

[54] **METHOD IN THE MANUFACTURE OF LIGNOCELLULOSIC FIBREBOARD**

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[58] Field of Search 264/91, 121; 162/201, 21

[56] **References Cited**

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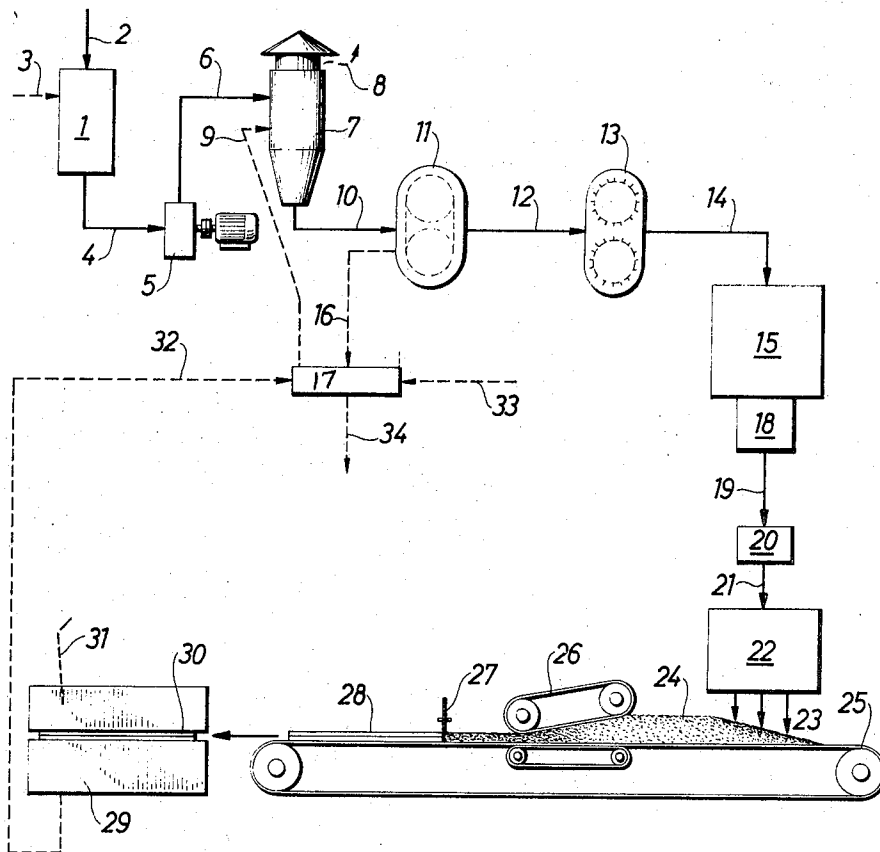
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[57] **ABSTRACT**

A semi wet method of manufacturing lignocellulosic fiberboard in which the lignocellulosic material is soften and disintegrated to form a stream of wet pulp. The wet pulp stream is subjected to mechanical pressing to remove liquid water and substantially eliminate variations in the moisture content. The resulting pulp is suspended in a flow of gas and then separated from the said gas flow to form a pulp web.

