Sept. 6, 1960 P. VAJDA ET AL 2,951,269

FELTING METHOD AND APPARATUS

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3 Sheets-Sheet 1

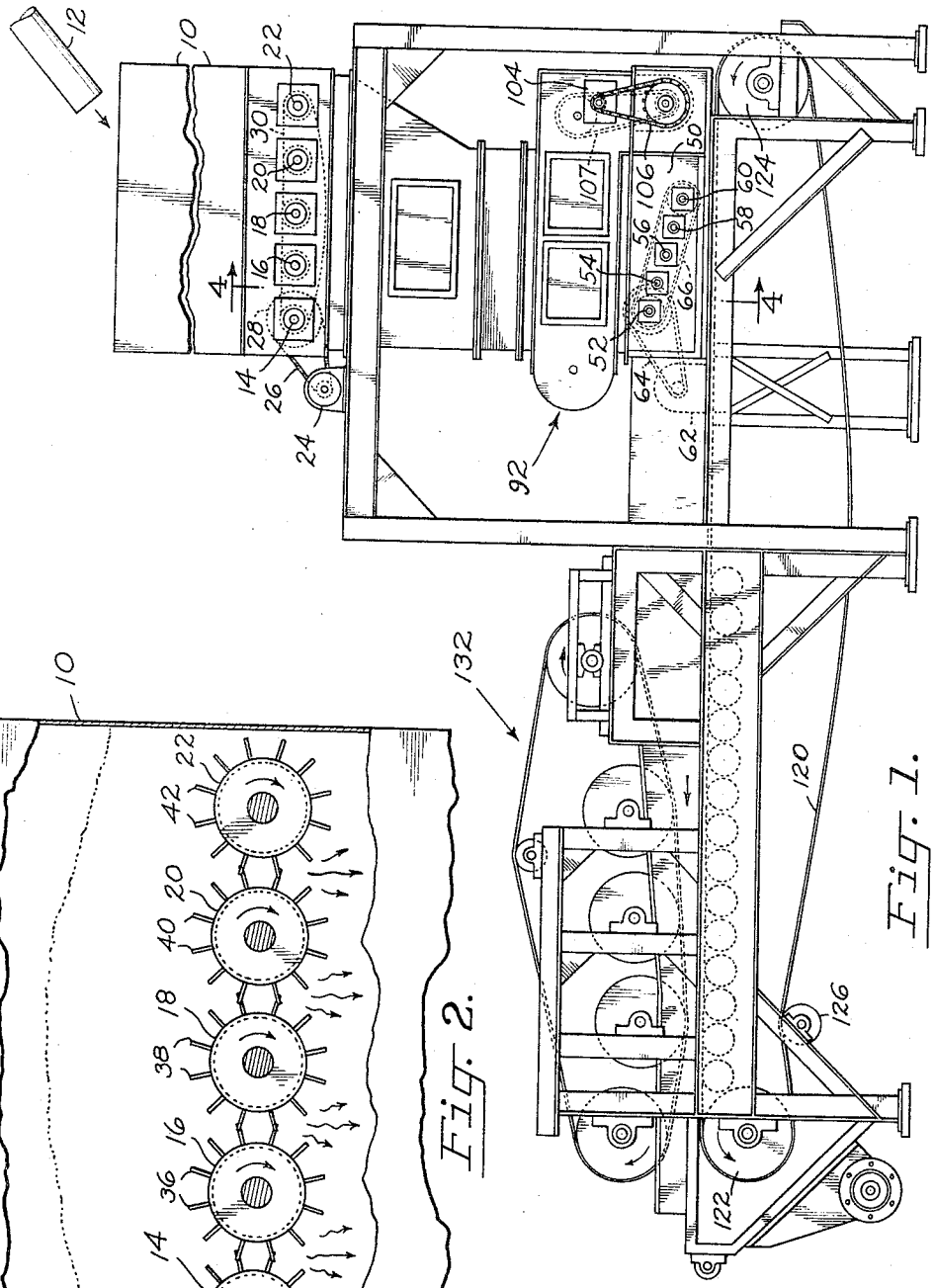


Fig. 1.

Fig. 2.

