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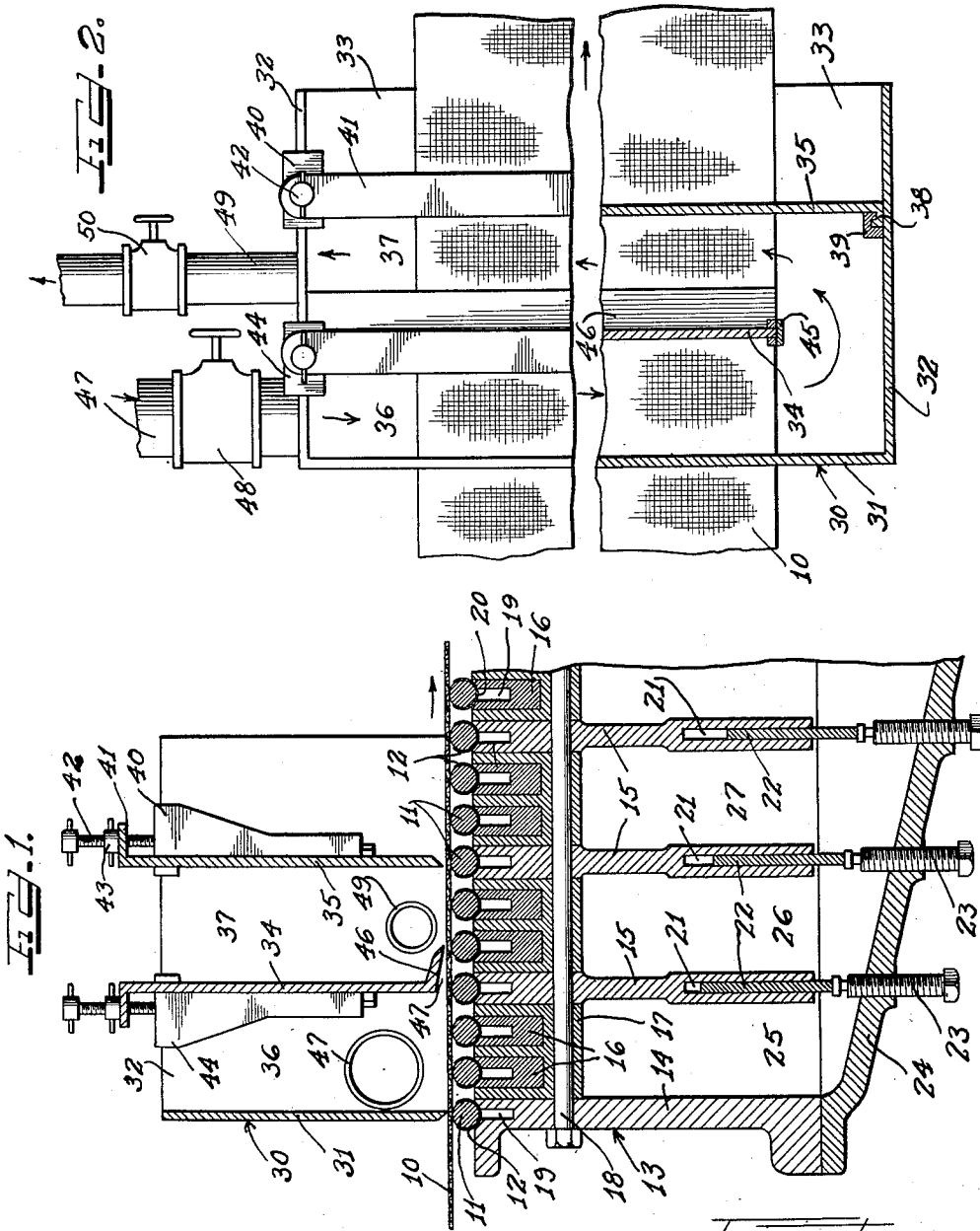
E. E. BERRY

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CROSS-CURRENT FLOW FOURDRINIER PAPER MAKING MACHINE

Filed Sept. 24, 1936

2 Sheets-Sheet 1



INVENTOR
EARL E. BERRY.