6 Claims, 7 Drawing Figures



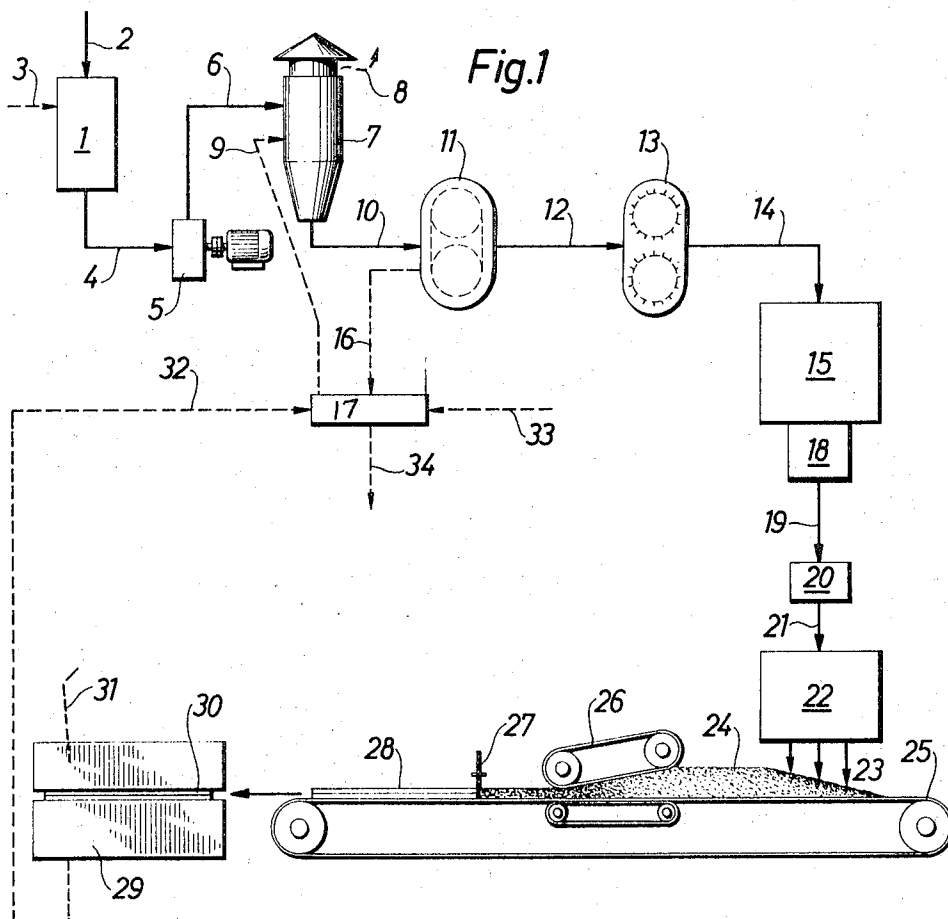


Fig. 2

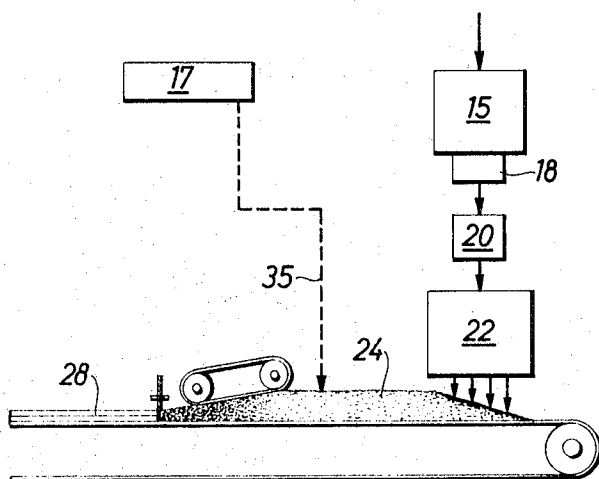


Fig.3

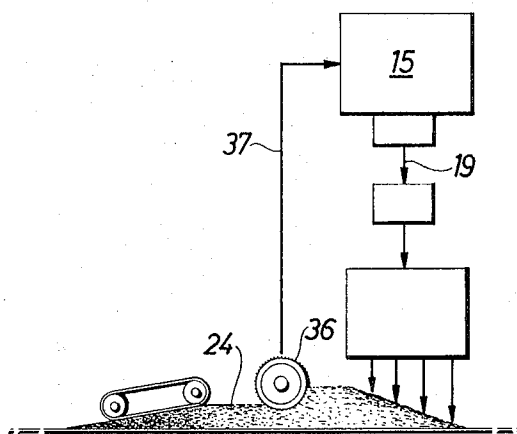
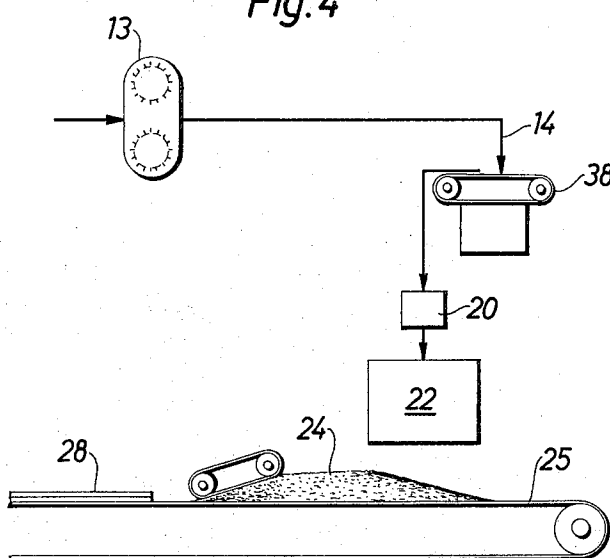
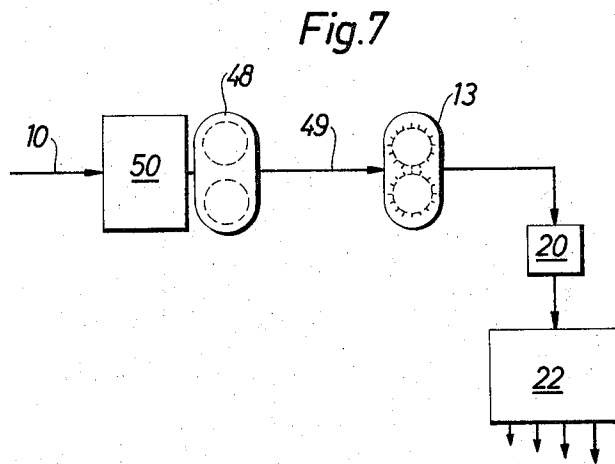
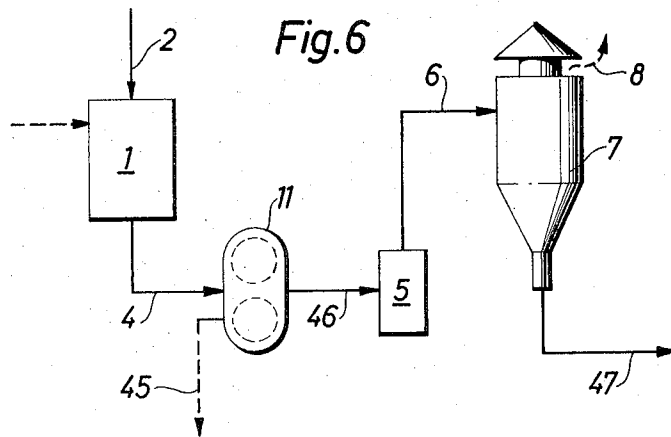
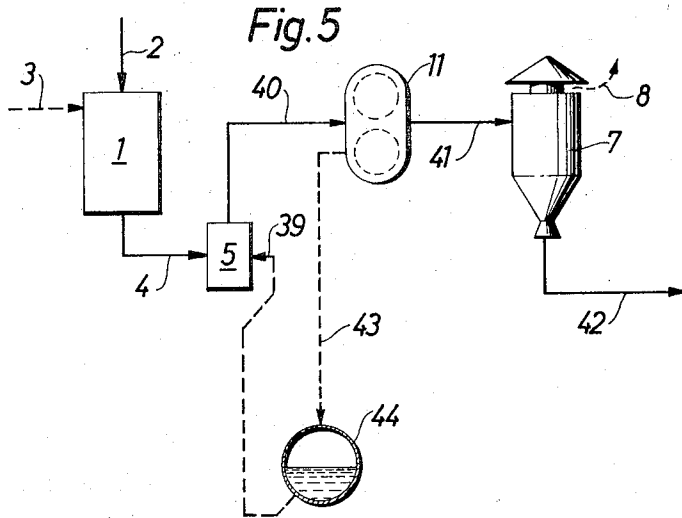


Fig.4





METHOD IN THE MANUFACTURE OF LIGNOCELLULOSIC FIBREBOARD

In the manufacture of wood fibreboard or the like, a raw material such as moist chips is softened by thermal and/or chemical treatment and then disintegrated into a wet pulp by grinding processes for example. The thermal treatment is normally effected by direct heating of the material with steam to temperatures in excess of 100°C and the grinding process is also normally carried out at high temperature and pressures above atmospheric. The moisture ratio of the pulp, i.e. weight relationship of water to dry goods, at atmospheric pressure is normally about 1 and depends on the moisture ratio of the raw material, the amount of steam added and the applied grinding energy.