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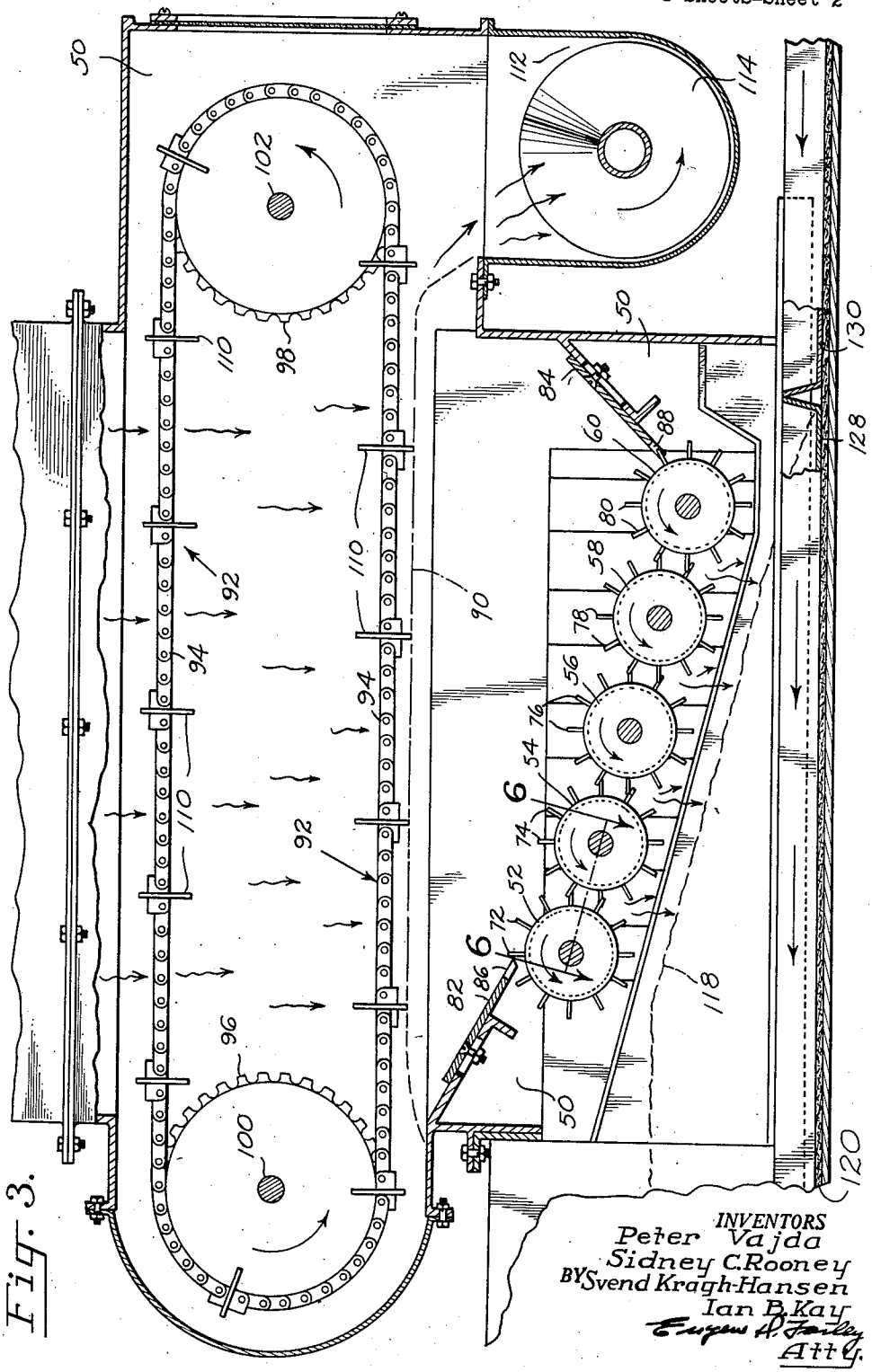


Fig. 3.

