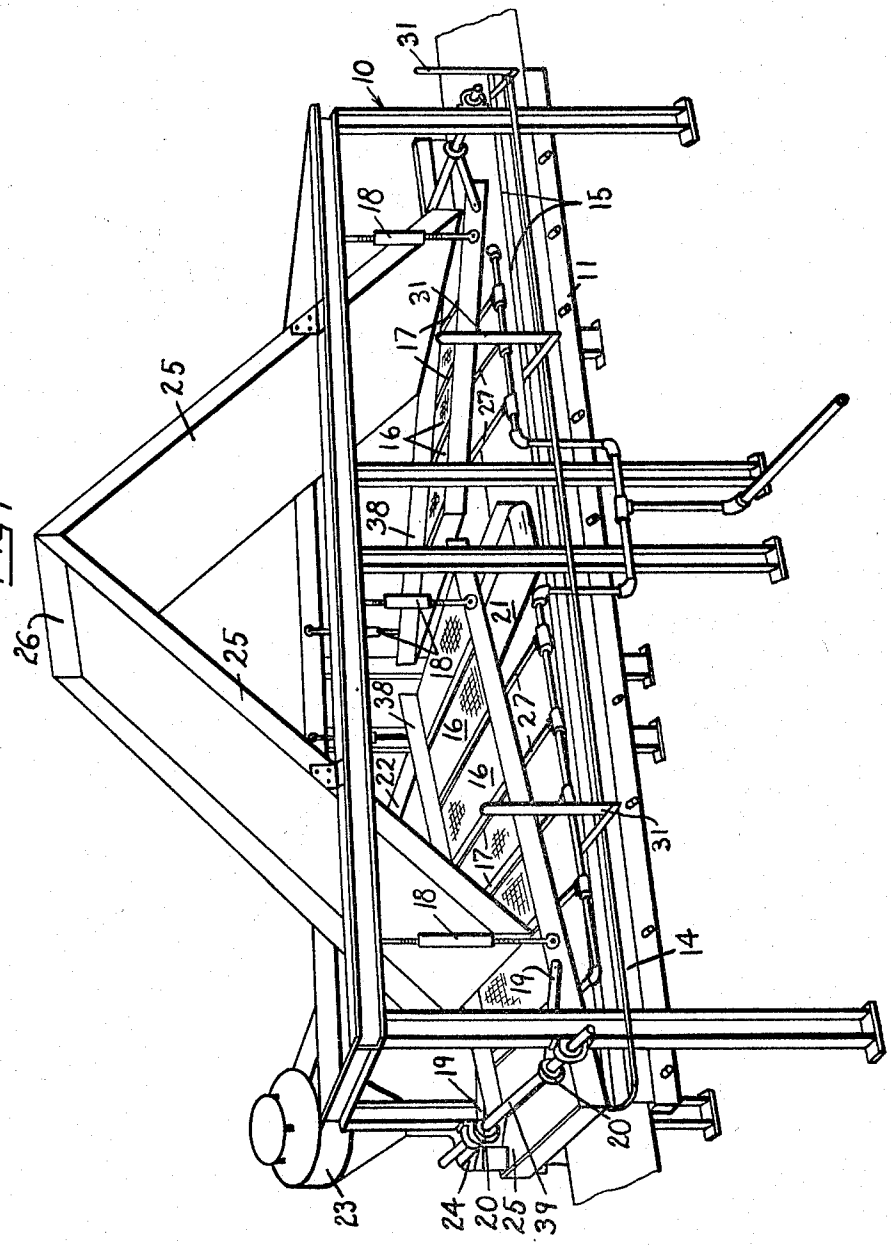
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MANUFACTURE OF PARTICLE BOARD.

