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AUTOMATIC VACUUM SUCTION BOX IN PAPERMAKING

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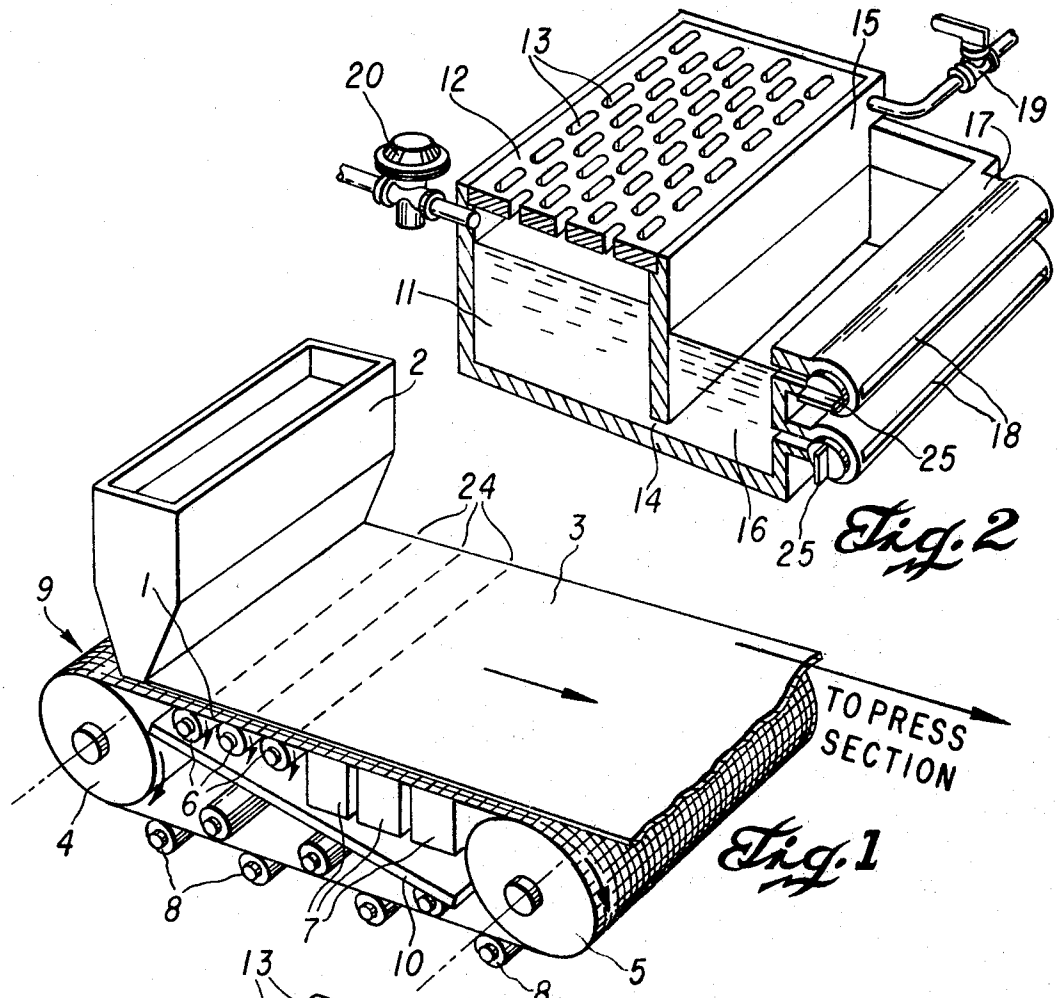


