July 17, 1956 J. D'A. CLARK 2,754,540

METHOD AND APPARATUS FOR TREATING BOARDS MOLDED OF FIBROUS MATERIAL

Filed Aug. 18, 1952

Fig. 1

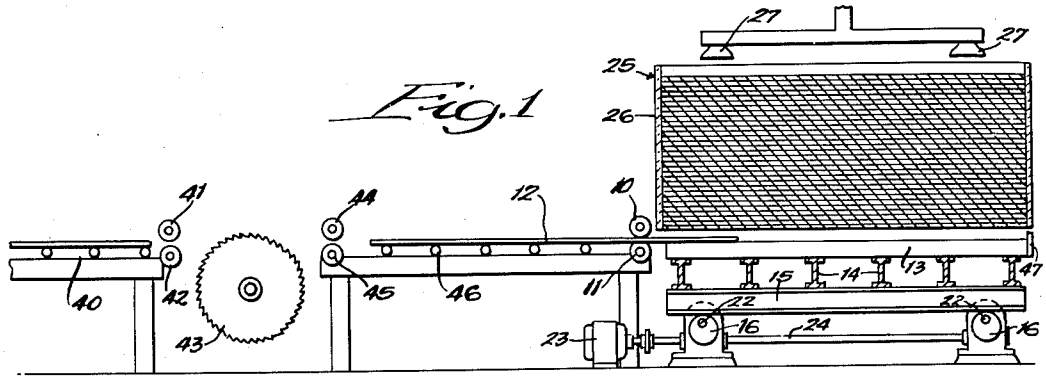


Fig. 2

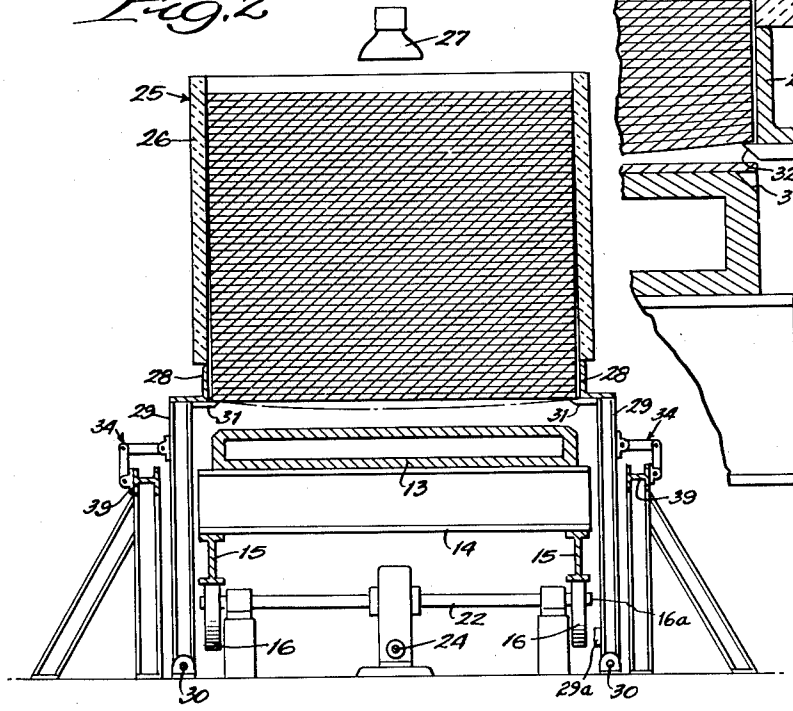


Fig. 3

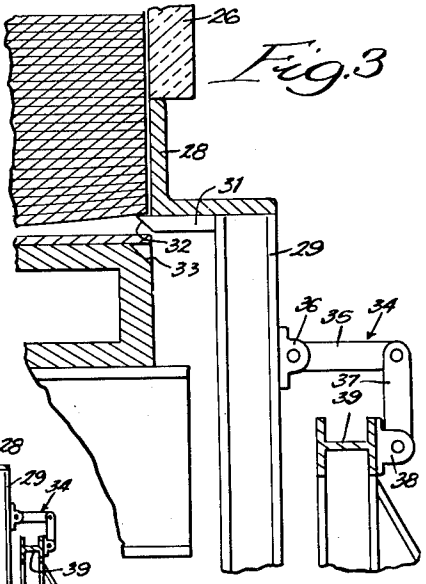


Fig. 4

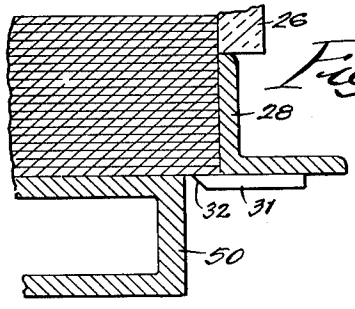


Fig. 5



INVENTOR:
James d'A. Clark,
BY
Dawson & Coma,
ATTORNEYS.

United States Patent Office 2,754,540 Patented July 17, 1956

2,754,540

METHOD AND APPARATUS FOR TREATING BOARDS MOLDED OF FIBROUS MATERIAL

James d'A. Clark, Longview, Wash.

Application August 18, 1952, Serial No. 304,923

11 Claims. (Cl. 18—1)

This invention relates to the manufacture of panels, boards and the like molded of fibrous elements, such as woody wafers or cellulose fibers and it relates more particularly to apparatus and to a method for treating such structures immediately subsequent to their molding operation for the purpose of improving their resistance to water and the strength properties of the molded products and to condition the boards for better dimensional stability.

Various techniques for the heat treatment of boards subsequent to molding have been tried but the difficulties involved have scarcely been justified by the minor improvements secured in the molded products and the great majority of such techniques have thus been abandoned. In one process, generally referred to as "hot stacking," the boards are piled one on top of the other as they issue from the hot molding press. While some of the heat of the molding operation remains in the boards, much thereof is lost into the atmosphere since the board last to issue is placed on top of the stack where heat losses are maximum. As a result, the average temperature of the boards in the stack is relatively low so that little, if any, beneficial changes are secured and any such changes vary in character throughout the stack because the last boards are subject to a considerably less intense treatment than the boards in the bottom portion of the stack.

The need for a practical solution to a subsequent treatment of molded boards for the purpose of improving moisture resistance and dimensional stability becomes particularly important in the recent development of dry molded boards having very little, if any, additional resinous binder, such as is described in my copending application Serial No. 192,284, filed on October 26, 1950, now abandoned. It has been found that boards molded by the dry process described to a medium