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Description

This invention is concerned with paper making machines of the type having a "flat wire" or "open wire" forming section, which includes means to remove water from the stock by the use of suction.

In this type of machine, as opposed to "twin wire" machines, or "gap formers", an aqueous slurry known as the stock, which contains both fibers and other substances in an amount of from about 0.1% to 1.5% by weight, is fed from a head box slice onto a single moving forming fabric. Water is progressively removed from the stock through the forming fabric in what is known as the "forming section" of the paper making machine. In this forming section, a variety of drainage devices are used, until the stock contains from about 2% to about 4% by weight of solid material. At that point, the distribution and orientation of the fibers and other solids in the still very wet stock is largely determined, and will not change very much in the remaining paper forming steps unless other devices such as a dandy roll, or "top wire", is brought into contact with the stock. Thus at this point the formation of the paper is largely completed.

In outline, a conventional open wire forming section includes a forming fabric which is supported at the head box slice end by a breast roll, which is followed in sequence by a "forming board" and a series of drainage devices, which may be drainage foils or table rolls, and suction boxes. More recently, forming sections have included a forming board followed by suction boxes of the type described by Johnson, in U.S. Patent 4,140,573. These suction boxes heretofore have been distributed along the length of the forming section with gaps, or undrained spaces, in between them.

The one reported attempt to use vacuum assisted drainage for the full length of an open wire forming section appears to have been a failure. Such a paper making machine is described by E.J. Justus in U.S. 3,052,296 (issued in 1962, assigned to Beloit Iron Works). As described by Justus, the forming fabric is to be supported on a "continuous or substantially uninterrupted" series of suction boxes, starting as near to the head box slice as is practicable. These suction boxes are provided with a foraminous surface to support the forming fabric, for which several designs are proposed. Justus proffers several advantages for such a machine: an increase in fiber retention on the forming fabric of up to 70%, as compared to the usual figure of less than about 50%, reduced wire marking on the paper, and "better" paper. A further point made by Justus is that his essentially flat surfaced suction boxes do not cause the phenomenon known as "kick-up" in the stock associated with the table rolls then used as the primary dewatering devices. Kick-up results from the vertical deflection of the forming fabric caused by the suction produced by the roll as described in U.S. 2,928,465. When kick-up occurs, what is observed is an essentially vertical movement of both the forming fabric and the stock carried on it in the vicinity of a table roll: this movement can become so violent that it will literally lift the stock off the forming fabric. Such an occurrence is not conducive to the making of good paper. In a later communication originating from Beloit Iron Works (reported by P. Wrist in "The Formation and Structure of Paper", British Paper and Board Makers Association, London, England, 1962, at pages 863, 864) it is noted that although many of the benefits proffered by the all-vacuum assisted drainage technique proposed by Justus indeed are obtained, nevertheless "the formation of the [paper] sheet deteriorated to an unacceptable level." (Communication to P. Wrist, from Beloit Iron Works). In other words it proved to be impossible to make acceptable quality paper using the modified paper making machine proposed by Justus. Perhaps as a consequence of this failure, this approach to stock dewatering was not pursued further. Even Justus turned his attention to other methods (e.g. as in U.S. 3,102,066).

It has now been realized that the failure of the Justus attempts may be directly attributed to at least two seemingly unrelated causes. First, Justus in setting out to avoid the then known problems of heavy suction and kick-up becoming prevalent with table rolls (and which were becoming a handicap serving to limit paper making speed, since as the linear speed of the forming fabric increases the suction and kick-up effects become more violent) endeavoured to eliminate all stock agitation in the forming section.

It has now been known for some time that improved paper making operations can result if some deliberate and controlled agitation is introduced into the stock on the forming fabric whilst it is still in a highly fluid state.

It has now been discovered that the precise spacing of the devices used to generate stock agitation has a very important effect on paper sheet quality. When the devices are spaced apart in a uniform manner, they act in a periodic or harmonic relationship to each other, so that later devices (that is, ones further from the head box slice) can either reinforce and add to the stock agitation produced by earlier devices, or diminish and dampen that agitation. This provides a controlled and uniform stock agitation that is both easily generated and easily controlled, to benefit the paper sheet formation.

Second, Justus recommends to use a vacuum level ranging from a low level of effectively zero in a suction box adjacent the head box slice rising to a figure of 2 inches of mercury at the 3% point, that is a value of about 70 cms of water. It has been discovered that this is also a mistake, and that with dewatering devices somewhat similar to those advocated by Justus a far lower level of vacuum is often sufficient, rising from a very low level adjacent the head box slice to a value of no more than 50 cms of water at the end of the forming section. It has been discovered that much lower levels of vacuum than those suggested by Justus can be used with great benefit in retention and wire mark provided the above mentioned agitation or kick-up can be achieved. This can be achieved by the use of the static drainage unit known as the Isoflo (Trade Mark) which is described by Johnson in U.S. 4,140,573.

Thus it has now been discovered that if first, the correct level of vacuum is used in the suction boxes and second, the path through which the forming fabric moves whilst the stock is still highly fluid is properly controlled to provide some agitation in the stock, then a forming section can be successfully operated with continuous vacuum assisted drainage. By this means, it becomes possible to increase the area of the forming fabric that is subjected to vacuum assisted drainage by an amount of often more than 30%, the actual figure varying from machine to machine. Additionally, fiber retention is also significantly improved.

Retention is fundamental in paper making. The commonly used definition in paper making for first pass retention (FPR) is

$$\frac{\text{Head Bos Consistency} - \text{White Water Consistency}}{\text{Head Box Consistency}} \times 100$$

Values for FPR can range from 30 % in the case of papers with a high filler content to over 90% for some long fibered grades. Several factors affect the FPR including the type of stock, the kind of forming fabric, the use of chemical retention aids, the amount of stock agitation, the amount of suction used in forming the paper, and particularly the velocity induced in the stock by that suction while forming. Improving retention from 45% to 70% reduces the consistency of the recirculating white water considerably if the amount of slice opening is left unchanged. (By "consistency" in this context is meant the total suspended solids content in percent by weight in the stock or in the white water, as appropriate). This has beneficial effects on the entire paper mill and reduces the amount of fiber and filler loss. Alternatively, the paper maker may cut down on the slice opening and use less water to form the paper. Thus one benefit of this invention, which allows using low vacuums while still achieving good formation, is to reduce the velocity of drainage thereby improving retention and wire mark.

Thus, according to a first aspect of the present invention there is provided a paper making machine having an open surface forming section, including at least a travelling continuous forming fabric which passes over a breast roll adjacent a head box having a head box slice through which aqueous stock is deposited onto the forming fabric, and a plurality of stock dewatering devices beneath the forming fabric which include white water drainage means, a foraminous dewatering device adjacent the head box slice including a plurality of stationary drainage elements disposed in a supporting relationship substantially transversely of the forming fabric, a foraminous surface on the stock dewatering devices adapted to support the forming fabric and to provide both apertures through which the forming fabric drains and a vacuum tight seal between the forming fabric and the drainage means, and a vacuum means, including both vacuum supply means, vacuum control means, and a vacuum seal means for the white water drainage means, whereby a vacuum below ambient atmospheric pressure is provided in each drainage means; wherein, in said forming section, the solids content of the stock deposited from the head box through the head box slice onto the forming fabric rises from an initial low value to a value of from about 2% to about 4%; charactrized in that (i) the foraminous surface supporting the forming fabric provides a path through which the forming fabric moves which causes a controlled level of uniformly spaced periodic harmonic agitation within the stock on the forming fabric; (ii) the stock dewatering devices comprise a suction box extending from adjacent the foraminous dewatering device to the end of the forming section, which suction box includes a plurality of evacuated chambers and (iii) the vacuum means provides a vacuum in the evacuated chambers of the suction box controlled to a value that rises progressively along the length of the suction box from a minimum of 0.49 kPa (5 cms water gauge) below ambient atmospheric pressure adjacent the foraminous dewatering device to a maximum value of 4.9 kPa (50 cms water gauge) below ambient atmospheric pressure at the end of the forming section.

In one embodiment, the suction box comprises a plurality of contiguously adjacent suction boxes, each of which is the full width of the forming section. Alternatively, in a second embodiment, a series of vacuum-tight transverse divisions can be provided in a single large suction box. Thus the suction box comprises a sequence of separated drainage chambers, to each of which a controlled level of vacuum is applied, rising stepwise from a level of no more than 0.49 kPa (5 cms water gauge) below ambient atmospheric pressure adjacent the head box slice to no more than 4.9 kPa (50 cms water gauge) below ambient atmospheric pressure at the other end of the suction box, that is at the end of the forming section. Each drainage chamber is also provided with a separate vacuum-tight drainage means.