With the so-called wet method, the wet pulp is suspended in water to form a thin stock suspension, from which the fibres later sediment out into a so-called wet-lap forming machine, to form a uniform pulp web with a moisture ratio of 1.5-3:1. The pulp web is then divided into wet sheets which are pressed under high pressure and at high temperature into rigid, dry slabs. During pressing of the sheets, the moisture ratio is first reduced to about 1:1, by pressing the water from the sheets mechanically at high pressure, and then close to zero by an evaporation process at a lower pressure. The process water separated in the wet-lap-forming machine and the press can be recirculated for preparing a new stock, although in order to prevent the wet-lap machine from becoming blocked fresh water must be supplied and the process water is removed in quantities normally reaching 5-15m³/ton of finished product. The discharged water is contaminated with water-soluble substances which are released from the raw wood material during the manufacture of the pulp and which can be extremely harmful to the environment when discharged into rivers, lakes etc. The contaminants are present in the water in quantities reaching to between 5 and 15 percent of the amount of raw wood material charged to the system and are expensive to isolate.

Another disadvantage with the wet method is that when pressed at high pressures the wet sheets become so compact and stiff that the subsequent drying operation produces slabs with a density of more than 650 kg/m³, even if drying of the sheets is effected at low pressures. Consequently, in order to obtain slabs with a lower density it is necessary to reduce the amount of water removed by pressing so that drying of the sheets begins at a moisture ratio of 1.5-2:1. The evaporation process therefore takes a much longer time to accomplish and requires more heat, which together cause the production cost to be so high that slabs with a density of around 500 kg/m³ cannot be produced by this method.

With another method- the dry method - the wet pulp is dried to a moisture ratio of about 0.1:1, whereafter the pulp suspended in a gas, which is usually air, is sedimented to form a pulp web which is divided into dry sheets. The sheets are then pressed under high pressure and at high temperature into rigid, dry slabs. This method does not have the weaknesses of the wet method, but since the natural binders in the wet pulp are inactivated during the drying process, it requires the addition of synthetic resins, thereby increasing the cost of the product.

A semi-wet method is also known to the art (e.g. from the Swedish Patent Application No. 5132/64), according to which the wet pulp is suspended in a gas and then, with the moisture ratio substantially unchanged, is sedimented from the gas to a pulp web, which is divided into wet sheets and the wet sheets hot pressed.

Forming of the web from a gas phase solves the problem of contaminated effluent and enables slabs of low density to be produced economically, while the relatively high moisture ratio maintained throughout the entire process considerably reduces or eliminates the necessity of adding synthetic resins to the pulp. Because of the varying moisture ratio of the wet pulp, it is difficult to form a pulp web with a uniform distribution of weight over the surface of the dry goods. Even if the pulp web is machined to uniform thickness, the dry goods distribution still becomes uneven, since the degree of packing of the pulp varies with the moisture ratio. The semi-wet method has not yet been applied industrially.

The present invention relates to a method of producing according to the semi-wet method wood fibreboard and the like with uniform weight per unit of surface. The basic principle of the method according to the invention is that the unavoidable variations in moisture ratio of the softened wood chips or the wet pulp are equalized before the pulp is suspended in a gas and that this equalization of the variations in moisture ratio is accomplished by removing water by mechanical pressing operations. With known apparatus it is possible in this connection to obtain a moisture ratio equalization of within ± 2 percent, which value need not be impaired while the stock is suspended in the gas or when sedimenting out to form a pulp web. This means that when forming a pulp web with a constant total weight per unit of surface area and the aforementioned degree of moisture ratio uniformity a variation of dry substance per unit of ± 1 percent is obtained with a moisture ratio of about 1. A uniform distribution of dry goods is also obtained even when forming pulp webs of uniform thickness, since the degree of packing of the pulp becomes more uniform with decreasing variation in the moisture ratio.

