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(54) **Method of producing a board comprising wood chips**

(57) Method of producing a board containing wood chips from a wood-based starting material. According to the method, the starting material is disintegrated into wood chips of a preselected size for producing a mass, and then the mass containing wood chips is used for forming a board. According to the invention, the starting material is disintegrated with a continuous flow mixer (1) operating according to the impact mill principle, said mix-

er having at least two milling rotors, one inside the other (4-7, 10, 11), having milling vanes (10, 11), at least one of the rotor being rotatable and at least a part of the vanes (1) of the outermost milling rotor being disposed in an angular position with regard to the radial direction of the rotor. With the help of a disintegrator of the impact mill type, it is possible to continuously regulate the result of the milling/disintegration.

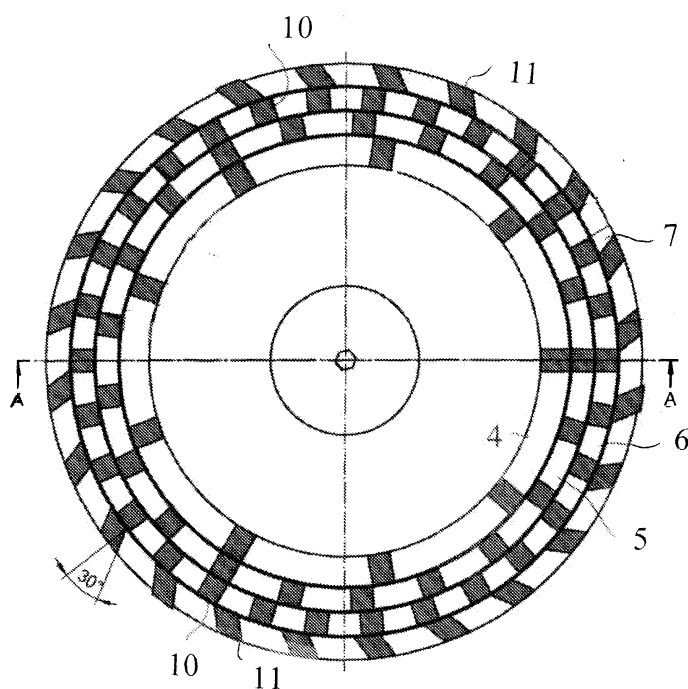


Fig. 1

Description

[0001] The present invention concerns a method according to the preamble of claim 1 for producing a board from a wood-based starting material.

[0002] According to a method of this kind, the starting material, such as wood chips, is disintegrated to a preselected size typically with the aid of a cutting grinder. After that a board, e.g. a particle board, is formed from the mass containing wood chips.

[0003] In the particle board industry, chips are crushed generally with a blade ring crusher or a chipping hammer. When using a blade ring crusher for crushing of the chips, the blades are subjected to considerable wear which is a problem. The wear of the blades has a negative impact on the shape and size of the chips obtained. Maintenance demand caused by wear of blades is a significant disadvantage both in terms of time and cost expenditure.

[0004] The fraction obtained with a chipping hammer is cubically shaped which is not the optimum form for the production of a particle board.

[0005] It is an aim of the present invention to eliminate at least a part of the problems relating to the prior art and to provide a completely novel method of producing a chips mass from a wood-based starting material, such as wood chips.

[0006] The invention is based on the idea of using, for disintegration of the starting material, a continuous flow mixer working according to the impact mill principle.

[0007] Such a device usually has at least two milling rotors, fitted one inside the other, with milling vanes, at least one of the rotors being rotatable and at least at part of the vanes of the outermost milling rotor being arranged in an angular position with regard to the radial direction of the rotor. The vanes are usually plate-like and they are placed perpendicularly against the radius of the mill (i.e. at an angle of 180 degrees). When the starting material hits the moving vane it is rapidly disintegrated into smaller particles.

[0008] In connection with the present invention it has been found that it is possible with an impact mill to produce a chips mass which is particularly suitable for producing particle boards. More specifically, the method according to the present invention is mainly characterized by what is stated in the characterizing part of claim 1.

[0009] Considerable advantages are obtained with the present invention. Thus, with a disintegrator of the impact mill type it is possible continuously to regulate the result of the grinding/disintegration. This is not possible with traditional milling or blade grinders. Further, with a disintegrator of the present kind there is no need for withdrawing air during disintegration as is the case with traditional grinders - air-removal is expensive and requires a separate apparatus and the use of energy. In the present solution, the rotational motion of the milling rotors gives rise to a flow of air which conducts the material which is to be disintegrated through a passage formed by the milling rings from the inside of the apparatus radially outwards.

dially outwards.

