Oct. 13, 1953

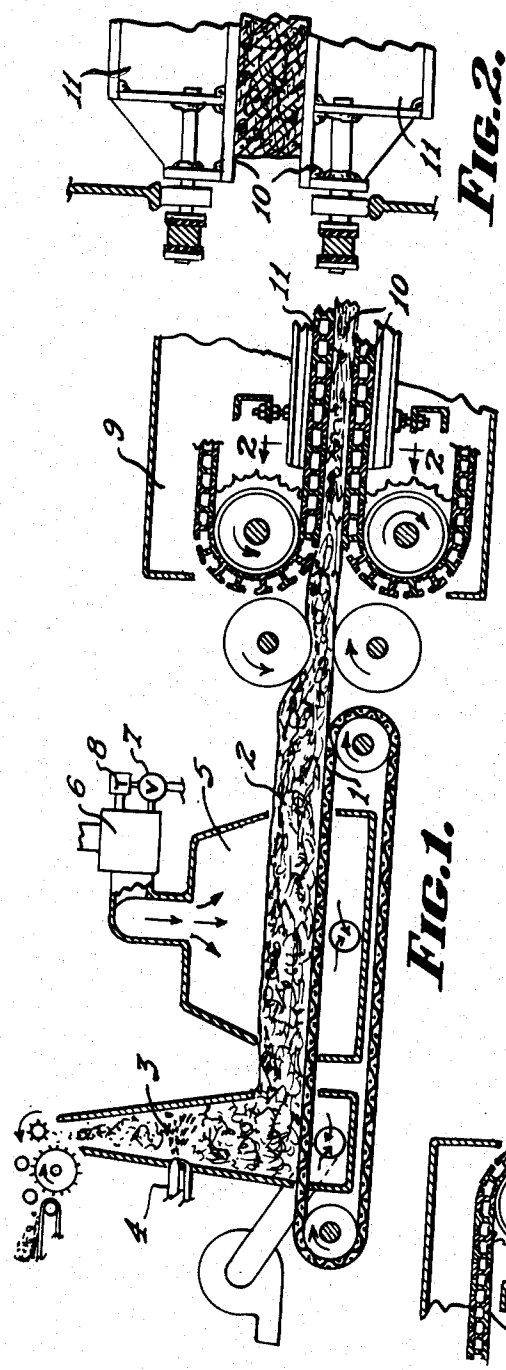
H. W. COLLINS

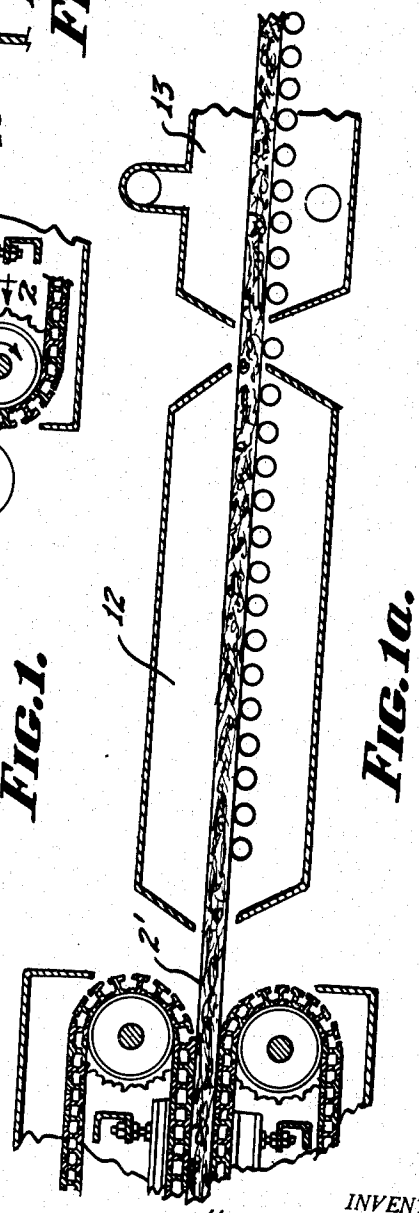
2,655,458

METHOD OF FORMING WOOD WOOL PANELS

Filed Nov. 1, 1951

2 Sheets-Sheet 1





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2 Sheets-Sheet 2

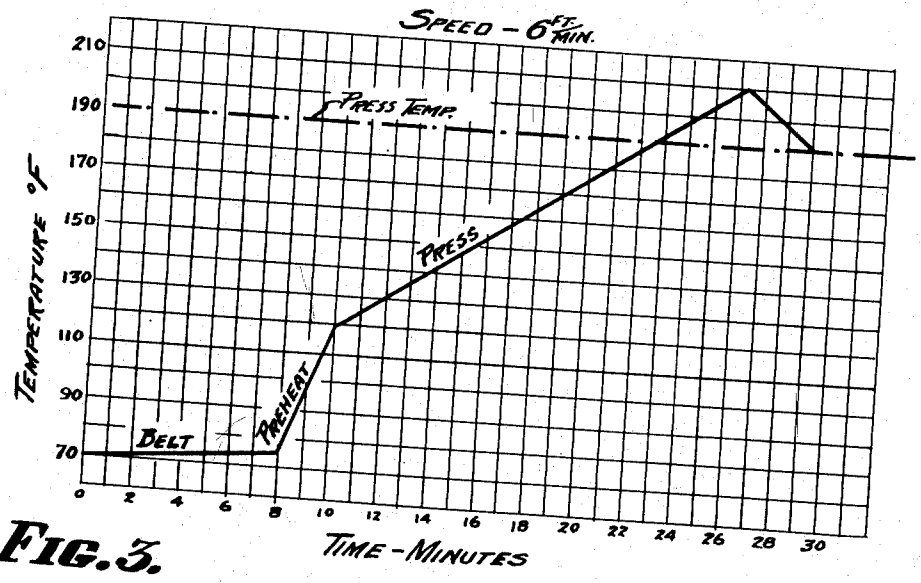

FIG. 3.

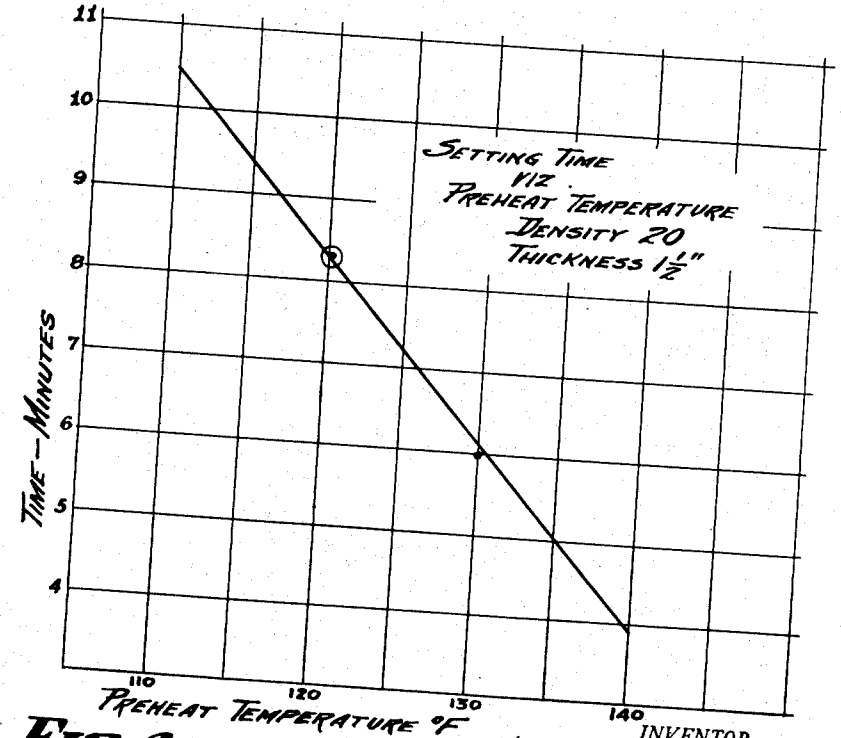

FIG. 4.

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METHOD OF FORMING WOOD WOOL PANELS

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Application November 1, 1951, Serial No. 254,275

8 Claims. (Cl. 154—101)

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My invention relates to a method of forming panels of wood wool or excelsior as it is commonly termed bonded together with magnesium cement in a continuous process. This application is a continuation-in-part of my application, Serial No. 790,914, filed December 10, 1947, now abandoned, and entitled Method of Forming Wood Wool Panels.