Fig. 2

Fig. 1

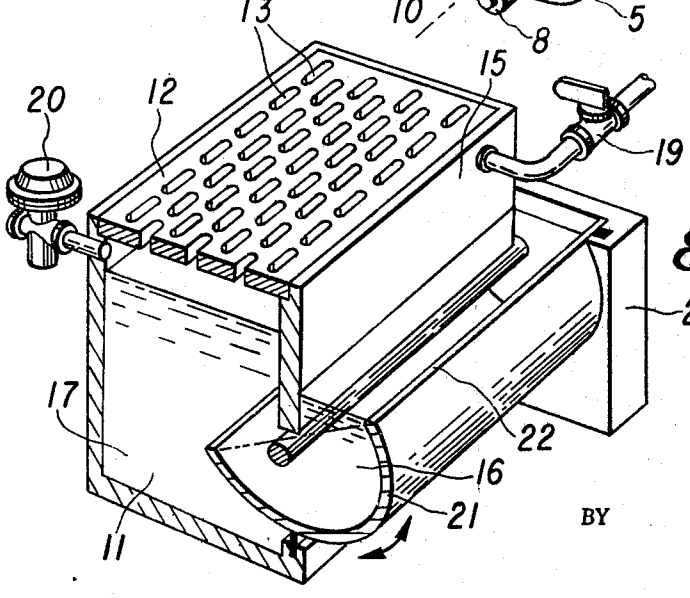


Fig. 3

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AUTOMATIC VACUUM SUCTION BOX IN PAPERMAKING

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ABSTRACT OF THE DISCLOSURE

Disclosed is a suction box for removing liquid from low solids content stock which automatically maintains a predetermined vacuum without the use of a pumping system by using the removed liquid to maintain a constant head of water. The suction box is composed of a vacuum chamber and an outlet chamber having a common side wall with a bottom opening therebetween the outlet chamber having variable height outlet means whereby water entering the vacuum chamber passes into the outlet chamber and out of the outlet means, the vacuum in the vacuum chamber being maintained by the difference in water levels between the vacuum chamber and the outlet chamber.

BACKGROUND OF THE INVENTION

This invention relates to a suction box for removing liquid from a low solids content slurry. More particularly it relates to an automatic vacuum suction box for removal of water from paper stock in the papermaking process.

It is an object of this invention to provide an automatic vacuum suction box which maintains an adjustable vacuum without the use of a vacuum pumping system.

Another object of the invention is an automatic vacuum suction box that uses an adjustable self-maintained vacuum caused by the water to be removed from low solids content stock.

Another object of the invention is to provide an automatic vacuum suction box with an adjustable vacuum that can be automatically maintained by an adjustable bleed-off system.

The novel features believed to be characteristic of the invention are set forth with particularity in the appended claims. The invention itself, however, as well as further objects and advantages thereof may best be understood by reference to the following detailed description when read in conjunction with the accompanying drawing wherein:

FIGURE 1 is a pictorial view of a part of a Fourdrinier papermaking machine illustrating that portion of the machine which lies between the wet end and the press section according to the present art;

FIGURE 2 is an isometric view, partly in section, of one embodiment of the automatic vacuum suction box of the invention;

FIGURE 3 is an isometric view, partly in section, of another embodiment of the automatic vacuum suction box of the invention.

Briefly, the invention is an automatic vacuum suction box with an adjustable vacuum produced by the flow of the water to be removed from the paper stock. The suction box is so constructed that the water level of the outlet chamber can be adjusted in relationship with the higher water level within the vacuum chamber. The difference in height between the two water levels is the degree of vacuum produced within the vacuum chamber. To pull a vacuum in the vacuum chamber, the required water flow through the suction box is furnished by the water removed from the stock. The difference in water levels is adjusted to obtain the desired vacuum, and a valve connected to the vacuum chamber is set to maintain the desired vacuum. The water removed from the stock is allowed to leave the outlet chamber across the entire length of the suction box instead of just at the end as in a conventional suction box. Because there is no need for the relatively greater depth at the outlet end of the conventional suction box, the automatic vacuum suction box can be used at the wet end of the machine.

Referring now to the figures of the drawing, FIGURE 1 illustrates that part of a Fourdrinier papermaking machine which lies between the wet end **9** and the pressure roll section (not shown) as used in the papermaking industry today.

In the manufacture of paper, very low fiber content stock, say in the order of about 0.5% fiber, is used as the starting material. Such a low fiber content is necessary to obtain the required random distribution of the individual fibers when the water is removed.