In a preferred embodiment, the foraminous surface comprises a slotted type fabric-supporting cover comprising a series of spaced apart forming fabric-supporting blades having generally planar top surfaces transverse to the direction of travel of the fabric in a common essentially horizontal plane providing therebetween suction-accessible gaps in which the forming fabric is substantially unsupported and is drawn downward to form stock-agitating undulations in said gaps, the cover including water seal-forming blades disposed intermediately in the gaps between the fabric-supporting blades and having top surfaces transverse to the direction of travel of the fabric at a lower level than the top surfaces of the fabric-supporting blades, and at least forming water seals at the downward undulations of the forming fabric thereby interrupting the suction temporarily to limit drainage while causing vertical agitation of fibers on the fabric passing through the forming section. In a most preferred embodiment, the fabric supporting blades are spaced apart equally from each other for the length of the forming section. This provides the desired and required agitation in the stock, since the forming fabric and the paper stock thereon undulate in a periodic or harmonic manner for the length of the forming section.

In certain circumstances it is contemplated that it may not prove to be either practicable or desirable to utilize a full length open surface forming section using vacuum assisted drainage, for example when modifying an existing paper making machine. Furthermore, it has to be noted that obtaining and controlling the very small vacuum levels needed adjacent a head box slice itself is quite difficult. As noted above, a pressure difference of less than 0.49 kPa (5 cms water gauge) below ambient atmospheric pressure, or approximately only 0.5% of an atmosphere, is being used. The basic concepts of this invention can still be used, nevertheless, in paper making machines having an open surface forming section wherein a vacuum assisted section is preceded by a short dewatering section using other static dewatering devices.

According to a second aspect of the present invention there is provided a process for improving paper formation in a paper making machine having an open surface forming section including at least a travelling continuous forming fabric which passes over a breast roll adjacent a head box having a head box slice through which aqueous stock is deposited onto the forming fabric, and a plurality of stock dewatering devices beneath the forming fabric which include white water drainage means, a foraminous dewatering device adjacent the head box slice including a plurality of stationary drainage elements disposed in a supporting relationship substantially transversely of the forming fabric, a foraminous surface on the stock dewatering devices adapted to support the forming fabric and to provide both apertures through which the forming fabric drains and a vacuum tight seal between the forming fabric and the drainage means, and a vacuum means, including both vacuum supply means, vacuum control means, and vacuum seal means for the white water drainage means, whereby a vacuum below atmospheric pressure is provided in each drainage means; wherein in said forming section, the solids content of the stock deposited from the head box through the head box slice onto the forming fabric rises from an initial low value to a value of from about 2% to about 4%, said process comprising discharging onto the moving forming fabric an aqueous paper making fiber stock across the width of the forming fabric, and causing the forming fabric to move through the forming section, characterized in that (i) a controlled level of uniformly spaced periodic harmonic agitation is created in the stock, by causing the forming fabric to follow a path constructed and arranged to induce the desired agitation and (ii) a controlled level of vacuum below ambient atmospheric pressure is applied below the forming fabric by means of a suction box extending from adjacent the foraminous dewatering device to the end of the forming section, the vacuum applied rising from a minimum of 0.49 kPa (5 cms water gauge) below ambient pressure adjacent the foraminous dewatering device, to a maximum value of 4.9 kPa (50 cms water gauge) below ambient atmospheric pressure at the end of the forming section.

In a preferred embodiment, the vacuum in the suction box is controlled in such a way that it rises in a stepwise fashion in the separate sections of the box along the length of the forming section, from the initial low value of below 0.49 kPa below ambient atmospheric pressure (5 cms water gauge) to a maximum value of no more than 4.9 kPa below ambient atmospheric pressure (50 cms water gauge). Desirably, there are as many vacuum levels as possible, preferably more than three, and most preferably at least five.

The invention will now be described by way of reference to the attached drawings in which:

Figure 1 shows diagrammatically the initial part of a conventional prior art paper making machine;

Figure 2 shows a conventional prior art foil blade;

Figure 3 shows a so-called Isoflo unit according to US-A-4 140 573;

Figure 4 shows schematically harmonic stock agitation associated with a series of foils;

Figure 5 shows diagrammatically a paper making machine modified according to one aspect of this invention;

Figure 6 shows a modification to the machine of Figure 5; and

Figure 7 shows a detail of Figure 5.

In these Figures, relevant like parts have been given the same numbers.

In Figure 1, the forming section of a conventional prior art open surface paper making machine is shown, incorporating a forming fabric 1, which moves in the direction of the arrows shown at 1A and 1B. The forming fabric moves over a breast roll 2, and various tensioning and idling rollers 3. The stock is deposited onto the forming fabric 1 from the head box shown diagrammatically at 4, through a slice 5, which extends across the forming fabric 1. Beneath the forming fabric in the dewatering zone are placed a sequence of drainage devices 6, 7, 8, 9, 10, 11 and 12, provided with white water drains 15, 16, 17, 18 and 19. The first of these drainage devices, 6, comprises a forming board, the second, 7, comprises a open foil unit, and the remainder are so-called Isoflo units (Trade Mark). Boxes 8 to 12 are also provided with a controlled vacuum, through the vacuum pipes 20, 21, 22, 23 and 24 respectively. The vacuum applied will typically range from zero to 5 cms water gauge in box 8, to no more than 50 cms water gauge in box 12; the white water drains 15, 16, 17, 18 and 19 contain suitable vacuum legs. A key feature of this conventional prior art open surface paper making machine is that not all of the forming section is being actively drained. The drainage and suction boxes are separated by the spans marked a, b, c, d, e and f which represent undrained areas, apart from any water which may happen to drain through under gravity. In the prior art machine shown, these spans represent nearly 30% of the total area of the forming section.

In this machine, which is typical of existing prior art machines, three different forms of drainage element are used, in sequence away from the head box slice 5. The first of these is a set of conventional flat forming board blades associated with box 6.

In box 7 the drainage elements 25 are conventional foil blades broadly conforming to the design shown is section in Figure 2. These foils comprise a supporting bar 28 with a tee-shaped head, onto which is slid the foil blade proper, 29. This includes a flat face 30 onto which the forming fabric 1 rests, and a divergent trailing face 31. In the figure the divergent angle Z is shown exaggeration for clarity. Generally it is far smaller than it is shown, ranging from about 1 degree to about 5 degrees, with angles of 2 to 2.5 degrees being commonly used. As the forming fabric moves over the foil in the direction of the arrow 32, as a consequence of hydraulic phenomena created in the nip provided by the trailing face 31, water is sucked from the stock through the forming fabric.

In boxes 8 through 12 a so-called Isoflo unit is used, which is described in detail in Johnson, U.S. 4,140,573. This is shown in Figure 3 (which corresponds broadly to Johnson's Figure 4), and can be seen to incorporate two groups of static devices 26 and 27. Devices 26 and 27 are each supported on a tee-bar 28; these tee bars 28 are supported across the width of the box by suitably placed supports 33. Although similar in appearance to the foil blades of Figure 2, the static devices 26 and 27 differ in two separate ways. The top faces of all of these devices which bear against the forming fabric 1 are generally planar and either in the plane of the forming fabric (devices 26) or a little below it (devices 27). As shown in Figure 3 the vertical lowering of the devices 27 is indicated at A, which is exaggerated for clarity. In practise, this distance generally will range from about 0.5 mm to about 5.0 mm. The forming fabric in moving over such a foraminous surface undulates between successive devices 26, and the intervening devices 27 are so placed vertically as to provide a water seal to the underside of the forming fabric. Sealing elements, not shown, are also provided along the sides of the boxes in between the drainage devices, parallel to the sides of the forming fabric. Water is drawn from the stock through the forming fabric by the application of vacuum to the box.

There is a further feature which is common to both of these forms of static drainage devices. Figure 4 shows diagrammatically the harmonic, or periodic, stock agitation that can be generated by a regular and uniform spacing of the vertical pulses generated by foil blades supporting a forming fabric. In Figure 4, a small section of the forming fabric 1 is shown moving in the direction of arrow 1A. The forming fabric passes over a series of foil blades all uniformly spaced apart by the distance Y, as indicated between foil blades 45 and 46 mounted on the tee bars 41 and 42. Because the stock agitation is generated by vertical movement of the forming fabric caused by the foil blades, which are each spaced apart by the constant distance Y, the area of vertical stock agitation shown by 48 is followed by another area 50. Similarly, the quiescent zone 49 is followed by another quiescent zone 51, following the area 50. As Figure 4 indicates, both the areas of vertical agitation 48 and 50 and the zones of quiescence 49 and 51 are each spaced apart at the same distance Y. As shown in Figure 4, with no foil blade on the tee bar 43, vertical agitation of the stock still occurs at the location 52 (which is differently shaded in Figure 4 to emphasize that there is no foil blade on tee bar 43), although the amplitude of the agitation at the location 52 is somewhat less than is obtained with a foil blade in place on tee bar 43. The occurrence of this activity in the vicinity of the tee bar 43 (which has no foil blade) is referred to as occurring at a "ghost blade". It is also important to note that these areas of agitation and quiescence in the stock do not move with the forming fabric, but rather remain in essentially the same place. A similar quiescent zone 53 follows the "ghost blade", and foil induced agitation 54 occurs in the vicinity of foil 47.