The invention will now be described in more detail as applied to the manufacture of wood fibreboard and with reference to FIGS. 1-7. The apparatuses used for carrying out the method of the invention are well known and will not be described in detail. Such conveying means as pumps, fans etc. will not be shown either, although the flow directions are marked in the drawing with arrows.

FIG. 1 illustrates a chip digester 1, to which are charged chips 2 and steam 3 at a pressure above atmospheric. The thermally softened chips 4 are fed at gauge pressure to a disc refiner 5, where the chips are ground to a wet pulp 6, which is blown by the steam pressure in the refiner 5 into an atmospheric cyclone 7 where, by lowering the pressure, the temperature of the pulp falls to 100°C and steam 8 is given off. The pulp is mixed in the cyclone 7 with water 9 and the wetted pulp 10 is passed to a mechanical de-watering apparatus 11, which discharges dewatered pulp 12 to a shredder 13, which produces a flow of pulp 14 having a piece size suitable for transportation to and storage in a pulp bunker 15.

The water 16 separated in the de-waterer 11 is passed to a tank 17 from which the water 9 to the cyclone 7

is supplied. A feeder 18 passes a uniform flow of pulp 19 from the bunker 15 to a disc refiner 20, which resolves the pulp into fibres and fibre bunches and passes a flow of fibres 21 to a forming machine 22. In the forming machine is created a gas-fibre suspension, from which the fibres sediment out to form a pulp web 24 on a support surface 25 which is movable relative to the forming machine. The pulp web is then compressed by a compressing device 26 and divided by a saw 27 into sheets 28, which are charged to a hot press 29 and consolidated to form rigid slabs 30 while giving off steam 31. If the hot press is permitted to exert a sufficiently high force on the pulp sheet, water 32 is also given off in liquid phase, this water being passed to the tank 16. With the illustrated embodiment, if the average moisture ratio of the wet pulp 6 is balanced by the steam 8 from the cyclone 7 and the steam 31 from the press 29 and the moisture ratio in the finished slabs 30, no excess or deficiency of water is obtained. If, for some reason, less fresh water 33 is fed to the process, e.g. to the tank 17, the amount of steam given off in the hot press 29 must be increased, which requires a longer press time. The press time can be reduced by instead removing a determined minor quantity of discharge (waste) water 34 from the process.

FIG. 2 illustrates a system wherein the fibre pulp can be stored in the bunker 15, discharged by the feed means 18, resolved in the disc refiner 20 and formed by the forming machine 22 at a lower moisture ratio than that possessed by the pulp sheets 28 when the sheets are charged to the hot press 29. This is accomplished by passing a flow of water 35, whose magnitude is adjusted according to the rate of growth of the web 24, to the web 24, e.g. from the tank 17.

FIG. 3 illustrates a system with which the requirement of a uniform flow of pulp 19 from the bunker 15 can be reduced, and the evenness of the web 24 is provided for by a cutter 36 which planes the web, the removed material 37 being returned to the bunker 15.

FIG. 4 illustrates a system which includes a shredder 13, from which a flow of pulp 14 is passed over a belt weigher 38, which which continuously senses the magnitude of the pulp flow and proportionally regulates the speed of the support surface 25, which is movable relative to the forming machine 22, whereby the pulp web 24 becomes uniform, provided that the changes in speed are not displaced in time to the same extent as the time taken to convey the pulp from the belt weigher 38 through the disc refiner and the forming machine to the movable support surface 25. Bunkering of the pulp can be dispensed with when using the illustrated system. In order to obtain uniform charging of the pulp sheet 28 to the press 29 when the growth rate of the web 24 varies, the length of the web 24 or the number of pulp sheets in front of the press 29 can be varied in a known manner.