density of about 0.6 to 0.9 will not have a high degree of moisture resistance unless a high concentration of wax is employed as a size for the fibers. When hydrophobic waxes are present in sufficient quantity to impart a high resistance to moisture, the bonding relation between fibrous elements becomes markedly reduced and a molded product of relatively low strength results. The usual method of hot stacking previously described provides some improvement in water resistance but scarcely sufficient to justify the effort. Preheating of the fibrous elements to temperatures up to 350° F. improves water resistance but the strength of the product molded therefrom is then thereby considerably decreased.

It is an object of this invention to provide a method and apparatus for the treatment of boards molded of fibrous material for the purpose of increasing their water resistance without loss of strength and it is a preferred object of this invention to provide a new and improved method and apparatus for the heat treatment of boards subsequent to molding whereby their moisture resistance is increased and their strength properties are also increased in a practical and an economical manner.

It is another object to provide a heat treatment of the type described which makes sufficient use of the heat remaining in the boards subsequent to molding and subjects each board to substantially identical aging conditions to equalize their properties prior to conditioning the boards to become in equilibrium with the ambient atmosphere.

A further object is to provide an effective and economical system for greatly improving the resistance of the fibrous molded board to water and to minimize dimensional changes and warping responsive to changes in ambient atmospheric conditions.

These and other objects and advantages of this invention will hereinafter appear and for purposes of illustration, but not of limitation, embodiments of the invention are shown in the accompanying drawing in which—

Figure 1 is a plan view of a system for handling molded boards in accordance with the practice of this invention;

Figure 2 is an elevational view in section showing in detail a hot stacker embodying features of this invention;

Figure 3 is an enlarged sectional elevational view of a portion of the hot stacker;

Figure 4 is a fragmentary sectional elevational view of a modification in a hot stacker embodying features of this invention, and

Figure 5 is a sectional elevational view of a modified form of platen or table.