[0010] The solution will also reduce the danger that the material which is to be disintegrated will heat up so much that its surface darkens.

5 [0011] The chips of the chips mass to be produced are suitable in size for the production of particle boards; in particular the average thickness of the chips is less than about 2 mm, typically less than 1.5 mm.

10 [0012] The structure is steady and wear of the milling vanes is small whereby greater production rates can be reached than with traditional blade grinders. Disintegration of the starting material is influenced by internal chafing of the particles of the feed. However, lack of homogeneity of the starting material is not as critical for the disintegration as when, for instance, a blade grinder is used.

15 [0013] Next, the invention will be examined more closely with the aid of a detailed description with reference to the attached drawings.

Figure 1 shows a simplified top view of a set of milling rotors of the disintegrator and

Figure 2 shows section A-A in Figure 1.

25 [0014] As appears from the above, the method according to the invention for producing wood chips suitable for the production of, e.g., particle boards, comprises disintegration of the starting material to a predetermined size with a continuous flow mixer operating according to the impact mill principle, said mixer having at least two milling rotors, one inside the other, with milling vanes, at least one rotor being rotatable and at least a part of the vanes of the outermost rotor being arranged into an angular position against the radial direction of the rotor.

30 [0015] The outermost milling rotor preferably comprises a planar ring base to which milling vanes are secured in essentially perpendicular position with regard to the plane of the ring base, the milling vanes being secured to the ring base at a first end, whereas a second, opposite end is being left free.

35 [0016] The apparatus has at least one rotatable rotor. The rotor can be assembled in a fixed position, i.e. it is a so-called stator. It is however preferred to use a mill where there are at least two rotatable milling rotors, preferably there are 3 to 12 rotatable milling rotors, it is particularly preferred to have 2 to 6 milling rotor pairs.

40 [0017] Figures 1 and 2 show an apparatus 1, with a frame 2, to which four ring bases 4, 5, 6 and 7, one inside the other, are rotatably pivoted with a rotatable shaft 3. Between the ring bases there is a milling or disintegration zone 8.

45 [0018] The milling or disintegration zone is formed when the ring bases 4, 5, 6 and 7 of the milling rotors define a passage through which the material which is to be disintegrated flows. The ring bases are arranged on opposite sides of the passage. The passage forms in this case the afore-said milling or disintegration zone 8.

50 [0019] The drawings show a case wherein the ring bas-

es are arranged alternately on opposite sides of the passage 8, whereby the passage preferably opens radially from the inside of the mixer to the outside. In practice, the distance between the planes of the ring bases 4, 5, 6 7 increases inside out.

[0020] The milling rotors comprise in addition to ring bases 4, 5, 6, 7 also vanes 10 and 11 secured to these. Reference numeral 10 is used for designating the vanes of the inner rotors and reference numeral 11 for the vanes of the outermost rotor. The inner rotors typically have vanes 10 which are quadratic or rectangular in shape in the direction of the ring base. Their number can vary freely. There can be equally many or a different number of them on different rotors, whereby in the case shown in the figure there are 9 vanes on the innermost rotor 4, the next rotor (no. 5) contains 21 vanes, then again 30 vanes and on the outermost rotor there is 24 vanes. These numbers are only indicative, generally there are 1 to 100 vanes/rotor, preferably about 2 to 75/rotor depending on the size of the apparatus.

[0021] As can be seen from Figure 1, the side of the vane of the outermost ring base 7 facing the rotational direction of said ring base, is disposed in an angular position against the rotational direction such that the surface of the vane opens inwards to the mixer. The vanes can be cut from vanes which have the shape of a square or rectangle, but they can also be such that their cross-section is primarily shaped as a parallelogram or even as a rhomb.

[0022] In contrast to the case of the figure, all vanes of the outermost ring do not have to be assembled in an angular position, but generally speaking at least 10 %, preferably 20 - 100 %, of the vanes of the outermost milling rotor are arranged in an angular position with regard to the radial direction of the rotor.

[0023] The front surface of the vanes forms preferably an angle of about 1 to 75°, in particular about 5 to 45°, preferably about 15 to 40° in the radial direction of the rotor. In the case according to Figure 1, the angle is about 30°.

[0024] According to a preferred embodiment, for example the apparatus depicted in Figures 1 and 2 is operated in the following fashion for producing chips:

[0025] As a wood-containing starting material, wood chips or wood pieces are used. When necessary, the starting material is dried to a relative moisture content of about 10 to 30 % before milling. It is also possible to feed completely non-dried, fresh wood. If the raw-material is too dry, steam, in particular pressurized steam, can be fed into the continuous flow mixer during disintegration/milling. Thus, the chips are fed into the apparatus either in dry form or together with water and steam.

