Sept. 15, 1964 D. E. ROBINSON 3,149,028

PAPER MAKING MACHINE AND PROCESS

Filed Sept. 26, 1961 3 Sheets-Sheet 1

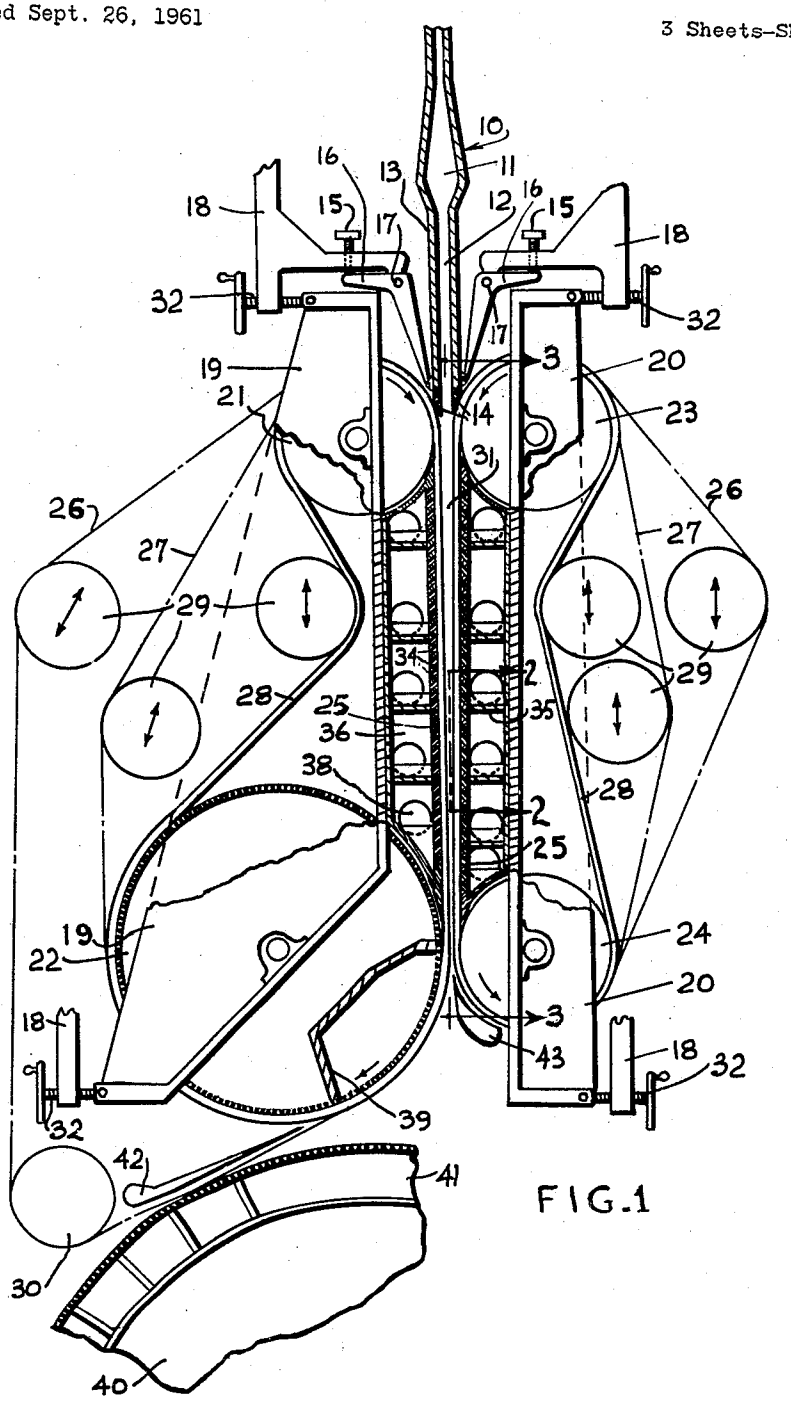

FIG. 1

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Filed Sept. 26, 1961 3 Sheets-Sheet 2