It has been found that in dry molding, boards of the type described may be greatly improved in their water resistance and dimensional stability while also increasing the strength properties thereof when such boards are conditioned at a temperature ranging from about 230° to 360° F. under slight pressure subsequent to molding for from several hours to about half an hour for the highest temperature, and it is an object of this invention to provide means for expediently subjecting the boards to the conditions described in an economical and uniform manner.

In accordance with the practice of this invention there is provided a new and improved hot stacking apparatus operating on a principle unlike that which has heretofore been employed in the molding industry. Instead of removing the hot molded boards and piling them one on top the other where the heat can radiate therefrom rapidly to reduce the effective temperature and thereby markedly reduce the average temperature of the boards in the pile, an improved hot stacker is provided wherein the boards last removed from the molding press are fed from the bottom into the pile and the bottom of the pile rests on a hot plate which not only insulates the boards against heat loss but supplies additional heat from its surface. By displacing boards upwardly from the bottom and removing the heat treated boards from the top, each board is subjected to substantially identical temperature, time, and pressure conditions whereby greater uniformity exists in the final products.

My new and improved hot stacker comprises a pair of feed rolls 10 and 11 for advancing boards 12 onto the upper surface of a hot plate 13 dimensioned to correspond in size and shape to the molded boards. The hot plate is channeled for heating by hot water or steam or by electrical resistance units. The hot plate is supported on a plurality of spaced cross beams 14 and longitudinal beams 15 forming a table adapted to be actuated vertically between a raised and a lowered position of adjustment by suitable actuating means, such as the cams 16 mounted on rotatable shafts 22. The shafts are adapted to be turned by a motor 23 having a drive shaft 24 operatively connected to shafts 22 by a worm and worm gear arrangement. It will be understood that other means well known in the industry for actuating such units in vertical movement may, in the alternative, be

used, such for example as hydraulically operated rams or the like.

The stacker in which the boards are aged under heat and pressure to improve the physical properties thereof comprises a rectangular housing 25 preferably formed of heat insulating side walls 26 which may also be provided with heating elements therein for the purpose of maintaining the desired temperature and the housing is dimensioned to conform in size and shape to the boards adapted to be stacked therein. The housing is open at its upper end to permit removal of the uppermost board as by a lift having a vacuum cup 27 to grip the face of the board, or removal may be effected by other means. The housing is also open at an end near the bottom to admit boards subsequently advanced therein over the hot plate 13. The stack of boards is supported within the housing by the hot plate which ordinarily forms its bottom wall or by removable shelves operating in timed relation with the movement of the hot plate. The shelves move into position of support in advance of withdrawal of the hot plate for reloading with more boards for the hot stacker.

While description will be made to the holding assembly associated with one side wall of the housing, it will be understood that a similar assembly is provided with both side walls for operation in the manner described in cooperation with the housing and board feeding means. Aligned with the underside of the housing wall and preferably positioned to form a continuance thereof is an elongate structural member of high strength, such as an angle iron 28 supported at its underside by a plurality of upright rigid columns 29 pivoted at their lower end on brackets 30 for rocking movement in the direction toward and away from the wall. Secured to the underside of the angle iron 28 is a shelf plate 31 which extends a short distance into the opening defined by the housing to engage the underside of the lowermost board in the stack and provide a rest therefor. If the boards are trimmed to the width of the hot plate, the underside of the shelf is chamfered as at 32 in its outer end portion to cooperate with a chamfered side edge 33 of the hot plate to permit movement of the shelves into position to engage the underside of the lowermost board for support thereof in advance of withdrawal of the hot plate to retracted position. Otherwise, if untrimmed, the sides of the boards overlap the sides of the hot plate as shown in Figure 4. In such instance it is preferred to have the hot plate 50 dimensioned to be less than the distance between the chamfered edges 32 of the shelf plates 31 and the edges of the hot plate need not be chamfered for cooperation therewith.