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Fig 1




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Fig 2

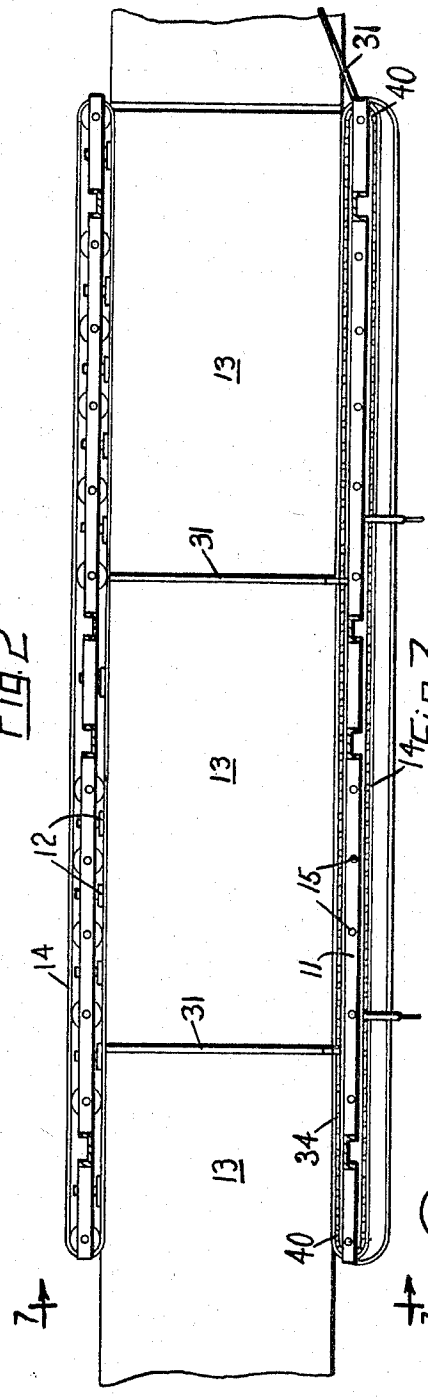
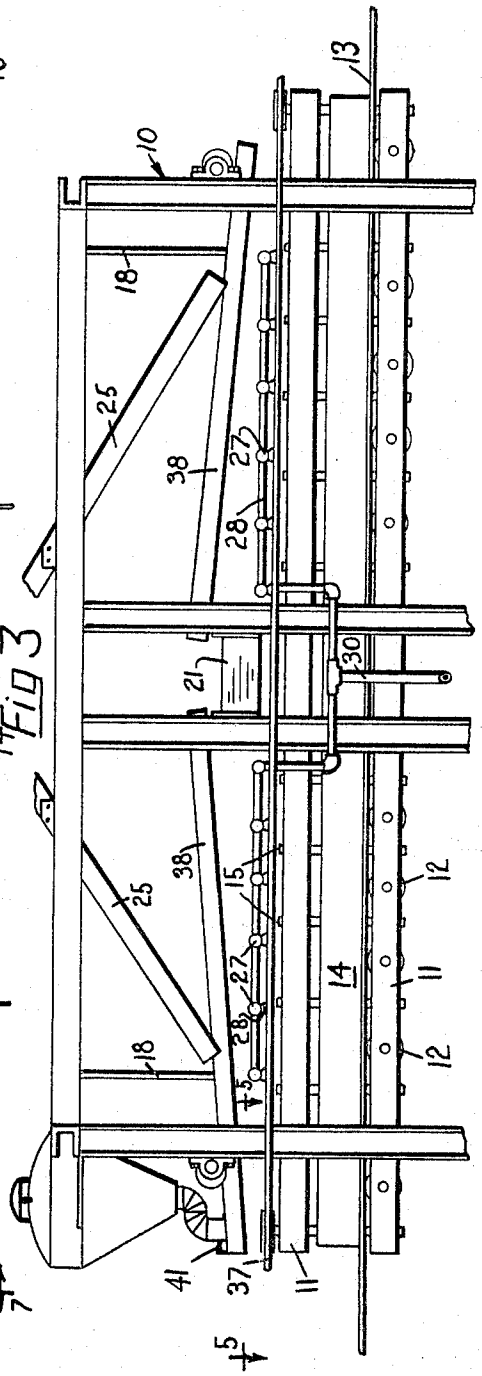



Fig 3




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MANUFACTURE OF PARTICLE BOARD