In a Fourdrinier papermaking machine enough water is removed from the stock by vacuum methods to raise the fiber content of the stock to about 26% before the stock reaches the press section of the machine. At the wet end **9** of the machine where the stock is introduced, table rolls **6** and/or foils (not shown) are used to remove some of the water before the stock reaches the suction boxes **7** which precede the pressure roll section (not shown). The water dripping from the table rolls falls on the inclined saveall pan **10**, from which the water is finally removed at the lower end of the pan by means not shown. The vacuum produced by the table rolls **6** is determined by their speed which is, in turn, dictated by the desired speed of the forming wire belt **1** that carries the stock **3** through the machine. Thus the vacuum cannot be as closely controlled as desired to remove a predetermined amount of water from the stock. In addition, the high vacuum generated at the tangential line **24** where the surface of each roll begins to rotate away from the forming wire belt **1** tends to seal the stock, making further removal of water difficult. Foils (not shown), whether fixed or adjustable, run into the difficulty of non-uniformity of foil angle across the width of the forming wire belt **1**, causing different vacuums to be created by the foils at different points across the wire and in addition cannot be used at high speeds. The fixed foil, of course, having a fixed foil angle, cannot be adjusted to create a different vacuum for different grades of paper.

The use of conventional suction boxes **7** at the wet end **9** of the machine, as well as in their usual position just before the press section, is virtually rendered impossible by the presence of the inclined saveall **10** which limits the depth of the boxes to much less than is necessary to remove the required quantity of water.

The Fourdrinier paper making machine shown in FIGURE 1 operates as follows: A slurry or stock with a fiber content of about 0.5% is applied to the moving closely-woven forming wire belt **1** at the wet end **9** through the headbox **2** in a continuous web **3** of wet material. The looped forming wire belt **1** is supported on a breast roll **4** and a couch roll **5**. The upper run of the wire belt **1** is supported by table rolls **6** and conventional suction boxes **7** (vacuum system not shown) while on the lower run or return, the wire belt **1** is supported by guide rolls **8**. The wire belt **1** is so closely woven that the small amount of fiber content in the web **3** allows very little water to pass through the belt unless a negative pressure, or vacuum, is applied to the underside of the belt.

As already indicated, the first vacuum applied to the

web 3 is caused by either the table rolls 6 or foils (not shown) near the wet end 9 of the machine. The vacuum created by each roll at the line 24 where the surface of the roll begins to rotate away from the moving web 3 is about 6 to 8 inches of mercury for only a very short period of time on a particular portion of the web or stock 3. The foils create a vacuum of about 4 inches of water for a somewhat longer length of time. The web 3 continues its travel and passes over the suction boxes 7, which are located just before the press section (not shown). The suction boxes are adjustable to create a relatively strong vacuum of from ½ inch to 20 inches of mercury.

The web of stock continues on into the press section and drying section (not shown) for further moisture removal until a final solids content of about 95% is reached. The inclined saveall pan 10 placed at an angle beneath the machine catches the droppings, water and fiber, from the machine so that the droppings can be returned to the head box 2 for reuse.

As can be seen from FIGURE 1, due to the lack of space at the wet end 9 of the machine, the suction boxes 7 cannot be used at that position because of their relatively large depth. As explained previously, a variable vacuum system as provided by a suction box at the wet end of the machine would be a definite improvement over the table rolls or foils presently being used in the paper industry. By the use of a variable vacuum at the wet end 9, the machine could be optimized for different types of fiber and type of paper desired. This, however, would require boxes of very shallow depth operating in conjunction with a vacuum system, an arrangement which is impossible with conventional suction boxes.

In FIGURE 2 there is illustrated one embodiment of the automatic vacuum suction box of the invention which operates without a continuous vacuum pumping system, the water from the automatic suction box falling directly into the saveall pan thus eliminating the greater depth of the conventional suction boxes. Equivalent parts of the two different embodiments of the invention illustrated in FIGURES 2 and 3, respectively, are generally designated by the same numerals.

The automatic vacuum suction box has a vacuum chamber 11 over which the suction box cover 12 is placed. The suction box cover 12 has a plurality of perforations, openings or holes 13 therein through which water is withdrawn from the web of stock 3 as the latter is drawn across one or more suction boxes by a forming wire belt such as the belt 1 shown in FIGURE 1. The vacuum chamber 11 has an opening 14 at the bottom of the common side wall 15 between the vacuum chamber and the outlet chamber 16 which runs across the entire length of the common side wall 15. The opening 14 allows water from the vacuum chamber 11 to enter the outlet chamber 16. The opposite side 17 of the outlet chamber has a series of outlet means 18 disposed in a vertical alignment such as the arrangement shown in FIGURE 2, for example, by which the level of water in the outlet chamber 16 is controlled. The difference between the level of water in the vacuum chamber 11 and the level of water in the outlet chamber 16, or the head of water, determines the vacuum in the vacuum chamber 11. The head of water is varied by changing the effective height of the outlet chamber by the use of different height outlet means 18, each of said outlets having a key 25 controlling an interior shutter that opens and closes the vent through which the water is discharged when the level of the water in the outlet chamber gets above the level of the first opened vent.

