

Jan. 22, 1952

M. W. BAKER ET AL
APPARATUS FOR MANUFACTURING BOARDS OF COMPRESSED
CELLULOSE MATERIAL AND THE LIKE

2,583,249

Filed Nov. 13, 1948

4 Sheets-Sheet 1

Fig. 2.

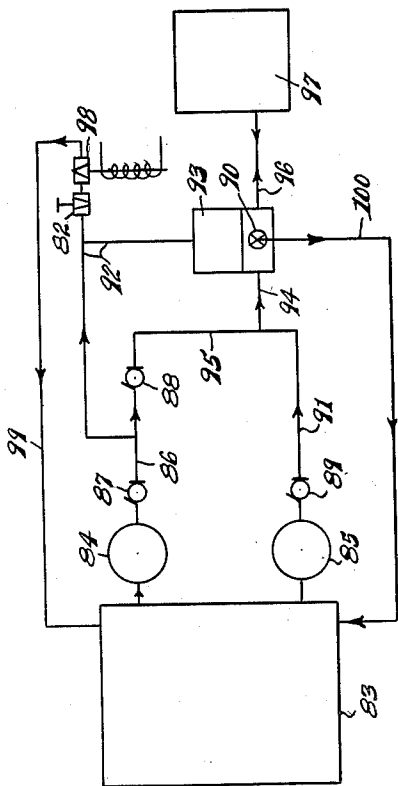
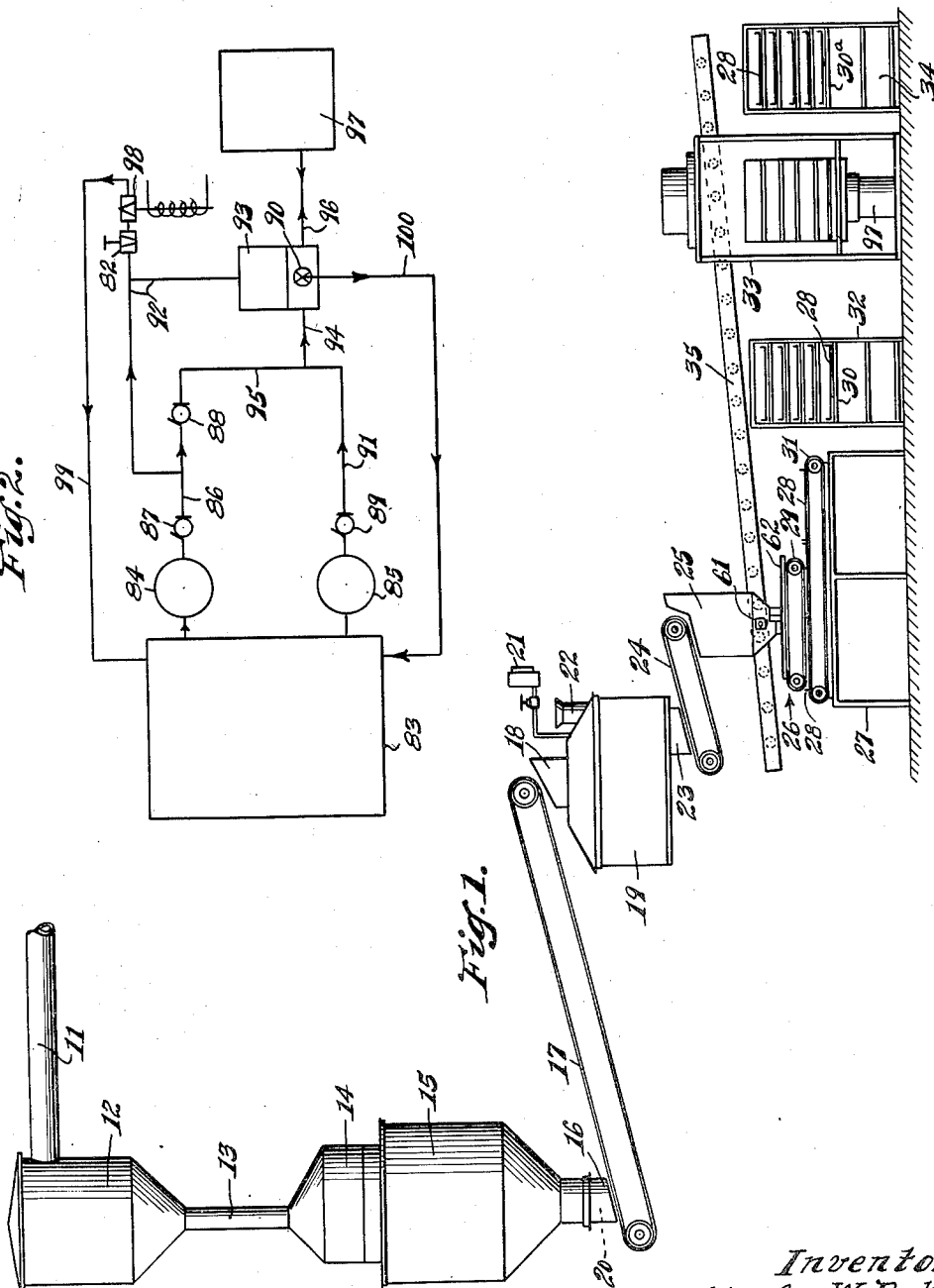


Fig. 1.