[0026] In a preferred embodiment, during the disintegration of the starting material, the starting material is fed to the continuous flow mixer in the form of a steady flow. Preferably the mass flux of the feed varies less than max. ± 30 %, in particular at the most ± 15 %, per time unit.

[0027] The milling rings 4, 5, 6, 7, 10 and 11 of the

device (in the following also called "the rotors") are rotated with a motor (not shown) such that they generally attain a speed of about 5 to 250 m/s. Preferably every second rotor is rotated in opposite direction, whereby the speed difference between adjacent rotors will become about 10 to 500 m/s, typically about 50 - 200 m/s.

[0028] A mixing/shearing zone having high energy intensity is formed in the apparatus. The material to be disintegrated is typically conducted through the apparatus from the center of the rotors radially outwards, the vanes present on the rotors subjecting the material, which is conducted in an outwards directed flow, to both impacts and counter-impacts. Shearing forces, turbulence and vacuum and overpressure pulses are created which exert an influence with activates the material and disintegrates it.

[0029] As regards to operation of an impact mill, reference is herewith made to the published International Application WO 98/29596.

[0030] For disintegrating the starting material energy is used in a quantity of about 1 to 250 kWh/t of dry starting material, in particular about 10 to 100 kWh/t dry starting material, preferably about 20 to 50 kWh/t dry starting material.

[0031] With the aid of the invention, a chip mass can be produced which is excellently suited for the production of particle boards. Typically, at least 95 wt-% of the chip mass is formed by chips which have an average length of less than 4 mm and a thickness of less than 2 mm. A preferred embodiment further comprises the feature that the outlet product of the mixer is recovered, it is sieved and at least a part of it is being recycled and combined with fresh feed. Dust is preferably removed from the outlet product and taken to combustion.

[0032] Typically, the chip mass is first dried. The chips of the mass are also mostly classified before use.

[0033] For producing a particle board, a chip mass produced as described above is blended into an adhesive, in particular it is mixed with an adhesive which is thermally hardened. The blend/mixture of chips and adhesive is spread layer-by-layer to form a blank, for example a plate-like blank, which then is taken to a hot-press where it is pressed using heat and pressure to form a uniform board. After hardening the board is cooled. If so desired the board can be mechanically processed after compressing; typically the edges are cut straight and then the boards are cut into sizes suitable for selling, they are sanded and sorted.

[0034] Suitable thermosets, such as phenol-formaldehyde, ureaformaldehyde and melamine formaldehyde based glues can be used as adhesives. Additives can be mixed into the glues and the chips, such as known fire retardants and antimoulding agents.

[0035] The moisture content of the wood material varies during the production process of the board. Thus, the raw-material used for producing a particle board can exhibit a moisture of typically, e.g., even up to 60 to 120 %, whereat it is lowered to below a level of 10 %, e.g. to a

value of 1 to 2 %, after drying. During gluing the moisture content may increase somewhat and it is then for example about 6 to 12 %. The moisture content of the ready board is typically 5 to 7 %.

[0036] The use of the wood-based starting material for production of particle boards and corresponding composite boards represents a preferred application of the invention. It should however be pointed out that a wood mass produced by a disintegration method according to the invention is suitable for the production of other kinds of compression products formed by wood particles. Thus, it is possible to produce for example wood pellets from the mass containing wood particles which are suitable for combustion and energy production.

[0037] The following non-limiting example illustrates the invention:

Example

[0038] Spruce chips were disintegrated with a device as previously described, having four rotors (rotors 1 and 3 and 2 and 4, respectively). The energy consumption was 2 x 55 kW. The rotational speeds were 1300 / 1300 rpm; current rate was 57/65 A, 43 Hz.

Feed (chips):

[0039]

2-4mm	3.41 %
4-8mm	14.91 %
>8mm	79.8 %
balance less than 2 mm	

Fibre size distribution of the HPD product:

[0040]

mm	%
< 0.25	0.63
0.25 - 0.5	11.70
0.5 - 1.0	20.00
1.0 - 2.0	25.71
2.0 - 4.0	38.13
4.0 - 8.0	3.84
> 8	0.00

[0041] The obtained mass was well-suited for the production of particle boards.

Claims

1. Method of producing a board containing wood chips from a wood-based starting material, according to which method

- the starting material is disintegrated to a preselected size in order to form a mass of wood chips and then

- a board is formed from the mass of wood chips, **characterized in that**

- the starting material is disintegrated with a continuous flow mixer (1) operated according to the impact mill principle, said mixer having at least two milling rotors (4-7, 10, 11), with grinding vanes (10, 11), at least one rotor being rotatable and whereby at least a part of the vanes (11) of the outermost grinding rotor is being placed in angular position with regard to the radial direction of the rotor.