At the start of the operation of the automatic vacuum suction box, priming water is introduced into the vacuum chamber 11 by the water inlet means 19. Once the water level in the vacuum chamber is at the height to furnish the desired vacuum, the web of stock 3 is allowed to pass over the suction box cover 12, and the water flow from the water inlet means 19 may be stopped if desired. The water from the web of stock being drawn through the holes 13 in the suction box cover 12 then furnishes the necessary water to continue the vacuum operation. The vacuum control valve 20 is set at the desired vacuum so that an increase or decrease in vacuum over the preset value in chamber 11 is prevented by bleeding air at atmospheric pressure into the vacuum chamber through the vacuum control valve or withdrawing excess air. In addition, a sensing device could be incorporated with the water inlet means 19 so that water could be automatically introduced through water inlet means 19 when the head of water in the vacuum chamber 11 dropped below a desired level. In order that the automatic vacuum suction box should be able to handle all the water received from the web, the cross-sectional areas presented by the opening 14 and the outlet 18 each are equal to or greater than the total cross-sectional area of the holes 13 in the suction box cover 12.

Although the invention is not limited to any particular method of setting the variable water level of the outlet chamber 16, one of many alternate methods other than the use of outlet means 18 as described in conjunction with FIGURE 2 is illustrated in FIGURE 3. The outlet chamber 16 is formed by a rotatable concave member 21 which pivots on its axis and two end supports 23 (only one shown). By rotating the concave member 21, the level of its outer edge 22 can be varied in height, thus varying the height of the water flowing over the edge 22. The vacuum is begun by introducing water into the vacuum chamber 11 by the water inlet 19 and the vacuum is maintained by the valve system 20, as previously described in conjunction with FIGURE 2.

Since only a slight vacuum measured in inches of water is desired at the wet end of the machine, the automatic vacuum suction box of the invention can be quite small in depth and thus fit quite easily between the saveall pan 10 and the forming wire belt 1 as shown in FIGURE 1. For example, the depth of an automatic vacuum suction box furnishing a vacuum of twelve inches of water will have a depth not too much greater than twelve inches.

While the invention has been described with reference to specific embodiments, it is to be understood that various changes, substitutions and alterations can be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

What is claimed is:

1. An automatic suction box for use in conjunction with a Fourdrinier papermaking machine and positioned under the wet end thereof, comprising:

a shallow vacuum chamber and an outlet chamber, a side wall common to said vacuum chamber and said outlet chamber having a bottom opening therebetween, a cover for said vacuum chamber having a plurality of openings therein over which paper stock on a wire belt of the Fourdrinier machine passes, said outlet chamber having variable height outlet means whereby water entering said vacuum chamber from said paper stock passes through said bottom opening into said outlet chamber and out of said outlet chamber through said variable height outlet means thereby maintaining an automatic vacuum in said vacuum chamber by controlling the difference between the level of water in said vacuum chamber and the level of water in said outlet chamber, and a valve connected between the atmosphere and said vacuum chamber above the water level therein for adjustment of the vacuum in said vacuum chamber.

2. The automatic suction box as defined in claim 1 wherein said variable outlet means comprise a series of outlet vents disposed at different heights in said outlet chamber.

3. The automatic suction box defined in claim 1 including water inlet means for introducing priming water

into said vacuum chamber thereby to pull the initial vacuum therein.

4. The automatic suction box defined in claim 1 wherein said outlet chamber and said outlet means are formed by a pivotal concave member secured to a side of said vacuum chamber by two end supports whereby water entering said vacuum chamber passes through said bottom opening into said outlet chamber and over an edge of said concave member thereby maintaining an automatic vacuum in said vacuum chamber and the level of water in said outlet chamber by the height of said edge.

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