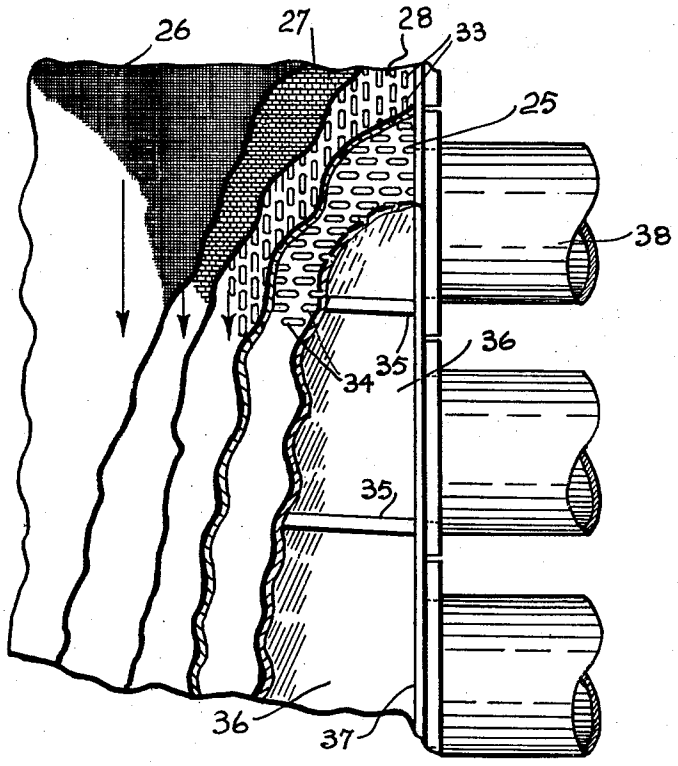

FIG. 2

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Filed Sept. 26, 1961 3 Sheets-Sheet 3

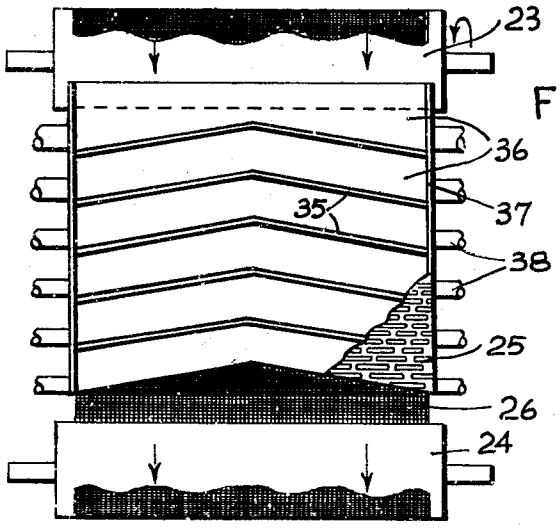

FIG. 3

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United States Patent Office 3,149,028 Patented Sept. 15, 1964

3,149,028

PAPER MAKING MACHINE AND PROCESS

David E. Robinson, Norwalk, Conn., assignor to Paper Machine Components, Incorporated, Norwalk, Conn., a corporation of Connecticut

Filed Sept. 26, 1961, Ser. No. 140,778
15 Claims. (Cl. 162—303)

This invention relates to paper making machines and methods. More specifically, it pertains to improvements in the Fourdrinier sections of paper making machines and to a process for forming paper, board and the like.

The present application is a continuation-in-part of my copending application Serial No. 45,858, filed July 28, 1960, now abandoned.

The manufacture of paper is based essentially upon the principle of forming a web of fibers from "stock mixture," containing paper forming fibers in water suspension, by depositing the fibers against a supporting foraminous surface.

Heretofore, the majority of Fourdinier machines, whether single wire or twin wire devices, employed either a shake or forming boards and grooved and plain rolls to even out the thick and thin streaks in the web and to obtain suitable formation. Further, such machines relied on doctor blades or slices and vacuum devices for removing the water vehicle directly from the stock mixture.

While Fourdrinier machines of the type heretofore known have been used for many years, there are a number of disadvantages inherent in their operation which result in little or no control over the rate of drainage, poor formation control and considerable basis weight variation. It is known that table rolls, doctor blades and the like, when in direct engagement with the wire on which the web is formed, cause disruption of the forming sheet, a high fines loss and possible pinholing as the result of intense localized dewatering. Further, such direct engagement may result in stapling at the doctor blades, slices and the like which produces thick and thin streaks in the formed sheet.

Another problem with known paper making machines is their excessive size resulting from the great distance it is necessary to travel the suspension or web so that sufficient water is removed during sheet forming operations.

The present invention overcomes the problems aforenoted by substantially eliminating table rolls, doctor blades and the like and providing a method and means for dewatering the stock at a rapid rate in a relatively short travel distance without disruption or reabsorption, thus facilitating control over the rate of drainage and formation and reducing variation in basis weight.