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4 Sheets-Sheet 2

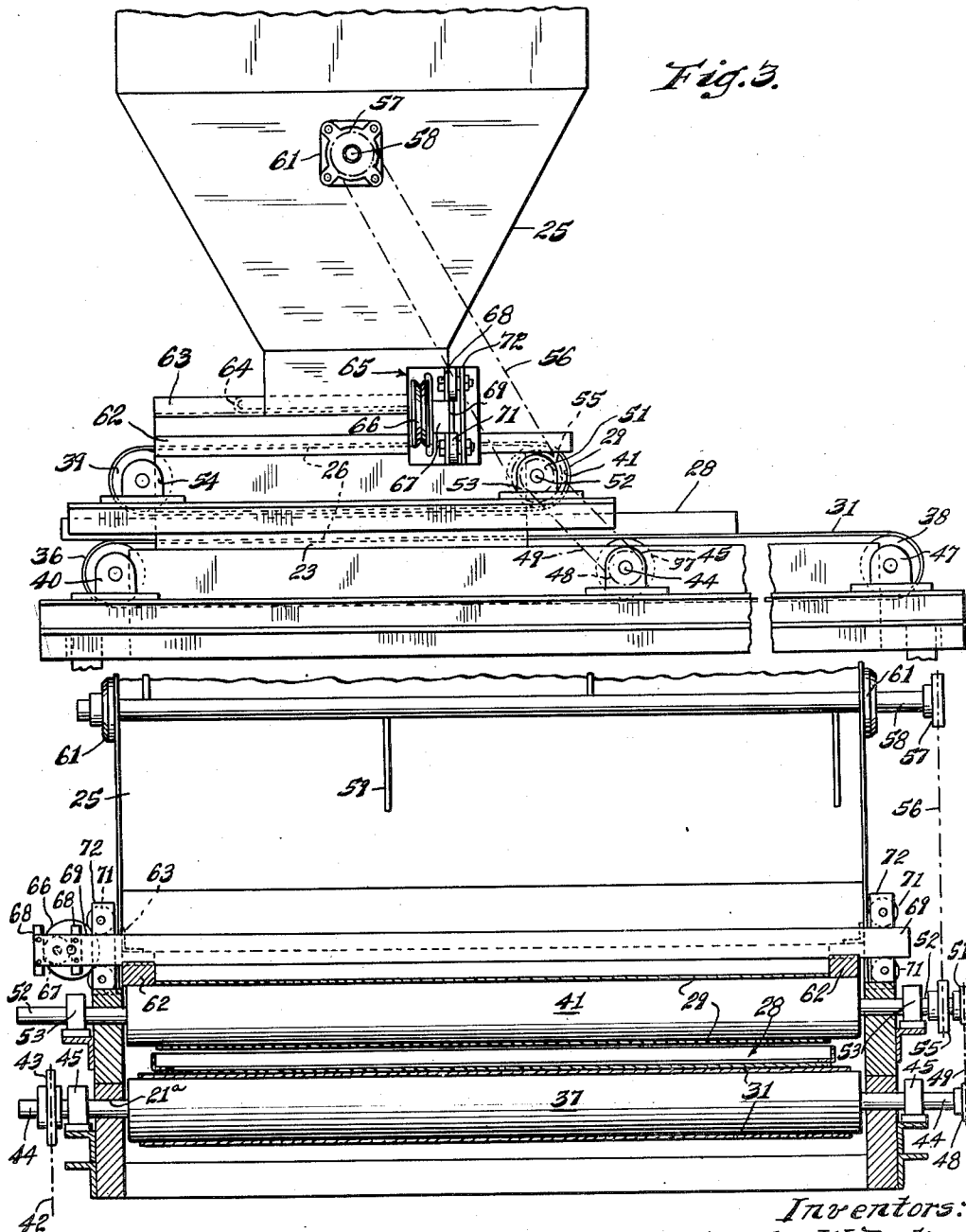


Fig. 3.

Fig. 4.

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4 Sheets-Sheet 3

Fig. 6.

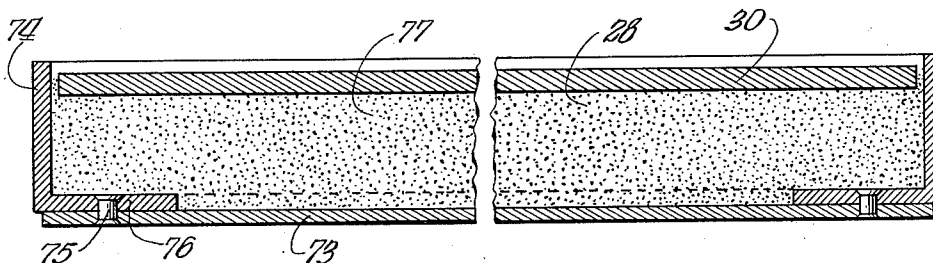


Fig. 7.

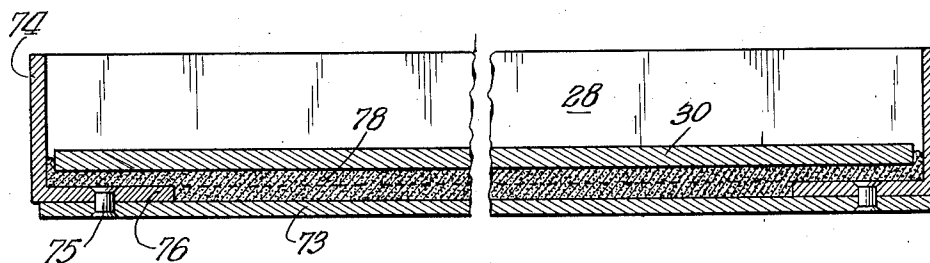


Fig. 8.