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Fig 4

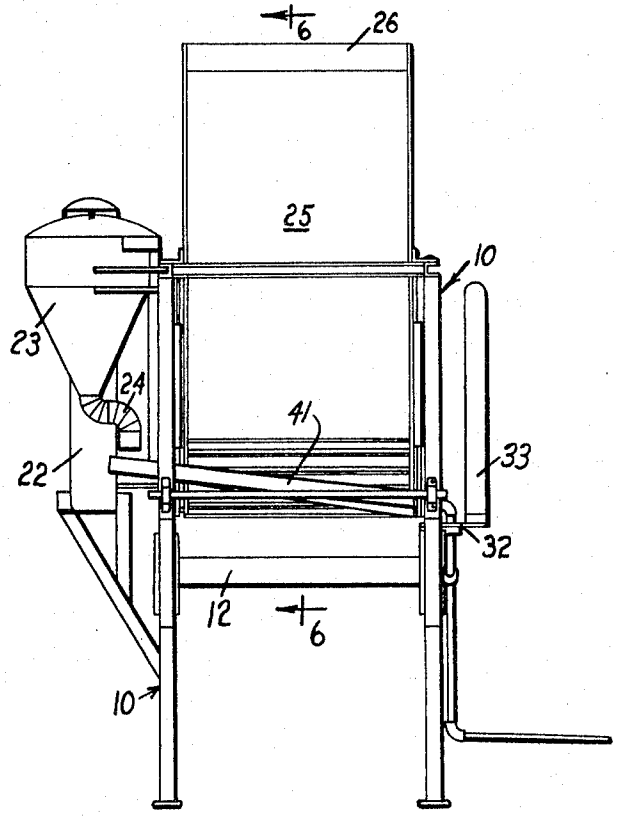
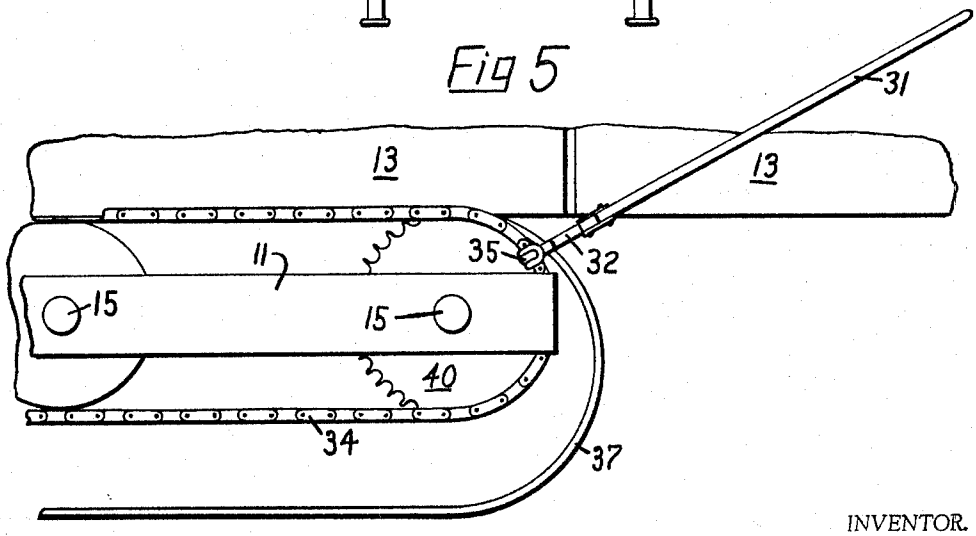