2. The method according to claim 1, **characterized in that** at least a part of the vanes (11) of the outermost rotor (7, 11) is placed in an angular position of about 1 to 75°, in particular about 5 to 45°, preferably about 15 to 40° with respect to the radial direction of the rotor.

3. The method according to claim 1 or 2, **characterized by** using a mixer (1), in which at least 10 %, preferably 20 - 100 %, of the vanes (11) of the outermost milling rotator (7, 11) are placed in angular position with respect to the radial direction of the rotor.

4. The method according to any of claims 1 to 3, **characterized in that** at least the vanes (11) of the outermost milling rotator (7, 11) have a quadratic or rectangular shaped cross-section in the direction of the plane of the milling rotator, preferably the vanes are flat vanes.

5. The method according to claim 4, **characterized in that** the side of the vanes (11) of the outermost milling rotor (7, 11) pointing in the rotational direction of the mixer is placed in an angular position against the direction of rotation such that the surface of the vane opens inwards to the mixer.

6. The method according to any of the preceding claims, **characterized in that** the outermost milling rotor comprises a planar ring base (7), wherein the rotor vanes (11) are secured in essentially perpendicular position in relation to the plane of the rotor plate, a first end of the milling vanes being attached to the rotor plates and a second, opposite end of the milling vanes being left free.

7. The method according to any of the preceding

claims, **characterized by** using a mill (1), which has at least two, for example 3 to 10, rotatable milling rotors (4-7, 10, 11).

8. The method according to claim 7, **characterized in that** speed difference between adjacent milling rotors is at least 10 m/s. 5
9. The method according to any of claims 1 to 8, **characterized in that** the rotor plates (4 - 7) define a passage (8) in the mixer, through which the material which is to be disintegrated is conducted, the ring bases of the milling rotors being arranged on opposite sides of the passage (8), preferably the ring bases are alternately arranged on opposite sides of the passage (8). 10
15
10. The method of claim 9, **characterized in that** the passage (8) opens radially from the inside of the mixer outwards. 20
11. The method according to any of the preceding claims, **characterized in that** steam, in particular pressurized steam, is fed into the continuous flow mixer during milling. 25
12. The method according to any of the preceding claims, **characterized by** producing a chips mass, at least 95 weight-% of which is formed by chips which have an average length of less than 4 mm and a thickness of less than 2 mm. 30
13. The method according to any of the preceding claims, **characterized by** using wood chips or wood pieces as wood-based starting material, the starting material preferably being dried before milling to a relative moisture content of 10 to 30 %. 35
14. The method according to any of the preceding claims, **characterized by** recovering the outlet product of the mixer, sieving it and recycling and combining it with fresh feed, dust preferably being removed from the effluent and being conducted to combustion. 40
45
15. The method according to any of the preceding claims, **characterized by** using for disintegration of the starting material energy in an amount of about 1 - 250 kWh/t dry starting material, in particular about 10 - 100 kWh/t dry starting material, preferably about 20 - 50 kWh/t dry starting material. 50
16. The method according to any of the preceding claims, **characterized in that** during disintegration of the starting material it is fed through the continuous flow mixer in an even stream, the mass flow varying per time unit at most with $\pm 30\%$, the starting material preferably being fed to the continuous flow mixer with 55

a belt conveyor.

17. The use of a method according to any of the preceding claims for the production of a mass suitable for manufacturing particle boards.

