March 5, 1957 H. N. SKÖLDKVIST 2,783,689

ARRANGEMENT FOR REMOVING OF WATER IN PRESS SECTION OF MACHINES FOR FORMING A FELTED PULP WEB

Filed March 26, 1954 2 Sheets-Sheet 1

Fig. 1.

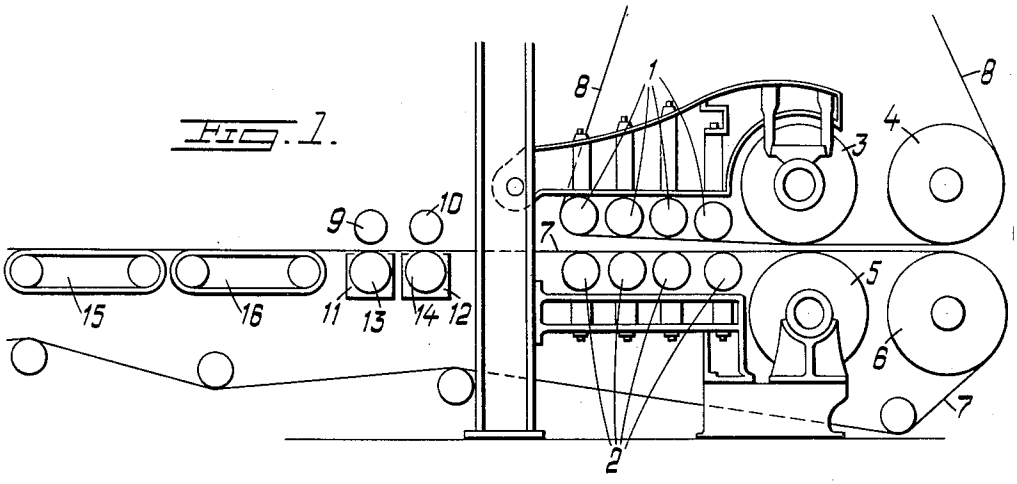
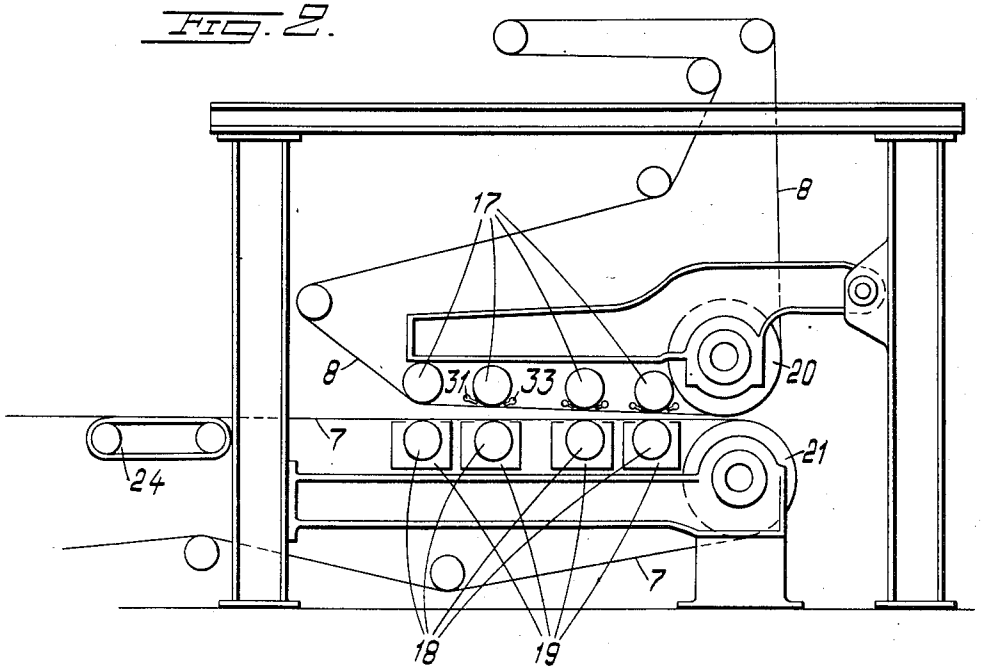


Fig. 2.