Fig 5



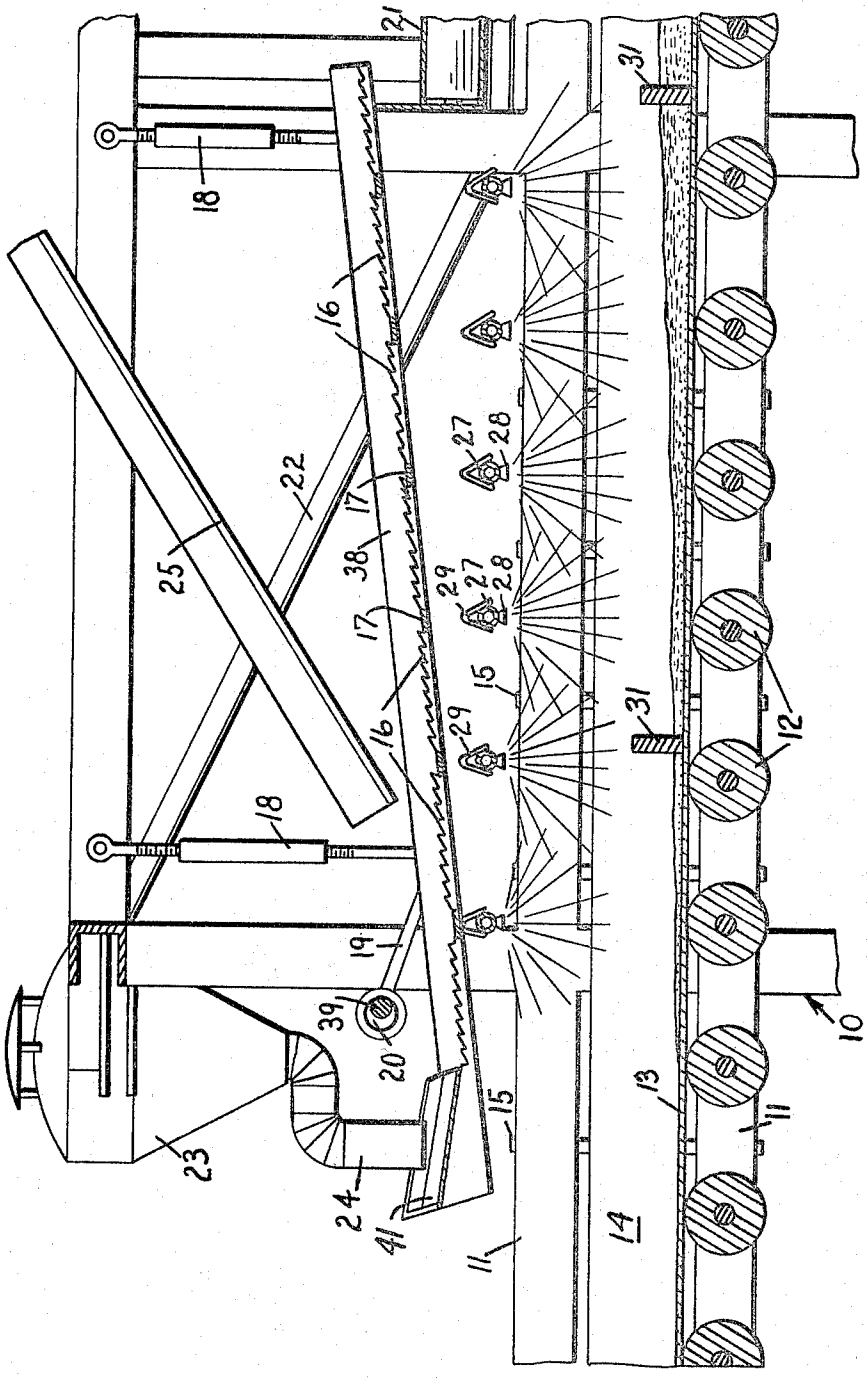

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Fig 6



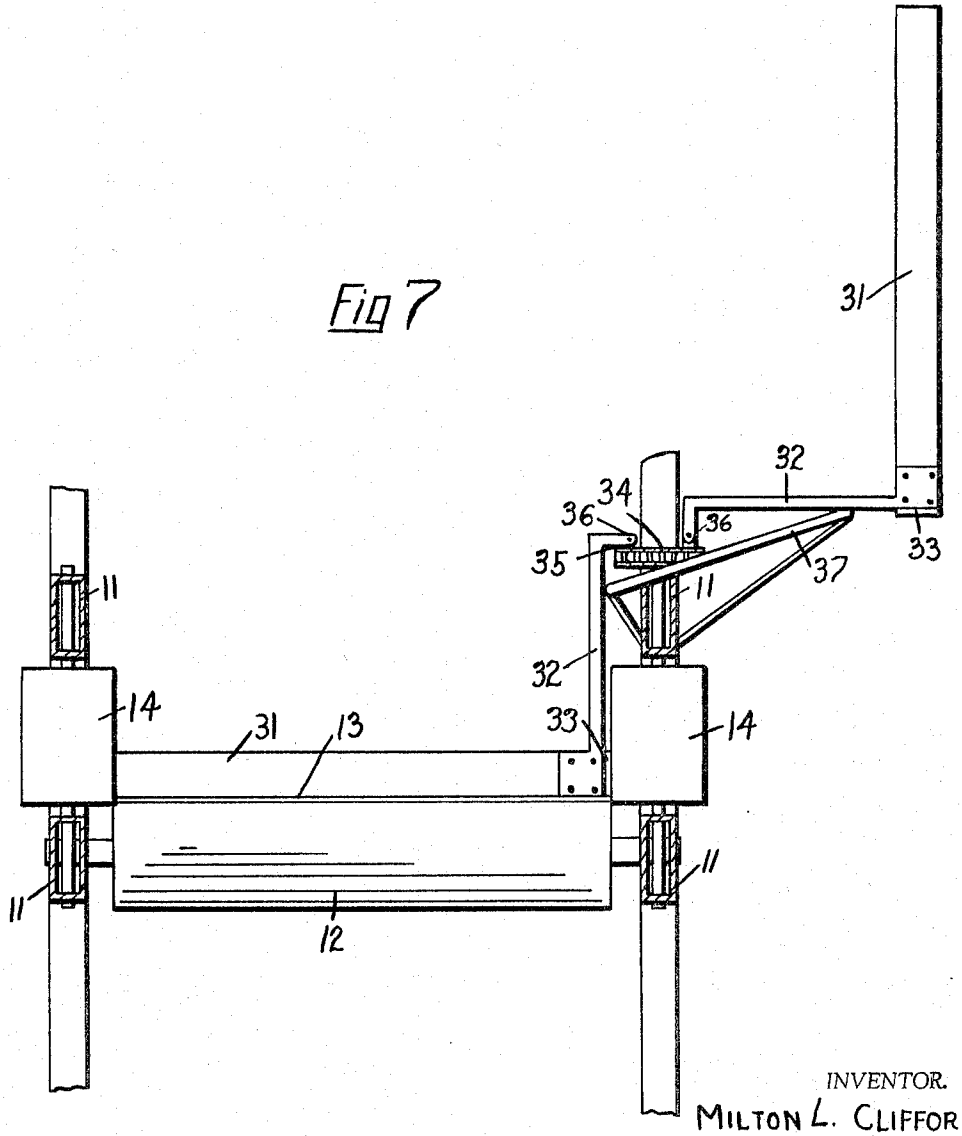

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Fig 7




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United States Patent Office 3,284,266 Patented Nov. 8, 1966



3,284,266

# MANUFACTURE OF PARTICLE BOARD

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Filed Sept. 24, 1962, Ser. No. 225,681
6 Claims. (Cl. 156—373)

This invention relates to the manufacture of particle board.

There have been many prior attempts, both commercially and experimentally, to produce board from waste wood particles so as to better utilize the entire tree. Such particle board has found acceptance for finishing purposes and as an insulating and sound proofing material. The present invention is concerned with a novel particle board designed to act as a lumber substitute, particularly in the building of walls. The board is designed to be manufactured from trees not otherwise commercially usable. Such trees may have very small growth due to overcrowding or may be of a species not suitable for lumber use. The present invention utilizes the entire trees, including needles, bark and roots. The tree is reduced to particles of various sizes which are then stratified in distinct layers to produce a finished board having a varying density through its thickness. More specifically the board has extremely dense and hard outside surfaces and a less dense and soft center. Such a board has unique structural qualities and further acts as an efficient insulating medium.

It is a first object of this invention to provide such a board having the above qualities and being adaptable to normal building procedures such as are used in the contruction of walls in both residences and commercial buildings. The board has a unique appearance due to the full utilization of needles and bark from the harvested trees. The coloration of the outside surfaces may be shaded or lightened to any degree required.