Normally the columns 29 are adapted to be rocked outwardly to displace the shelves from the housing opening as the hot plate or table rises to position operatively to engage the lowermost board in the stack and supply the support therefor. Such rocking movement in timed relation with the hot plate is achieved by an operative connection with the cams and a lever assembly 34 operatively engaging the columns at an intermediate portion thereof as by means of a lug 16^a on the cam 16 which is adapted to engage a projection 29^a fixed to the arm 29 and lying in the path of the lug 16^a during rotation of the cam 16 to raise the table 13. Such lever assembly may include a horizontally disposed lever 35 pivoted at one end on an ear 36 fixed to the column while the other end is pivoted at the upper end of a vertically disposed lever 37 pivoted at its lower end upon an ear 38 fixed to a stationary frame member 39.

In operation, when the boards 12 are removed one at a time or in groups from the hot molding press, they are stacked on a roller conveyor 40 or other conveying means or by a suitable pusher means to between rollers 41 and 42 located at the end thereof for feeding the boards between a pair of saws 43 which trim the boards to desired dimension. From the trimming saws, the boards 12 are advanced in substantially continuous fashion by cooperating rollers 44 and 45 to another roller conveyor 46 or the like into feeding relation with the rollers 10 and 11 of the described hot stacker. If desired, the rolls 41, 42, 44 and 45 and the saws 43 may be dispensed with and the untrimmed boards fed directly between rolls 10 and 11.

Normally the hot plate 13 is in its raised position of adjustment and functions as the bottom wall of the housing to support the boards therein while also imparting heat to the lowermost board for assistance in compensating for heat losses and to maintain a high temperature level within the housing. When it is desired to lower the hot plate for receiving additional boards to be inserted within the stacker, the columns 29 and the attached shelves 31 are rocked to their operative position of adjustment whereby the edge portion 32 cooperates with the edge 33 of the hot plate to permit movement of the shelves into position of use supporting the stack of boards within the housing in advance of removal of the hot plate from its raised position of adjustment. Upon removal, it will be apparent that at least the bottommost group of boards will be flexed to some degree, as indicated by the broken lines in Figure 2 as their center support is withdrawn. Such flexing action, especially with certain board constructions, such as facing the lower surface of the board with a veneer having its grain parallel to the length of the board, has been found most desirable in relieving strains and stresses existing within the board structures. With other board constructions, the boards may be flexed upwardly by providing a hot plate 51 with a cylindrical convex surface 52, as shown in Figure 5.

When in their lowered position of adjustment, the feed rollers 10 and 11 are operated to advance the boards over the roller conveyor onto the upper surface of the hot plate until stopped in properly aligned position by the stop plate 47. Then the table is cammed to its raised position of adjustment in cooperation with mechanism operatively connected thereto for withdrawing the shelves 31 from the path of the boards as they are carried into the housing to displace the stack upwardly therein. As previously pointed out, the uppermost boards in the stack have been subjected while in the hot stacker to an average temperature in the order of 230° to 360° F. It will also be obvious that the boards, as they are introduced and while they are in the hottest and most reactive conditions are subject to maximum pressures comprising the cumulative weight of the boards positioned thereover in the stack and that such boards continue to be under pressure though of lesser magnitude as the boards continue to rise by displacement upwardly through the stacker. Under such conditions, it has been found that marked improvement is not only secured in the resistance to water and to warpage but that the strength and other physical properties of the boards are increased. Some darkening of the boards usually takes place under the conditions of hot stacking described but the boards which are to be used in exposed areas are usually faced with a surface ply or the like which completely conceals any imperfections or undesirable discoloration.

As the boards are raised above the level of the housing or into the upper portion thereof, a pusher mechanism may be used for displacement of the boards onto a conveyor for storage or a suction device of the type described may be used to lift the boards out of the stacker one at a time for displacement to storage or packing devices. At this stage, the uppermost board is relatively cool and capable of being handled.