For the Johnson Isoflo device shown in Figure 3, the area of the stock vertical agitation is due to the downward deflection of the fabric as it moves from fabric support surfaces 26 to surfaces 27, and periodicity similar to that of Figure 4 is observed.

Thus it has been found that spacing of the various support surfaces for the forming fabric can be used to generate, to optimize and to control the agitation occurring in the stock on the forming fabric. The dewatering support surfaces can be placed to control the vertical movement which is initiated by earlier drainage devices.

This flexibility of control of the amount of vertical agitation permitted to occur in the stock on the forming fabric allows for better dewatering of the stock as it travels on the forming fabric through the forming section. Two possible ways of utilizing this invention are shown in Figures 5 and 6. Each of these figures shows essentially the same portion of a paper making machine as is shown in Figure 1, but with certain differences. In common with Figure 1, the forming fabric 1 passes over the rollers 3, around the breast roll 2, and then past the head box slice 5, at which point the stock is deposited onto it. Drainage is initiated by the forming board section on box 6, and continued by the foils associated with box 7; it is to be noted that boxes 6 and 7 are still separated by the gap a.

The remainder of the forming section comprises a single extended suction box 100, which is separated into the sequence of separate chambers 8, 9, 10, 11 and 12, either by using a single continuous suction box with dividers, or by using a plurality of smaller boxes, butting up closely to each other. These suction units also differ from the arrangement shown in Figure 3 in another way. In that figure, the first support surface 26 is an upper one, and is followed by a lower one, 27. As described by Johnson in U.S. 4,140,573, the last support surface in the box is also an upper one. When a sequence of boxes of this type are brought into the contiguous relationship of this invention, one of these surfaces becomes redundant, since the last support surface in any one box also becomes the first support surface for the next one. This is shown more clearly in Figure 7.

There are two different ways in which the continuous suction box of this invention can be utilized to improve the sort of machine shown in Figure 1. In Figure 5, the gaps c through f have been eliminated by lengthening the boxes 8 through 12, and therefore the overall length of the forming section has not been changed. Alternatively, the same effect could be achieved by adding another box to match the span of gaps c through f, and moving boxes 9, 10 and 11 to accommodate it. In either case, the length of the forming section is retained unchanged. The other option is simply to move the suction boxes 8 through 12 together to eliminate gaps c through f. Whilst this is effective, it has two disadvantages. The first is that it will still leave an equivalent length of forming fabric (corresponding substantially to the eliminated gap length) effectively unused, unless the somewhat drastic step of reducing overall machine length is also taken. The second is that although the same amount of water is being removed from the stock, the use of an overall shorter forming section means that water is being removed more rapidly, than is the case if the length of the forming section is retained unchanged. It appears to be advantageous to retain the forming section length, since removing the same amount of water over a longer length of forming fabric reduces the rate at which that water is removed. Decreasing the drainage rate generally improves the quality of the paper being made, since better paper mat formation occurs and wire marking is lessened. Further, the FPR figures also improve; it appears to be feasible to obtain an improvement of the order of 20% with the method of this invention.

In Figure 5 two of the noted gaps which are not actively drained are still present in the forming fabric: these are a and b. As is shown in Figure 6, it is also possible to eliminate gap b, and hence to lengthen the suction box 100 a little further. The same considerations will also apply concerning whether the gap b is removed by lengthening box 100, by adding another box, or by laterally displacing box 100 as are mentioned above in respect of Figure 5. It appears to be preferable to lengthen box 100, to remove gap b. It should also be noted that if gap b is to be eliminated, then the last foil in box 7, which will generally be over the wall of box b adjacent the gap, will become redundant, as the arrangement shown broadly in Figure 7 needs to be used, with a fabric support blade over the contiguous walls of chamber 7 and the suction box 100.

Claims

1. A paper making machine having an open surface forming section, including at least a travelling continuous forming fabric (1) which passes over a breast-roll (2) adjacent a head box (4) having a head box slice (5) through which aqueous stock is deposited onto the forming fabric, and a plurality of stock dewatering devices beneath the forming fabric which include white water drainage means, a foraminous dewatering device (6,7) adjacent the head box slice including a plurality of stationary drainage elements disposed in a supporting relationship substantially transversely of the forming fabric, a foraminous surface (26,27) on the stock dewatering devices adapted to support the forming fabric and to provide both aperture through which the forming fabric drains and a vacuum tight seal between the forming fabric and the drainage means, and a vacuum means, including both vacuum supply means, vacuum control means, and vacuum seal means for the white water drainage means whereby a vacuum below ambient atmospheric pressure is provided in each drainage means; wherein in said forming section, the solid content of the stock deposited from the head box through the head box slice onto the forming fabric rises from an initial low value to a value of from about 2% to about 4%; characterized in that

(i) the foraminous surface (26,27) supporting the forming fabric provides a path through which the forming fabric moves which causes a controlled level of uniformly spaced periodic harmonic agitation (48,50) within the stock on the forming fabric;

(ii) the stock dewatering devices comprise a suction box (100) extending from adjacent the foraminous dewatering device (6,7) to the end of the forming section, which suction box includes a plurality of evacuated chambers (8,9,10,11,12); and

(iii) the vacuum means provides a vacuum in the evacuated chambers of the suction box controlled to a value that rises progressively along the length of the suction box from a minimum of 0.49 kPa (5cms water gauge) below ambient atmospheric pressure adjacent the foraminous dewatering device to a maximum value of 4.9 kPa (50 cms water gauge) below ambient atmospheric pressure at the end of the forming section.

2. An apparatus according to Claim 1 characterized in that the suction box (100) comprises either a single box (100) extending from adjacent the foraminous dewatering device (6,7) to the end of the forming section which is provided with a plurality of pressure tight transverse divisions between each of which a separate controlled vacuum can be applied and each of which has a separate white water drainage means (15,16,17,18,19), or a plurality of contiguously adjacent boxes extending from adjacent the foraminous dewatering device, to each of which a separate controlled vacuum can be applied, and each of which has a separate white water drainage means (15,16,17,18,19).

3. An apparatus according to Claim 1 characterized in that the dewatering device (6,7) comprises two separately drained and separated static drainage devices comprising a forming board section (6) adjacent the head box slice (5), and a separate foil section (7) spaced therefrom, in which section each foil (29) comprises a flat support surface (30), and a trailing portion (31) (in the direction of forming fabric travel) diverging from the plane of the fabric (1) at an angle greater than zero degrees and less than 5 degrees.

4. An apparatus according to Claim 1 characterized in that the foraminous surface on the suction box comprises a slotted-type fabric cover comprising a series of spaced forming fabric-supporting blades (26) having a generally planar top surface transverse to the direction of travel of the fabric in a common essentially horizontal plane providing therebetween suction-accessible gaps in which the forming fabric is substantially unsupported and is drawn downward to form stock-agitating undulations in said gaps, said cover including water seal forming blades (27) disposed intermediately in said gaps between the fabric supporting blades and having top surfaces transverse to the direction of travel of the fabric at a lower level than the top surfaces of the fabric supporting blades and at least forming water seals at the downward undulations of the forming fabric, thereby interrupting the suction temporarily to limit drainage while causing vertical agitation of fibers on the fabric passing through the forming section; wherein both the first, the last, and any intermediate support-blades placed over either an internal transverse vacuum tight division or a pair of contiguous transverse walls of two adjacent suction boxes, are all forming fabric-supporting blades (26).

5. An apparatus according to Claim 3 characterized in that in the foil section, the separate foils (29) are so placed as to contribute toward controlled agitation of the stock on the forming fabric.

6. A process for improving paper formation in a paper making machine having an open surface forming section including at least a travelling continuous forming fabric (1) which passes over a breast-roll (2) adjacent a head box (4) having a head box slice (5) through which aqueous stock is deposited onto the forming fabric, and a plurality of stock dewatering devices beneath the forming fabric which include white water drainage means, a foraminous dewatering device (6,7) adjacent the head box slice including a plurality of stationary drainage elements disposed in a supporting relationship substantially transversely of the forming fabric, a foraminous surface (26,27) on the stock dewatering devices adapted to support the forming fabric and to provide both apertures through which the forming fabric drains and a vacuum tight seal between the forming fabric and the drainage means, and a vacuum means, including both vacuum supply means, vacuum control means, and vacuum seal means for the white water drainage means whereby a vacuum below ambient atmospheric pressure is provided in each drainage means; wherein, in said forming section, the solid content of the stock deposited from the head box through the head box slice onto the forming fabric rises from an initial low values to a value of from 2% to about 4%, said process comprising discharging onto the moving forming fabric an aqueous paper making fiber stock across the width of the forming fabric, and causing the forming fabric to move through the forming section, characterized in that

(i) a controlled level of uniformly spaced periodic harmonic agitation is created in the stock, by causing the forming fabric to follow a path constructed and arranged to induce the desired agitation;

(ii) a controlled level of vacuum below ambient atmospheric pressure is applied below the forming fabric by means of a suction box extending from adjacent the foraminous dewatering device to the end of the forming section, the vacuum applied rising from a minimum of 0.49 kPa (5 cms water gauge) below ambient pressure adjacent the foraminous dewatering device, to a maximum value of 4.9 kPa (50 cms water gauge) below ambient atmospheric pressure at the end of the forming section.