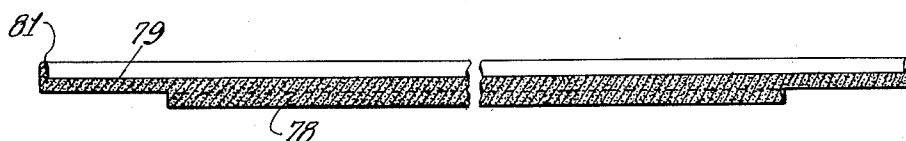


Fig. 9.

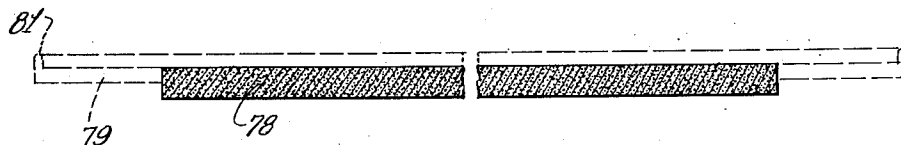
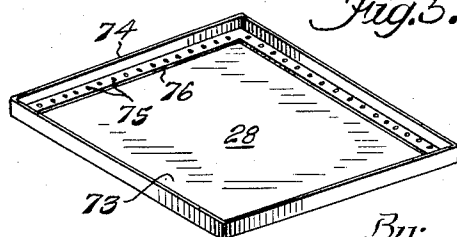


Fig. 5.



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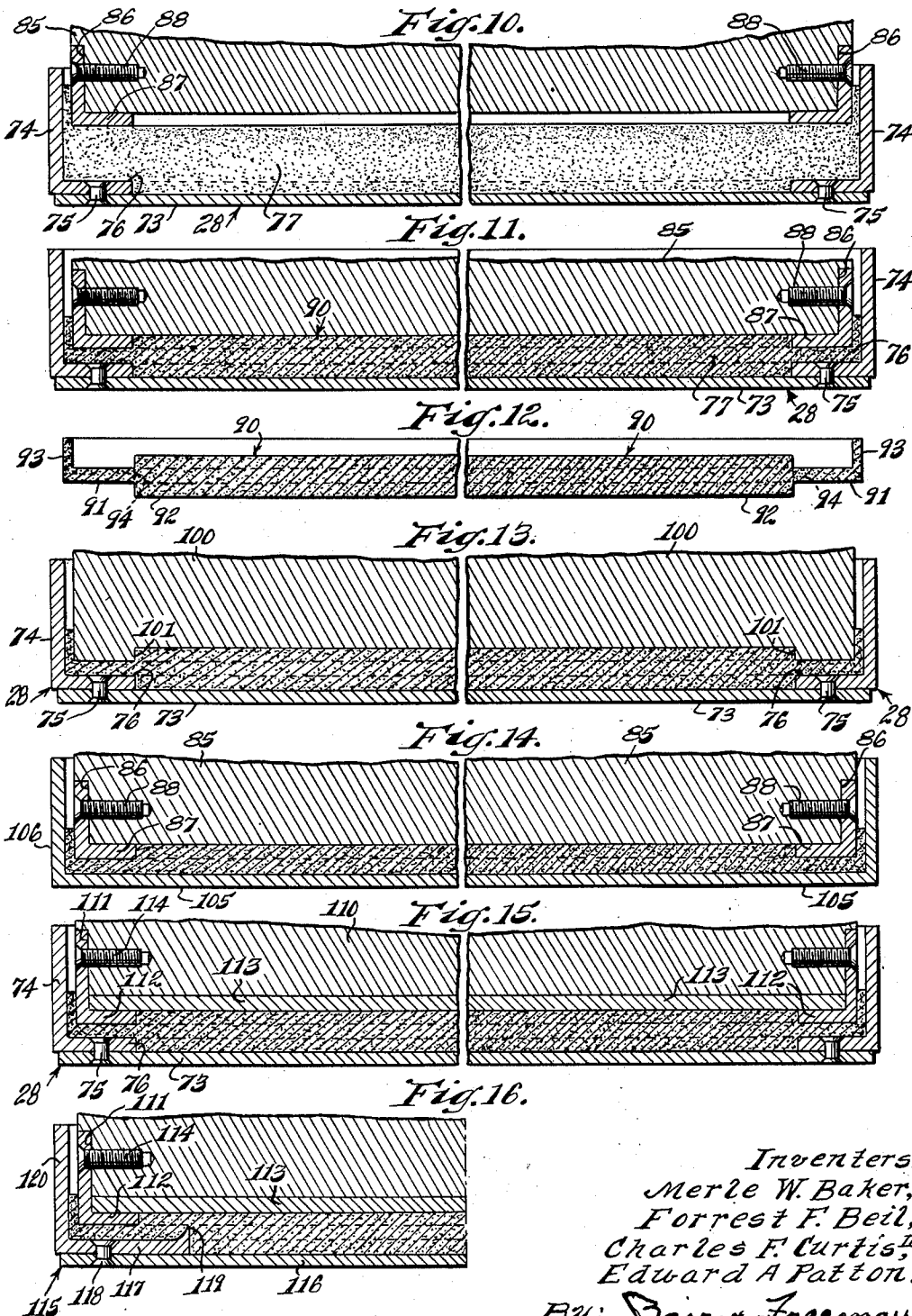
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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,583,249

APPARATUS FOR MANUFACTURING
BOARDS OF COMPRESSED CELLU-
LOSE MATERIAL AND THE LIKE

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Application November 13, 1948, Serial No. 59,903

2 Claims. (Cl. 18—16)

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This invention relates to molding apparatus including pans for compressing granular material to form boards or the like.