In the problem of forming a wood wool magnesium cement panel in a continuous process, certain very definite problems present themselves which are not present when the process is not continuous.

Magnesium cement as preferably used in my process consists of a water-borne mixture of magnesium oxide and magnesium sulphate. The magnesium oxide and magnesium sulphate is combined just before it is sprayed on the wood wool. While it immediately commences to react chemically, the time it sets is well over an hour. In a continuous process such as the subject matter of this invention and wherein the wood wool mat impregnated with the cement is continuously moved along a conveyor, it is necessary that some provision be made for greatly speeding up the setting time of the magnesium cement.

In my process, after the cement has been added to the wood wool which is matted on a belt conveyor, it is moved by the conveyor and at some stage before the completion of the panel, the conveyor carries the mat between the plates or rolls of a heated press which forms the mat into a panel of the desired thickness. Thus, it is necessary that the cement set sufficiently to maintain the thickness of the formed panel before it leaves the press, but not before the press has acted upon the mat. Hence, it is a problem when forming wood wool panels in this way to so time the setting of the cement that it will occur just as the panel leaves the pressing plate or roll.

While wood wool panels have previously been formed by slow processes, it has always been considered unfeasible and as a practical commercial matter impossible to form wood wool panels with a magnesium cement as a continuous process. The only continuous process known heretofore by me is a German process wherein the forming or pressing is done between steel belts pulled between steel plates which are kept at an extremely high temperature such as 500° F. At such heats, it is, of course, impossible to use rotating machinery, since any lubricant would be dispersed or boiled away and any rubber or fabric material, such as a conveyor belt, would be quickly disintegrated.

It is an object of my invention to provide a

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method of forming wood wool panels by a continuous process wherein the magnesium cement is forced to set at about the time the panel itself is leaving the press.

It is a further object of my invention to provide a method of forming wood wool panels wherein the process is continuous and wherein rotating machinery may be used as well as rubber belts for conveying purposes, since the temperature to which the equipment and belts are subjected is reasonably below a temperature which would vaporize or injure any lubricating means or injure the rubber or fabric conveyor belts.

A further object of my invention is to provide a method of forming wood wool panels by a continuous process which is commercially practical, relatively inexpensive to maintain, includes simple moving parts and moving machinery and hence is relatively easy to adjust and repair when necessary.

These and other objects of my invention which will be set forth hereinafter or will be apparent to one skilled in the art upon reading these specifications, I accomplish by that certain construction and arrangement of steps of which I shall now describe an exemplary embodiment. Reference is now made to the drawings which form a part thereof and in which:

Figures 1 and 1a are side elevational diagrams in section of the apparatus, Figure 1a being a continuation of Figure 1.

Figure 2 is a detailed section on a larger scale taken on the section line 2—2 of Figure 1.

Figure 3 is a graph showing the different temperatures at different times throughout my novel process.

Figure 4 is a graph showing the time of setting of the cement at different degrees of preheating.

Briefly, in the practice of my process, I provide a moving belt-type conveyor of the usual type. The belt is preferably foraminated or perforated to permit air or vapors to pass through the mat and the conveyor belt. On this belt conveyor, I deposit a smooth mat of wood wool to a predetermined thickness depending upon the thickness of the final panel. Just after the wood wool has been deposited on the conveyor, it is sprayed with my magnesium cement. My magnesium cement consists substantially of a mixture of 35% magnesium sulphate dissolved in water to which has been added 65% of magnesium oxide. These percentages are not critical, but merely exemplary, since the quality of the magnesium oxide may vary substantially and the amount be varied

in accordance with its previously found chemical activity.

Just as soon as the magnesium oxide has been mixed with magnesium sulphate solution, the resulting cement commences to set. However, the setting at normal temperatures takes well over an hour. The chemical reaction between magnesium oxide and magnesium sulphate is exothermic and in order to take advantage of this and to greatly decrease the setting time of the cement, I have provided at the first station along the moving loaded conveyor belt a preheating oven.

