March 9, 1948. J. S. HILL 2,437,254

DRUM DRIER FOR SHEET MATERIAL

Filed July 30, 1943

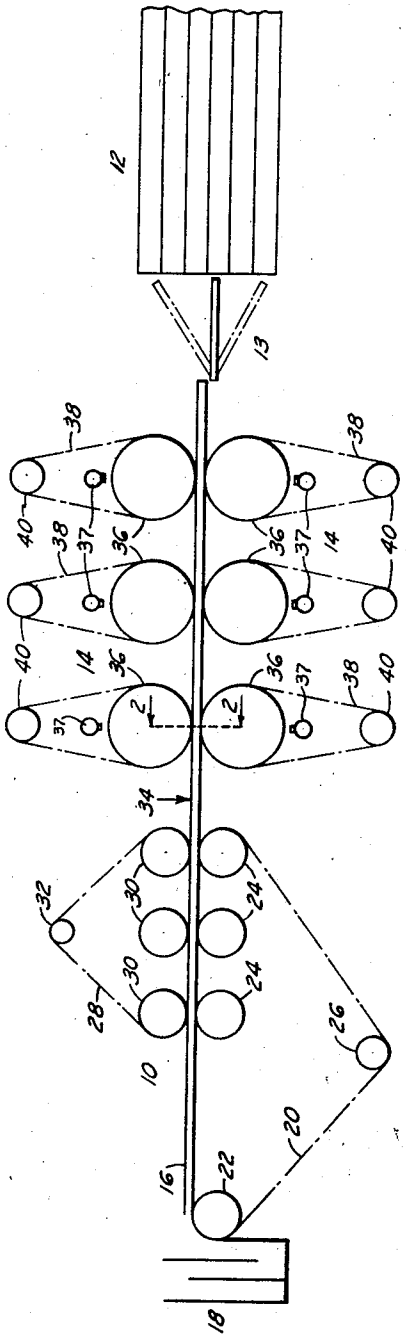


Fig. 1

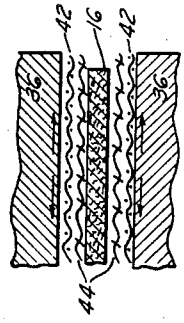


Fig. 2

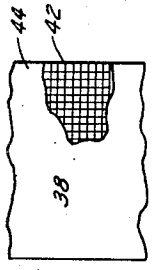


Fig. 3

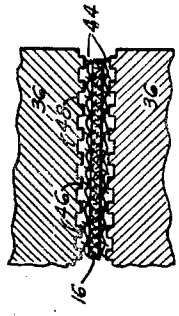


Fig. 4

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DRUM DRIER FOR SHEET MATERIAL

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4 Claims. (Cl. 34—116)

1

The invention relates to manufacture of fiber board products, and particularly to reducing the water content of fiber sheets before they are finally dried to thereby get quicker and better drying.

Wetlap fiber sheets from the wet machine in which they are formed oridnarily contain about 50–60% of water and are quite thick. The reason for this is that, if the pressure on the squeeze-rolls of the wet machine were increased much in an effort to reduce water content and thickness, the backward stream of expressed water meeting the lap material entering the pinch between the rolls would injure or even cut the lap.

Decrease of water content and increase of compactness of the wetlap going to the drier, as a hot air drier of the "Coe" type, for example, is highly desirable because the drying time will be shortened in several ways as follows: To begin with there is less water to be removed in the drier. The reduced thickness reduces the distance for heat to travel from sheet surface to sheet center, and the extra compacting reduces the heat-insulating properties of the lap, enabling the heat to travel therein more readily. Not only is the drying time reduced, but the drying operation is more controllable and the uniformity of dryness of the dried sheets is improved.

My invention provides a process and apparatus for reducing the water content and reducing the thickness of the formed wetlaps in order to obtain beneficial results as above described when these wetlaps are dried. The drying may be done in an air drier if desired.

However, instead of sending the more highly compacted wetlap to a hot air drier, it may be used for making hardboard and like products by being dried in a multiple-platen press with wire mesh in contact with one surface of the sheet. While the removal of extra water from the formed wetlap before sending to the press is not so important in this case, it is important to have the wetlap which is introduced into the press as well compacted and strong as practicable. This is because with more fragile and softer wetlap, particles and scraps of various kinds would fall from upper sheets on to lower sheets and considerable press time would be lost by blowing away such particles and pieces of lap with compressed air, or otherwise removing same, before the boards can be pressed.

In my preferred apparatus and process, the formed wetlaps are pressed between heated surfaces with foraminous or porous sheets in contact with the wetlap and with means, such as wire screen or equivalent, for conducting away water

2

and steam from between these foraminous sheets and the heated pressing surface. The foraminous sheets should be of material having low heat conductivity, since with use of material which conducts heat efficiently, a skin may be formed on the wetlap which may interfere with later drying of the sheet.

The general object of the present invention is to provide a process and apparatus for reducing the water content of water-containing fiber sheets, known as wetlaps, before subjecting to final drying treatment.