Reference is made to our copending application Serial No. 28,158, filed May 20, 1948, and entitled "Board of Compressed Cellulose Material and Method for Manufacturing the Same." This copending application shows a method of preparing cellulosic board material which comprises subjecting a layer of mixed disintegrated wood and a thermosetting resin to heat and pressure. The margins of said layer are compressed to from 40% to 60% of the thickness of the compressed mixture within said margins. Since the margins of the layer are compressed very much more than the remaining portions of the layer, the moisture content of the mixed wood and resin is maintained practically constant and uniform throughout the pressing operation. In other words, the pressed margins or edges act as a seal to prevent the escape of moisture. There is, therefore, no tendency to warping or twisting after the pressing operation has been completed.

As explained in our copending application, the sealing of the edges by extra compression of the edges serves to hold water vapor in the material during the pressing and curing operation and thereby makes possible the manufacture of a panel having uniform strength, rigidity and other characteristics from the center of the panel all the way to the edge. Such uniformity not only prevents warping or twisting but is also an otherwise very desirable feature of the panels made by the apparatus of this invention.

We have now provided a press suitable for carrying out the method of said copending application. This press comprises a lower pan-like container for receiving granular material having a bottom and upstanding side walls and an upper press plate adapted to fit within said side walls. The container and the press plate together define a pressing or molding chamber determining the shape of the board being formed. More particularly, the container and the press plate are so formed that the marginal portions of the chamber defined therebetween have smaller height than the inner portion of the chamber, for instance, a height ranging from 40 to 60% of the height of the inner portion of said chamber.

It is therefore an important object of this invention to provide improved apparatus for the manufacture of boards or the like from com-

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pressed cellulose material or other similar compositions.

It is also an object of the invention to provide improved pans or containers for receiving granular wood or other cellulose material or other granular material in which pans the material is to be compressed.

Another object of the invention is to provide improved molding presses including pans or containers for receiving granular wood or other cellulose material or other granular material, in which presses the material is compressed more highly marginally than within said margins.

It is a further object of the invention to provide apparatus for producing boards from granular wood material or the like which will form panels having a seal around the edges thereof composed of material which is denser than the main body portion of the panel whereby the main body portion is sealed in during the pressing operation.

With these and other objects in view, the invention consists in the construction, arrangement and combination of various parts of our device whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in the claims and illustrated in the accompanying drawings, wherein:

Figure 1 is a diagrammatic view of apparatus utilized for effecting a complete process in the manufacture of wood panels from granulated wood or cellulose products;

Figure 2 is a diagrammatic view of the hydraulic system used for the hot press;

Figure 3 is a side elevational view of the pan-filling machine;

Figure 4 is a partial vertical sectional view of the machine shown in Figure 3;

Figure 5 is a perspective view of a pan which may be utilized in the pan-filling machine, which pan is ultimately utilized for forming the compressed product;

Figure 6 is an enlarged sectional view of the pan of Figure 5 with the material to be compressed therein, as it appears prior to compression, with a cover disposed on top of the material;

Figure 7 is an enlarged sectional view of the pan and cover of Figure 6, after the material has been compressed, with the material shown therein in compressed condition;

Figure 8 is an enlarged sectional view of the compressed material after it has been removed from the pan;

Figure 9 is an enlarged sectional view of the

material after it has been removed from the pan and the compressed edges cut off, the compressed edges being shown in dotted lines;

Figure 10 is a fragmentary vertical cross-sectional view, with parts shown in elevation, of the pan of Figure 5 as used in combination with an upper press platen of modified construction;

Figure 11 is a view similar to Figure 10 but showing the material within the pan in compressed condition;

Figure 12 is a sectional view of the compressed material molded in the apparatus of Figures 10 and 11 after the material has been removed from the pan;

Figure 13 is a fragmentary view similar to Figure 10 but showing an upper press platen of still another construction;

Figure 14 is a view similar to Figure 10 but showing a pan of different construction;

Figure 15 is a view similar to Figure 10 but showing still another modified press platen construction; and

Figure 16 is a view similar to Figure 10 but showing still another modified pan construction.

Referring specifically to the drawings for a detailed description of the invention, numeral 11 designates a conduit which conveys, preferably, waste material through a dust collector system. The waste material may contain a high percentage of knot sections. For example, the waste may consist of about 50% machine waste and about 50% knot sections.

The refuse or waste is delivered by the conduit 11 to a cyclone 12, which is preferably equipped with a magnetic separator (not shown) to remove any metal therefrom, which may cause sparks and possibly a fire. From the cyclone 12, the material is delivered through a conduit 13 to an ordinary commercial hammermill 14, which pulverizes or granulates the waste material and is equipped with a suitable screen (not shown) to deliver pulverized waste directly into a storage bin 15. This part of the process is continuous, the remainder being accomplished by a batch method. The storage bin 15 may be provided with an automatic shut-off device (not shown), which shuts off the delivery of waste through the conduit 11, when a predetermined level has been reached in the bin 15.

The pulverized material is fed through an outlet 16 from the bin 15 to a belt conveyor 17. A screw conveyor 20 is provided in the outlet conduit 16, and the belt conveyor 17 and screw conveyor 20 are synchronized electrically by any suitable means to introduce a predetermined amount of pulverized material into a waste measure 18. An automatic water valve 21 delivers a predetermined amount of water to each measured batch of pulverized material that is delivered to a muller or mixer 19. An inlet funnel 22 also communicates with the muller 19, and a predetermined amount of powdered or liquid resin or other binder is added to each measured batch of pulverized material. After mulling, this mixture is then dumped onto a belt conveyor 24 through an outlet conduit 23, and is delivered to a hopper 25 of the pan filling machine.