Charles Mills ATTY.

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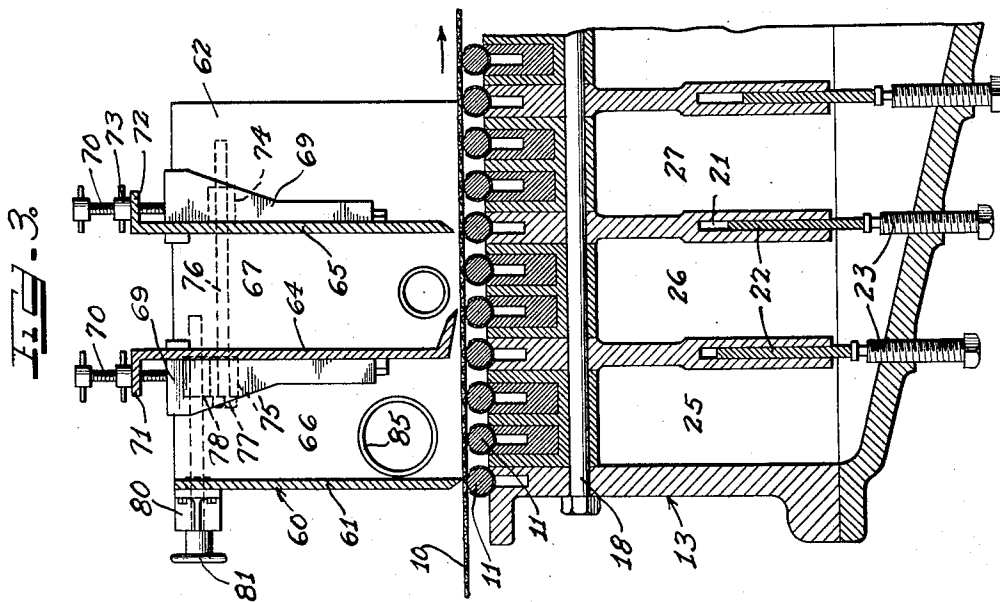
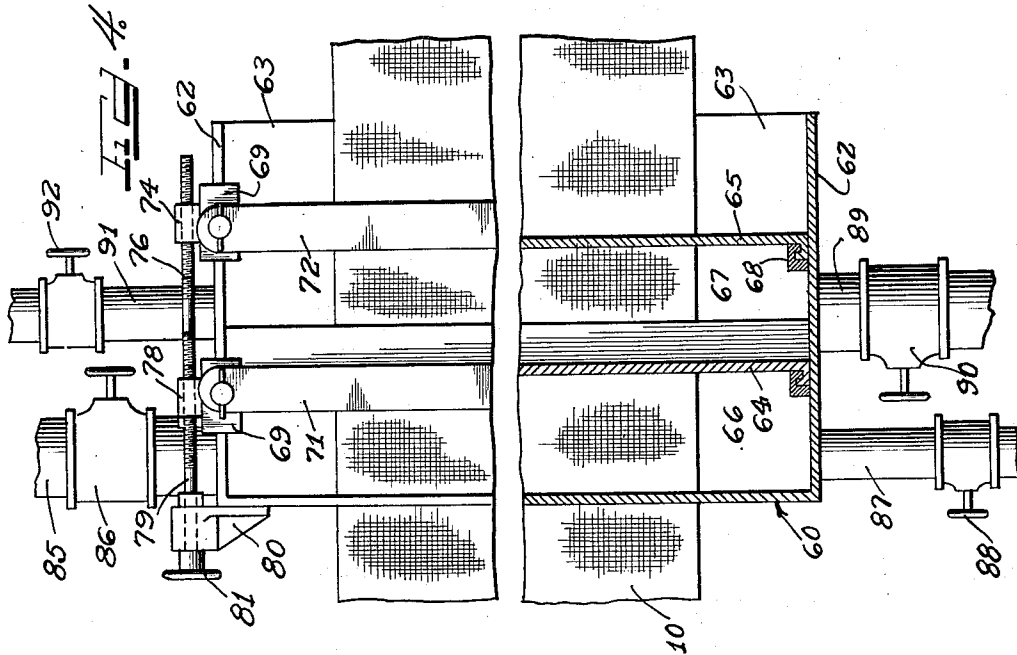
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Inventor
EARL E. BERRY.