As a rule, the hot stacker is used in conjunction with a hot press for consolidating fibrous elements into panels, boards and the like. It is desirable to effect the transfer of the boards to the stacker as quickly as possible so that the major portion of the heat introduced into the board during molding may be maintained. That which

is lost can be made up quickly such as by replacement of heat from the hot plate into the bottom surface of the lowermost board which is subject to greatest heat loss during transfer. Heat which is lost from the upper surface of the top board during transfer to the stacker is also capable of being substantially completely replaced by the high temperatures existing on the underside of the lowermost board already in the stacker which has been in contact with the surface of the hot plate prior to its being lowered for loading. Thus heat is reintroduced in the boards at places most needed; nevertheless, all of the boards soon become equalized substantially to uniform temperature in the stacker although a temperature gradient will exist from bottom to top.

By way of illustration, if four boards of about ⅜ inch thickness are molded on a 6-minute cycle and advanced as a group for hot stacking, boards totaling about 15 inches will be introduced into the stacker hourly. Thus in a stacker having a height of 60 inches, each board will be subject to the temperature and pressure conditions therein for about 4 hours. With boards molded of woody wafers sized with 2 percent wax and bonded with about 1½ percent phenol formaldehyde resin, it has been found that a very desirable improvement in resistance to water is secured in the hot stacker of the type described when subjected to an average temperature of about 360° F. for ½ hour or about 1 hour at 340° F. or from 2 to 4 hours at temperatures of 320° to 280° F. Additional time at the temperature employed is helpful to relieve strains by further small amounts through plastic flow which is believed to take place continually.

It will also be seen that by the practice of this invention, the necessary dwell time in the press to set the resinous binder in the molded board may be reduced to a minimum relying upon the further advancement of the resinous binder especially that in the center lamina of the board to the cured stage during the passage of the board through the hot stack. This advantage will accrue in addition to the improvement in water resistance and the equalization of forces within the boards so that they are caused to lie flat with little or no tendency to warp or twist. Reaction of the binder to an advanced stage of polymeric growth in the stacker and the action of heat upon the wood substance is also responsible for an increase in strength in the final product. It is possible that these improvements in characteristics with respect to water resistance, reduction in warpage and increase in strength might be accomplished by reduction of pressure in the consolidating press and extending the molding cycle of the boards therein. However, this would reduce the output of the press to an impractical low value and would be most undesirable.

If the side edges of the boards are not trimmed with the saws until after the hot stacking operation, they may collectively serve as a good insulating wall for the stack in place of or in addition to the insulated walls **25**, the only drawback being an increased stroke and bite of the side supporting members. In this case, the edges are permitted to overlap the sides of hot plate **13** by about 2 inches and the stroke of the rocking arms increased by this distance.

It will be understood that various changes may be made in the details of construction, arrangement and in operation without departing from the spirit of the invention, especially as defined in the following claims.

I claim:

1. The method of heat treating boards of fibrous material compounded with a thermosetting binder comprising the steps of placing a board after hot molding and while the board still retains much of its heat on a heated plate, separating the board from the plate, introducing a second board therebetween to form a stack of boards, separating the lowermost board of the stack from the plate, introducing additional hot boards therebetween and continuing the separation of the stack and plate and the introduction of additional boards until the stack is of a desired height, and thereafter removing a number of boards from the top of the stack corresponding to the number intermittently inserted beneath it to maintain the stack at the desired height whereby each board is given substantially the same heat treatment during its passage upwards through the stack.

2. In the method of conditioning boards of fibrous material compounded with a thermosetting binder and molded under heat and pressure to an advanced but incomplete stage of cure, the steps of conditioning the boards with heat, immediately after molding, in a hot stacker comprising positioning the boards immediately after molding on a hot plate before appreciable amounts of heat from the molded board have escaped from the surfaces thereof, bringing the hot plate and stacker together so that the hot plate forms the bottom wall of the stacker whereby the boards on the hot plate are introduced into the bottom of the stacker for displacement of the others therein upwardly to form a pile in which the boards introduced form the bottom of the pile, supporting the pile of boards in the stacker at the edge portion of the lowermost board when the stacker and hot plate are separated for receiving additional boards whereby the pile of boards in the stacker flex downwardly through the central portions thereof, and removing a number of boards from the top of the pile corresponding to the number of boards introduced into the stacker to form the bottom of the pile.