From the hopper 25, the pulverized and mixed material is delivered to a belt system, which is generally indicated by the numeral 26. The entire pan filling machine is supported on a table 27, and the pans which are filled by the machine are shown generally at 28. A continuous belt 29, and a second continuous belt 31, are provided for conveying the pulverized mixed material to the

bins, and for conveying the pans to a loading rack 32, respectively. It will be noted that the loading rack is provided with a number of shelves or supports 30a for the pans 28. From the loading rack 32, the pans are delivered either by manual or mechanical means to a hot press generally indicated at 33. The hot press itself is of modified standard design, and pressure is applied to the material in the pans, and at the same time the material is heated. When the compression step is completed, the pans with the compressed material therein are delivered to the unloading rack 34, which likewise has a number of shelves 30a for the reception of the pans 28. The pans are then removed from the rack 34, either manually or mechanically, and the compressed material is taken out of the pans by inverting them. The inverted pans 28 are then placed on a gravity roller conveyor 35, which terminates adjacent the pan loading mechanism.

Referring specifically to Figures 3 and 4 of the drawings for a detailed description of the pan filling machine, it will be noted that three rollers 36, 37 and 38 are provided for guiding and driving the lower continuous belt 31. Two rollers 39 and 41 are provided for guiding and driving the upper continuous belt 29. The roller 37 for belt 31 is driven by the chain 42, which engages a sprocket 43 connected to a shaft 44 for the roller 37. Bearings 45 are provided on each side of the machine for the shaft 44. The chain 42 is driven from any suitable source of power, such as an electric motor (not shown).

Two additional sets of bearings 46 and 47 are provided on each side of the machine for the rollers 36 and 38, respectively.

The shaft 44 for the roller 37 is provided with a sprocket 48 at one end thereof, which drives a chain 49 engageable with a sprocket 51, which is secured to a shaft 52 for the roller 41. A bearing 53 is provided at each side of the machine for the shaft 52, and a bearing 54 is provided at each side of the machine for the shaft or roller 39.

A second sprocket 55 is secured to shaft 52 and drives a chain 56, which engages with a sprocket 57 secured to a shaft 58 for driving a stirring device having stirring rods or fingers 59. The rotation of the fingers 59 maintains the mixed pulverized material in the hopper 25 in loose condition, so that it will fall by gravity onto the belt 29. Bearings 61 are provided on each side of the machine for the shaft 58 of the mixing device.

A member 62 is provided at each side of the machine adjacent the upper reach of the belt 29, in order to guide the belt, and also to prevent mixed pulverized material from spilling off the sides of the belt. Angle irons 63 are secured to the hopper 25, and a slide 64 is guided by the angle irons 63. Obviously, the slide 64 may be moved to open or close the outlet from the hopper 25 the desired amount, so that approximately the proper amount of mixed pulverized material will be delivered to the belt 29.

A doctor bar assembly is shown generally at 65, and comprises a pulley 66 adapted to be driven by a V-belt (not shown) from any suitable source of power, preferably the same electric motor which operates the other parts of the pan filling machine. A rotatable ball bearing member 67 is eccentrically connected to the pulley 66, and a pair of guide members 68 are engaged by the ball bearing member 67 to impart reciprocating motion to the doctor bar 69.

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to which the guide members 68 are secured. The doctor bar 69 is reciprocated between rollers 71 provided on both sides of the machine. The rollers are supported in a pair of brackets 72. The doctor bar 69 is preferably serrated.

Referring now to Figures 5 to 9, inclusive, for a detailed description of the pans 28, the pan is formed, preferably, of aluminum, because of its lightness and heat conductivity. Furthermore, the aluminum is of fairly thick gauge and does not have too much tendency to warp under heat. Also, there is very little tendency for the compressed material to stick to the aluminum surface. Obviously, however, other metals may be used for the pans, such as brass or iron.

The pan 28, preferably, comprises a flat base member 73, which has an angle shaped flange 74 secured thereto, as by rivets 75. The horizontal portion 76 of the angle 74 overlies the base plate 73, for a purpose hereinafter described.

The mixed pulverized or granulated material is shown in Figure 6 by the numeral 77. The compressed board, as it is removed from the pan, is shown in Figures 7 and 8 by the numeral 78. When the compressed board is removed from the pan, a thin flange 79 is formed completely around the main portion of the board, because of the fact that the horizontal angle 76 of the angle piece 74 extends above the base 73. As shown in Figure 9, the thin border 79, together with a slightly upturned edge 81, which is formed between the cover 30 and the sides of the angle member 74, are removed so that a board of uniform thickness results. The portions 79 and 81, which are then removed, preferably by sawing, may then be returned to the waste or refuse material and repulverized.

Referring now to Figure 10, there is shown a pan 28 such as that described hereinabove filled with a layer of material 77 to be compressed. An upper press platen 85 has its lower outer margin recessed as at 86. An angle iron 87 has one leg fitted in said recess with its outer surface flush with the outer surface of the press platen. A screw 88 may be used to hold the angle 87 on the platen 85. The other leg of the angle iron overlies the outer margin of the lower surface of the press platen in opposed relationship to the horizontal angle 76 of the angle piece 74. Thus, when the material 77 has been compressed, as shown in Figures 11 and 12, to form a pressed panel generally designated by the reference numeral 90, this panel will be characterized by a thin flange 91 formed completely around the main portion 92 of the board and having its upper and lower surfaces offset from the upper and lower surfaces of the main portion. The panel 90 may further include a thin upturned edge 93 rising from the outer edge of the flange 91 and formed between the vertical angle of the angle piece 74 and the vertical leg of the angle 87. As shown in Figure 12, the flange 91 and edge 93 may be severed from the main portion 92 along the dotted lines 94, to leave a board of uniform thickness.

