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Pallet and apparatus for forming a pallet with deep drawn legs

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Inventors
A method and apparatus for molding articles such as pallets from flake-like wood particles mixed with binder, the pallets housing a deck and integral molding legs. A loosely fitted mat of wood flakes is formed by depositing a first plurality of layers of wood flakes onto a supporting surface with a flake aligner provided for causing alignment of those flakes which will form legs of the pallet. A second plurality of layers are formed with a flake aligner provided for causing alignment of flakes which will form legs of the pallet and in a direction transverse to the direction of alignment of the flakes of the first layers.
PALLET AND APPARATUS FOR FORMING A PALLET WITH DEEP DRAWN LEGS

This is a continuation of U.S. patent application Ser. No. 456,050, filed Dec. 26, 1989 which is a continuation of U.S. patent application Ser. No. 227,007, filed Aug. 1, 1988, which is a division of U.S. patent application Ser. No. 879,737, filed Jun. 30, 1986 now U.S. Pat. No. 4,790,966.

FIELD OF THE INVENTION

The present invention relates to construction of molded wood particle products such as pallets used for material handling and to methods and apparatus for use in making such molded wood products.

BACKGROUND PRIOR ART

Due to the increasing expense of wood and lumber, efforts have been made to construct a pallet of the type for use in material handling from alternative materials such as wood chips, wood pulp and wood particles. Examples of pallets comprised of composite wood material are illustrated in the Coughy et al. U.S. Pat. No. 4,248,163 issued Feb. 3, 1981; and the Haataja U.S. Pat. No. 4,408,544 issued Oct. 11, 1983, assigned to the assignee of the present invention.

A method for molding articles such as wood pallets from loosely felted mats of wood flakes is also illustrated in the Haataja U.S. Pat. No. 4,440,708, issued Apr. 3, 1984 and in the Haataja U.S. Pat. No. 4,337,710, issued Jul. 6, 1982. Those patents illustrate a method and apparatus for molding composite wood flake pallets wherein a loosely felted mat of wood flakes is positioned on a lower press die. The loosely felted mat is comprised of elongated thin wood flakes with the flakes lying in horizontal planes and with the flakes having a random orientation in those planes. The die includes a plurality of cavities which form the integral downwardly extending legs of the pallet. Male die members of an upper die extrude the mat material down into the cavities in the lower die during compression of the mat to form the legs of the pallet.

During the compression of the mat, the wood flake material in the area of the die cavities forming the legs is extruded downwardly into the cavities. In applications where the legs are relatively long, there is substantial extrusion of the mat material into the die cavities, and in some applications, the mat material may be pulled apart to form voids in the compressed mat, and in some applications these voids result in localized weaknesses in the pallet.

SUMMARY OF THE INVENTION

The present invention is directed to an improved method and apparatus for forming a pallet comprised of compressed wood particles of the type wherein a loosely felted mat of wood flakes mixed with a binder is placed between dies in a press and compressed to form a load supporting deck and hollow legs extending downwardly from the deck, the legs being formed integrally with the deck. The method and apparatus of the invention provides an improved means for forming the legs of the pallet, particularly where the legs are sufficiently long that a relatively deep draw of the mat material is required to form the legs.

In one embodiment of the invention, the method includes the steps of providing a caul sheet having a configuration conforming to the desired configuration of the lower press die and being adapted to be placed in the press and supported by the lower press die during compression of the pallet. The method includes a first step of filling the cavities of the caul sheet with wood flakes. A first layer of the loosely felted mat is then deposited onto the caul sheet, with the wood flakes of at least these portions of the first layer locate above the leg cavities being aligned generally parallel to one another. A second layer of the mat is then formed with at least the wood flakes of these portions of the second layer located above the leg cavities being aligned in generally parallel relation with respect to one another and extending generally transversely to the aligned wood flakes of the first layer.

When the wood flakes comprising the mat are aligned in this manner, during the pressing operation wherein the wood flakes are forced into the die cavities to form the pallet legs, the formation of voids is prevented.

In one embodiment of the invention wood flakes can be deposited directly into the die cavities of the lower die plate. The remainder of the loosely felted mat, and including the layers of the aligned wood flakes, can be formed on a flat caul sheet and can then be transferred onto the lower die plate.