7. A process according to Claim 6 characterized in that the suction box (100) comprises either a single box extending from adjacent the foraminous dewatering device (6,7) to the end of the forming section which is provided with a plurality of pressure tight transverse divisions between each of which a separate controlled vacuum can be applied and each of which has a separate white water drainage means (15,16,17,18,19), or a plurality of contiguously adjacent boxes extending from adjacent the foraminous dewatering device, to each of which a separate controlled vacuum can be applied, and each of which has a separate white water drainage means (15,16,17,18,19).

8. A process according to Claim 6, characterized in that:

(a) an aqueous paper making fiber stock is discharged onto the moving forming fabric across the width thereof;

(b) the forming fabric moves over a foraminous dewatering device comprising in combination a forming board section, adjacent the head box slice, and a foil unit section in which section each foil comprises a flat support surface, and a trailing portion (in the direction of forming fabric travel) diverging from the plane of the fabric at an angle greater than zero degrees and less than 5 degrees;

(c) the forming fabric moves thereafter over a continuous suction box including a plurality of chambers to each of which a controlled level of vacuum is applied at uniformly spaced apart zones transverse to the direction of the travel of the fabric and permitting the fabric to sag in gaps between the supported zones and forming vertical fabric undulations in said gaps, thereby inducing uniformly spaced periodic harmonic agitation in the stock;

(d) water seal means are provided intermediately of the gaps in a plane below where the fabric is supported to interrupt the suction;

(e) vacuum is applied in said gaps to the underside of the forming fabric to draw the fabric downwardly between the gaps, the suction applied in each gap being interrupted by the water seal forming means as the aqueous paper-making suspension of fibers is dewatered; and

(f) controlling the vacuum applied in the chambers below gaps so that the applied vacuum rises progressively from a minimum value of 0.49 kPa (5 cms water gauge) below ambient atmospheric pressure adjacent the foil unit, to a maximum value of no more than 4.9 kPa (50 cms water gauge) below ambient atmospheric pressure at the end of the forming section.

Patentansprüche

1. Papierherstell-Maschine mit einem offenflächigen Siebabschnitt, die enthält mindestens ein wanderndes kontinuierliches Siebtuch (1), welches über eine Brustwalze (2) hinwegtritt, die einem Auflaufkasten (4) mit einem Stoffauflaufschlitz (5) benachbart ist, durch welchen wäßriger Papierstoff auf das Siebtuch aufgelegt wird, und eine Vielzahl von Papierstoff-Entwässerungsgeräten unterhalb des Siebtuchs, welche enthalten Siebwasser-Entwässerungsmittel, ein mit Öffnungen versehenes Entwässerungsgerät (6, 7) benachbart dem Auflaufschlitz, welches eine Vielzahl von stationären Entwässerungselementen enthält, die in einer Stützbeziehung im wesentlichen quer zu dem Siebtuch angeordnet sind, eine mit Öffnungen versehene Fläche (26, 27) an den Papierstoff-Entwässerungsgeräten, die ausgelegt ist zum Abstützen des Siebtuchs und zum Schaffen sowohl der Öffnungen, durch welche das Siebtuch entwässert, als auch einer Unterdruckabdichtung zwischen dem Siebtuch und dem Entwässerungsmittel, und ein Unterdruckmittel, das sowohl Unterdruck-Zuführmittel, als auch Unterdruck-Steuermittel und Unterdruck-Dichtmittel für das Siebwasser-Entwässerungsmittel enthält, wodurch ein unter Umgebungsdruck liegender Unterdruck in jedem Entwässerungsmittel geschaffen wird; wobei in dem Siebtuchabschnitt der Feststoffanteil des aus dem Auflaufkasten durch den Auflaufkastenschlitz auf das Siebtuch abgeschiedenen Papierstoffs von einem anfangs niedrigen Wert auf einen Wert von etwa 2% bis etwa 4% ansteigt; dadurch gekennzeichnet, daß

(i) die mit Durchbrüchen versehene Fläche (26, 27), welche das Siebtuch abstützt, einen

Weg schafft, durch den sich das Siebtuch bewegt, der ein gesteuertes Niveau von gleichmäßig mit Abständen voneinander versehener periodischer harmonischer Bewegungsbeeinflussung (48, 50) innerhalb des Papierstoffs auf dem Siebtuch verursacht;
(ii) die Papierstoff-Entwässerungsgeräte umfassen einen Saugkasten (100), der sich von der Nachbarschaft zu dem mit Öffnungen versehenen Entwässerungsgerät (6, 7) bis zum Ende des Siebtuchabschnitts erstreckt, welcher Saugkasten eine Vielzahl von unterdruckbeaufschlagten Kammern (8, 9, 10, 11, 12) enthält; und
(iii) das Unterdruckmittel einen Unterdruck in den unterdruck-beaufschlagten Kammern des Saugkastens schafft, der auf einen Wert gesteuert wird, welcher in Längsrichtung des Saugkastens von einem Minimalwert von 0,49 kPa (15 cm Wassersäule) unter Umgebungsdruck benachbart dem mit Öffnungen versehenen Entwässerungsgerät auf einen Maximalwert von 4,9 kPa (50 cm Wassersäule) unter Umgebungsdruck am Ende des Siebabschnitts ansteigt.

2. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß der Saugkasten (100) umfaßt entweder einen Einzelkasten (100), der sich von dem Anschlu an das mit Öffnungen versehene Entwässerungsgerät (6, 7) zu dem Ende des Siebabschnitts erstreckt und mit einer Vielzahl von druckdichten Querteilungen versehen ist, zwischen welchen jeweils ein separat gesteuerter Unterdruck angelegt werden kann und von denen jedes ein getrenntes Siebwasser-Ablaufmittel (15, 16, 17, 18, 19) besitzt, oder eine Vielzahl von aneinander anstoßenden benachbarten Kästen, die sich von der Nachbarschaft zu dem mit Öffnungen versehenen Entwässerungsgerät erstrecken, von denen an jeden ein separat gesteuerter Unterdruck angelegt werden kann und jedes ein separates Siebwasser-Ablaufmittel (15, 16, 17, 18, 19) besitzt.

3. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß das Entwässerungsgerät (6, 7) umfaßt zwei mit separatem Ablauf versehene und getrennte statische Ablaufgeräte, welche einen Siebtuch-Auflagenabschnitt (6) benachbart dem Auflaufkastenschlitz (5) umfassen, und einen getrennten Foil-Abschnitt (7) mit Abstand davon, in welchem Abschnitt jedes Foil (29) eine ebene Stützfläche (30) umfaßt und einen Nachlaufabschnitt (31) (in Laufrichtung des Siebtuchs), das von der Ebene des Tuchs (1) mit einem Winkel größer als 0° und kleiner als 5° abweicht.

4. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die mit Öffnungen versehen Fläche an dem Saugkasten umfaßt eine geschlitzte Gewebeauflagedecke, welche umfaßt eine Reihe von mit Abstand voneinander versehenen Siebtuch-Stützleisten (26) mit einer allgemein planaren oberen Fläche quer zur Laufrichtung des Gewebes in einer gemeinsamen im wesentlichen horizontalen Ebene, die dazwischen saugzugängliche Spalte schaffen, in welchem das Siebtuch im wesentlichen unabgestützt ist und nach unten gezogen wird, um den Papierstoff bewegende Wellungen in den Spalten zu bilden, wobei die Auflagedecke enthält Wasserabdicht-Siebleisten (27), die in den Spalten zwischen den Gewebeabstützleisten angeordnet sind und obere Flächen quer zur Laufrichtung des Gewebes besitzen an einem niedrigeren Niveau als die Oberflächen der Gewebestützleisten und mindestens Wasserabdichtungen an den nach unten gehenden Wellungen des Siebtuchs bilden, dadurch die Saugwirkung zeitweilig unterbrechen, um die Entwässerung zu begrenzen, während sie gleichzeitig eine Vertikalbewegung der Fasern an dem sich durch den Siebabschnitt bewegenden Tuch verursachen; wobei sowohl die erste, wie auch die letzte und irgendwelche Zwischenstützleisten, die entweder über eine innere unterdruckdichte Querteilwand oder zwei aneinanderstoßende Querwände von zwei benachbarten Saugkästen gesetzt sind, alle zusammen Tuchabstützleisten (26) bilden.