The angle iron 87 is removable, so that angle irons having horizontal legs of any desired thickness may be used.

Figure 13 shows a combination of the pan 28 such as that disclosed hereinabove with an upper press platen 100 having a depending marginal flange 101 opposed to the horizontal angle 76 of the angle piece 74. This combination functions exactly as the combination shown in Figure 10,

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apart from the fact that the depending flange 101 is not removable.

Figure 14 shows a combination of an upper press platen 85 such as that shown in Figure 10 with a pan having a flat bottom 105 and upstanding side walls 106. When this combination is used for compressing a mixture of granulated wood and resin, the compressed margin will have its bottom flush with the rest of the compressed panel but its upper surface offset downwardly from the rest of the panel.

Figure 15 shows a combination of the pan 28 such as that described hereinabove with an upper press platen 110 having its outer margins recessed as at 111 to receive an angle piece 112 having a vertical leg flush with the outer surface of the press platen and a horizontal leg clampingly retaining a plate 113 against the lower surface of the press plate 110. A screw 114 may be used to retain the angle iron 112 in the indicated position.

The device of Figure 15 functions exactly as the device of Figure 10, apart from the fact that by using plates 113 of different thicknesses and angle irons 112 having vertical legs of different lengths, the apparatus of Figure 15 can be used for producing boards of any desired thickness.

Figure 16 shows a combination of an upper press platen 110 such as that described hereinabove with a pan generally indicated at 115 and including a flat bottom portion 116 and an angle iron having a horizontal angle piece 117 overlying the margins of the bottom 116 and affixed thereto as by rivets 118. The inner edge of the angle piece 117 is formed with an upstanding sharp edge 119. The sides of the pan 115 are formed by the vertical angle piece 120 of the abovementioned angle iron. The apparatus of Figure 17 functions exactly as that described in Figures 5 through 9 apart from the fact that when the material is compressed, as shown in Figure 17, not only is the marginal material compressed more than the material within the margin, but the cutting edge 119 shears through, for instance, about $\frac{1}{8}$ of the thickness of the pressed panel. Thus, when the pressed panel has been removed from the pan 115, the dense edge of marginal portion outside the cutting edge 119 can easily be broken off whereby the trimming operation described hereinabove is eliminated.

The following materials have been found to provide a very satisfactory board formed of compressed wood or other cellulose type material. Disintegrated wood or any species of tree may be used. Very satisfactory results have been obtained with pine wood. Preferably at least 50% of the wood is disintegrated to a 16 to 40 mesh particle size.

The resin employed is preferably one having a flow point not higher than 125° C. The resin may be a thermosetting resin capable of flowing for an appreciable period of time before it is cured or set in the press and capable of acting as a bonding agent for the wood particles. We prefer to use a resin having a curing time of from 40 to 100 seconds at 150° C. resins of various chemical compositions share these characteristics. We can use, for instance, resins of the phenol-formaldehyde type or the urea-formaldehyde type, or furfural resins and the like. Obviously, resins characterized by excessive tendency to absorb water or by insufficient resistance to weathering agents or having other undesirable characteristics should not be employed. We have successfully used, inter alia, three

phenol-formaldehyde resins characterized by the following flow points and cure times:

Resin	Seconds Cure at 150° C.	Flow Point ° C.
A-----	80-100	110-125
B-----	45	85- 90
C-----	55- 65	95-105

It is understood that the thermosetting resins herein referred to are capable of curing or setting under the conditions of the pressing operation. In other words, the binding agents employed may or may not be resinous when initially incorporated with the granulated wood but are definitely present as resins in the finished boards. We may therefore employ binding compositions made up of resin-forming materials in any resin-forming stage short of the final or cured or set stage. The resinous binding agent may be employed in wet or dry condition. We prefer to use a solid finely pulverized resin-forming composition, since such products are most easily and most uniformly blended or mixed with the wood particles. Nevertheless, we can also employ moist or dissolved or dispersed resin-forming compositions, due regard then being had for the moisture content of the resin-forming composition when making up the mixture to be pressed.

The amount of resin employed may range upwardly from 4% or 5% of the mixture being pressed. We prefer to employ from 5% to 8% resin. When a dry powdered phenol-formaldehyde resin is used, very satisfactory results have been obtained at a resin content of from 6% to 7%. While there is no critical upper limit for the resin content, it should be remembered that a particular feature of the present invention is the provision of a cellulosic board of high structural strength containing much less resin than sawdust boards heretofore prepared. Hence, and solely from a cost standpoint, we prefer to keep the resin content at from 5% to 8%. Obviously, the exact amount of resin to be used will vary somewhat according to the specific nature of the particular resin being used. In general, more resin is used when the wood is more finely disintegrated.

The water content of the pressing mixture is maintained at from 5% to 25%, depending on the pressure employed in the pressing operation. At lower moisture contents, the boards obtained are characterized by excessive thickness, structural weakness, excessive porosity, the presence of voids in the interior of the board and by pitted surfaces, even when relatively high pressures are used. At moisture contents in excess of 25% there is a tendency for the boards to stick or adhere to the mold walls and to the formation of blisters or even explosive disintegration of the board on release of the pressure, whether or not such release is accomplished slowly, if sufficient pressure has been used to form a firm board. The correlation between the moisture content and the pressure is discussed hereinbelow. Ordinary wood waste accumulated in mill work operation commonly contains about 6 to 8% moisture. This moisture content is taken into account when the total moisture content of the pressing mixture is calculated.

It should be understood that besides the above enumerated ingredients, other materials may also be incorporated with the pressing mixture. Such added material may include pigments such as titanium dioxide, iron oxides and the like,

inert fillers such as chalk or barium sulfate, materials commonly used as fillers or extenders for resins, finely divided carbon and many other materials.