FIG. 5 illustrates a system which includes a chip digester 1, a disc refiner 5 and a de-watering device 11, all of which are under elevated pressure, and an atmospheric cyclone 7. The chip digester 1 is charged with chips 2 and steam 3 and softened chips 4 and water 39 are passed to the disc refiner 5. Wet pulp 40 is then passed to the de-watering apparatus 11, from which de-watered pulp 41 is blown to the cyclone 7, where steam 8 is given off and a de-watered and de-vapourized flow of pulp 42 is obtained, the pulp then being passed to a pulp bunker for example. The water 43 separated in the

de-watering apparatus is passed to a tank 44 which is under the same gauge pressure as the de-watering apparatus 11 and from which water 39 is passed to the disc refiner 5.

FIG. 6 illustrates a system which includes a chip digester 1, from which softened chips 4 are fed at gauge pressure to a mechanical de-watering apparatus 11, which discharges water 45 and de-watered chips 46. The chips 46 are passed under gauge pressure from the apparatus 11 to a disc refiner 5, where they are ground to a wet pulp 6, which is then passed to an atmospheric cyclone 7. Steam 8 is given off in the cyclone and pulp 47, obtained from de-watered chips, is passed therefrom to a pulp bunker for example. The system illustrated in FIGS. 5 and 6 enables the chips to be de-watered at a temperature in excess of 100°C, whereby the moisture content can be decreased more easily than would otherwise be the case, and the moisture content is further reduced when the pulp is blown out in the cyclone at atmospheric pressure by the temperature fall to 100°C and the steam generation caused thereof.

FIG. 7 illustrates a system which includes a mechanical de-watering apparatus 48 of the type which discharges a de-watered flow of pulp 49, which is uniform both with respect to the moisture ratio and to the flow of dry goods. The flow 49 is passed to the forming machine 22 via a shredder 13 and a disc refiner 20. A pulp container 50 which has been pre-connected to the de-watering apparatus 48 is provided to even out the varying weight per unit of time of the moistened flow of pulp 10.

If the quantity of insufficiently disintergrated wood — so-called shives — delivered by the disc refiner reaches impermissible limits, the pulp can be further ground in the disc refiner 20 or in the shredder 13 or in a disc refiner (not shown) especially intended for the purpose, installed behind the disc refiner 5 or the cyclone 7. The energy necessary to effect this secondary grinding process is mainly converted to heat in the pulp, whereupon steam is given off and a drier pulp is obtained as a result thereof.

Further increase in the dry content of the pulp is naturally obtained during transportation of the pulp to the forming machine 22, particularly if this is effected by means of air, and during the actual forming operation itself. The increase in the dry content of the pulp enables the press time in the press 29 to be shortened, but the pulp should not be allowed to dry to such an extent that the natural binding agents of the pulp are inactivated.

When it is necessary to add colouring agents, insecticides or other chemicals to the system, this can be done at the tank 17 for example, or to any of the water flows 9, 32, 33 or 35.

I claim:

1. A method of manufacturing lignocellulosic fibre-board according to the so-called semi-wet method, in which lignocellulosic material is softened and disintegrated to form a stream of wet pulp, said pulp stream is suspended in a flow of gas, and said suspended pulp is separated from said gas flow to form a pulp web, characterized in that said stream of wet pulp prior to suspension in said gas flow is passed through a zone in which mechanical pressure is applied to said stream to remove liquid water and substantially eliminate variations in the moisture content along said stream.

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2. A method according to claim 1 characterized in that the mechanical pressing zone is maintained at a temperature of about 100°C or higher.

3. A method according to claim 1 characterized in that the stream of wet pulp is passed through said mechanical pressing zone at a substantially uniform speed.

4. A method according to claim 1 wherein after passage through the mechanical pressing zone, said pulp stream is dried to a moisture ratio of not lower than 1:3

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before being suspended in said gas flow.

5. The method of claim 1 wherein any variation in the moisture content of said web after passage through said zone is not greater than ± 2 percent.

6. The method according to claim 5 wherein sufficient liquid water is removed from said stream of wet pulp as to produce a ratio of liquid to solids in such stream of about 1.

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