Charles H. Mills ATTORNEY.

UNITED STATES PATENT OFFICE

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CROSS-CURRENT FLOW FOURDRINIER
PAPER MAKING MACHINEEarl E. Berry, Beloit, Wis., assignor to Beloit
Iron Works, Beloit, Wis., a corporation of Wis-
consin

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This invention relates to Fourdrinier paper making machines wherein paper stock is flowed onto the Fourdrinier wire transversely of the direction of travel of the wire to produce a fibrous web having high tear strength in both directions.

More specifically this invention relates to the maintenance of ponds of paper stock above the Fourdrinier wire of a paper making machine while flowing the stock transversely of the direction of travel of the wire and subjecting the under side of the wire to regulated degrees of vacuum.

It is customary on Fourdrinier paper making machines to flow the paper stock onto the Fourdrinier wire in the direction of travel of the wire or to maintain quiescent ponds of stock on the Fourdrinier wire from which ponds the stock is deposited on the wire. In these types of machines the wire is usually shaken laterally of its direction of travel to rearrange the fiber formation of the stock thereon so that all of the fibers will not be lying in the direction of travel of the wire. The shaking of the Fourdrinier wire is not desirable, however, since it requires added mechanism and decreases the life of the wire.

According to this invention stock is now floated onto the Fourdrinier wire at an angle to the direction of travel of the wire so that the fibers of the paper web being formed on the wire will not largely be in a direction parallel with the travel of the wire. The invention provides for the maintenance of flowing ponds of stock above the Fourdrinier wire and the depositing of the stock directly from the ponds onto the wire. In one form of the invention the stock can be flowed transversely of the direction of travel of the wire across the wire, have its direction of travel reversed and flowed back over the wire. In another form of the invention separate types of stock can be flowed transversely across the wire so as to produce paper built up from several different types of stock. The invention also provides for the maintenance of the wire passing under the ponds of stock under the influence of controlled degrees of suction so that the white water from the stock can be drained through the wire at a desired rate.

It is then an object of this invention to manufacture paper having a high tear strength in both directions on a Fourdrinier type machine without the aid of shaking mechanism.

A further object of this invention is to provide a Fourdrinier paper making machine with a cross current stock feed so as to supply the stock fibers to the Fourdrinier wire lying in a direction at an angle to the direction of travel of the wire,

A further object of this invention is to maintain cross flowing ponds of stock on a Fourdrinier forming wire for depositing the stock on the wire transversely of the direction of travel of the wire.

Still another object of this invention is to provide a Fourdrinier paper making machine with a head box supplying flowing ponds of stock over the Fourdrinier wire in a direction transverse to the direction of travel of the wire.

Another object of this invention is to provide a head box for a Fourdrinier type paper making machine containing a plurality of open bottomed compartments for receiving ponds of stock therein together with means for flowing said ponds of stock across the Fourdrinier wire transversely of its direction of travel.

A specific object of this invention is to provide a Fourdrinier paper making machine with a cross current stock feed disposed over the wire while simultaneously subjecting the under side of the wire to controlled amounts of suction.

Other and further objects of this invention will become apparent to those skilled in the art from the following detailed description of the annexed sheets of drawings which disclose preferred embodiments of the invention. It should be understood, however, that the illustrated embodiments are only examples of apparatus embodying the principles of the invention and that many other modifications of the apparatus will be apparent without departing from the teachings and scope of this invention.

On the drawings:

Figure 1 is a fragmentary, vertical cross-sectional view of the stock receiving end of a cross current flow Fourdrinier paper making machine according to this invention.

Figure 2 is a broken, fragmentary top plan view of the apparatus indicated in Figure 1 with parts shown in horizontal cross-section.

Figure 3 is a fragmentary vertical cross-sectional view of the stock receiving end of a modified form of cross current flow paper making machine according to this invention.

Figure 4 is a fragmentary, broken top plan view of the apparatus illustrated in Figure 3 with parts shown in horizontal cross section.