The above disclosed ingredients of the pressing mixture are mixed with each other at a temperature below the flow point of the resin.

The pressure applied during the hot pressing operation ranges from 150 to 400 pounds per square inch or higher and is correlated with the moisture content of the pressing mixture according to the following table:

Pressure in Pounds per Square Inch	Broad Range	Moisture Content Preferred Range	Example
	Per Cent	Per Cent	Per Cent
150	20-25	22-25	25
200	15-25	17-23	20
300	10-20	12-18	15
400	5-15	7-13	10
400	5-10	5- 8	7

The exact pressures and moisture contents to be employed will vary, within the tabulated limits, according to a number of factors such as the thickness, strength and density required or desired in the finished board. Obviously, these characteristics vary according to the end use of the finished board. Further, moisture contents and pressures will vary somewhat, within the tabulated limits, according to the nature and prior preparation of the wood, the nature and amount of specific resin employed, and like factors. In making boards suitable for most, if not all purposes, on a large scale, we prefer to use a pressing mixture containing from 12 to 15% moisture, and to press this mixture at from 300 to 400 pounds per square inch, using a powdered phenol-formaldehyde resin as binding agent in an amount ranging from 5 to 8%. Thus, a batch of material to be pressed may have the following composition:

- 86.3% by weight pulverized mill waste
- 7.7% by weight water
- 6.0% by weight powdered phenol-formaldehyde resin having a flow point of 110°-125° C. and a cure time of 80-100 seconds at 150° C.

The correlation between the moisture content of the pressing mixture and the pressure may also be tabulated as follows:

Moisture Content in Per Cent	Pressure in pounds per square inch	
	Minimum	Preferred Maximum
20-25	150	200
15-20	200	300
10-15	300	400
5-10	400	500

As explained hereinabove, the pressure is at least sufficient, at the prevailing moisture content and temperature, to cause the wood to be plasticized and at the same time not great enough to cause blistering when the pressure is released slowly.

The temperature of pressing is at least 280° or 300° F. A temperature of 338° F. insures very satisfactory results with the above disclosed specific mixture. In general, the temperature must be sufficient to bring about curing or setting of any thermosetting resin employed. The time of pressing should be sufficient to bring about cur-

ing or setting at the prevailing temperature. Ordinarily, from about $3\frac{1}{2}$ to 10 minutes' pressing time is sufficient. With the above disclosed specific mixture, a pressing time of 5 minutes has been found satisfactory. The full pressure should be applied at the beginning of the pressing operation, to insure flow of resin before the resin is cured or set. When longer pressing times and higher temperatures are employed, the resulting board material will be more stable dimensionally under varying humidity conditions, i. e. the material is less hygroscopic.

The pans or other molds may be coated with magnesium stearate to prevent adherence. For the same purpose, the molds may be preheated, say, to 150° to 175° F. before the press mixture is introduced.

In the pressing operation, the margins on the layer being pressed are compressed to about 40% to 60% of the thickness of the middle portions of the finished board. Some warping tendency is evident if the margins are compressed to less than 60% of the thickness of the remainder of the board. Wood cannot be compressed to less than about $\frac{1}{3}$ of its original thickness. Hence, when the edges or margins have been compressed to about $\frac{1}{3}$ of the thickness of the remaining portions of the board, these margins act as stops preventing further compressing of the middle of the board. Preferably, the margins are compressed to about 45% to 55% of the thickness of the middle portions of the board. In the case of the above disclosed specific mixture, very satisfactory results have been obtained by compressing the margins to one-half of the thickness of the remaining portions of the board. In the case of a panel 4 ft. square, compressed margins 1" wide function very satisfactorily to seal the moisture content of the pressing mixture.

Referring specifically to Figure 2 of the drawings, a hydraulic system for operating the hot press 33 is there shown. The hydraulic system is conventional in its makeup, with the exception of the fact that a needle throttling valve 82 is provided for a purpose to be described.

The system comprises an oil supply tank 83, to which is connected a high pressure pump 84 and a high volume pump 85. A pipe line 86 is connected with the outlet of the high pressure pump, and has two normally closed valves 87—88 therein. A normally closed check valve 89 is provided in an outlet pipe 91 from the high volume pump 85. A pipe line 92 is connected between the valves 87 and 88 to a cylinder drain valve chamber 93. Likewise, a pipe 94 is connected to a pipe 95 extending between the valves 88 and 89 and pipe 94 is also connected to the cylinder drain valve chamber 93. The pipe 96 then connects the cylinder drain valve chamber 93 with a hydraulic piston 97, which provides the required pressure for the hot press 33.

The press 33 and the hydraulic system are provided with a standard electrical timer (not shown), which maintains a high pressure on the hydraulic piston 97 until the pressing is completed. At this time, a solenoid operated valve 98 is partially opened. The needle valve 82 functions as a pilot valve for the valve 98 and is adjusted so as to provide a very small opening. The high pressure hydraulic fluid from the hydraulic piston 97 slowly passes back through the pipe 96, through one branch of the pipe 92, through needle valve 82, through the partially open solenoid operated valve 98 and back to the oil supply tank through a pipe 99. Since the

valve 82 is so adjusted as to permit the fluid to flow slowly into the main valve, a number of seconds will elapse while the initial pressure is being reduced. As soon as the pilot valve 82 is full of hydraulic fluid, the main valve 98 is opened completely and the press opens rapidly. A pipe 100, having a hand valve 90 therein, connects the cylinder drain valve chamber 93 with the oil supply tank 83 for the obvious purpose of draining the cylinder of the hydraulic piston 97 when desired.