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Fig. 3.

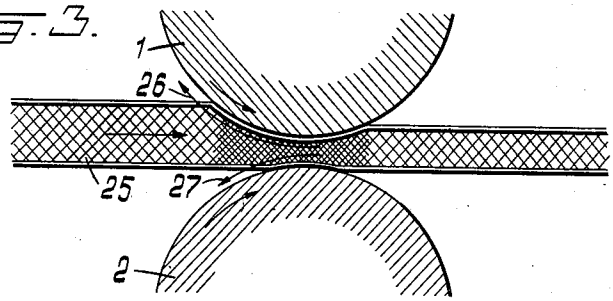


Fig. 4.

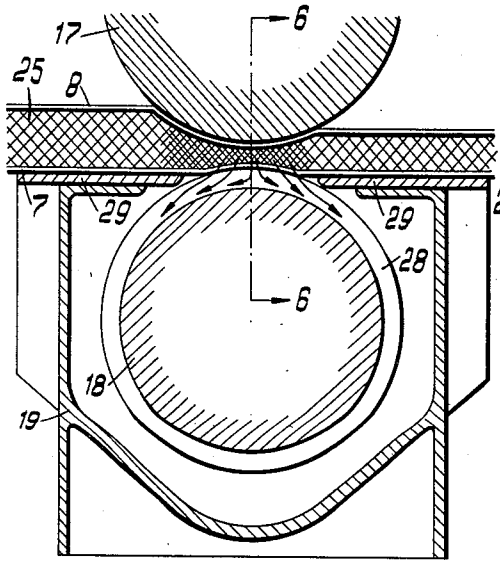


Fig. 5.

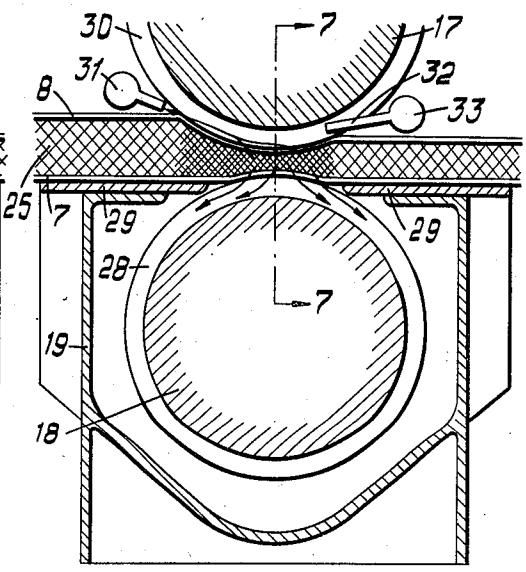


Fig. 6.

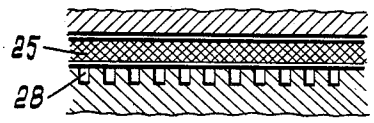
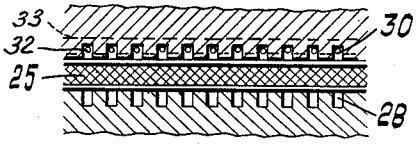


Fig. 7.



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ARRANGEMENT FOR REMOVING OF WATER IN PRESS SECTION OF MACHINES FOR FORMING A FELTED PULP WEB

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4 Claims. (Cl. 92—49)

The forming of a pulp web in a Fourdrinier machine for the production of for instance wallboard plates, carton forming material, mechanical pulp, cellulose filament and the like is currently made in such a way that a mixture of fiber and water has to flow out onto a moving endless wire cloth. The wire cloth or screen carrying the mixture will at first run over a number of register rolls, thereafter over one or more suction boxes, plane or rotating, or a combination of the same and finally through the wet press section. The purpose is to extract water successively from the mixture and thereby to mat the same to form a pulp web having the lowest possible water content. The problem of obtaining a pulp web having the lowest possible water content imposes important technical and economical considerations.