According to one form of the invention, this is achieved by distributing and arranging the fibers in the stock prior to feeding it into the forming zone and then forcing the stock into the forming zone between travelling belts at a velocity substantially equal to the velocity of the belts. The belts are of such a character as to be able to contain substantially all of the water removed from the stock at any given instant without impeding its flow from the stock. Thereafter, the stock and belts move together through the forming zone, which may be regulated to control its contour, and the water is removed from the stock into the belts and finally disposed of in any convenient manner.

It is therefore an object of the present invention to provide a paper making machine having a slice or nozzle, which is adapted to distribute and arrange the fibers of the stock mixture, positioned to feed the mixture directly into the forming zone between opposed travelling belts at a velocity substantially equal to the velocity of the belts.

It is also an object of the invention to provide a paper making machine having a pair of opposed travelling belts defining the forming zone for the sheet, which travels with the sheet or mixture during the dewatering operation and cooperativvely provide passages for conducting the water away from the sheets at both sides.

Another object of the invention is to provide a paper making machine wherein twin belts defining the forming zone travel with the web during the forming of the sheet and cooperatively provide pores or passages for conducting water away from the web, the pores or passages being of a length to provide sufficient volume for containing within themselves substantially all the water to be removed from the web at any given instant without substantially affecting the flow of water from the web.

Another object of the invention is to provide a paper making machine having a pair of opposed foraminous belts, each including at least one sheet forming wire, which define the forming zone and travel with the sheet forming web, the belts cooperatively conducting the water away from the web during the dewatering operation.

Still another object of the invention is to provide a paper making machine in which the forming zone is substantially vertically disposed and defined by opposed supported foraminous belts adapted to travel with the forming sheet and conduct the water therefrom.

It is thus still further an object of the invention to provide an apparatus for dewatering a web in the forming of a paper sheet in which the water is rapidly, progressively removed from the web in a relatively short vertical forming zone without disruption of the web.

Other objects and advantages will be apparent from the specification and claims when considered in connection with the attached sheets of drawings, illustrating one form of the invention, wherein like characters represent like parts, and in which:

FIG. 1 is a schematic side elevation partly in section of a Fourdrinier section of a paper making machine and its associated parts in accordance with embodiment of the invention.

FIG. 2 is a fragmentary elevational view taken along line 2—2 of FIG. 1, with some of the parts broken away.

FIG. 3 is an elevational view taken along line 3—3 of FIG. 1.

Referring to FIG. 1, the machine includes a slice or jet nozzle arrangement 10 for feeding stock mixture into the forming zone between a pair of opposed travelling belts, as will be hereinafter described. While the slice may take any form which will function to distribute and arrange the fibers prior to feeding the stock into the forming zone, in the illustrated form of the invention it has a throat or contracting section 11 and a passage 12 of constant or substantially constant cross-sectional area defined by the slice proper 13. The slice 13 has its walls terminating in semi-rigid, wear-resistant lips 14 which are preferably made of rubber or other suitable material. The width of the slice opening may be adjusted by means of screws 15 which engage respectively a pair of two-armed levers 16 pivotally mounted centrally at 17 on supporting frame members 18. The free ends of levers 16 engage the outer surfaces of the slice 13 adjacent lips 14.

The Fourdrinier section includes a pair of frames 19 and 20. Frame 19 has mounted at the upper end thereof a breast roll 21 and at the lower end a couch roll 22. Similarly the frame 20 supports another breast roll 23 and a presser roll 24. Each frame assembly includes a foraminous plate 25 mounted tangent to rolls 21, 22 and 23, 24 respectively, and having sharp leading and trailing edges which ride or substantially ride the rolls at both ends of the plate or extend in close proximity thereto, in

order to provide continuous support between the rolls and further to prevent breast roll "pumping."

A set of endless travelling belts is mounted on each frame assembly and rides respectively on the breast and couch roll 21, 22 of frame 19 and on the breast and presser roll 23, 24 of frame 20. Each set, as shown in greater detail in FIG. 2, includes a fine mesh wire 26, a coarse mesh wire 27 and a foraminous or porous sheet or belt 28 of flexible plastic or other suitable material. The two wires and the sheet are backed by the plate 25 on each assembly, which are movable to adjust for slack and ride on outer guide rolls 29; the wire 26 of frame 19 rides furthermore on an outboard guide roll 30.