A further object is to reduce the thickness of the wetlap so as to shorten the distance through which the heat must travel in order to reach the center of the board, and to compact the wetlap so as to increase the strength and cohesiveness of wetlaps which are to be subjected to hot-pressing with wire mesh in contact with the wetlap surface.

An additional object of the present invention is to reduce the amount of heat required for drying the wetlap by providing for removal of a considerable portion of the water in the liquid phase.

A further additional object of the invention is to provide a process and apparatus whereby the water content of wetlaps may be mechanically reduced to a proportion well below the weight of dry fiber, without the expressed water being so related to the wetlap as to cause injury or cutting thereof.

In the accompanying drawing forming a part of this specification.

Fig. 1 is a diagrammatical, longitudinal, sectional view of a form of apparatus adapted to carry out my new procedure;

Fig. 2 is an enlarged sectional view on line 2—2 of Fig. 1;

Fig. 3 is a fragmentary sectional view and shows a portion of the foraminous sheet and a screen which is adapted to provide an air space between the foraminous sheet and the heated pressing means, and

Fig. 4 is a view in section of a modification of my apparatus showing elevations and depressions on the roll surface with cloth and fibrous sheet between rolls.

Reference character 10 designates generally, and more or less diagrammatically, a wet machine or sheet-forming machine, 12 a drier, including a tipple 13, and 14 an intermediately-arranged apparatus for partial removal of water from and partial compaction of the wetlap 16. The head-box 18 of wet machine 10 receives watery fibrous pulp from which the wetlap 16 is

formed. From the head-box 18, the fibrous pulp is run on to a travelling Fourdrinier wire 20 to form the sheet or wetlap 16. This Fourdrinier wire runs around breast roll 22, over squeeze rolls 24, 24 and under idler roll 26. A wire screen 28 passes around the companion squeeze rolls 30, 30 and idler 32, the wetlap 16 being interposed and traveled between rolls 24, 24 and 30, 30, and also between screens 20 and 28. The squeeze rolls 24, 24 and 30, 30 and suction boxes (not shown) remove a large quantity of water from the formed sheet. A cut-off is diagrammatically indicated at 34 for cutting the wetlap 16 into suitable board lengths, which are then ready for further treatment.

In previous operations, the wetlap 16 was either moved directly into drier 12, or carried into a heated press on a wire screen (not shown). The feature of providing novel pressure-applying means to remove additional liquid from the formed wetlap 16 and partly compact the same before passing into drier 12 or into a press is the important feature of the present invention, and such means is designated generally by reference character 14.

After the fibrous sheets 16 have been cut into proper lengths at 34, the sheets are conveyed between heated pressing rolls 36, 36. The pressing rolls are heated by any suitable heating means, as for example, gas burners 37. Belts are interposed between the wetlap 16 and pressing rolls 36, 36. In the drawing endless belts 38 are shown passed around rolls 36, 36 and also around idler rolls 40.

The belts 38, 38, as here shown, comprise inner sheets 42 of foraminous metallic material such as wire screens adapted to afford openings for outlet of water, steam, vapors, and the like, and also comprise outer sheets 44 of foraminous material of low heat conductivity such as cotton cloth, for example, the inner belt sheets 42 contacting rolls 36, and the outer belt sheets 44 contacting wetlap 16.

When pressure is applied to wetlap sheets 16 as they are moved between the heated pressing rolls 36, 36, water is forced from the wetlap through foraminous sheets 44 and into the airspace formed by the mesh formation of screens 42 located between sheets 44, 44 and the rolls 36, 36. A considerable portion of the water is immediately transformed into vapor or steam upon contacting heated rolls 36, 36, so that some pressure is built up in the meshes of screen 42. The vapor or steam will thus move towards the region of lower pressure at the ends of the rolls 36, 36 as indicated by the directional arrows in Figure 2. As the steam etc. moves towards the ends of the rolls, unvaporized water will also be forced out therewith.

The fibrous sheets 16 may be passed between a series of such steam and water-removing rolls 36, 36 in order to decrease the water content before passing on into drier 12. Three pairs of rolls are here shown.

The following example illustrates the invention by one set of results obtained by passing a wetlap containing about 55% of water on weight of wetlap, or about 122% on weight of dry fiber, between heated rolls, with wire mesh and cotton cloth between the rolls and the wetlap. Steam pressure of 150 lbs. per sq. in. was used for heating the rolls, and the pressure between the rolls was about 3800 lbs. per linear inch. On passing the wetlap through one pair of rolls at a speed of 32 feet per minute, the moisture content of the sheet was reduced to about 73% of the dry weight of the wetlap. The thickness of the sheet was also materially reduced. After three roll passes the moisture was thereby reduced to about 43% of the dry weight of the wetlap, and the thickness of the sheet was still further reduced.