Another object of this invention is to provide a novel process of stratifying particle board so as to prevent the particles of one layer from becoming interspersed with those of adjacent layers. This process is designed to maintain the stratification throughout the processing of the particle board.

Another object of this invention is to provide a simple apparatus for carrying out the manufacturing process and for manufacturing the particle board described above. The apparatus is adapted to produce the stratification of the particle layers and to maintain the layers undisturbed until the board has been cured and pressed.

Another object of this invention is to provide an apparatus which can fully utilize particles cut from an entire tree structure without waste of any particles. This is accomplished by a regenerative cycle wherein particles initially unusable in the apparatus are reprocessed so as to be finally fully utilized in the end product.

These and further objects will be evident from a study of the following description taken in conjunction with the accompanying drawings which show one exemplary apparatus for carrying out this invention and which illustrates the steps of my novel process as well as the nature of the particle board. It is to be understood that this apparatus is merely an example of the structure which might be used to carry out this invention and that it is not intended to limit or restrict the scope of the invention which is definitely set out in the claims following the written disclosure.

In the drawings:

FIGURE 1 is a perspective side view of the machine designed to carry out this invention;

FIGURE 2 is a top view of the caul deck shown in FIGURE 1, looking downward below the screens;

FIGURE 3 is a fragmentary side view of the machine illustrated in FIGURE 1;



FIGURE 4 is an end view of the machine illustrated in FIGURE 1 as viewed from the left hand end;

FIGURE 5 is an enlarged top view of one end of a side deckel and a caul plate;

FIGURE 6 is an enlarged vertical section view taken through the left hand half of the machine shown in FIGURE 1 and cut along line 6—6 in FIGURE 4; and

FIGURE 7 is an enlarged view taken along line 7—7 in FIGURE 2, illustrating the construction and operation of the caul dividing boards.