In one preferred embodiment of the invention, the apparatus for use in forming the mats includes a conventional mat former adapted to drop uniform loosely felted layers of wood flakes onto a supporting surface or caul sheet. A structure is provided for positioning the caul sheet beneath the mat former and for causing reciprocal movement of the caul sheet beneath the mat former. During each pass of the caul sheet beneath the mat former a thin layer of wood flakes is deposited onto the caul sheet. During the initial formation of the mat, a first alignment structure is placed on the caul sheet and is moved with the caul sheet beneath the mat former. This alignment structure includes a rectangular frame of approximately the same size as the caul sheet and includes a plurality of parallel baffle plates positioned in vertical orientation and in parallel spaced apart side-by-side relation. The baffle plates are aligned with the direction of movement of the caul sheet and are positioned at opposite sides of the caul sheet and above the areas of the mat which will form the legs of the pallet. This flake aligner is positioned on the caul sheet during a first predetermined number of passes of the caul sheet beneath the former. The first flake aligner is then removed, and a second flake aligner is positioned on the caul sheet. This second flake aligner includes a plurality of baffle plates supported above the openings of the caul sheet to define the leg cavities. This second flake aligner includes baffles which are vertically oriented and supported in spaced apart relation and defining planes perpendicular to the direction of alignment of the first set of baffle plates of the first flake aligner. The second flake aligner is supported on the caul sheet for a second predetermined number of passes beneath the mat former. Subsequently, the second flake aligner is removed from the caul sheet and then the caul sheet is moved back and forth beneath the mat former to form the remaining layers of wood flake material forming the mat.

Various features and advantages of the invention will be apparent by reference to the following description of a preferred embodiment, from the drawings and from the claims.
The deck 12 and legs 16 are molded as a one-piece unit from a mixture of a suitable resinous particle board binder and flakelike wood particles as will be described below. The sidewalls 20 of the legs 16 are inclined or tapered to facilitate molding and also to permit nesting of several pallets 10 into a compact stack so as to minimize the space required for shipment and storage. In the specific construction illustrated, the sidewalls 20 are substantially flat, and the legs have the general form of an inverted truncated hollow pyramid.

Manufacturing a pallet from wood particles includes the steps of comminuting small logs, branches or rough pulp wood into flake-like particles, drying the wood flakes to a predetermined moisture content, classifying the dried flakes to obtain wood particles having a predetermined size, blending predetermined quantities of a suitable resinous particle board binder and optionally a liquid wax composition with the dried and sized flakes, forming the resultant mixture of binder, wax and wood flakes into a loosely felted, layered mat, placing the mat in an open mold or press including separable male and female dies defining a mold chamber having the desired shape of the pallet, closing the mold and applying sufficient pressure to the mat to compress it into substantially the desired shape and size of the pallet, removing the molded pallet from the press and trimming the peripheral edges of the pallet with a power saw or the like to the desired final dimensions.

The wood flakes used can be prepared from various species of suitable hardwoods and softwoods used in the manufacture of particle board. Representative examples of suitable woods include aspen, maple, oak, elm, balsam, fir, pine, cedar, spruce, locust, beech, birch and mixtures thereof.

In a preferred form of the invention the wood flakes will comprise aspen species, Populus Tremuloides or Grandidentata. The wood should be purchased in pulp wood log form, commonly four inches in diameter and larger than 100 inches long or longer.

Suitable wood flakes can be prepared by various conventional techniques. In a preferred form of the invention, pulp wood grade logs are converted into wood flakes by a conventional round wood flaker.

The size distribution of the flakes is important, particularly the length and thickness. The wood flakes should have a target or mean flake size of approximately 0.20 inches thick by 0.50 inches wide by 2.0 to 3.0 inches long. In any given batch, some of the flakes can be shorter or longer than the target flake size so long as the overall average length is within the above range. The same is true for the thickness.

While the flake size can be controlled to a large degree during the flaking operation as described above, it usually is necessary to use some sort of classification in order to remove undesirable particles, both undersized and oversized, and thereby insure the average length, thickness and width of the flakes within the desired ranges.

Flakes from some green wood can contain up to 90% moisture content. The moisture content of the mat must be substantially less than this for molding as discussed below. Also, wet flakes tend to stick together and complicate classification and handling prior to blending. Accordingly, the flakes are preferably dried prior to classification in a conventional type dryer, such as a tunnel dryer, to the moisture content desired for the blending step. The moisture content to which the flakes
are dried usually is on the order of about seven weight percent or less based on the dry weight of the flakes. A known amount of the dried classified flakes is introduced into a conventional blender, such as a drum type blender, wherein predetermined amounts of a resinous particle binder, and optionally a wax and other additives, is applied to the flakes as they are tumbled or agitated in the blender. Suitable binders include those used in the manufacture of particle board and similar pressed fibrous products and, thus, are broadly referred to herein as "resinous particle board binders." In one form of the invention an adhesive binder comprising Modur E441 Polyisocyanate, manufactured by Mobay Chemical Co., is applied at a rate of 8 percent and wax comprising Casco Wax EW 403-E, manufactured by Borden Chemical Co., is applied at a rate of 2 percent of the oven dry wood weight.