This preheating oven is a very important feature of my method, since the temperature to which the preheating oven is maintained determines the time within which the magnesium cement will set. The preheating oven consists of a casing which surrounds the conveyor belt on which the wood wool matting is carried and includes blowers which blow heated, water-saturated air down through the matting and preferably through the conveyor belt which is foraminated to permit the passage of this air and assist in matting the wood wool. Communicating with the preheating oven is a chamber to which is run a source of steam through a valve which is thermostatically controlled so as to admit steam to an extent where the vapor in the chamber is raised to a predetermined temperature. The temperature of the vapor or water saturated air in this chamber usually ranges from 110° F. to 140° F. The vapor in the chamber at its predetermined temperature flows into the preheating oven and thence through the mat upon the conveyor.

The limits of 110° F. to 140° F. in the oven will result in the magnesium cement setting from about the maximum of 10½ minutes to a minimum of 4 minutes. The ratio of the temperature to the time of setting is dependent upon the chemical activity of the magnesium oxide used in the cement and hence this activity is predetermined, and a graph such as that shown in Figure 4 is prepared for the given batch of magnesium oxide.

Since the heating vapor used in the preheating oven is water-saturated air of a predetermined temperature, the vapor or air entering the preheating oven is completely saturated with a relative humidity of 100%.

At the next station along the belt conveyor, I provide for the actual press which forces the matted material together and forms the panels at their predetermined thickness. The press preferably used by me consists of two rubber conveyor belts backed up by a series of transverse platens which contact each other to form a plate when in the horizontal or pressing position. Hence, the press while acting as two plates press on each side of the matted material, also acts as a conveyor for moving material through the press.

As stated above, it is important that the magnesium cement, when the matting reaches the press, be in a condition where it has not quite set since the press itself crushes and diminishes the thickness of the mat and if the cement were set, it would be broken by the crushing action. On the other hand, after the material has been compacted and pressed to predetermined thickness, the cement should be set at least sufficiently to maintain this thickness.

I preferably keep the temperature of the press about 190° F., but this temperature is not sufficient to speed up the setting action of the cement sufficiently for a continuous process such as mine. As an example, with the temperature of the press at 190° F. and using a mat thickness of wood wool that results in a three inch panel, it would still take 45 minutes from the time the cement is applied to the mat for it to set sufficiently for my purpose. This, of course, is entirely too long for a continuous process such as mine.

In order to provide for a continuous process with cement of this type, I predetermine the distance between the point on the moving conveyor where the cement is applied to the material and the outlet end of my press. Since the material is moved to and through the press at a uniform rate of speed, the distance between these two points is a function of time. Thus, by using a chart similar to that shown in Figure 4, I can determine what the temperature shall be in the preheating oven to insure the setting of the cement at the proper place in the press. Of course, for mats of different thicknesses, the speed of the conveyor belt is varied but the rate is always kept uniform.

As an example, if in accordance with the speed of my conveyor belt it will take 8¼ minutes for the material to run from the point where the cement is applied to the exhaust end of the press; I will look at my graph similar to Figure 4 and note that a temperature of 120° F. is correct for the preheating oven.

It will be noted from the above that by predetermining the heat in the preheating oven, it will add to the exothermic heat created by the chemical action of the cement so as to speed up the setting of the magnesium cement and thus make it possible to form wood wool panels in a relatively rapid continuous process. By using water-saturated vapor in the preheating oven, I add very little moisture to the material and any excess, of course, is removed in the final drying ovens.

Referring to the drawings, Figures 1 and 1a show my apparatus schematically. A moving conveyor belt 1 is provided which travels at a predetermined constant speed depending upon the thickness of the wood wool mat 2. The loose wood wool 3 is placed upon the conveyor belt 1 in a uniform manner and is saturated with magnesium cement consisting of a mixture of water-borne magnesium sulphate and magnesium oxide by the sprays 4. The water-borne cement may be distributed over the mat after it has been positioned on the conveyor belt 1; but in Figure 1, I have merely shown the nozzles 4 in the chute leading to the belt. However, the method of saturating the mat is not critical to my process.

As the conveyor belt 1 moves to the right in Figure 1, the mat 2 comes within the preheating oven 5. There is a chamber 6 connected to the preheating oven 5, and a steam valve 7 controlled by a thermostat 8 regulates the steam entering and mixing with the air in the chamber 6 until a predetermined temperature is reached at which the thermostat 8 shuts off the steam valve 7. This temperature is predetermined by use of a chart similar to that shown in Figure 4.

While the mat 2 is in the preheating oven 5, the hot vapor of the oven combined with the exothermic heat of the chemical reaction within the magnesium cement raises the temperature so that the setting time of the magnesium cement is greatly decreased and controlled so it will set up

sufficiently, while the mat is within the press 9 at the next station along the line.