The present invention is concerned with the manufacture of particle board having a novel structure. The particular particle board with which this disclosure is concerned has a varying density through its thickness. The surfaces of the board are manufactured of extremely fine particles and therefore have a very dense and heavy structure which is capable of maintaining a polished finish. The particles increase in size toward the center of the board in definite stratified layers and at the center of the board there is an area of least density containing the largest particles. This board has wide utility as a construction material and is particularly adapted to use as a wall material, due to its insulating effects and its high density surfaces.

The process by which this particle board is stratified comprises successive steps of placing particles on a caul plate in distinct layers, each layer having a particular particle size. As each layer is formed the board being processed is successively subjected to the application of a binding agent which coats the newly placed layer and acts to prevent intermingling of new particles. This successive application of particles and binder maintains the stratification desired in the final product. In producing the particular board enumerated above, the particles first are extremely fine and increase in size until a maximum particle size has been utilized at the center of the board and then progressively decrease in size to the outside surface, which again is composed of extremely fine particles.

This process and the resultant product can be effectively manufactured from particles cut or ground from a complete tree, including bark, limbs, needles and roots. The process is particularly applicable to the harvesting of unwanted small trees and tree varieties, which are unwanted in the lumber industry. A mechanical harvesting arrangement is contemplated wherein the entire tree would be uprooted and carried to a processing unit where it would be ground into particles for chips of the sizes desired in the board. The bark and needles will naturally form very small particles and will therefore be found in the outer stratifications of the finished board. This will produce a coloration in the finished board which is extremely attractive. However, if such coloration is unwanted, wood particles may be used in one or both outside surfaces, as will be described below. Further it appears evident that either or both surfaces may be colored by bleaching, dying or other methods during the fabrication of the particles or during the fabrication of the board product.

One example of an apparatus adapted to carry out this invention is illustrated in the drawings. It includes a rigid supporting framework generally designated by the numeral **10** and including vertically spaced longitudinal rails **11** mounted along each side of the framework **10**. Extending transversely across the framework **10** and carried by the lowermost rails **11** are a series of longitudinally spaced rollers **12** which are driven in unison by a driving unit (not shown). The rollers **12** are designed to longitudinally support caul plates **13**, upon which the successive layers of particles are to be positioned. The particles will then remain on the caul plate **13** after leaving the disclosed apparatus and the caul plate **13** will serve as a supporting structure during the curing and pressing of the finished board. The rollers

12 therefore serve to maintain the caul plates 13 in a horizontal position and to effect longitudinal movement of the caul plates 13 relative to the framework 10.

In order to define the transverse sides of the particle board a pair of deckel conveyors 14 are provided at each side of the framework 10 and rest directly on the rollers 12. The deckel conveyors 14 are driven by rollers mounted on shafts 15 which are carried between the rails 11 at each side of the framework 10. The deckel conveyors 14 are driven at the same speed and in the same direction as the caul plates 13 and therefore form a moving side boundary for the particles which are placed on the upper surfaces of the caul plates 13.

Mounted above the rollers 12 and caul plates 13 are a series of screens 16. As illustrated, the screens 16 are located on two movable frames 38, although any number of independently movable frames might be used if desired. The screens 16 are separated longitudinally by partitions 17 which are solid and which extend transversely across the width of the screens 16. Each screen 16 has a different screen opening. Viewing FIGURE 6 which shows the left hand side of the machine shown in FIGURE 1, the screens become progressively larger in screen opening size from left to right. The screens 16 therefore provide a progression of particle sizes which can fall through the screen openings along the length of rollers 12. The right hand screens, shown in FIGURE 1, are oriented just oppositely to the left hand screens and become progressively smaller from left to right. Thus the largest particles fall to the caul plates 13 at the center of the framework 10 and the fine particles fall at the ends of the framework 10.

Each frame 38 is pivotally carried on the framework 10 by adjustable suspension links 18. The links 18 may be lengthened or shortened in order to vary the amplitude of the suspended motion of the frames 38. The frames 38 are maintained in motion by a crank arm 19 driven by an eccentric crank 20 on a driving shaft 39 which is operated from a suitable source of power (not shown).