The furnish or blended wood flakes and binder is deposited by a mat former or dispensing system 30 (FIG. 5) onto a caul plate 32 to form a loosely felted mat of wood flake material. In the illustrated arrangement, the mat former 30 includes a hopper 34 adapted to contain a quantity of furnish 36 comprised of the wood flakes mixed with binder. A conveyor belt 38 having a horizontal upper flight 40 is positioned beneath the hopper 34 and one or more picker wheels 42 are provided at the bottom of the hopper 34 to cause furnish to be metered through an opening 44 in the bottom of the hopper in a loosely dispersed state onto the upper flight 40 of the conveyor belt. The furnish is conveyed by the conveyor belt 38 from the hopper to the discharge end 39 of the conveyor belt where it is deposited as a thin horizontal upper flight 40 of the conveyor belt. The furnishes are then be removed from the carriage 56, and a vacuum mask 74 (FIG. 7) is positioned over the caul plate 32. The vacuum mask 74 includes a rectangular chamber or housing adapted to fit over the caul plate, and the housing is provided with a plurality of fixed plates 76 adapted to engage the upper surface of the caul plate to cover the leg cavities 72. The fixed plates 76 function to hold the wood flakes in the leg cavities in place. A vacuum hose (not shown) is connected to the housing 74 and functions to remove any wood flakes on the caul sheet 72 not secured in place by the fixed plates 76.

After the leg cavities 72 are filled with furnish, and the excess furnish is removed from the surface of the caul plate, the caul plate 32 is again placed on the carriage 56 for movement back and forth beneath the discharge end 39 of the conveyor belt.

Means are also provided for causing a first portion of the wood flakes deposited on the caul plate 32 to be aligned in parallel relation to each other, this first portion of the wood flakes forming the portion of the loosely felted mat which will become the legs 16 of the molded pallet 10.

In the illustrated construction this means for causing the flakes to be aligned includes a flake aligner 80 (FIGS. 8 and 9) supported above the caul plate 32 as the caul plate 32 moves back and forth under the mat former 30. The flake aligner 80 is comprised of a rigid rectangular frame 82 including side members 84 and end members 86, the frame 82 being open at the top and bottom. The frame 82 is positionable on the caul plate 32 or carriage 56 such that furnish can fall through the frame 82 onto the caul plate. The frame includes two sets of planar baffle plates 88 housed in the opening defined by the frame 82, one of the sets of baffle plates 88 being positioned above one row of leg cavities 72 of the caul sheet and the other set of baffle plates 88 being positioned above a second row of leg cavities 72 of the caul sheet. Each set of baffle plates 88 is comprised of a plurality of spaced apart thin sheet metal plates supported at their opposite ends by the end walls 86 of the frame 82. The plates are spaced apart by a distance greater than the width of the widest flakes to be deposited on the caul sheet 32 but substantially less than the length of most of the flakes such that the flakes fall from the discharge end 39 of the conveyor belt onto the moving caul sheet 32, the baffle plates will result in
alignment of the flakes falling onto that area of the caul sheet 32 including the leg cavities 72. In one form of the invention, the baffle plates are spaced apart by approximately 1.5 inches.

As seen in FIG. 9, in a preferred form of the invention, the height of the baffle plates 88 is varied or staggered to prevent the flakes from lying across the baffle plates 88 and for causing the flakes to fall between the baffle plates so that they become aligned.

In a preferred form of the invention the caul plate 32 having the flake aligner 80 positioned thereon will be moved beneath the mat four times to form a first layer of wood flakes. The flake aligner 80 is then removed and a second flake aligner 90 (FIG. 10) is positioned above the caul plate 32. The second flake aligner 90 is intended to provide a means for causing a portion of the loosely felted flakes forming the next layers to be aligned in directions transverse to the direction of alignment of the wood flakes of the first layer. More particularly, the second flake aligner 90 includes a rectangular frame 92 similar to frame 82 and adapted to be positioned above the caul sheet 32 and to be supported by the carriage 56. The second flake aligner 90 also includes a plurality of sets of baffle plates 94, each set of baffle plates 94 including a plurality of baffle plates positioned in side-by-side spaced apart relation and extending inwardly from the sides 96 of the frame 92. The sets of baffle plates 94 are intended to be positioned above the leg cavities 72 of the caul sheet 32, and the aligned flakes of the first layer of flakes. In a preferred arrangement, the baffle plates 94 of the second flake aligner 90 have a staggered height to facilitate alignment of the flakes and to prevent the flakes from lying across two or more baffle plates. In a preferred form of the invention, the baffle plates 94 of the second flake aligner will be spaced apart approximately 1.5 inches.