As shown on the drawings:

As shown in Figures 1 and 2, the reference numeral 10 indicates a Fourdrinier forming wire of the usual construction used on Fourdrinier paper making machines. The forming wire 10 is supported on a plurality of small diameter table rolls 11 rotatably mounted in bearing shells 12 extending for more than 180° around the periphery of

the table rolls 11 and throughout substantially the entire length of the rollers. The bearing shells 12 are carried by a drain box 13 on end walls 14 and partition walls 15 of the box and on bars 16 extending transversely across the box. The bars 16 are supported in fingers 17 carried by tie rods 18 extending longitudinally through the box 13.

The end walls 14 of the drain box 13; the partition walls 15 and the transverse bars 16 have passageways 19 extending across the tops thereof below the bearing shells 12. These bearing shells 12 have openings 20 joining the interiors of the passageways 19 with the interiors of the shells. Water or other lubricating fluid is supplied to the passageways 19 and forced between the bearing shells 12 and the table rolls 11 to lubricate the rollers or, if desired, to hydraulically overbalance the rollers for floating the same in their bearing shells.

The bottom ends of the partition walls 15 do not extend to the bottom of the box 13 but are slotted as at 21. The slots 21 in the partition walls 15 receive slides 22 therein adapted to be moved up and down relative to the partition walls 15 by means of set screws 23 threaded through a sloping bottom pan 24 on the bottom of the drain box 13. In this manner, individual compartments such as 25, 26 and 27, are formed in the drain box 13 and drainage from each compartment is controlled by the position of the slides 22. The drain box 13 can be evacuated and the degree of vacuum in each compartment regulated by drainage of white water from the compartment. In this manner, the forming wire 10 is maintained under controlled degrees of suction over each of the compartments in the drain box. It should be understood, of course, that the fingers 17 supporting the bars 16 are quite thin and therefore drainage of white water into the compartments is unobstructed. At the same time, however, the forming wire 10 is fully supported by the table rolls which can be disposed as close together as desirable.

According to this invention a head box 30 having a back wall 31, side walls 32 and bottom walls 33 extending only up to the edges of the wire 10 is disposed over the wire.

Vertical slice plates 34 and 35 are mounted between the side walls 32 of the head box 30 in spaced relation from each other and from the end wall 31 of the head box to define compartments 36 and 37 in the head box.

The slice plate 35 is provided with flanges 38 along the ends thereof. These flanges 38 are slidable vertically in tracks 39 (Figure 2) formed on saddle members 40 suspended over the top edges of the side walls 32 of the head box. The saddle members 40 are slidable along the side walls 32 of the head box to move the plate 35 in horizontal directions.

The plate 35 has a top flange 41 adapted to have threaded therethrough adjusting screws 42 for raising and lowering the plate 35 relative to the saddle members 40 and to the head box. The adjusting screws 42 abut the tops of the saddle members 40 and a rotation of the said screws 42 will thus raise the plate relative to the saddle members or permit the plate to be lowered relative to the saddle members. The set screws can be locked in adjusted position by means of lock nuts 43 threaded around the screws 42 and abutting the top of the flange 41.

The bottom of the slice plate 34 can be main-

tained at any desired distance from the top of the wire 10 by raising and lowering the plate.

The plate 34 is vertically slidable in a saddle member 44 in a manner identical with the manner in which the slide plate 35 is vertically slidable. However, the other end of the plate 34 terminates short of the side wall 32 of the head box and is slidable in a bracket member 45 (Figure 2) mounted in the head box. The slice plate 34 has a forwardly projecting sloping flange 46 defining a tapering passageway 47 (Figure 1) beneath the bottom of the plate 34 and the top of the forming wire 10.