Since there is considerable internal steam or superheated water in the panel 78 during the pressing process, the panel 78 is liable to blister or explode if the press is permitted to open instantaneously. With the needle valve 82 installed as shown, and adjusted to a very small opening, the high pressure oil is forced to pass through the small opening when the solenoid valve 98 trips or opens. Therefore, several seconds are required for the pressure to be reduced on the press 33, thus causing a gradual release of pressure in the board and eliminating blistering and possible exploding of the panel 78.

Operation

The operation of the apparatus and process has already been described up to the time that the mixed pulverized material is delivered to the hopper 25. Also, as stated before, the mixing device 59 maintains the granulated material in loose form. The slide 64 is first adjusted to control the amount of mixed pulverized material which is to be delivered to the belt 29. Obviously, the thickness of the material which is eventually delivered to the pan 28 will primarily control the thickness of the finished board 78.

The pans 28 are filled with a uniform depth of pulverized material, regardless of any warping or twisting of the pan, to produce a finished panel of uniform density, thickness and hardness. This is accomplished by delivering a predetermined thickness of the material on the belt 29 carried by the two upper rollers 39 and 41. The belt 29 carries the material toward the right, as viewed in Figure 3, so that the material is discharged from the right hand end of the upper reach of the belt 29 into the pans 28. The pans 28 are carried along successively toward the right or toward the left, as viewed in Figure 3, by the upper reach of the belt 31. As stated before, the belt 31 is carried and driven by the three lower rollers 36, 37 and 38. The speed of the belts 29 and 31 is synchronized to produce a uniform thickness of mixed material in the pan. When the two belts 29 and 31 move in opposite directions, fine material does not tend to stratify in the pans 28, as may happen when the two belts move in the same direction.

As the material falls from the hopper 25 onto the belt 29, the doctor bar 69 is reciprocated back and forth to smooth off the material and insure that the proper thickness is delivered to the trays 26. The doctor bar 69 is adjustable vertically by any suitable means (not shown), in order to vary the thickness of the material which is delivered to the belt 29. Obviously, it is not desirable to deliver too much excess material to the belt 29. The slide 64 permits the operator to control this factor.

If the thickness of the material delivered to the belt 29 is uniform, then a uniform thickness of material will cover every part of the bottom of the pan 28. Therefore, if the pan is warped, the amount of material delivered to the warped

portion is unchanged, and the thickness and density of the product will be the same throughout.

The moisture is retained within the panel during the compressing process by the leg 76 of the angle 74, and/or by the leg 87 of the angle 86, and/or by the flange 101 of the press platen 100 and/or by the horizontal leg of the angle 112. After the pans have been filled with the material to be compressed, obviously, they are carried into the hot press 33, the covers 30 having been placed over the pans so that they may be forced downwardly into each pan when proceeding according to the specific method illustrated in Figures 5 through 9.

Since the metal leg 76 cannot be compressed, the portion of the panel immediately above it is compressed considerably more than the remainder of the panel, producing an extremely dense edge 79-81 around the panel, which prevents the escape of an excessive amount of steam and moisture during the pressing process. A seal results around the edge of the panel, and in addition to preventing the escape of moisture, also maintains uniform moisture distribution throughout the panel during pressing. Uniform moisture distribution brings about uniform physical characteristics in the finished panel and, in particular, minimizes internal strains in the panel, resulting in a flat panel with a minimum tendency to bow or curl due to internal strains resulting from unequal distribution of moisture during pressing.

Similar results are obtained when proceeding according to the methods illustrated in Figures 10 through 17.

Another difficulty encountered in retaining the steam in the panel during the pressing operation is the tendency of the panel to explode, due to internal steam pressure, when the pressure on the hot press 33 is released. This has been overcome by installing a needle valve 82 in the hydraulic system of the hot press to permit very gradual release of pressure on the panel, as explained above.

From the foregoing it will be apparent that we have provided an improved method and apparatus for forming dense board from granulated or pulverized wood or other cellulose material.

Changes in construction may be made without departing from the real spirit and purpose of our invention and it is our intention to cover by our claims any modified forms which may be reasonably included within their scope without sacrificing any of the advantages thereof.

We claim as our invention:

1. A container for receiving granular material to be pressed into the form of a board, said container comprising a substantially flat bottom member, side walls extending upwardly from the

periphery of said flat bottom member to form a pan-like structure, and a flange overlying and disposed parallel to said bottom member adjacent to said side walls for effecting greater compression of marginal portions of a layer of said granular material when compressed in said container as compared to a central portion of said layer extending inside said flange, said flange being provided with an upstanding cutting edge extending around the inner edge of said flange to a height no greater than the upper lever of the board formed by compression of said material in said container and thus operative to define a depressed score line in said board extending at the transition from the more highly compressed margins of said board to the less highly compressed central portion of said board.

2. A press for pressing granular material into the form of a board, said press comprising a lower press member including a substantially flat bottom member and side walls extending upwardly from the periphery of said flat bottom member to form a pan-like container; an upper press member capable of entering said pan-like lower container and defining in cooperation therewith a pressing chamber in which said granular material is compressed; and a flange member disposed within said pressing chamber adjacent the sides thereof for effecting greater compression of marginal portions of a layer of said granular material when compressed in said pressing chamber as compared to a central portion of said layer extending inside said flange; said flange being provided with a cutting edge extending around the inner edge of said flange and projecting vertically into said pressing chamber for a distance no greater than the thickness of said more greatly compressed marginal portions of said board and thus operative to define a depressed score line in said board extending at the transition from the more highly compressed margins of said board to the less highly compressed central portion of said board.

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