In one embodiment of the invention, the caul plate 32 having the second flake aligner 90 thereon is moved back and forth beneath discharge end 39 of the conveyor belt 38 for eight passes to build up additional layers of wood flakes on the caul sheet 32.

The second flake aligner 90 is then removed and a third frame structure 100 is placed above the caul sheet 32 for the remainder of the passes under the mat former and until a mat having a thickness of approximately 6 inches is formed on the caul sheet. The third frame structure 100 includes a rectangular frame 102 like those of the first and second flake aligners, and further includes a plurality of intersecting rods 104 supported by the rectangular frame 102, the intersecting rods 104 supporting a plurality of cylinders 106 provided to cause the flakes falling onto the mat to be diverted away from areas of the mat. Diversion of flakes from these areas during formation of the top layers of the mat aids in molding of channels during the pressing operation.

Once a mat has been formed on the caul sheet 32, the caul sheet is positioned on the lower die plate 68 of the press with the legs 110 of the caul sheet 32 nested in complementary cavities 112 of the lower die plate 68. The loosely felted mat is compressed between the heated die plates 68 and 114 to form a densified product. The compressed pallet 10 is then removed from the press, and the edges of the pallet are trimmed as required to form straight sides on the pallet and to meet the dimensional requirements of the pallet.

In one preferred form of the invention, the dies are maintained at a temperature of approximately 350° or more during the pressing operation to provide for proper cure of the binder. Due to the alignment of the layers of wood flakes used to form the pallet legs and by filling the caul plate cavities with additional furnish material, during the initial steps of depositing wood flakes onto the caul plate, during the pressing operation, a pallet having relatively long legs can be formed in a single stage compression operation and without formation of tears or voids in the mat material during the pressing operation.

While in the illustrated arrangement the caul plate has a configuration complementing the configuration of the lower die plate, and is adapted to be inserted into the press during the molding operation, in other arrangements, furnish can be placed directly in the die cavities of the lower die plate and then the remainder of the loosely felted mat can be formed on a flat caul sheet with the wood flakes forming the mat being aligned in the same manner as described above. The caul sheet and mat are then placed between the dies of the press, and the caul sheet is stripped from the mat leaving the mat on the lower die plate.

In another embodiment of the invention, during the formation of the mat, a first layer or portion of the mat can contain aligned wood flakes in the areas to form the legs of the pallet. This portion of the mat can comprise approximately 25% of the mat thickness. The remainder of the mat can then be formed with randomly oriented wood flakes.

Various features of the invention are set forth in the following claims.

We claim:
1. A pallet comprising:
a generally flat rectangular deck having a major plane and a flat upper surface,
a plurality of spaced apart hollow leg members integral with said deck and projecting downwardly from said deck to support said deck,
said deck and said leg members being molded as a one-piece unit from a mixture of a resinous particle board binder and thin elongated wood flakes, said thin elongated wood flakes being deposited in a loosely felted layered mat onto a supporting surface such that said thin elongated wood flakes lie in horizontal planes, the loosely felted layered mat being formed by depositing a first layer of thin elongated wood flakes onto a supporting surface and then depositing a second layer of thin elongated wood flakes onto the first layer, the first layer of thin elongated wood flakes of said loosely felted mat having selected portions, the thin elongated wood flakes of said selected portions being aligned in a first direction substantially parallel to one another, and the remainder of the thin elongated wood flakes forming said first layer lying in horizontal relation but in random orientation with respect to one another, and the second layer of said looselyfelted mat having selected portions overlying said selected portions of said first layer and said selected portions of said second layer being comprised of thin elongated wood flakes aligned in substantially parallel relation to one another in a direction substantially perpendicular to the direction of alignment of the elongated wood flakes of said selected portions of said first layer, and the remainder of the thin elongated wood flakes forming said second layer lying in horizontal relation but in random orientation with respect to one another, said loosely felted mat being compressed in a mold to form said one-piece unit, and said hollow leg members being molded from said selected portions of said first layer and said selected portion of said second layer.