A stock feed pipe 47 communicates through a side wall 32 of the head box 30 with the compartment 36 therein formed behind the plate 34. A valve 48 in the pipe line 47 controls the feed of stock into the compartment 36. The stock entering into the compartment 36 flows transversely across the head box 30 and over the wire 10 where part of the stock is deposited on the wire transversely of the direction of travel of the wire. The amount of stock deposited on the wire from the compartment 36 can be regulated by controlling the size of the passageway 47 under the plate 34, the head of stock maintained in the compartment and the rate of white water drainage through the wire. The size of the passageway 47 is controlled by raising or lowering the plate 34 relative to the wire 10. Stock which is not deposited on the wire in the compartment 36 flows around the end of the plate 34 as indicated in Figure 2 and into the compartment 37 behind the slice plate 35. The stock thus again travels over the wire 10 transversely to the direction of travel of the wire but in a direction opposite to the direction in which it flows in the compartment 36. Additional stock is thus deposited on the wire in an amount controlled by the spacing of the slice plate 35 from the wire 10, the head of stock maintained in the compartment 37 and the drainage of white water through the wire. Excess stock is removed from the compartment 37 through a stock discharge pipe or conduit 49 and the amount of discharge is controlled by a valve 50 in the conduit 49.

In this manner two flowing ponds of stock are maintained over the forming wire 10 flowing in opposite directions transversely to the direction of travel of the wire. The stock fibers in these flowing ponds are largely disposed parallel to each other in the direction of flow and thus have their lengths transverse of the direction of travel of the wire. As these fibers are deposited on the wire, some of them will, of course, be pulled around in the direction of travel of the wire while others will remain with their lengths transverse of the direction of travel. In this manner a web is formed on the wire having the fibers thereof criss-crossed in desired relation to each other, thereby producing a paper sheet having a high tear strength in both directions. The tear strengths of the paper can be controlled by the speed of flow of the stock through the compartments 36 and 37. Thus the maintenance of rapidly flowing ponds of stock transversely to the direction of travel of the wire will produce a paper sheet having more fibers arranged with their lengths transversely of the travel of the wire and thus produce a paper having a high tear strength in the direction of travel of the wire. As is known, Fourdrinier formed paper generally has a higher tear strength in the direction transversely of the machine direction,

and even vigorous shaking of the wire cannot materially offset this result on high speed machines. The cross current flow machine of this invention, on the other hand, can be run at very high speeds to produce paper having higher tear strength in the machine direction than transversely of the machine if desired.

The size of the compartments 36 and 37 can be regulated by sliding the movable plates defining walls of these compartments relative to the head box. Thus the compartment 37 can be made materially smaller or larger than the compartment 36 by merely moving the saddles 49 along the tops of the side walls 32 of the head box toward or away from the plate 34.

In Figures 3 and 4, parts identical with parts described in Figures 1 and 2 have been marked with the same reference numerals and it is evident from Figures 3 and 4 that the same drain box 13 as described in Figures 1 and 2 is used below the forming wire 10.

In Figures 3 and 4, however, a head box 60 having an end wall 61, side walls 62 and bottom walls 63 extending only up to the edges of the forming wire 10 is disposed over the forming wire as indicated.

Vertical slice plates 64 and 65 are disposed in the head box 60 and extend transversely thereacross to define compartments 66 and 67 in the head box. The plates 64 and 65 are slidably mounted at their ends in tracks 68 formed in saddle members 69 which are suspended over the top edges of the side walls 62 of the head box. The plate 64, however, unlike the plate 34 in Figures 1 and 2, extends the full width of the head box.

The plates 64 and 65 are raised or lowered relative to the forming wire 10 by adjusting screws 70 threaded through flanges 71 and 72 formed respectively on the tops of the plates 64 and 65. The said screws 70 abut the tops of the saddles 69 so that a rotation of the screws 70 in one direction will raise the plates relative to the saddles and to the forming wire while a rotation in the other direction will permit the plates to be lowered. The said screws can be locked in adjusted position by lock nuts 73 abutting the tops of the flanges 71 and 72 of the plates.

The saddles 69 are slidable horizontally along the side walls of the head box.

The horizontal movement of the saddle members 69 relative to the head box can be nicely effected by providing threaded bosses 74 and 75 on the outside portions of the saddles as indicated. An elongated bolt or threaded rod 76 can be threaded through the bosses 74 and 75. The rod 76 can be provided with a head 77 for engagement with a wrench to permit rotation of the rod.