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FELTING METHOD AND APPARATUS

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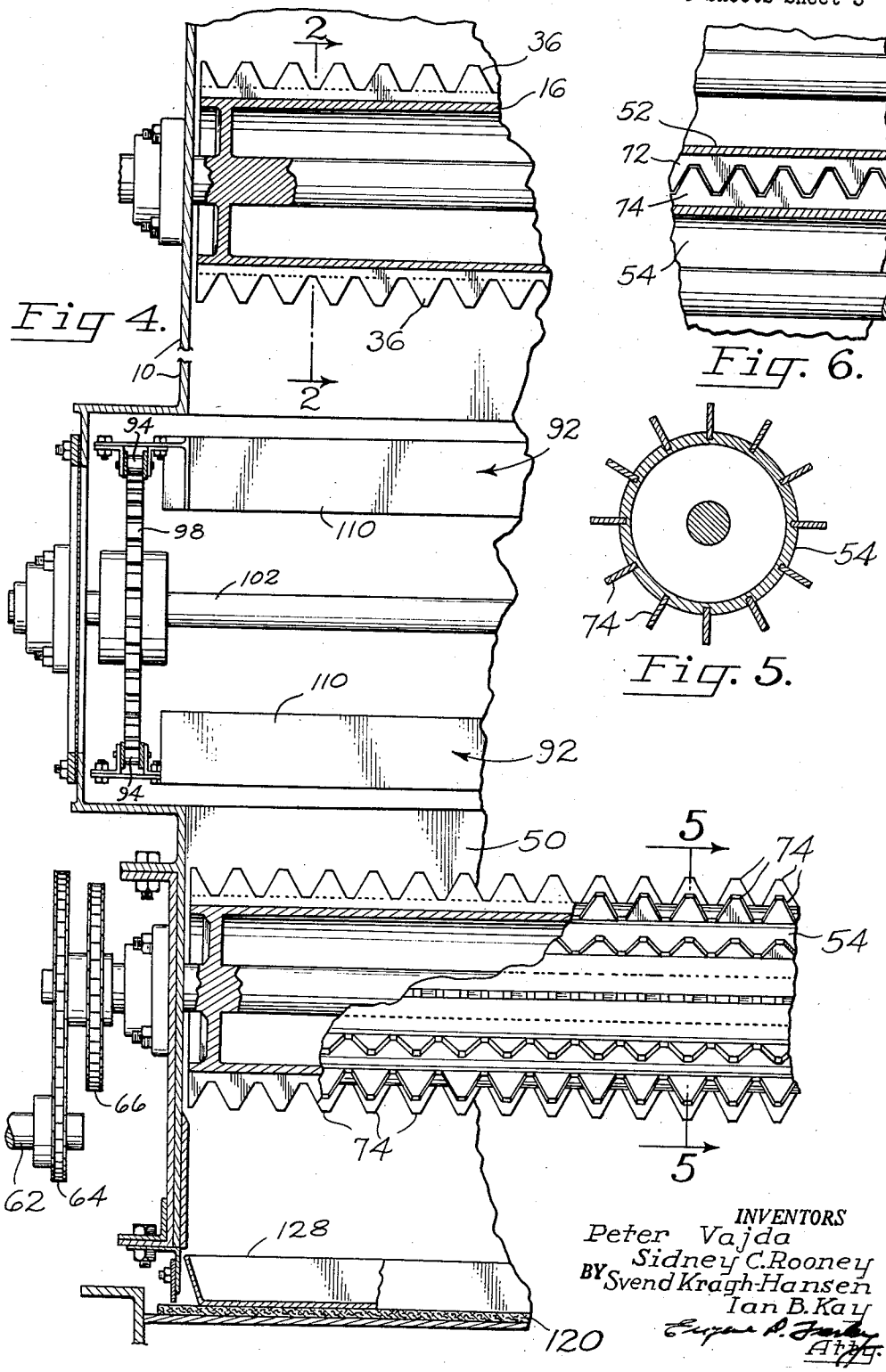


Fig 4.

Fig. 6.

Fig. 5.

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FELTING METHOD AND APPARATUS

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This invention relates to method and apparatus for forming wood particles and other feltable materials into a mat. It pertains particularly to method and apparatus for felting wood particles into a mat of predetermined, controlled thickness preliminary to pressing the mat into fiberboard.

In the dry and moist processes for the manufacture of hardboard and other fiberboards, wood first is reduced to the form of small pieces of the desired size and configuration. These are mixed with adhesive and formed into a mat. The mat then is introduced into a hot press and pressed to the desired density.

In this sequence of operations, it is of primary importance to control precisely the thickness and bulk density of the mat, since any irregularity in the mat will be reflected in a corresponding irregularity in the pressed board product. However, the necessary precision of control is difficult to obtain.