Another illustration showing the advantage of passing wetlap through rolls for compaction and moisture reduction is given in the following example. A wetlap received from the Fourdrinier machine and containing about the same percentage of water as before was passed between rolls at a speed of 7 feet per minute, with the same cloth and screen arrangement as before. Steam pressure applied to the rolls was about 140 lbs. per sq. in., and linear pressure on the rolls was about 3800 lbs. per inch. After passing through one pair of rolls, the moisture in the fibrous sheet was reduced to about 61% on dry weight of fiber. After three roll passes, the water content had been reduced to about 34% on dry weight of fiber.

In the drawing, the air space between the heated rolls 36 and the foraminous sheet of cotton domestic cloth 44 has been shown as formed by screen wire 42. Similar air spaces or passages to lead vapors and liquids to the atmosphere may be formed by other means, as for example, by providing corrugations or other elevations 46 with intermediate depressions 48 as shown in Fig. 4 on the surfaces of the rolls which may be used instead of screen wire.

The method of pressing wet fibrous sheets with a foraminous sheet and having air spaces between the heated pressing surface and the foraminous sheet can also be used with flat presses. When flat presses are used, continuous operation as obtained in the case of rolls is not readily practicable, and for this reason heated rolls are preferred.

The numerous advantages of reducing the water content of fibrous sheets by the method and apparatus of the present invention will thus be apparent. The foraminous material, which contacts the fibrous sheet from which the water is being forced, being made of material such as cloth, for example, is of low heat conductivity and will not transfer heat from the heated rolls to the wetlap so rapidly as to form a skin on the surface of the sheet, which would interfere with removal of water and with ready penetration of heat to the center of the sheet in subsequent drying treatment, and if formed in one set of rolls would give rise to blistering in subsequent roll passes. Furthermore, the air space between such foraminous sheet and the heated pressing surface, as the roll surfaces for example, enables vapors and liquids to be removed via the end regions of the rolls. The water being at least principally removed in this way, water expressed so as to travel backwardly against the lap entering the pinch of the rolls will be minimized and cutting or crushing of the lap is obviated.

A further advantage which is obtained by the use of the present invention consists in better controllability of content of water solubles in the finished board. If desired, the content of water solubles can be reduced in about the same proportion as the water content of the lap. That is to say, if for example from original 120% of water content based on dry weight of fiber, the water in the lap is reduced by my improved method to say 40% on the same basis, the finished board would contain only about one-third as much water-soluble material as in the case where the original wetlap was directly subjected to drying with hot air.

If, however, reduction in water soluble content of the finished board should not be desirable, then it would become possible to increase the content of water solubles in the suspension of fiber and water which is supplied to the head-box. As for example, if with use of my invention the water content of the formed wetlap should be reduced from say 120% to 40% for example on weight of dry fiber, and no reduction in content of water solubles in the dried board was desired, the concentration of water solubles in the pulp in the wet-machine head-box could be three times as great as when wetlaps are directly dried without the use of my invention.

Another advantage which is obtained by the use of the present invention consists in the effective use of resins, particularly thermo-setting resins in fiber boards. Heating of the surface and center portions of the lap will be relatively uniform, thus the resins will be uniformly activated throughout the thickness of the fibrous sheet. This feature was not possible in previous drying procedures because the resins in the surface portion of the fibrous sheet were activated before heat could penetrate into the body portions of the sheet.

Sheets of suitably prepared ligno-cellulose fiber, when treated for partial removal of water content and partial compaction, and then dried in a hot air drier, as heretofore described, are well adapted for use with the processes of U. S. patent to Mason No. 2,120,137 and U. S. patent to Mason et al. No. 2,317,394, and for making the product of U. S. patent to Mason 2,234,126.

The examples given are for illustration only and not for limitation of the invention, which is of the broad scope defined by my claims.

I claim:

1. An apparatus for removing liquids from sheets of fibrous material, which comprises opposed rotatable heated pressing rolls between which the sheets are passed, a rotatable idler roll spaced from each pressing roll, an endless belt extending around each pressing roll and around its associated idler roll, said endless belts consisting of foraminous sheets of low heat conductivity and wire screens, the screens being in contact with the heated rolls and the foraminous sheets in contact with the sheet of fibrous material.

2. An apparatus for removing liquids from sheets of fibrous material, which comprises opposed rotatable heated pressing rolls between

which the sheets are passed, a rotatable idler roll spaced from each pressing roll, an endless foraminous belt having low heat conductivity extending around each pressing roll and around its associated idler roll, and means to form substantial air spaces between the heated pressing roll and the foraminous belts.

3. An apparatus for removing liquids from sheets of fibrous material, which comprises opposed rotatable heated pressing rolls between which the sheets are passed, each pressing roll having elevations and depressions on the roll surface, a rotatable idler roll spaced from each pressing roll, and an endless foraminous belt having low heat conductivity extending around each pressing roll and around its associated idler roll.

4. An apparatus for removing liquids from sheets of fibrous material, which comprises opposed rotatable heated pressing rolls between which the sheets are passed, each pressing roll having elevations and depressions on the surface of the roll, a rotatable idler roll spaced from each pressing roll, and an endless foraminous belt having low heat conductivity extending around each pressing roll and around its associated idler roll, said depressions forming air spaces extending from one end of the roll to the opposite end behind the foraminous belts.

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