5. Vorrichtung nach Anspruch 3, dadurch gekennzeichnet, daß in dem Foilabschnitt die separaten Foils (29) so gesetzt sind, daß sie zur gesteuerten Bewegungsbildung des Papierstoffs an dem Siebtuch beitragen.

6. Verfahren zum Verbessern der Papierausbildung in einer Papierherstell-Maschine mit einem offenflächigen Siebabschnitt, der mindestens ein kontinuierliches wanderndes Siebtuch (1) enthält, welches über eine Brustwalze (2) benachbart einem Auflaufkasten (4) mit einem Auflaufkastenschlitz (5) geht, durch welchen Schlitz ein wäßriger Papierstoff auf das Siebtuch aufgebracht wird, und eine Vielzahl von Papierstoff-Entwässerungsgeräten unterhalb des Siebtuchs, welche enthalten Siebwasser-Ablaufmittel, ein dem Auflaufkastenschlitz benachbartes, mit Öffnungen versehenes Entwässerungsgerät (6, 7), das eine Vielzahl von stationären Ablaufelementen enthält, die in einer Stützbeziehung im wesentlichen in Querrichtung des Siebtuchs angeordnet sind, eine mit Öffnungen versehene Fläche (26,27) an den Papierstoff-Entwässerungsgeräten, die ausgelegt ist, das Siebtuch ab-

zustützen und sowohl Öffnungen zu schaffen, durch welche das Siebtuch entwässert, wie auch eine Unterdruckabdichtung zwischen dem Siebtuch und dem Ablaufmittel, und ein Unterdruckmittel einschließlich sowohl eines Unterdruck-Zuführmittels, wie auch eines Unterdruck-Steuermittels und eines Unterdruck-Abdichtmittels für die Siebwasser-Ablaufmittel, wodurch ein unter Umgebungsdruck liegender Unterdruck in jedem Ablaufmittel geschaffen wird; wobei in dem Siebabschnitt der Feststoffgehalt des von dem Auflaufkasten durch den Auflaufkastenschlitz auf das Siebtuch aufgebrachte Papierstoffs ansteigt von einem anfänglichen niedrigen Wert auf einen Wert von etwa 2% bis etwa 4%, welches Verfahren umfaßt, daß auf das sich bewegende Siebtuch ein wäßriger Papierherstell-Faserstoff über die Breite des Siebtuchs ausgelassen wird und das Siebtuch zur Bewegung durch den Siebabschnitt veranlaßt wird,
dadurch gekennzeichnet, daß

(i) ein gesteuertes Niveau von mit gleichförmigem Abstand versehener periodischer harmonischer Bewegungsbildung in dem Papierstoff dadurch geschaffen wird, daß das Siebtuch veranlaßt wird, einem zum Einführen der gewünschten Bewegungsbildung aufgebauten und eingerichteten Weg zu folgen;
(ii) ein gesteuertes unter Umgebungsdruck liegendes Unterdruckniveau unter dem Siebtuch aufgebracht wird mittels eines Saugkastens, der sich von der Nähe des mit Öffnungen versehenen Entwässerungsgerätes bis zum Ende des Siebabschnitts erstreckt, wobei der angelegte Unterdruck von einem Minimalwert von 0,49 kPa (5 cm Wassersäule) unter Umgebungsdruck benachbart dem mit Öffnungen versehenen Entwässerungsgerät auf einen Maximalwert von 4,9 kPa (50 cm Wassersäule) unter Umgebungsdruck am Ende des Siebabschnitts ansteigt.

7. Verfahren nach Anspruch 6, dadurch gekennzeichnet, daß der Saugkasten (100) entweder einen Einzelkasten umfaßt der sich von der Nachbarschaft zu dem mit Öffnungen versehenen Entwässerungsgerät (6, 7) zu dem Ende des Siebabschnitts erstreckt und mit einer Vielzahl von druckdichten Querteilwänden versehen ist, zwischen welchen ein separat gesteuerter Unterdruck angewendet werden kann und von denen jede ein separates Siebwasser-Ablaufmittel (15, 16, 17, 18, 19) besitzt, oder eine Vielzahl von aneinander anstoßenden benachbarten Kästen, die sich von der Nachbarschaft zu dem mit Öffnungen versehenen Entwässerungsgerät erstrecken, an denen jeweils ein separat gesteuerter Unterdruck angelegt werden kann und von denen jedes ein separates Siebwasser-Ablaufmittel (15, 16, 17, 18, 19) besitzt.

8. Verfahren nach Anspruch 6, dadurch gekennzeichnet, daß:

(a) ein wäßriger Papierherstell-Faserstoff auf das sich bewegende Siebtuch über dessen gesamte Breite ausgelassen wird;
(b) das Siebgewebe sich über ein mit Öffnungen versehenes Entwässerungsgerät bewegt, welches in Kombination umfaßt einen Siebleistenabschnitt benachbart zum Auflaufkastenschlitz und einen Foileinheiten-Abschnitt, in welchen Abschnitt jedes Foil umfaßt eine ebene Stützfläche und einen Nachlaufabschnitt (in der Laufrichtung des Siebtuchs), der von der Ebene des Tuchs mit einem Winkel größer als 0° und kleiner als 5° abweicht;
(c) das Siebgewebe sich danach über einen kontinuierlichen Saugkasten bewegt, der eine Vielzahl von Kammern enthält, von denen an jede ein gesteuertes Unterdruckniveau angelegt wird, in mit gleichmäßigem Abstand voneinander versehenen Zonen quer zur Laufrichtung des Tuchs, und zugelassen wird, daß das Tuch in die Spalte zwischen den abgestützten Zonen einsackt und vertikale Tuchwellungen in den Spalten bildet, um dadurch mit gleichmäßigem Abstand versehene periodische harmonische Bewegungsbildung in den Papierstoff einzuführen;
(d) Wasserdichtmittel zwischen den Spalten in einer Ebene vorgesehen sind, die unter der liegt, wo das Tuch abgestützt ist, um die Saugwirkung zu unterbrechen;
(e) Unterdruck in den Spalten an die Unterseite des Siebtuchs angelegt wird, um das Tuch zwischen den Spalten nach unten zu ziehen, wobei die in jedem Spalt angelegte Saugwirkung durch das die Wasserdichtung bildende Mittel unterbrochen wird, wenn die wäßrige Papierherstell-Faseraufschlämmung entwässert wird; und
(f) der an die Kammern unter den Spalten angelegte Unterdruck so gesteuert wird, daß der angelegte Unterdruck fortschreitend von einem Minimalwert von 0,49 kPa (5 cm Wassersäule) unter Umgebungsdruck benachbart der Foil-Einheit auf einen Maximalwert von nicht mehr als 4,9 kPa (50 cm Wassersäule) unter Umgebungsdruck am Ende des Siebabschnitts ansteigt.

Revendications

1. Machine à papier comprenant une section de for-

mage à surface ouverte, comprenant au moins un tissu de formage continu (1) en déplacement qui passe sur un rouleau de tête (2) au voisinage d'une bâche d'alimentation (4) laquelle présente une fente (5) à travers laquelle de la pâte à papier aqueuse est déposée sur le tissu de formage, et comprenant une pluralité de dispositifs d'élimination d'eau pour la pâte à papier, au-dessous du tissu de formage et qui incluent des moyens de drainage pour les eaux de blanchiment, un dispositif poreux pour l'évacuation d'eau (6, 7) adjacent à la fente de la bâche d'alimentation et comprenant une pluralité d'éléments de drainage stationnaires disposés en une relation de supportage sensiblement transversalement par rapport au tissu de formage, une surface poreuse (26, 27) sur les dispositifs d'évacuation d'eau pour la pâte à papier, adaptée à supporter le tissu de formage et à assurer à la fois les ouvertures à travers lesquelles le tissu de formage est drainé et un joint étanche au vide entre le tissu de formage et les moyens de drainage, et comprenant un système de vide, comprenant des moyens d'alimentation de vide, des moyens de commande de vide, et des moyens de joints à vide pour les moyens de drainage de l'eau de blanchiment, grâce à quoi on alimente dans chaque dispositif de drainage un vide au-dessous de la pression atmosphérique ambiante, et dans ladite section de formage, la teneur en solides de la pâte à papier déposée depuis la bâche d'alimentation à travers la fente sur le tissu de formage s'élève depuis une valeur initiale faible jusqu'à une valeur comprise entre environ 2% et environ 4%;
caractérisée en ce que

(i) la surface poreuse (26, 27) qui supporte le tissu de formage fournit un trajet le long duquel se déplace le tissu de formage et lequel provoque un niveau contrôlé d'agitations harmoniques périodiques uniformément espacées (48, 50) au sein de la pâte à papier sur le tissu de formage;
(ii) des dispositifs d'évacuation comprenant une boîte de succion (100) qui s'étend depuis le voisinage du dispositif poreux d'évacuation d'eau (6, 7) jusqu'à l'extrémité de la section de formage, ladite boîte de succion comprenant une pluralité de chambres évacuées (8, 9, 10, 11, 12); et
(iii) le système à vide établissant un vide dans les chambres évacuées de la boîte de succion, commandé à une valeur qui s'élève progressivement le long de la longueur de la boîte de succion depuis un minimum de 0,49 kPa (5 cm de colonne d'eau) au-dessous de la pression atmosphérique ambiante au voisinage du dispositif poreux d'évacuation d'eau jusqu'à une valeur maximum de 4,9 kPa (50 cm de colonne d'eau) au-dessous de la pression atmosphérique ambiante à l'extrémité de la section de formage.