Thus in one dry felting procedure the starting material is fed at a constant volume rate from the bottom of a hopper and deposited directly onto a series of cauls or trays passing continuously beneath the hopper. It is readily apparent, however, that any changes or variations in the depth of material in the hopper, or in the rate of flow from the hopper, will change the bulk density of the material deposited on the cauls. As a result, the feed rate on a weight basis can not be kept constant, and the felt built up on the cauls will be of non-uniform height and density.

As a partial solution to the foregoing problem the top portion of the felt sometimes is removed so that the residue is of uniform height. This may be accomplished by brushing the felt to scalp off a predetermined thickness of the mat surface. However, such a geometric leveling of a mass of material of random height is not effective to form a finished felt of uniform bulk density.

In another dry felting procedure a predetermined weight of material equal to the weight of material to be deposited on a caul tray is placed in a hopper, which then is oscillated back and forth over the length and width of the tray. The material is fed continuously in this manner until all of its has been deposited on the tray. This method insures that a known weight of material is fed to the tray, but an even weight distribution over the tray area can only be obtained if (1) the feed rate of the mechanism is uniform on a weight basis throughout the feeding operation; and (2) the completion of the feeding coincides exactly with the completion of an integral number of oscillations.

In practice, these two requirements have been found difficult if not impossible of accomplishment. Furthermore, the commercial feasibility of the method is severely restricted by the fact that it may be used only in batch operations where each individual mat is formed separately. Hence it can not be used in a high speed production flow line.

We now have discovered that the foregoing deficiencies

of the prior art felting procedure may be overcome by use of a method and apparatus characterized by the following objects and advantages.

(1) A felt or mat of substantially uniform bulk density, and hence a substantially uniform pressed fiberboard product are produced.

(2) The felt produced is substantially uniform even though the caul or tray surface upon which it is deposited is uneven because of wear, corrosion, warping or other facts.

(3) A uniform felt is formed without brushing or leveling the felt surface.

(4) A wide variety of feltable materials, particularly wood particles or fibers of varying density, configuration and moisture content, may be employed as starting materials.

(5) The felting operation is flexible in that the felt thickness is infinitely instantaneously controllable, without changing the lineal speed of the conveyor or caul upon which the felt is deposited.

(6) An integral weight determination of the laid up unit felt is possible.

(7) A rapid, continuous, high capacity felting operation is also possible.

The manner in which the foregoing and other objects and advantages of the present invention are attained will be apparent from the following specification and claims, considered together with the drawings wherein:

Fig. 1 is a view in side elevation of the herein described felting apparatus;

Fig. 2 is a sectional view taken along line **2—2** of Fig. 4;

Fig. 3 is a sectional view in side elevation illustrating the felting chamber of the herein described felting apparatus;

Fig. 4 is a sectional view in end elevation of the apparatus, taken along line **4—4** of Fig. 1;

Fig. 5 is a detail view of one of the felting rolls, taken along line **5—5** of Fig. 4; and

Fig. 6 is a fragmentary view of the felting rolls, taken along line **6—6** of Fig. 3.

In accordance with the present invention, method and apparatus are provided for felting in two stages. In the first stage, the feltable material is taken from a source which need not have uniform bulk density. It is metered or felted from this source into a primary felt or mat of substantially uniform bulk density and of substantially constant height. Next, the material comprising the primary felt is metered or felted at a controlled rate onto a felting surface. This results in the formation of a secondary or final felt or mat which is of substantially uniform bulk density and thickness irrespective of the fiber properties and caul irregularities.

Considering the foregoing in greater detail and with particular reference to the drawings:

As is particularly apparent from Figs. 1 and 2, feltable material, such as wood fibers, sawdust, shavings, etc., preferably mixed with adhesive, is fed into a hopper **10** by any suitable means, as via conduit **12**. Hopper **10** is sufficiently large to hold a substantial quantity of material and serves as a reservoir from which the material is fed to the felting elements of the apparatus. Varying amounts of material may be accumulated in the hopper during the operation of the apparatus, and consequently this material has a variable bulk density depending upon its depth in the hopper and other factors.

The bottom end of hopper **10** is open and within this opening are mounted means for feeding the feltable material to the felting elements of the assembly. In the illustrated form such means comprise a plurality of spaced apart feed rolls **14–22** journaled into the end walls of the hopper base and all driven in the same direction by

a motor **24** acting through chain **26**, sprocket **28** and a flexible drive member such as chain **30**.