At the center of the framework 10 is a conveyor 21 which extends transversely across the framework 10 and which is positioned below the discharge end of the screens 16 at each side of the framework 10. Thus particles having a size too great to fall through any of the screens 16 will be placed on the conveyor 21 and will be carried by the top flight thereof to an elevating conveyor 22 at the back side of the machine as seen in FIGURE 1 and FIGURE 4. Elevating conveyor 22 is any standard type of conveyor which will carry the chips from conveyor 21 to a mill 23 for reprocessing. The mill 23 may be any conventional mill or grinding unit which will reduce the size of particles fed thereto. The outlet of the mill 23 is a chute 24 which is directed to an inclined surface 41 which spreads the chips across the left hand screen 16, as illustrated in FIGURE 6.

Chips are initially delivered to the screen 16 by means of a pair of inclined chutes 25 leading from a vertical divider 26. Normally the chips or particles will drop from a hopper (not shown) above the dividing wall 26 and will therefore fall along the chutes 25 to a fine screen 16. The chips will then progressively move along the screens 16 and particles capable of falling through each screen 16 will be deposited thereunder upon the caul plate 13.

In order to produce a particle board, a chemical binder must be utilized to secure the particles of one another in a solid state. According to this invention, the binder is supplied through transverse pipes 27 fixed to the framework 10 vertically below the spacing partitions 17 between screens 16. The pipes 17 are provided with nozzles 28 which direct a constant mist of a suitable binding agent laterally and vertically. This mist is adapted to coat each particle falling from the screens 16. In order to accommodate the larger surface area of the fine particles, nozzles of greater capacity may be used at each end of the machine as shown, or the spacing between pipes 27 may be lessened. One function of the binding agent in this instance is to prevent the amalgamation of particles from one layer into the next. Since the mist is entirely below the screens 16, the screens 16 are not clogged by liquid. In order to insure that particles do not interfere with the operation of pipes 27, protective shields 29 may be applied to each pipe 27 so as to deflect the particles from the pipes 27. The various pipes 27 are supplied with binding material from a main supply pipe 30.



In order to lessen the expense of trimming the finished boards, it is desirable to provide a positive longitudinal boundary along each caul plate 13, as well as the lateral boundary provided by the deckel conveyors 14. This is accomplished by means of a separator board 31 which may be seen in detail in FIGURES 2, 5 and 7. The board 31 is simply a vertical board which extends across the caul plate 13 and which is carried by a supporting arm 32 at one side of the machine. A spacer plate 33 is provided on the arm 32 and is adapted to rest on the deckel conveyor 14. The boards 31 and arms 32 are carried along the length of the framework 10 by means of a horizontal chain 34 entrained about sprockets 40. The speed of the boards 31 is exactly that of the deckels 14 and caul plates 13 so that no relative motion occurs between these various elements.

The arm 32 of each board 31 is pivotally carried on the top of chain 34 by means of a bracket 35 and a hinge pin 36. Thus the arm 32, while positioned along the length of the chain 34, may be raised about a longitudinal axis. This is accomplished at each end of the machine by a cam track 37 which is adapted to fit within the space left by the spacer 33 and along which rides the arm 32 so as to attain a vertical position along the return flight of the chain 34. Thus the arm 32 is raised vertically from the caul plates 13 so as not to disturb the particles which will abut the board 31 during operation of the machine.

The operation of this machine should be evident from the foregoing description. Particles are continuously fed down the chutes 25 and onto the fine screens 16 at each end of the frames 38. The motion of the frames 38 causes these particles to sift through the screens 16 where possible, and further causes the particles too large to sift through the screens 16 to slide across the partitions 17 onto the next larger screen in size. Thus a continuous progression of particles is accomplished along the frames 38. The caul plates 13, which move continuously along the rollers 12, have deposited thereon a progressive series of particles becoming first greater in size and then diminishing in size. The very fine particles therefore are deposited at the outside surfaces of the board and the central thickness of the board is produced of increasingly larger particles so as to have less density than the surfaces.