2. Appareil selon la revendication 1, caractérisé en ce que la boîte de succion (100) comprend soit une boîte unique (100) qui s'étend depuis le voisinage du dispositif poreux d'évacuation d'eau (6, 7) jusqu'à l'extrémité de la section de formage et qui est pourvue d'une pluralité de divisions transversales étanches à la pression entre chacune desquelles on peut appliquer un vide commander séparément, et qui comporte chacune des moyens de drainage séparés (15, 16, 17, 18, 19) pour l'eau de blanchiment, soit une pluralité de boîtes adjacentes et contiguës qui s'étendent depuis le voisinage du dispositif poreux d'évacuation d'eau, dans chacune desquelles peut être admis un vide commandé séparément, et qui comportent chacune des moyens de drainage séparés (15, 16, 17, 18, 19) pour l'eau de blanchiment.

3. Appareil selon la revendication 1, caractérisé en ce que le dispositif d'évacuation d'eau (6, 7) comprend deux dispositifs de drainage statiques, séparés et séparément drainés, qui comprennent une partie constituant une planche de formage (6) au voisinage de la fente (5) de la bâche d'alimentation, et une section séparé à feuilles (7) espacée de la précédente, dans laquelle chaque feuille (29) comprend une surface de support (30) plane, et une partie de queue (31) (dans la direction de déplacement du tissu de formage) qui diverge du plan du tissu (1) sous un angle supérieur à 0° et inférieur à 5°.

4. Appareil selon la revendication 1, caractérisé en ce que la surface poreuse sur la boîte de succion comprend une couverture en tissu du type présentant des fentes, qui comprend une série de lamelles (26) espacées qui supportent le tissu de formage, les lamelles ayant une surface au sommet généralement plane et transversale à la direction de déplacement du tissu, dans un plan commun essentiellement horizontal, et assurant entre elles des intervalles accessibles à la succion, dans lesquels le tissu de formage est sensiblement non-supporté et est tiré vers le bas afin de former dans lesdits intervalles des ondulations qui agitent la pâte à papier, ladite couverture comprenant des lamelles (27) qui forment une étanchéité vis-à-vis de l'eau disposées de façon intermédiaire dans lesdits intervalles entre les lamelles qui supportent le tissu et qui ont des surfaces au sommet transversales à la direction du déplacement du tissu et à un niveau inférieur aux surfaces au sommet des lamelles qui supportent

le tissu, et formant au moins des joints à eau au niveau des ondulations inférieures du tissu de formage, en interrompant ainsi temporairement la succion afin de limiter le drainage tout en entraînant une agitation verticale des fibres du tissu qui passe à travers la section de formage; et en ce que la première lamelle de support, la dernière lamelle de support et toute lamelle de support intermédiaire placée au-dessus d'un compartiment interne transversal étanche au vide ou une paire de parois transversales contiguës de deux boîtes de succion adjacentes, forment toutes des lamelles (26) qui supportent le tissu.

5. Appareil selon la revendication 3, caractérisé en ce que dans la section à feuilles, les feuilles séparées (29) sont placées de manière à contribuer à une agitation contrôlée de la pâte à papier sur le tissu de formage.

6. Procédé pour améliorer la formation de papier dans une machine à papier ayant une section de formage à la surface ouverte qui comprend au moins un tissu de formage continu (1) en déplacement qui passe sur un rouleau de tête (2) adjacent à une bâche d'alimentation (4) qui comporte une fente (5) à travers laquelle de la pâte à papier aqueuse est déposée sur le tissu de formage, et une pluralité de dispositifs d'évacuation d'eau hors de la pâte à papier au-dessous du tissu de formage et comprenant des moyens de drainage pour l'eau de blanchiment, un dispositif poreux d'évacuation d'eau (6, 7) adjacent à la fente de la bâche d'alimentation et comprenant une pluralité d'éléments de drainage stationnaires disposés en relation de supportage sensiblement transversalement au tissu de formage, une surface poreuse (26, 27) sur les dispositifs d'évacuation d'eau étant adaptée à supporter le tissu de formage et à fournir à la fois les ouvertures à travers lesquelles le tissu de formage est drainé et un joint étanche au vide entre le tissu de formage et les moyens de drainage, et un système à vide comprenant des moyens de fourniture de vide, des moyens de commande de vide, et des moyens formant joints pour les moyens de drainage de l'eau de blanchiment, grâce à quoi un vide au-dessous de la pression atmosphérique ambiante est appliquée dans chacun des moyens de drainage; procédé dans lequel, dans ladite section de formage, la teneur en solides de la pâte à papier déposée depuis la bâche d'alimentation et à travers la fente sur le tissu de formage augmente depuis une valeur initiale faible jusqu'à une valeur comprise entre environ 2% et environ 4%, ledit procédé comprenant les opérations consistant à décharger sur le tissu de formage en déplacement une pâte à papier fibreuse et aqueuse sur la largeur du tissu de formage, et à amener le tissu de formage à se déplacer le long de la section de formage, caractérisé en ce que :

(i) un niveau contrôlé d'agitations harmoniques périodiques uniformément espacées est provoqué dans la pâte à papier, en amenant le tissu de formage à suivre un trajet construit et agencé de manière à induire les agitations désirées;

(ii) un niveau contrôlé de vide au-dessous de la pression atmosphérique ambiante est appliquée au-dessous du tissu de formage au moyen d'une boîte de succion qui s'étend depuis le voisinage du dispositif poreux d'évacuation d'eaujusqu'à l'extrémité de la section de formage, le vide appliqué augmentant depuis un minimum de 0,049 kPa (5 cm de colonne d'eau) au-dessous de la pression ambiante au voisinage du dispositif poreux d'évacuation d'eau, jusqu'à une valeur maximum de 4,9 kPa (50 cm de colonne d'eau) au-dessous de la pression atmosphérique ambiante à l'extrémité de la section de formage.

7. Procédé selon la revendication 6, caractérisé en ce que la boîte de succion (100) comprend soit une boîte unique qui s'étend depuis le voisinage du dispositif poreux d'évacuation d'eau (6, 7) jusqu'à l'extrémité de la section de formage et qui comprend une pluralité de sections transversales étanches à la pression, entre chacune desquelles on peut appliquer un vide commandé séparément, et qui comportent chacune des moyens de drainage séparés (15, 16, 17, 18, 19) pour l'eau de blanchiment, soit une pluralité de boîtes adjacentes et contiguës qui s'étendent depuis le voisinage du dispositif poreux d'évacuation d'eau, à chacune desquelles peut être appliqué un vide séparément commandé, et qui comportent chacune un moyen de drainage séparé (15, 16, 17, 18, 19) pour l'eau de blanchiment.

8. Procédé selon la revendication 6, caractérisé en ce que :

(a) on décharge une pâte à papier fibreuse et aqueuse sur le tissu de formage en déplacement et sur la largeur de celui-ci;

(b) le tissu de formage se déplace sur un dispositif poreux d'évacuation d'eau qui comprend en combinaison une section constituée par une plaque de formage, adjacente à la fente de la bâche d'alimentation, et une section à feuilles dans laquelle chaque feuille comprend une surface de support plane, et une partie de queue (dans la direction de déplacement du tissu de formage) qui diverge du plan du tissu sous un angle supérieur à 0° et inférieur à 5°,

(c) le tissu de formage se déplace ensuite au-dessus d'une boîte de succion continue comprenant une pluralité de chambres à chacune desquelles on applique un niveau de vide commandé, suivant des zones écartées de façon uniforme transversalement à la direction de déplacement du tissu, et permettant au tissu de s'affaisser dans les intervalles entre les zones supportées et formant dans lesdits intervalles des ondulations verticales dans le tissu, induisant par conséquent des agitations harmoniques périodiques uniformément espacées dans la pâte à papier;

(d) des moyens formant joint vis-à-vis de l'eau sont prévus en position intermédiaire dans les intervalles dans un plan au-dessous du lieu où le tissu est supporté afin d'interrompre la succion;

(e) on applique du vide dans lesdits intervalles et à la face inférieure du tissu de formage afin de tirer le tissu vers le bas entre les intervalles, la succion appliquée dans chaque intervalle étant interrompue par les moyens formant joint tandis que la suspension aqueuse des fibres est égouttée;

(f) on commande le vide appliqué dans les chambres au-dessous des intervalles de telle manière que le vide appliqué augmente progressivement depuis une valeur minimum de 0,49 kPa (5 cm de colonne d'eau) au-dessous de la pression atmosphérique ambiante au voisinage de l'unité à feuilles, jusqu'à une valeur maximum qui ne dépasse pas 4,9 kPa (50 cm de colonne d'eau) au-dessous de la pression atmosphérique ambiante à l'extrémité de la section de formage.