About the surfaces of feed rolls **14–22** are a plurality of teeth **34–42**. These are arranged in spaced apart rows running longitudinally of the rolls. Each tooth is flat and its plane is parallel to the axis of the roll on which it is mounted. The dimensions of the rolls and of the teeth mounted thereon are such that the teeth mesh together as the rolls rotate. Since the teeth are flat and since the direction of rotation of all the rolls is the same, each tooth serves as a metering device which supports, as it assumes a horizontal position in its downward cycle, a quantity of feltable material determined by the dimensions of the tooth and the density of the material.

This amount is measured by the tooth quite precisely since as it moves downwardly it meshes with the teeth of the adjacent roll moving upwardly. As a consequence, any feltable material which may be lodged between the teeth of the felting roll is wiped away. Each of the teeth accordingly carries a measured load of material which is transferred in small increments out of hopper **10** into a felting chamber **50**.

Felting chamber **50** is open at its lower end and has for its function the maintenance of a primary felt of substantially uniform bulk density. To this end there are mounted across the open lower end of the chamber a plurality of spaced apart felting rolls **52–60** (Fig. 3). These rolls are mounted for rotation in any suitable manner, as by being journaled in opposite end walls of the felting chamber. They are driven in unison and in the same direction by a motor **62** acting through drive chains **64, 66** (Fig. 1).

Felting rolls **52–60** may have constructions similar to that described above in connection with feed rolls **14–22**. Thus each has along its peripheral surface a plurality of spaced, axially arranged rows of flat teeth **72–80**, respectively. The spacing of the rolls and the dimensions and configuration of the teeth are such as to permit intermeshing of the teeth on adjacent rolls as they rotate. Accordingly each tooth on its downward cycle meters a small quantity of the felting material to the space below the rolls, the amount thus metered being sharply defined volumetrically by reason of the fact that the spaces between the teeth are wiped free of material by the upcoming teeth of the adjacent roll.

To seal off the felting chamber further, there are provided a pair of plates **82, 84**. These are affixed to the frame of the apparatus and are provided with teeth **86–88**, respectively, which have a configuration and spacing conforming to that of teeth **72–80** on the felting rolls with which they mesh.

Felting rolls **52–60** are arranged progressively in increasing distances upwardly from the bottom of the felting chamber. As a consequence, the plane of the felting roll assembly is at an angle to the horizontal which is predetermined to be substantially parallel to the plane of the raw or newly formed edge of the felt as it is deposited. This is for the purpose of insuring that the distances between each roll and the surface of the mat immediately below will be approximately equal. Accordingly, the amount of separation of the feltable material as it falls from the felting roller to the final felt is the same beneath each roll and a uniform felt results.

The material metered down into felting chamber **50** from feed rolls **14–22** builds up within the felting chamber a primary felt **90**, the surface of which is continuously leveled by suitable means. In the illustrated embodiment the leveling means comprises a flight conveyor indicated generally at **92**. It comprises a pair of endless chains **94** mounted on sprockets **96, 98** which in turn are mounted on shafts **100, 102**. The chain assembly is driven by suitable motor means, for example from motor **104** operating through drive chains **106, 107** (Fig. 1).

Chains **94** carry the transversely disposed leveling blades **110**. The dimensions of these blades, and the spacing of flight conveyor **92** from feed rolls **52–60** is such that the primary felt **90** built up in the felting chamber is maintained at a predetermined, substantially uniform height. Accordingly this may be used to advantage as a reservoir for feeding its component particles to the surface upon which the felt is to be laid.

The surplus material scraped off the top of the primary felt by flight conveyor **92** may be conveyed to storage via conduit **112** containing a screw conveyor **114**, which also is operated from motor **104** and drive chain **106**. Preferably conduit **112** communicates with conduit **12** so that the surplus material is cycled back to hopper **10**.

For fast, continuous operation, it is preferred to form the final felt **118** on a continuously moving surface such as is provided by endless belt **120** which is mounted on pulleys **122, 124, 126** and is driven by suitable means not illustrated so that its working stretch moves from right to left as viewed in the drawings.