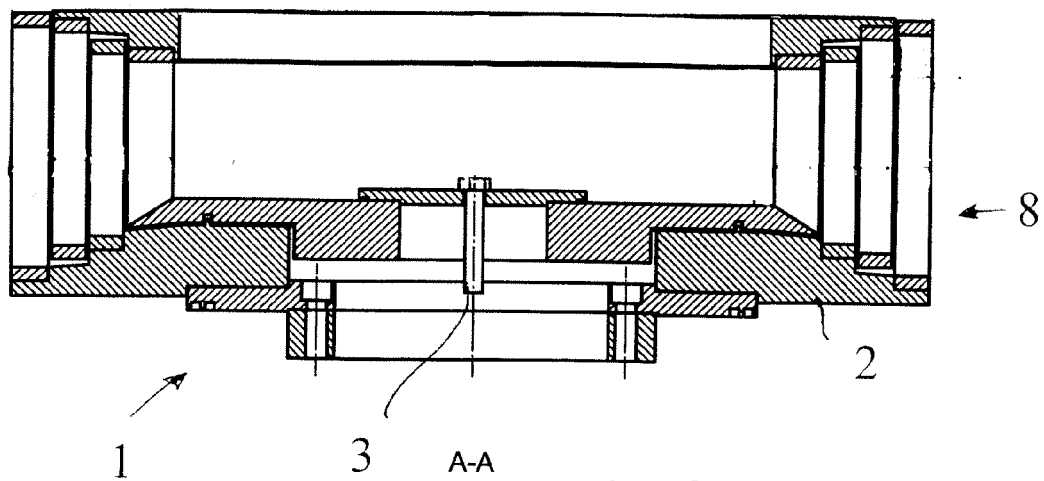


Fig. 2

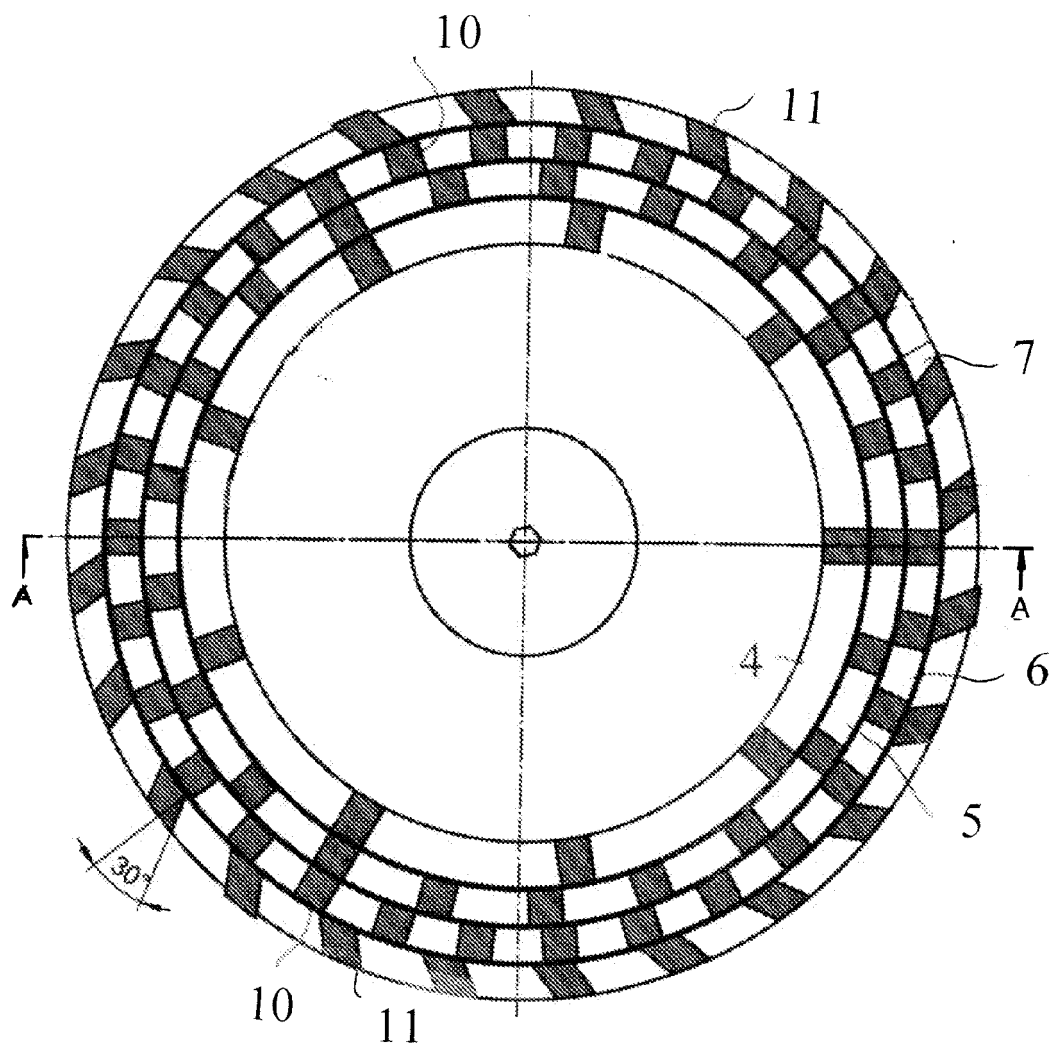


Fig. 1



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Application Number
EP 11 16 2486

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Place of search The Hague		Date of completion of the search 24 June 2011	Examiner Söderberg, Jan-Eric
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