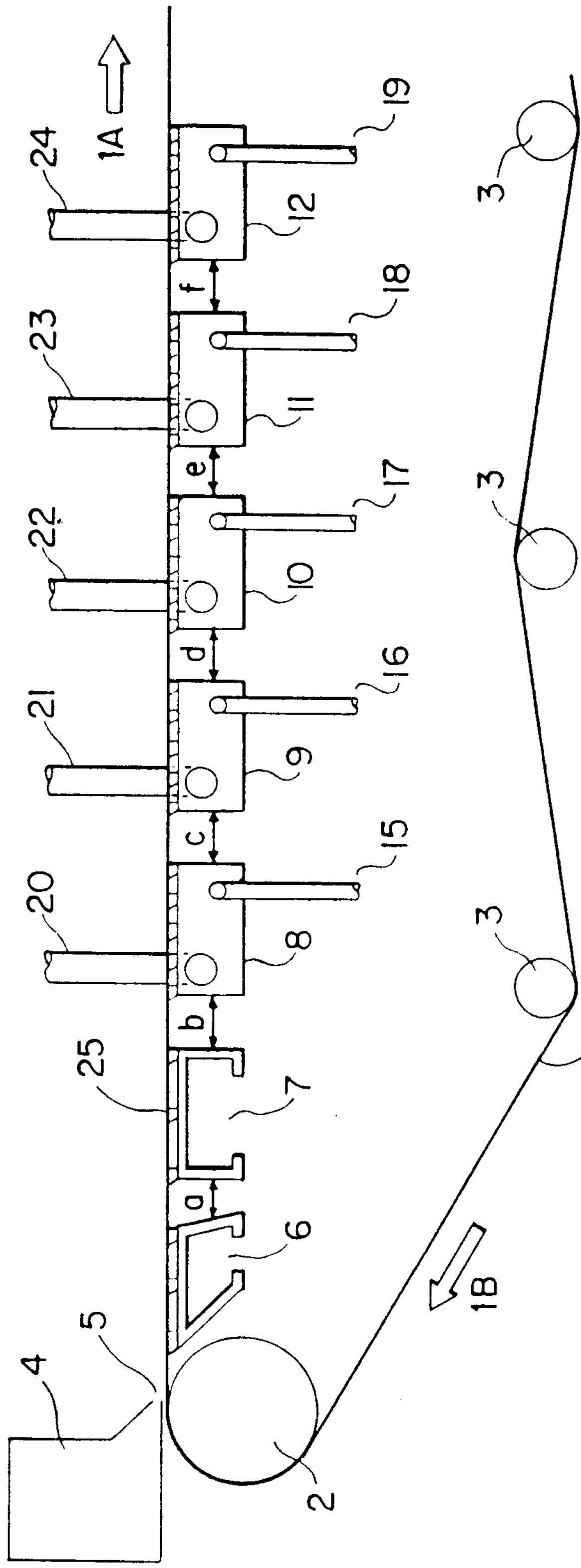

FIG. 1

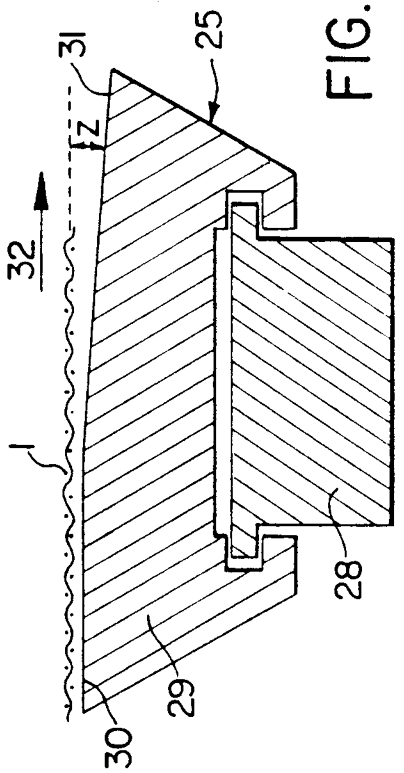

FIG. 2

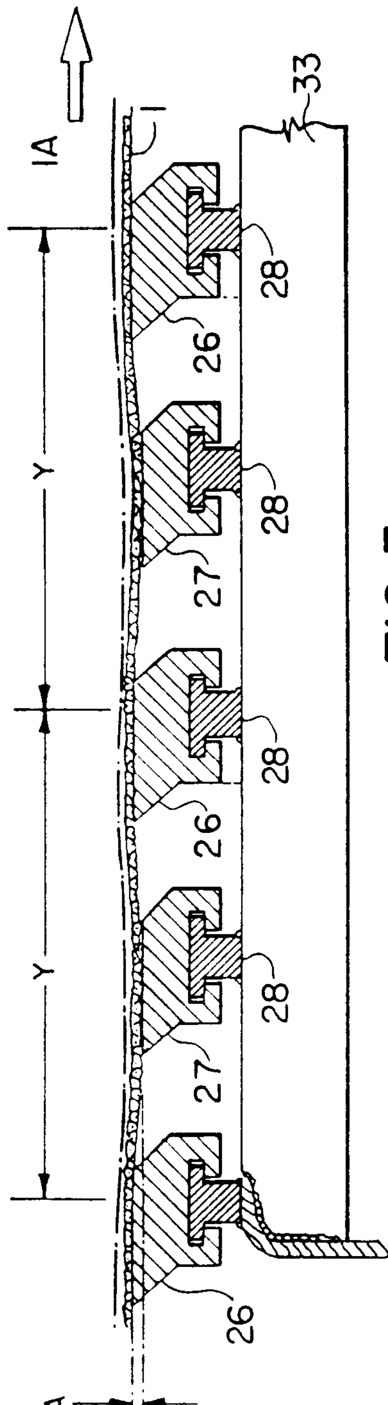

FIG. 3

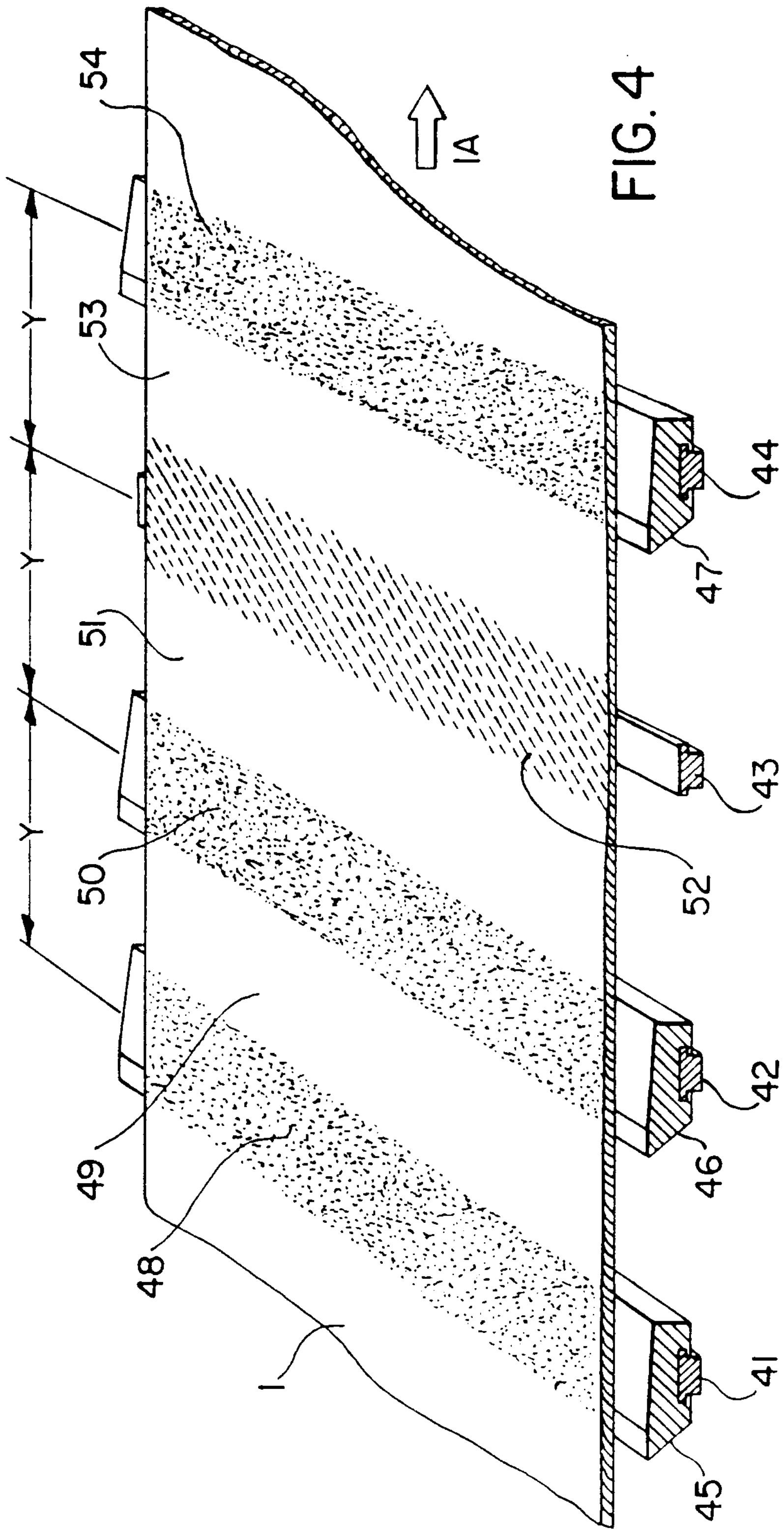