Caul plates or trays **128, 130** may be placed on the belt. As they pass beneath the felting apparatus, they are filled with a uniform layer of material. They then pass through a pre-pressing unit, indicated generally at **132**, where they are compacted sufficiently for further handling, preliminary to introducing them into a press for consolidation to the predetermined density.

Operation

The operation of the herein described felting apparatus is as follows:

Defiberized wood or other feltable material coated with adhesive is deposited in hopper **10** where it is supported by feed rolls **14–22** and formed in a mass of non-uniform bulk density. It is fed by the feed rolls down into felting chamber **50** in continuous streams where it builds up a primary felt **90** on felting rolls **52–60**. This felt is continuously leveled off by flight conveyor **92**, the excess being transferred to conduit **112** where it is conveyed by conveyor **114** to conduit **12** which cycles it back to hopper **10**.

The material in the primary felt is passed through felting rolls **52–60** at a constant volume rate. This result is obtained through the action of the flat, spaced intermeshing teeth on the rolls.

Since all of the rolls rotate in the same direction, the teeth traveling downward and carrying material behind them are met by meshing teeth traveling upward. The latter teeth pick up all the material which may be deposited between the downward traveling teeth. Therefore only the material deposited behind each downwardly traveling tooth will pass between the rolls. As a result, small increments of volumetrically controlled masses of material are metered through the rolls.

Since the volume of material deposited between the toothed rows on the felting rolls is always the same, the amount fed down per revolution of roll is constant within limits. Therefore the rate of felting and the resulting thickness of the felt can be controlled readily by simply varying the speed of rotation of the rolls.

To produce a felt having a smooth surface, an even number of felting rolls are used. This is for the reason that the feed from one roll causes small humps and hollows on the felt corresponding to the location of the teeth on the roll. The feed from the adjacent roll, which has its teeth offset by one pitch, will fill in the hollows and produce an even and smooth surfaced mat.

Also, the centers of the felting rolls should be inclined to coincide with the slope at which the material is built up in the felt. This avoids an excessively long fall between the rolls and the felt, which is desirable since the material has a tendency to separate during a long fall and cause uneven surfaces in the mat. To accommodate feltable materials of various particle sizes and shapes, the shape and spacing of the teeth on the rolls, and the

spacing of the rolls relative to each other, may be adjusted as required.

The material fed down by felting rolls **52–60** is deposited in the form of a continuous final felt **118** on trays **128–130** carried by endless belt **120**. These then pass through the pre-pressing unit **132** where the felts are partially consolidated preliminary to introduction in the press. If desired, each loaded tray may be weighed to provide a constant check on the operation of the apparatus.

As the product of the foregoing double felting procedure there are formed felts of substantially uniform density and weight which can be pressed into consolidated fiberboard products of uniform properties. This result is obtained in spite of possible irregularities on the caul surfaces and in spite of varying density, configuration and moisture content of the feed. It is applicable to the felting of any type of fiber or particle now used for making dry or moist process hardboard or any type of particle board. In addition, the method does not require a brushing or scalping of the final felt, and is intimately and instantaneously controllable as required to form felts of predetermined dimensions and density.

Having thus described our invention in preferred embodiments we claim as new and desire to protect by Letters Patent:

1. Felting apparatus comprising a hopper adapted to contain a quantity of feltable particles, and open at its lower end, a plurality of feed rolls positioned across the open end of the hopper, motor means connected to the feed rolls for driving them at a substantially uniform rate, a felting chamber open at its lower end and communicating with the hopper, a plurality of felting rolls mounted for rotation across the open end of the felting chamber and adapted to support feltable particles fed thereon by the feed rolls, thereby forming a primary felt, leveling means operating across the felting chamber for leveling the surface of the primary felt, thereby providing a felt of substantially uniform bulk density, drive means connected to the felting rolls for driving them, thereby passing between the rolls measured quantities of the feltable particles, and stationed below the felting rolls a felting surface adapted to receive the particles and to support the felt formed therefrom.

2. The felting apparatus of claim 1 wherein the leveling means comprises a flight conveyor.

3. The felting apparatus of claim 1 wherein the felting rolls comprise cylinders having along their peripheral surfaces spaced apart rows of flat teeth, the plane of the teeth being parallel to the axis of the rolls, the teeth of adjacent rolls meshing with each other and all of the rolls being rotated in the same direction by the drive means.