After the mat 2 leaves the preheating oven 5, it enters the press 9. This press is preferably composed of opposed rubber conveyor belts 10 which are backed up by metal platens 11 which form a flat surface when in the horizontal position, as shown in Figure 1 of the drawing. As can be seen from the drawings, the backed up belts 10 of the press crush the mat to its predetermined final thickness and hence it is important that the magnesium cement be relatively plastic and not sufficiently set to result in a breaking up or disintegration of the cement during this crushing action. I preferably maintain the temperature of the press 9 at approximately 190° F.

As the mat 2 moves through the press, the magnesium cement sets sufficiently to maintain the thickness formed by the press, so when the mat leaves the press as at 2' it will not swell or expand, but will remain the desired predetermined thickness.

In order to insure the complete setting of the magnesium cement before the formed mat enters the drying ovens, I preferably provide a chamber 12 just beyond the exit of the press 9. This chamber 12 is maintained at the same temperature as the press, that is about 190° F. and is merely for the purpose of insuring the complete setting of the magnesium cement and eliminating the necessity of making the relatively expensive press 9 sufficiently long for this purpose. After the formed mat leaves the chamber 12, it enters a series of drying ovens 13 wherein heated air is blown through the mat, thus removing excess moisture. While in Figure 1a, I have merely shown the entering end of one oven 13, it is to be understood that it is preferable to have a series of drying ovens of any conventional type to insure the complete drying of the formed mat before it is cut to predetermined size and shipped.

Figure 3 depicts a graph showing the different temperatures as the bat moves through the different stations during my process. Of course, this graph is merely exemplary and depicts the belt conveyor moving at the rate of six feet a minute and the preheating oven set at 120° F. Depending upon the chemical activity of the magnesium oxide, the temperature of the preheating oven is varied and it is also varied depending upon the speed of the belt conveyor.

Figure 4 shows an exemplary graph where the preheating temperature is plotted against time. This graph is used in determining the preheating temperature of this oven depending upon the speed of the conveyor which is uniform and hence a function of time and the chemical activity of the magnesium oxide. Such a chart or graph is preferably prepared for each separate new batch of magnesium oxide and in accordance with an initial test showing the chemical activity of the batch in relation to the speed of its setting.

From the above, it is apparent that I have provided a method of forming wood wool panels using a cement comprising magnesium oxide and magnesium sulphate as a binder in a rapid continuous process. As can be seen from the graph in Figure 3, the total time it has taken the wood wool mat saturated with the cement to travel from its point of application to the end of the press where the cement has set up sufficiently to prevent the expanding of the mat is less than twenty-six minutes. As stated above, the mat then passes through a heated chamber which assures the complete setting of the cement after which it is dried by forced hot air as it passes through a series of drying ovens. After the mat leaves these drying ovens, it is cut to size and is ready for shipping.

The detailed procedure necessary to accomplish this method or practice is substantially as follows:

First of all, the batch of magnesium oxide to be used is tested as to its chemical activity and from these results a graph such as that shown in Figure 4 is prepared. After the graph has been made, the temperature of the preheating oven is predetermined by use of the graph and the thermostatic control valve is set accordingly. After setting of the thermostatic valve 8, there is no other adjustment to be made, assuming that the press has been set for a predetermined thickness and the speed of the conveyor belt adjusted in accordance with the thickness desired.

As the mat enters the preheating oven, the saturated vapor is forced downwardly through the mat so that the heat of the vapor, together with the exothermic heat generated by the chemical action, speeds up the setting of the cement. The slight condensation resulting from elevation of the temperature of the mat and the lowering of the temperature of the vapor within the oven is relatively negligible and, of course, all excess moisture is removed by the drying ovens at the end of the run.

It should be particularly noted that throughout the apparatus, no part or portion has been elevated above 220° F. and hence rotating equipment where lubrication is needed and rubber and fiber belts which deteriorate at high temperature may be used.

The charts and drawings I have shown are not critical but merely exemplary, since the time and temperature themselves depend upon many factors, such as the purity and chemical reactivity of the magnesium oxide, the length of the press, the distance from the point where the cement is applied to the point in the press where the cement should have set; also, the speed of the belt conveyor moving the mat is varied in accordance with the thickness of the mat and the desired final panel.