The apparatus disclosed is adapted to process entire trees which have been ground as a unit. Normally initial processing will produce particles which are too large to pass through the screen 16 so as to produce a structurally sound particle board. Such particles will normally be wood particles, since bark and needles crumble very easily and will produce smaller particle sizes. These wood particles are then carried by the conveyors 21 and 22 to the mill 23 for further processing. After being finely ground these particles are then deposited on a very fine screen 16 at one end of the machine so as to produce one outside surface of the finished board. When the reprocessed particles are utilized at only one end of the machine a very clear surface is obtained at one side of the finished board which contrasts most effectively with the normally dark surface obtained at the remaining side of the board. However, if desired, the reprocessed particles may be deposited upon fine screens located at each end of the frame 10.

The application of the binding agent to the particles produces coated stratified layers of particles having a quite uniform particle size and prevents the inclusion of smaller particles into the crevices left in the larger particles. Thus the finished board is assured of dense outside surfaces having a less dense interior which attributes better insulating qualities to the board than can be obtained with natural wood structures.

It should be obvious from the description of the above process and the resulting product that many different devices could be utilized to carry out this process. The machine described therefore is merely exemplary and it is admitted that many changes could be made in its structure without deviating from the basic concepts embodied in this invention. Therefore the machine structure is not intended to limit or restrict the scope of this invention except as that structure is defined in the claims.

Having thus described my invention, I claim:

1. An apparatus for stratifying tree particles for use in the production of particle board, comprising:
- a supporting framework;
- caul support means on said framework adapted to maintain individual cauls in a horizontal position and to effect longitudinal motion thereof;
- screen means mounted above said caul support means, said screen means comprising a plurality of longitudinally adjacent screen sections having varying screen openings in a progressive size sequence along the length thereof, each section being separated from the sections adjacent thereto by transverse solid partitions;
- reciprocating drive means on said framework operatively connected to said screen means adapted to effect motion of particles on said sections progressively along the sections toward the section having the largest screen openings;
- delivery means located above said screen means adapted to deposit a mixture of tree particles upon a screen section having relatively small screen openings;
- and transverse binder supply means located intermediate the caul support means and said screen means vertically below each partition of said screen means adapted to direct a binding agent toward said caul support means in a laterally dispersed downward direction.

2. An apparatus as defined in claim 1 further comprising:
- vertical deckel means mounted on said framework adjacent each side edge of cauls moving along said caul support means;
- and means on said framework operatively connected to said vertical deckel means adapted to move said vertical deckel means at the same speed as the cauls.

3. An apparatus as defined in claim 1 further comprising:
- vertical deckel means mounted on said framework adjacent each side edge of cauls moving along said caul support means;
- and mechanical dividing means mounted on said framework for movement along said framework, said dividing means being adapted to extend transversely across the caul top surfaces so as to define the longitudinal boundaries of the particle board;
- and means on said framework operatively connected to said vertical deckel means and to said dividing means adapted to move said vertical deckel means and said dividing means longitudinally relative to said framework at the same speed as the cauls.



4. An apparatus as defined in claim 1 further comprising:
- particle reducing means adapted to reduce the size of particles processed thereby, including an inlet and an outlet for particles;
- first conveyor means on said framework leading from the exit end of said screen means adjacent the screen section having the largest screen openings to the inlet of said particle reducing means adapted to transfer particles too large to pass through said screen means;
- and second conveyor means on said framework leading from the outlet of said particle reducing means to a screen section having relatively small openings adapted to transfer reduced particles thereto.

5. An apparatus for stratifying tree particles for use in the production of particle board, comprising:
- a supporting framework;
- caul support means on said framework adapted to maintain individual cauls in a horizontal attitude and to effect longitudinal motion of the cauls relative to the framework;
- two series of individual screens mounted on said framework above said caul support means in longitudinal progressions, said screens of each series being of progressively larger aperture sizes from the ends of the framework toward the center;
- feed means on said framework adapted to direct particles to the screens at each end of said framework;
- means on said framework adapted to effect motion of particles on the screens toward the center of said framework;
- and transverse binder supply means located intermediate the caul support means and said screens vertically below each partition, said binder supply means being adapted to direct a laterally dispersed spray of binding agent toward said caul support means across the width thereof at a rate of application proportional to the surface area of the particles contacted thereby.

6. An apparatus as defined in claim 5, further comprising:
- particle reducing means adapted to reduce the size of particles processed thereby, including an inlet and an outlet for particles;
- first conveyor means on said framework leading from the exit ends of said screen series to the inlet of said particle reducing means adapted to transfer particles too large to pass through said screens;
- and second conveyor means on said framework leading from the outlet of said particle reducing means to a screen of one of said screen series adapted to transfer reduced particles thereto.


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