After the pulp web is formed it is generally dried in air dryers over cylinder sections or in plane presses, depending upon which fibrous material is being treated and which final product is desired. A pulp web with a lower content of water will, as a matter of course become cheaper to dry than a pulp web with a higher water content. Besides the economic gain that is attained by working a pulp web with as low a water content as possible a great many technical advantages are obtained. For instance in the pressing of hard wallboard plates in warm presses it may happen that if the water content in the pulp web is too high explosions in the presses may arise. This drawback is avoided if the water content is maintained below a suitable value. Also water spots will arise on the finished plates if the water content is too high. In order to obtain a good forming of the pulp web, the wet lap or sheet, during the manufacture of wallboard—and thereby provide great strength in the finished product—one endeavours to maintain the concentration as low as possible at the flowing in of the fiber mixture onto the wire cloth. Experience has proven that with a low concentration of the fibrous mixture, that is, high dilution, a substantially stronger wallboard is obtained than if the concentration is high. It is also known that a fine fiber or a one of high grinding degree or a fine fiber mixed with coarser fiber also considerably increases the strength of the finished product.

However, with the present construction of Fourdrinier machines it is not possible to maintain the desired dilution and the degree of grinding that will give maximum strength in the finished product. If the dilution and the degree of grinding is as high as desired the machine will not provide sufficient time for extracting water from the fibrous mixture to obtain the desired water content in the wet lap or sheet at a given speed of operation. Of course, if a high dilution, at the forming of the wet lap or sheet and a high degree of grinding, is desired, it is possible to decrease the speed of the machine in order to attain the required degree of dryness in the wet lap or sheet when the same leaves the Fourdrinier machine. However this will result in an undesired increase in the

capacity of this machine. In order to facilitate the extraction of water from the wet lap or sheet it is possible to increase the vacuum in available suction boxes or to increase the number of the same. However in such solution processes there will be the disadvantage of too much wear on the wire cloths or screens so that such a step will become economically impossible due to the wear effect on the wire cloth, the interruption of service and other disadvantages. Additionally, too high a vacuum may cause the wire cloth to be stuck while the driving rollers continue to rotate, so that the wire cloth will tear or break.

The press section in the Fourdrinier machine for wallboard of known type consists of a number of prepress rolls and behind these one or two pairs of main rolls. Due to the fact that the clearance between the pairs of rolls through which the wet lap or sheet has to pass decreases in the direction of movement of the sheet, the same will become successively compressed and the water will be extracted. The prepress rolls have heretofore consisted of smooth, ground steel rollers of smaller diameter than the main press rolls. The prepress rolls have been separately adjustable and the number of pairs thereof has been up to four. In addition to the above mentioned endless wire cloth, that passes over the lower rolls there is also provided an endless wire cloth trained beneath the upper rolls. The formed wet sheet will thereby be confined between an upper and a lower wire cloth, thus making it possible to increase the pressing in each step.

The disadvantage of using this construction consists in the fact that the water which is expressed out from the fibrous mixture in the compression zone between a pair of prepress rolls has to pass or flow off in a direction that is substantially opposite to the direction of movement of the wet sheet. If the compression and thereby the extraction of water in any one step is too great in comparison with a certain speed of movement of the wet sheet and the fiber is for instance desirably fine ground for the purpose, the extracted water will obtain such high speed relative to the wet sheet and so high a pressure that the matting in the sheet is damaged and a crushing effect arises. The risk of crushing thus limits speed of the extraction of water to a given speed of the machine. If the speed of the machine is fixed to maintain a certain production and the dryness in the wet sheet is fixed to a certain value, in order to obtain a sufficient extraction of water without risk of crushing it is necessary to control the dilution and the degree of grinding accordingly, i. e. the dilution and possibly the degree of grinding has to be decreased. This results, however, as previously pointed out, in a finished product of an inferior quality. If on the other hand a certain high dilution and degree of grinding has to be maintained, the speed of the machine has to be decreased to a value that for a certain dryness of the wet lap or sheet does not involve any risk for crushing. In order to force the extraction of water from the wet sheet as much as possible it has been necessary to arrange in front of the press section a plurality of rotatable or other suction boxes of conventional type and in addition thereto one has been compelled to maintain too high a vacuum in the same resulting in a considerable wear on and short time in the useful life of the wire cloths. That which is mentioned above in connection with the manufacture of wallboard is also fundamentally applicable for the manufacture of carton forming material, mechanical pulp and cellulose filament.