3. The method as claimed in claim 2 which includes the additional step of heating the boards by heating elements placed within the insulating walls surrounding the stack to maintain a temperature ranging from about 260° to 380° F. in the stack.

4. In the method of conditioning boards of fibrous material compounded with a thermosetting binder and molded under heat and pressure to an advanced but incomplete stage of cure, the steps of conditioning the boards with heat immediately after molding in a hot stacker comprising positioning the molded boards on a heated platen before appreciable amounts of heat from the molded boards have escaped from the surfaces thereof, introducing the boards on the heated platen into the bottom of the stacker whereby the boards introduced into the stacker form a pile with the boards most recently introduced forming the bottom of the pile, and removing boards from the top of the pile in the stacker, when the pile has reached a predetermined height, in amounts corresponding to the number of boards introduced to the bottom of the pile.

5. The method as claimed in claim 4 which includes the additional step of controlling the rate of introduction and removal of boards from the bottom and top of the pile respectively to provide for treatment within the stacker equivalent to at least four hours at 260° F.

6. A hot stacker for use in conjunction for receiving boards while hot from a hot molding press in the manufacture of boards molded of fibrous material and a thermosetting binder whereby the binder, during the molding operation, is advanced to a set but incomplete stage of cure comprising a vertical housing having heat insulating walls with an opening to discharge boards from its upper portion and an opening to receive boards in its bottom portion and in which the openings are dimensioned to have a size and shape corresponding with the size and shape of the boards adapted to be advanced therethrough, shelves extending horizontally into the opening at the underside of the housing, means mounting the shelves for shifting movement between normal position wherein the shelves extend laterally into the opening for support of boards contained within the housing and outwardly to a retracted position out of the path of the boards, a heated platen dimensioned to correspond with said opening in the underside of the housing, means for bringing the housing shelves and platen together normally to position the

platen as the bottom wall of the housing, and means responsive to movement of said housing shelves and platen together for displacing the shelves towards retracted position and for returning said shelves to normal position for supporting the boards within the housing in advance of separation between the housing shelves and platen.

7. A hot stacker as claimed in claim 6 in which the shelves are chamfered throughout their lower edge portion and the upper edge portion of the plates are similarly chamfered to permit actuation of said shelves to position of use for engaging the underside of the boards in advance of movement of the plate to retracted position.

8. A hot stacker for use in conjunction with a hot molding press in the manufacture of boards molded of fibrous material and a thermosetting binder wherein the binder during the molding operation is advanced to a set but incomplete stage of cure, comprising a housing formed of heat insulating walls open at the top and at the bottom and dimensioned in size and shape to correspond to the length and width of the molded boards adapted to be inserted therein, shelves extending horizontally into the opening at the underside of the housing, means mounting the shelves for shifting movement between normal position wherein the shelves extend laterally into the opening for support of boards contained within the housing and outwardly to a retracted position out of the path of the boards, a heated platen dimensioned to correspond with said opening in the underside of the housing, means

for bringing the housing and platen together normally to position the platen as the bottom wall of the housing, and means responsive to movement of said housing and platen together for displacing the shelves towards retracted position and for returning said shelves to normal position for supporting the boards within the housing in advance of separation between the housing and platen.

9. A hot stacker as claimed in claim 8 which includes feeding means in cooperation with said platen for advancing boards into a proper alignment thereon when in position for receiving the boards.

10. A hot stacker as claimed in claim 9 which includes stop means cooperating with said feeding means for properly locating said boards on said platen during feeding operations.

11. A hot stacker as claimed in claim 8 which includes heating elements in the insulated walls of the housing for maintaining a temperature level within the stacker in excess of 250° F.

References Cited in the file of this patent

UNITED STATES PATENTS

1,339,564	Kinnear et al.	May 11, 1920
1,358,394	Redman	Nov. 9, 1920
2,537,918	Skoog	Jan. 9, 1951
2,595,346	Federwitz	May 6, 1952