4. In felting apparatus of the class wherein feltable material is fed gravitationally onto a felting surface from a felting chamber containing a quantity of feltable particles; a plurality of felting rolls adapted to be positioned at spaced intervals across the outlet of the chamber and comprising cylinders having along their peripheral surfaces a plurality of spaced apart rows of radially extending flat teeth, the planes of the teeth being substantially parallel to the axes of the rolls, adjacent cylinders being arranged for rotation in the same direction and positioned for intermeshing of said flat teeth.

5. The method of forming felts from feltable particles which comprises forming a primary felt, continuously abstracting particles in small increments from the bottom side of the primary felt for building up a secondary felt of predetermined thickness, continuously adding particles to the upper side of the primary felt in quantity in excess of the particles abstracted, and continuously leveling the upper side of the primary felt to remove the excess particles whereby to maintain the primary felt at a substantially constant thickness.

6. The method of forming felts from feltable particles which comprises forming a primary felt, continuously abstracting particles in small increments from the bottom side of the primary felt and gravitationally depositing such increments onto a continuously moving supporting surface for building up a secondary felt of predetermnied thickness, continuously adding particles to the upper side of the primary felt in quantity in excess of the particles abstracted, and continuously leveling the upper side of the primary felt to remove the excess particles whereby to maintain the primary felt at a substantially constant thickness.

7. Felting apparatus comprising a primary felting chamber for forming therein a primary felt of feltable particles, abstracting means for withdrawing metered increments of particles continuously from the bottom side of the primary felt and for depositing such increments upon a felting surface for building up a secondary felt of predetermined thickness, means for feeding feltable particles continuously to the primary felting chamber in quantity in excess of the particles withdrawn, and leveling means for removing the excess particles continuously from the upper side of the primary felt to maintain the primary felt at a substantially constant thickness.

8. The apparatus of claim 7 wherein the abstracting means comprises a plurality of felting rolls positioned at spaced intervals across the outlet of the primary felting chamber and comprising cylinders having along their peripheral surfaces a plurality of spaced apart rows of radially extending flat teeth, the planes of the teeth being substantially parallel to the axes of the rolls, adjacent cylinders being arranged for rotation in the same direction and positioned for intermeshing of said flat teeth.

9. The apparatus of claim 7 wherein the felting surface comprises a continuously movable conveyor and the abstracting means comprises a plurality of felting rolls positoned at spaced intervals across the outlet of the primary felting chamber and comprising cylinders having along their peripheral surfaces a plurality of spaced apart rows of radially extending flat teeth, the planes of the teeth being substantially parallel to the axes of the rolls, adjacent cylinders being arranged for rotation in the same direction and positioned for intermeshing of said flat teeth, the axes of the cylinders being arranged on a plane which is inclined in the direction of movement of the conveyor.

10. Felting apparatus comprising a primary felting chamber for forming therein a primary felt of feltable particles, a plurality of felting rolls positioned at spaced intervals across the outlet of the primary felting chamber and comprising cylinders having along their peripheral surfaces a plurality of spaced apart rows of radially extending flat teeth, the planes of the teeth being substantially parallel to the axes of the rolls, adjacent cylinders being arranged for rotation in the same direction and positioned for intermeshing of said flat teeth, the felting rolls being operable to withdraw metered increments of particles continuously from the bottom side of the primary felt and to deposit such increments upon a felting surface for building up a secondary felt of predetermined thickness, and means for feeding feltable particles continuously to the primary felting chamber in quantity sufficient to maintain the primary felt at a substantially constant thickness.

11. Felting apparatus comprising a continuously movable conveyor, a primary felting chamber for forming therein a primary felt of feltable particles, a plurality of felting rolls positioned at spaced intervals across the outlet of the primary felting chamber and comprising cylinders having along their peripheral surfaces a plurality of spaced apart rows of radially extending flat teeth, the planes of the teeth being substantially parallel to the axes of the rolls, adjacent cylinders being arranged for

rotation in the same direction and positioned for intermeshing of said flat teeth, the axes of the cylinders being arranged on a plane which is inclined in the direction of movement of the conveyor, the felting rolls being operable to withdraw metered increments of particles continuously from the bottom side of the primary felt and to deposit such increments upon the movable conveyor for building up a secondary felt of predetermined thickness, and means for feeding feltable particles continuously to the primary felting chamber in quantity sufficient to maintain the primary felt at a substantially constant thickness.

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