The purpose of the present invention is to avoid the above mentioned disadvantages in the press section of a machine that forms a felted pulp web, wallboard, carton

forming material, mechanical pulp, cellulose filament and the like, when the water from the pulp web during its movement between the prepress rolls is successively extracted between an upper and a lower wire cloth. The invention is principally characterized in the fact that the compression of the pulp web is so arranged that the water is extracted in the compression zone, higher or lower, or under vacuum in combination with pressure air or without vacuum, is removed at right angles or substantially at right angles to the direction of movement of the pulp web. It has been proven that the vacuum, which has to be maintained in the purality of suction boxes which are required for a given relation in a Fourdrinier machine of known type, is 2 to 5 times higher than in a machine in accordance with the invention. In addition the number of suction boxes has been decreased to ⅔ or less than those heretofore required.

These and other characteristic features of the invention will be explained more in detail in connection with the following description of illustrated embodiments of the invention. In the drawings:

Figure 1 is a side view of the known arrangement of a press section in a board forming machine, while

Figure 2 is a side view of a press section constructed in accordance with the present invention.

Figure 3 diagrammatically illustrates the action during compression of a wet sheet between the prepress rolls, of known performance.

Figure 4 diagrammatically illustrates the action during compression of a wet sheet between prepress rolls made according to the invention.

Figure 5 illustrates the action during compression of a wet sheet between prepress rolls of another embodiment of the invention.

Figure 6 is a cross section taken along lines **6—6** of Figure 4 and

Figure 7 is a cross section taken along lines **7—7** of Figure 5.

In the embodiment according to Figure 1, there is shown the known arrangement of a press section in a board forming machine. The upper prepress rolls are designated at **1** and **2** designates the lower prepress rolls. The numerals **3** and **4** designate the upper and **5** and **6** the lower rolls in the main press section. Over the lower prepress rolls **2** and the lower main rolls **5** and **6** runs a wire cloth **7** and under the corresponding upper rolls runs a wire cloth **8**. In front of the press section, in the direction of movement of the wire cloth **7**, there is provided a wet sheet or pulp pressing arrangement consisting of two upper rolls **9** and **10** bearing against the pulp web and two lower rolls **13** and **14** journalled in suction boxes **11** and **12**. In front of the rolls **9** and **13** in the direction of movement of the wire cloth **7** there are provided two suction boxes **15** and **16** equipped with rotating rubber bands.

In the embodiment according to the invention, which is illustrated in Figure 2, the upper prepress rolls are designated at **17** and the lower prepress rolls at **18**. The last mentioned rolls are journalled in suction boxes **19**. In this embodiment the main press consists of one pair of rolls **20**, **21**, but can of course also consist of two pairs of rolls. Similarly as in the above decribed known embodiment a wire cloth **7** runs over the lower prepress rolls and the lower main roll and a wire cloth **8** runs under the corresponding upper rolls. In front of the prepress section, in the direction of movement of the wire cloth **7**, there is arranged a suction box **24** provided with a rotating rubber band. As will be seen from Figure 1, as well as from Figure 2, the successive pairs of rolls in the prepress section are arranged with decreasing clearance between upper and lower rolls, in the direction of movement of the wet sheet, whereby in the feeding forward of the sheet between the pairs of rolls the same is exposed to a successively increased compression.