FIG. 4

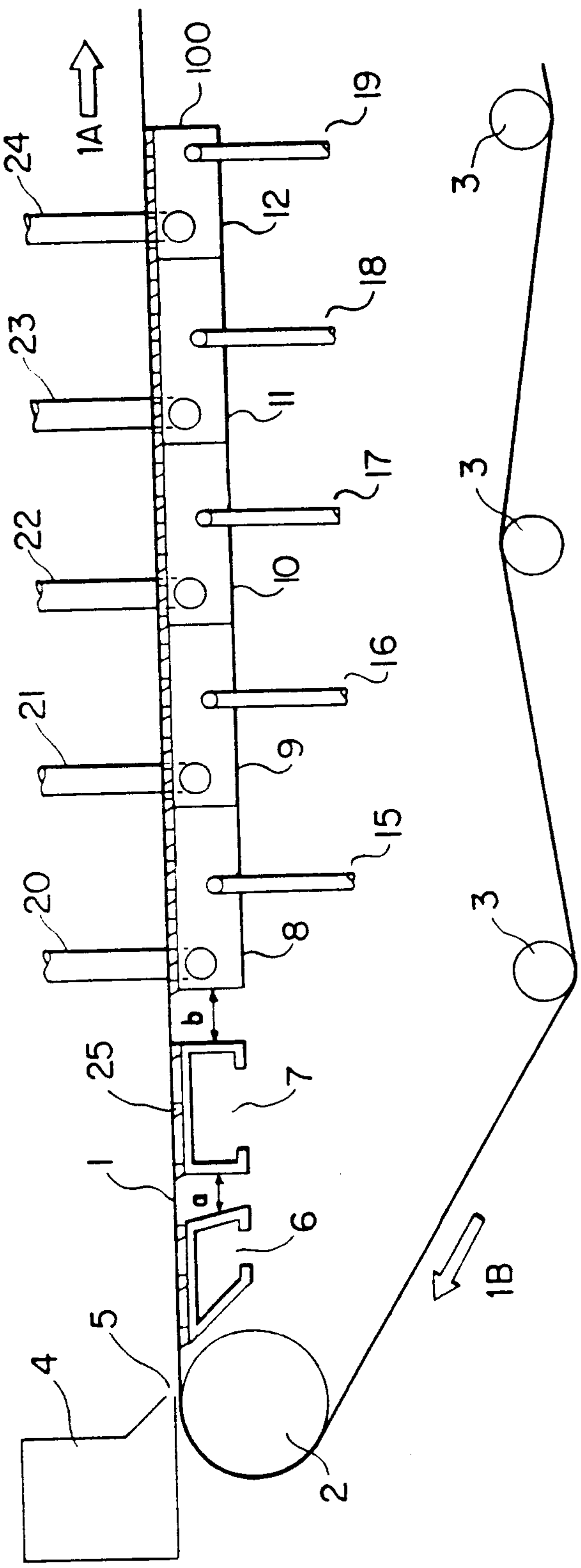

FIG. 5

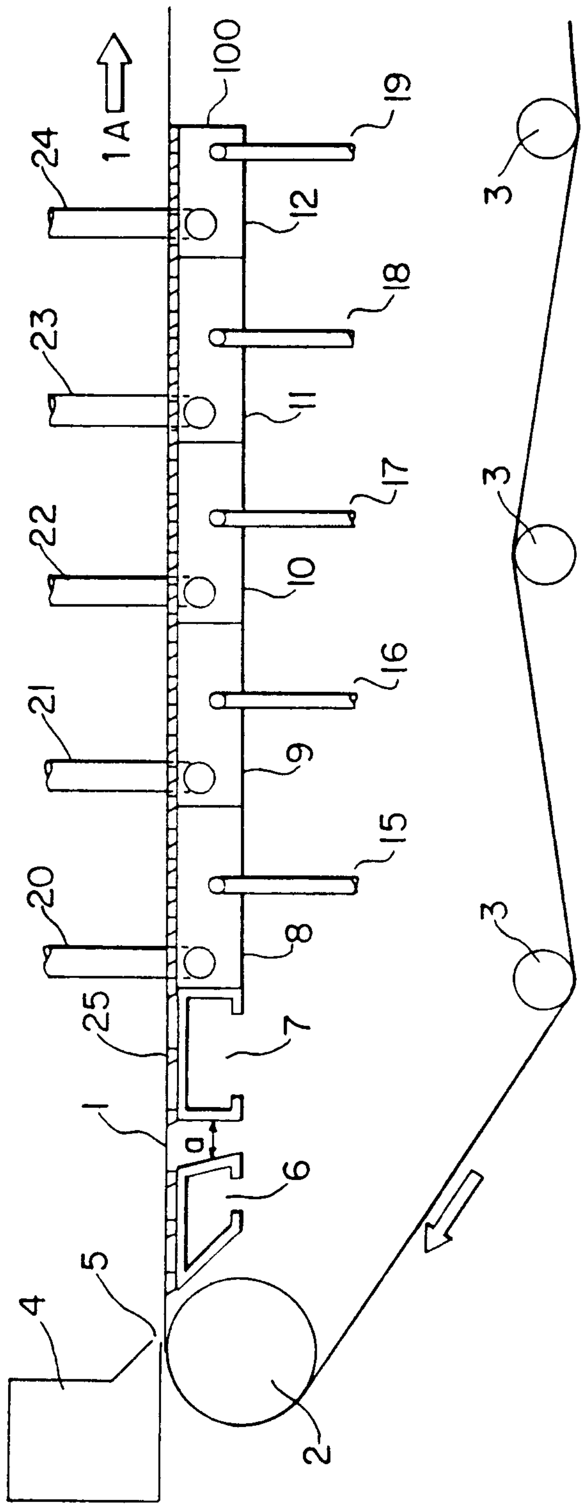

FIG. 6

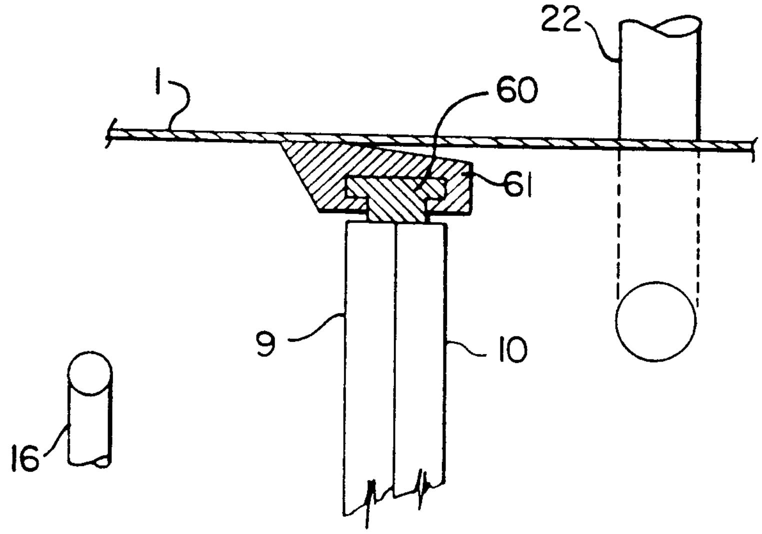

FIG. 7