The plate 64 can be moved horizontally relative to the head box by providing a second threaded boss 78 on a saddle member 69 supporting this plate. A threaded rod 79 can be threaded through the boss 78 and extend through a bearing in a bracket 80 secured on the rear wall 61 of the head box. The end of the rod 79 is provided with a hand wheel 81 permitting a rotation of the rod. Thus when the hand wheel 81 is rotated the plate 64 can be drawn toward or away from the rear wall 61 of the head box. Likewise a rotation of the rod 76 can be effected to move the plate 65 toward and away from the plate 64.

A stock feed conduit 85 communicates with the compartment 66 through a side wall 62 of

the housing. Flow of stock into the compartment from the feed conduit is controlled by a valve 86 in the conduit 85. The stock thus flows transversely across the compartment 66 and is partially deposited onto the forming wire 10. Excess stock can be removed through a discharge conduit 87 in communication with the compartment 66 through the other side wall 62 of the head box. The amount of discharge can be regulated by a valve 88 in the conduit 87.

A second stock inlet conduit 89 communicates through the wall 62 of the head box with the compartment 67 in the box to flow stock into the compartment in a direction opposite to the direction of flow through the compartment 66. The amount of stock introduced in the compartment 67 can be controlled by a valve 90 in the conduit 89.

Excess stock from the compartment 67 can be discharged through an outlet conduit 91 formed through the other wall 62 of the head box. The amount of discharge can be controlled by a valve 92 in the conduit 91.

In this manner two separate flowing ponds of stock are maintained above the forming wire 10. The stock introduced into the compartment 67 can be the same or different than the stock introduced into the compartment 66. However, both ponds of stock flow in directions transverse to the direction of travel of the forming wire so that the fibers of the stock are disposed with their lengths transverse to the direction of travel of the wire. The ponds of stock can be maintained at any desired depth in the compartments 66 and 67 and can further be flowed through the compartments at any desired rate.

In this modification, therefore, a paper web can be built up on the forming wire composed of two different types of stock and having the fibers thereof lying in a desired criss-cross condition without effecting a shaking of the forming wire. The cross current flow thus provides for the production of Fourdrinier webs having high tear strength in the machine direction since any desired proportion of the fibers composing the sheet can be made to lie transversely of the machine direction by controlling the speed of flow of the pond in the head box.

The amount of stock deposited from each compartment onto the forming wire can be controlled by the head of stock maintained in the compartment, the distance of the slices from the forming wire and the degree of vacuum maintained under the forming wire beneath these compartments.

The apparatus is simple and can be carefully controlled without difficulty. The apparatus eliminates the necessity for shaking the forming wire thereby greatly simplifying Fourdrinier paper machines and increasing the life of the Fourdrinier wire.

The fibers deposited on the forming wire can be set in web form almost immediately by the combined hydraulic pressure provided by the heads of stock in the ponds and the vacuum under the wire at the areas of fiber deposit. The tendency of the fibers to assume the machine direction of the forming wire like logs floating downstream can be prevented to almost any desired degree. Thus the increasing of the vacuum under the wire at the stock deposit areas, the increasing of the depths of the ponds of stock above the wire or both will increase the white water drainage through the wire and set the fibers into web form before they can be materially pulled around out of transverse alignment with the wire.

The drain box arrangement makes possible a subjecting of the sheet being formed to continuous vacuum from the time the stock first contacts the wire until it has passed the last slice and the water of flotation has been removed to such an extent that an actual sheet of paper has been formed. This continuous vacuum holds the fibers tightly to the wire and prevents them from being floated or swished around on the wire by the water of the stock either while passing through the forming area or under the last slice. It is thus possible to obtain from 75% to 95% of the sheet formation back of the last slice.

The last slice can therefore be maintained very close to the wire because with the major part of the sheet formation occurring back of this slice very little water of flotation passes under the slice. This prevents varying stock currents on the wire such as occur on the conventional Fourdrinier machine where all of the sheet is formed beyond the slice by allowing gravity drainage of the water of flotation.

