press for the purpose described comprising an upper bed and a lower platen, a plurality of superposed press plates therebetween, links suspending each plate in succession from the bed above, means to suspend the platen upwards towards the bed to contract the several plates for pressing the work therebetween, and means movable with the platen to support an intermediate plate and plates suspended therefrom, and yieldable with respect to the platen, for contraction of the plates to such intermediate plate.

7. The combination of element 6, wherein the links comprise closed loops of saw steel or equivalent material.

8. A press for the purpose described, comprising a bed, a platen, a plurality of independently movable superposed press plates therebetween, means operable to draw all said plates together, to close the press, and means engaging an intermediate plate in closed position of the press to
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5 Support its weight independently of the other press plates.

9. A press for the purpose described comprising an upper and a lower pressure member, superposed plates therebetween including a control plate, a plurality of plates thereabove adapted to be supported by said control plate when the press is in closed position, an equal number of plates below said control plate and suspended therefrom when the press is in open position, means to effect approach of the two pressure members to contract the several plates for pressing the work therebetween, and means engaging said control plate to exert a supporting force thereon substantially equal to the combined weight of said control plate and the said plurality of plates thereabove.

10. A press for the purpose described comprising a fixed upper pressure member and a movable lower pressure member, superposed plates therebetween including a control plate, a plurality of plates thereabove adapted to be supported by said control plate when the press is in closed position, an equal number of plates below said control plate and suspended therefrom when the press is in open position, means to raise said lower pressure member to contract the several plates for pressing the work therebetween, cylinders and pistons therein supported from said lower pressure member and engaged between such member and said control plate, to exert a supporting force directly on said control plate of a value substantially equal to the combined weight of said control plate and the said plurality of plates thereabove.

11. A press for the purpose described comprising an upper and a lower pressure member, superposed plates therebetween including a control plate, a plurality of plates thereabove adapted to be supported by said control plate, and a plurality of plates below said control plate adapted to be suspended therefrom, moving means to effect approach of the two pressure members to contract the several plates for pressing the work therebetween, means engaging said control plate to exert a constant force thereon equal to the weight of the control plate plus the weight of a predetermined number of additional plates, and means operable to assume, successively, the weight of plates suspended from said control plate, thereby enabling said control plate to support, successively, the weight of plates thereabove, as said moving means is operated to close the press.

12. A press for the purpose described comprising an upper and a lower pressure member, superposed plates therebetween, including a control plate, one or more upper intermediate plates between said control plate and said upper pressure member, and one or more lower intermediate plates between said control plate and said lower pressure member, said lower intermediate plates being of an aggregate weight equal to the aggregate weight of said upper intermediate plates, means to suspend said lower intermediate plates from said control plate, moving means to effect approach of the two pressure members to contract the several plates for pressing the work therebetween, and means engaging said control plate to exert a supporting force thereon substantially sufficient to support from said control plate a weight equal to the aggregate weight of the upper intermediate plates, but insufficient to support a weight appreciably in excess of such an aggregate weight.

13. A press for the purpose described comprising an upper and a lower pressure member, superposed plates therebetween, including a control plate, one or more upper intermediate plates between said control plate and said upper pressure member, and one or more lower intermediate plates between said control plate and said lower pressure member equal in number to the number of said upper intermediate plates, means to suspend said lower intermediate plates from said control plate, moving means to effect approach of the two pressure members to contract the several plates for pressing the work therebetween, and means engaging said control plate to exert a supporting force thereon substantially sufficient to support from said control plate a number of plates equal to the number of said upper intermediate plates, but insufficient to support more than such an equal number of plates.

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