During the pressing of the wet lap or sheet **25** between a pair of prepress rolls **1**, **2** according to the known arrangement, illustrated schematically in an enlarged scale in Figure 3, the water extracted from the wet sheet will pass, as indicated by arrows **26**, **27**, in a direction opposite to the direction of movement of the wet sheet, whereby will arise the disadvantages as to pressure above the atmospheric etc. described above, resulting in that the matting in the wet sheet will become damaged and the risk of a crushing effect will arise.

In Figure 4 there is illustrated on an enlarged scale the action in the compression zone between a pair of prepress rolls made according to the invention. In this instance water is extracted from the wet sheet **25** the lower roll **18** is provided with a plurality of circular grooves **28**, arranged along the circumference of the roll. By this arrangement the water that is extracted from the wet sheet will be exposed to a vacuum instead of a pressure above the atmospheric as is the case with the currently known arrangement and the water is removed in directions substantially at right angles to the direction of movement of the wet sheet as indicated by the arrows in Figure 4. The lower roll is, as already mentioned in connection with Figure 2, journalled in a box **19**, which is under vacuum. Due to this fact the water is sucked away from the wet sheet through said grooves **28** in the roll **18**. By means of this arrangement any pressure in the water above the atmospheric is avoided. The cover **29** of the suction box **19** consists preferably of a Bakelite plate or the like through which is provided an opening from which a portion of the roll **18** protrudes above the plate in order to decrease the friction effect on the wire cloth **7**. In this embodiment, according to the invention the upper roll **17** is smooth. In Figure 6 is illustrated the arrangement of the grooves **28** along the circumference of the roll **18**.

In Figure 5 there is illustrated another embodiment of a pair of prepress rolls according to the invention. This form differs from the embodiment according to Figure 4 in that the upper roll **17** is also provided with circular grooves **30** along the circumference of same and which grooves permit water forced up through the upper wire cloth **8** to be removed substantially at right angles to the direction of movement of the wet sheet. This embodiment also includes a suction pipe **31** located in front of the upper roll **17** and above the upper wire cloth **8**, through which pipe, water passing up through the upper wire cloth **8**, is sucked away. The arrangement further includes a pipe **33** and nozzle **32** on the opposite side of the upper roll **17** through which air under pressure flows to force away the water passing up through the upper wire cloth **8**. As shown in the drawings, Figure 5, the pipe or header **33** is disposed closely adjacent the circumference of the upper roll **17** and the nozzles **32** have an extent such as to be disposed in the grooves **30** so that their terminal and outlet ends are closely above the upper wire cloth or screen **8** in the compression zone. In Figure 7, which is a cross section along the line **7—7** in Figure 5, there is illustrated the circular grooves **30**, **28** arranged along the circumferences of the upper and lower rolls.

By building out the prepress roll section with some further pairs of rolls and suction boxes connected thereto it ought to be possible to spare all or at least part of the suction boxes provided with rotating rubber bands or other suction boxes of conventional type, whereby besides the economic gain that is made possible by this arrangement there is also avoided the danger of fastening of the lower wire cloth due to suction and possible breaking of the same at too high a vacuum.

Consequently by the present invention, among other things, the following advantages are attained:

1. The speed of the machine can be increased resulting in an increased production.

2. The concentration of the fibrous mixture can be decreased resulting in a stronger product.

3. The degree of grinding can be increased which also

increases the strength of the finished pressed product and furthermore improves the physical properties of the same product for example smoother surfaces can be attained.

4. The consumption of steam in the warm presses following behind or in the air dryers can be decreased depending upon the lower water content, which is made possible by the arrangement according to the invention.

5. Possibility of eliminating to a great extent the formation of water spots in the finished product, also contributing to the formation of a smoother surface.

6. Risk of explosions in the warm presses is avoided.

The invention is evidently not limited to the now described and illustrated embodiments but the same can be varied in a plurality of different ways within the scope of the invention.