It is to be understood that modification may be made in my invention without departing from the spirit thereof, and I do not intend to limit myself otherwise than as pointed out in the claims which follow.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. The method of forming a panel of wood wool and magnesium cement rapidly and continuously, which consists in forming a layer of wood wool impregnated with water borne magnesium oxide and magnesium salts of the group of sulphate and chloride, continuously passing the layer through a current of heated air and then passing the layer between continuously moving compressing surfaces, the temperature of the heated air being such that the cement will set sufficiently to hold the layer against expansion while the layer is between the compressing surfaces.

2. The method of forming a panel of wood wool and magnesium cement rapidly and continuously, which consists in forming a layer of wood wool impregnated with water borne magnesium oxide and magnesium salts of the group of sulphate and chloride, continuously passing the layer through a current of heated air and then pass-

ing the layer between continuously moving compressing surfaces, the temperature of the heated air being such that it will supplement the exothermic heat developed by the reaction of the magnesium cement to a point where the cement will not set before the layer passes between the compressing surfaces but will set sufficiently to hold the layer against expansion before it passes from between the compressing surfaces.

3. The method of forming a panel of wood wool and magnesium cement rapidly and continuously, which consists in forming a layer of wood wool impregnated with water borne magnesium oxide and magnesium salts of the group of sulphate and chloride, continuously passing the layer through a current of heated air and then passing the layer between continuously moving compressing surfaces, the temperature of the heated air being such that it will supplement the exothermic heat developed by the reaction of the magnesium cement to a point where the cement will not set before the layer passes between the compressing surfaces but will set sufficiently to hold the layer against expansion before it passes from between the compressing surfaces, and then maintaining the temperature of the layer until the cement has completely set and finally drying the layer so as to remove excess moisture.

4. In the method of rapidly and continuously forming a cement bonded wood wool panel wherein a layer of wood wool impregnated with a mixture of water borne magnesium oxide and magnesium sulphate is continuously moved between compressing surfaces, that step which consists in passing the layer through a draft of heated vapor prior to its movement between the compressing surfaces wherein the temperature of the heated vapor is predetermined to supplement the exothermic heat of the cement to a degree where it will set to an extent preventing expansion of the layer after the layer has been released from between the compressing surfaces.

5. That step in the method of rapidly and continuously forming a magnesium cement bonded mat of wood wool, which consists in forming a layer of the required thickness of wood wool mixed with water-borne magnesium oxide and magnesium salts of the group of sulphate and chloride, and immediately passing the layer while held on a foraminous traveling support, through a draft of air heated to a temperature to supplement the exothermic heat which the magnesium salt and oxide reaction would develop of itself, and controlling the moisture in the air so that it neither wets nor dries the layer to any substantial extent during said passage, whereby a rapid reaction takes place suitable for a continuous process.

6. That step in the method of rapidly and continuously forming a magnesium cement bonded mat of wood wool, which consists in forming a layer of the required thickness of wood wool mixed with water-borne magnesium salts of the group of sulphate and chloride, and immediately passing the layer while held on a foraminous traveling support, through a draft of air heated to a temperature between 100° F. and 140° F. and controlling the moisture in the air by saturating the same with moisture so that it does not dry the layer during said passage, whereby a rapid reaction takes place suitable for a continuous process.

7. The method of forming a mat of wood wool and magnesium cement rapidly and continuously to a condition of stiffness suitable for handling without deterioration, which consists in forming the layer of wood wool and water-borne magnesium oxide and magnesium salt of the group of sulphate and chloride, continuously passing the layer through a current of heated water-saturated air so as not to dry the layer, passing the layer between continuously moving compressing surfaces to condense it to a predetermined density while maintaining heat conditions, maintaining the temperature of the layer until all chemical reaction has ceased, and then drying the mat by passing it through currents of dry air, the temperature of the layer at no stage throughout the process being greater than 220° F.

8. The method of forming a panel of wood wool and cement rapidly and continuously which consists in forming a layer of wood wool impregnated with a water-borne dry powder cementitious material settable upon hydration by an exothermic reaction, continuously passing the layer through a current of heated air and then passing the layer between continuously moving compressing surfaces, the temperature of the heated air being such that the cement will set sufficiently to hold the layer against expansion while the layer is between the compressing surfaces.

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