By operating with different heads of stock in the various stock compartments and by regulating the distance of the intermediate slice from the wire, it is possible to create a certain amount of stock flow lengthwise of the wire. Thus, for example, when the second pond of stock, such as the pond formed in compartment 37 as shown in Figures 1 and 2, or compartment 67 shown in Figures 3 and 4, is maintained at a lower static head than the stock in the first compartment a regulation of the size of the passageway 47 under the lip of the first slice plate by raising this slice plate off the wire will permit a flow of stock under the slice from the first to the second pond. This flow will permit the fibers to assume a machine-wise direction like logs floating downstream.

In this manner the fibers first deposited on the wire from the first transversely flowing pond will lie transversely of the wire. The next mass of fibers deposited on the first deposited layer will take place as the wire advances through the passageway 47 formed under the slice and lip. These fibers will lie mainly in the machine direction and are therefore at right angles to the first deposited layer. As the wire then advances under the second pond where the fibers are flowing transversely across the wire the next layer to be deposited will have the fibers laying transversely of the machine direction.

In this manner a sheet is built up composed of outer layers having the fibers lying mainly in a cross machine direction and a middle layer composed of fibers lying mainly in a machine direction. The sheet will be of unitary formation, however, since all of the fibers are deposited in the forming area of the machine.

The resulting sheet will have very high tear, bursting and tensile strength. The continuous suction maintained under the wire in the forming area prevents the longitudinal flow of the fibers through the passageway 47 from displacing the transverse fibers deposited from the first pond. Likewise the transverse flow in the second pond will not displace the longitudinal fibers deposited in the passageway 47. Obviously the elongation of the lip 46 on the slice 34 will lengthen the passageway for longitudinal flow of fibers and will increase the forming area for the longitudinal fiber formation on the sheet to increase the relative size of the middle layer. Normally, however, the desired forming area for the middle layer can be obtained by regulating the

heads of stock in the two compartments and the distance of the slice 34 or 64 from the wire.

I am aware that many changes may be made and numerous details of construction may be varied through a wide range without departing from the principles of this invention, and I, therefore, do not purpose limiting the patent granted hereon otherwise than necessitated by the prior art.

I claim as my invention:

1. A Fourdrinier paper making machine comprising a forming wire, a plurality of small diameter table rolls supporting the wire along its upper run, a drain box carrying said rolls, means for regulating drainage from the wire into said box, a head box having an open bottom disposed over said forming wire, adjustable slice plates in said head box defining with the walls of the box chambers for ponds of stock and a stock inlet and a stock outlet at the sides of the head box communicating with opposite ends of said chambers whereby stock is flowed through the chambers at an angle to the direction of travel of the wire for deposit onto the wire.

2. A head box for Fourdrinier paper making machines comprising means defining a plurality of open bottomed chambers for ponds of stock, stock feed and stock discharge conduits at opposite sides of the head box communicating with opposite ends of said chambers whereby stock is flowed transversely of the chambers and adjustable slice plates forming the front walls of said chambers.

3. A head box adapted to be disposed over the top of the forming wire of a Fourdrinier paper making machine comprising a box having a rear wall, side walls and an open bottom portion adapted to register with the forming wire, a first slice plate in said box extending from one side wall of said box into spaced relation from the other side wall, a second slice plate in the head box in front of said first slice plate and extending transversely across the head box, means for raising and lowering the slice plates relative to the head box, a stock feed conduit in a side wall of the head box behind the first slice plate and a stock discharge conduit in the same side wall of the head box ahead of the first slice but behind the second slice whereby stock can be flowed behind the first slice around the end of said slice and back behind the second slice for deposit through the open bottom of the box onto the forming wire.

4. A stock head box adapted to be disposed over the forming wire of Fourdrinier paper machines comprising a box having a rear wall, side walls and an open bottom portion, slice plates extending transversely across the head box between the side walls thereof defining with the head box a plurality of open bottom compartments adapted to register with the forming wire, and separate stock inlet stock discharge conduits communicating with the compartments at opposite ends thereof on opposite sides of the forming wire to flow paper stock through the compartments transversely of the direction of travel of the forming wire for deposit of some of the stock through the open bottom of the compartments onto the forming wire.