What I claim is:

1. In the pre-press section of a machine for forming a felted pulp web, such as wallboard, carton forming material, mechanical pulp and cellulose filament, and in which section water is successively extracted from the pulp web while the same is moved forward between an upper and lower wire cloth, said pre-press section comprising at least one pair of rolls resiliently pressed against said wire cloths, said rolls constituting upper and lower rolls, the lower roll of said pair having circular grooves along its circumference, means for establishing water extracting currents in front of and behind the lower roll whereby water extracted from said pulp web in the compression zone between said rolls flows into said grooves substantially at right angles to the direction of movement of said pulp web so as to become distributed uniformly along the circumference of the lower roll on the front and rear sides thereof, suction means in front of the upper roll and above the upper wire cloth and including at least one nozzle directed toward the compression zone between the rolls, said upper roll also having axially spaced circumferential grooves therein, nozzle means above the upper wire cloth and directed toward the compression zone between the rolls and located on the opposite side of said upper roll from said suction means and means for supplying air under pressure to said last mentioned nozzle means to force any water penetrating through the upper wire cloth toward the suction means.

2. Apparatus for extracting liquid from a pulp web comprising a casing including opposite spaced front and rear walls and a top having a slot therein, a roll supported in said casing in spaced relation to said walls and with a portion of its periphery projecting into the slot, said roll having axially spaced circumferential grooves therein, another roll spaced above the first roll in parallelism therewith, means for moving a layer of pulp between the rolls comprising spaced upper and lower streams with the lower stream engaging said top whereby the rotation of the rolls toward one another establishes a compression zone above the slot for squeezing liquid from a layer of pulp, means applying suction to the casing to establish liquid extracting currents between the opposite front and rear sides of said first roll and said spaced front and rear walls so that liquid extracted from the rear flows into the grooves of said first roll substantially at right angles to the direction of movement of the rear whereby the liquid is uniformly distributed along the circumference of said first roll along the opposite front and rear sides thereof, said second roll constituting an upper roll and also having axially spaced circumferential grooves therein, suction nozzle means in front of the upper roll as regards the direction of movement of the layer and above the upper screen and directed toward the compression zone for sucking away any liquid passing through the upper screen, and nozzle means for supplying air under pressure located above the upper screen on the opposite side of the compression zone from said suction nozzle means and directed toward the latter for forcing any liquid passing through the upper screen toward the suction nozzle means.

3. In a pre-press section of a machine for forming a felted pup web, such as wallboard, carton forming material, mechanical pulp and cellulose filament and in which section water is successively extracted from the pulp web while the same is moved forward between an upper and a lower wire cloth, said pre-press section comprising at least one pair of rolls resiliently pressed against said wire cloths, said pair of rolls comprising an upper and a lower roll, each said rolls having axially spaced circumferential grooves therein, a casing surrounding said lower roll and having an opening parallel to the axis of said roll, said opening being located in the compression zone between said rolls, means subjecting the casing to vacuum whereby water extracted from a pulp web moving through said compression zone flows into the grooves of the lower roll substantially at right angles to the direction of movement of the pulp web so as to become distributed uniformly along the circumference of the lower roll on the front as well as on the rear side thereof, suction means in front of said upper roll and above the upper wire cloth and including at least one nozzle directed toward the compression zone between the rolls, and means above the upper wire cloth, extending along the whole length of said upper roll and located on the opposite side of said upper roll from said suction means and including a plurality of nozzles directed toward the compression zone and between said rolls, and means for supplying air under pressure to said last mentioned nozzles to cooperate with said suction means in forcing any liquid passing through the upper wire cloth through the grooves in the upper roll toward the suction nozzle means.

4. Apparatus as claimed in claim 2 in which said last mentioned nozzle means comprise a plurality of nozzles, a header pipe disposed above the upper screen closely adjacent the circumference of the upper roll and said nozzles extending from said pipe and having a length such as to terminate within the grooves closely superjacent the upper screen at the compression zone.

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