5. A cross current flow Fourdrinier paper machine comprising a forming wire, a plurality of small diameter table rolls supporting said wire, a drain box rotatably carrying said rolls at the top thereof, a plurality of partitions in said drain box defining a plurality of white water receiving

compartments therein, means for regulating the drainage from each compartment, a head box above the forming wire, a slice plate in said head box defining with the head box an open bottom chamber for paper stock above the forming wire, means for sliding said slice plate horizontally in the head box to bring the chamber in communication with one or more compartments in the drain box, a stock inlet and a stock outlet communicating with the chamber on opposite sides of the forming wire, means for supplying stock to the chamber through the inlet and means for draining stock from the chamber through the outlet whereby stock flows through the chamber at an angle to the direction of travel of the forming wire for deposit of some of the flowing stock through the open bottom of the box on the wire.

6. The method of making paper which comprises directing streams of stock over successive well defined areas of a traveling forming wire transversely of the direction of travel thereof, flowing stock longitudinally of said wire between said successive areas and applying suction to the under side of said wire to cause a deposition of fibers from said stock with the fibers lying largely in the same direction as the directions of flow of the respective streams of stock from which deposition occurs.

7. A method of making paper which comprises flowing two separate ponds of stock transversely across a traveling forming wire to deposit fibers on the wire lying mainly in a direction transversely of the direction of travel of the wire, flowing some of the stock longitudinally on the wire from the first pond to the second pond to deposit an intermediate layer of fibers lying mainly in the direction of travel of the wire and evacuating the under side of the wire to obtain from 75% to 95% of the paper formation under the pond areas.

8. In a paper machine in combination a traveling forming wire, a drain box having a plurality of small diameter table rolls supporting the wire, means for evacuating the drain box, a head box disposed over the wire having a rear wall and side walls, a pair of adjustable slices forming the front walls of individual compartments in said head box, a lip portion on the intermediate slice for defining a passageway thereunder and means for flowing stock transversely through the compartments under static heads for depositing fibers on the wire lying mainly in a cross-machine direction while flowing stock from the first pond into the second pond under the lip of the intermediate slice to deposit an intermediate layer of fibers lying mainly in the machine direction.

9. A Fourdrinier paper making machine com-

prising an elongated forming wire adapted to travel longitudinally of the machine, a head box having an open bottom disposed over a portion of the wire defining an open bottomed stock chamber above the wire, a stock inlet and a stock outlet communicating with the stock chamber on opposite sides of the wire, means for supplying stock to the chamber through the inlet and means for draining stock from the chamber through the outlet whereby stock flows through the chamber at an angle to the direction of travel of the wire for deposit of some of the flowing stock through the open bottom of the box onto the wire.

10. A cross current flow Fourdrinier paper making machine comprising an elongated forming wire adapted to travel longitudinally of the machine, means defining chambers for a plurality of ponds of paper stock above said forming wire with the bottoms of said chambers in communication with the forming wire, stock inlets and stock outlets communicating with opposite ends of the chambers on opposite sides of the forming wire, means for supplying stock to the chambers through the inlets and means for draining stock from the chambers through the outlets for deposit of some of the flowing stock on the wire in a direction transversely to the direction of travel of the wire and suction means below said wire for effecting a forced drainage of white water from the stock deposited on the wire.

11. A head box adapted to be disposed over the forming wire of a Fourdrinier paper making machine comprising a box having a rear wall, side walls and an open bottom portion, a plurality of slice plates in said box defining with the box a plurality of open bottomed compartments for ponds of stock, stock inlets and stock outlets at the sides of the box communicating with opposite ends of the compartments, means for supplying stock to the compartments through the inlets and means for draining stock from the compartments through the outlets whereby stock flows through the compartments transversely of the direction of travel of the forming wire.

12. The method of making paper which comprises directing streams of stock over successive well-defined areas of a traveling forming wire at an angle to the direction of travel of the forming wire, flowing stock longitudinally of said wire between said successive areas, and applying suction to the under side of the wire to cause a deposition of fibers from said stock with the fibers lying largely in the same direction as the directions of flow of the respective streams of stock from which deposition occurs.

EARL E. BERRY.