While the endless belts have been shown and described as including a fine mesh wire 26, a coarse mesh wire 27 and a foraminous sheet 28, it should here be noted that they need not be limited to such construction since the important function of the belts is their ability to cooperatively provide passages or pores having a volume sufficient for rapidly conducting all of the water away from the web that is being formed and containing such water, if necessary. In order to achieve this end, the foraminous sheets 28 are thick enough to cooperatively provide passages or pores of sufficient length to contain all or substantially all of the water removed from the stock mixture at any given instant without impeding the flow of water from the stock mixture and may be perforated, as at 33 in the illustrated embodiment of the invention, cellular or of like porous construction.

The two frame assemblies are mounted opposite each other so as to define between the foraminous plates 25 and the belts thereon a forming zone 31, into which opens directly the slice 13. As shown in the drawings the arrangement is preferably disposed vertically with the slice at the upper end, but it may also be disposed in any inclined or in a horizontal position, provided that gravity run-off of water is possible from both sides of the forming zone.

As shown, the wires 26 and 27 and sheet 28 of each belt move together through the forming zone, but it should be understood that they may be separated at any desired point therealong to remove the water containing sheet 28 from reabsorbing contact wtih the web.

The frames 19 and 20 are secured at their upper and lower ends to cranked adjustment screws 32 mounted in the supporting frame members 18 mentioned above, so that the frames are adjustable individually at each end to vary the spacing between them, and their angle of convergence. The slice lips 14 are suitably positioned with respect to the breast rolls 21 and 23 so that the inner edges of the lips 14 may be aligned tangentially with the outer faces of fine mesh wires 26, and so that the lips may ride or be in close proximity to the outer surfaces of the wires in substantial sealing contact therein.

It is noted that the apparatus is operative also if only one slice wall and if only one frame is mounted adjustably by means of screws 15 and 32 respectively. In this case one side of the slice and of the frame assembly is stationary and the other side may be moved towards or away from it to obtain the desired adjustment.

The perforations in the sheets 28 and in the plates 25 are preferably in the form of slots 33 and 34 respectively which in the sheets are disposed lengthwise along wire travel (FIG. 2) and in the plates transversely to wire travel, the slots of the sheet and plate partly intersecting each other. The slots 34 of the plates 25 extend downwardly at an angle of about 45° or less from the inwardly facing surfaces of the plates (FIG. 1) so as to present sharp leading edges which assist in scraping water from the sheets 28. The inclination of the slots 34 also tends to increase the suction pick-up from the web in the forming zone by reducing the angle at which the water is drawn off in relation to the direction of flow of the stock through the forming zone.

Slots 33 must be sufficiently narrow to prevent sagging of the wires 26 and 27 yet wide enough to prevent plugging. Furthermore the intervals between the slots must be wide enough to provide adequate support for the wires. The same criteria apply to slots 34 in the plates 25.

The plates 25 are rigidly supported by transversely disposed beams 35 secured to frames 19 and 20 and forming with the plates a plurality of transversely elongated suction boxes 36 closed at the sides by deckles 37. The beams 35 are sloped downwardly on both sides of the central plane of the machine (FIG. 3) and suction draining pipes 38 are connected to each suction box 36 at either end thereof. Suitable valving (not shown) is provided to control each suction box individually, and the pipes 38 are connected to an appropriate suction plant (not shown).

The couch roll 22 has a foraminous surface and includes a suction box 39. The run of fine mesh wire 26 between the couch roll 22 and the outboard roll 30 passes adjacent a suction pick-up roll 40 provided with a suction box 41.

Gutters 42 and 43 are provided respectively under the couch roll 22 and under the presser roll 24 to collect the spray from the wires, sheets and rolls.

The machine embodying my invention operates as follows:

The paper stock is pressure fed through the throat contracting section 11 of the slice and thence through the passage in slice 13 proper at a constant high velocity such as to ensure turbulent flow, resulting from boundary layer friction, of an order affording a completely random distribution of the fibers in the stream as it enters the forming zone 31. The passage in the slice is of sufficient length to permit the fibers to thus redistribute themselves in passing from the contracting section. The stream enters the forming zone at a pressure slightly above atmospheric. When the velocity of the stream and the speed of the forming wires are nearly matched, the fibers are laid on the wires in the same random arrangement as they leave the slice, and with such rapidity that the resulting web will be free from flocculation. By adjusting the speed of the forming wires so that it exceeds the delivery velocity of the stock a directional sheet may be obtained and any required adjustments can be made rapidly and with great accuracy to afford any degree of directional effect desired.

Thus the slice delivers a uniform layer of stock of the desired thickness, consistency and velocity to the forming and dewatering zone 31 between the wires 26 of the opposed travelling belts. The wires 26 carry the layer of stock between the opposed assemblies of suction boxes 36 so that white water is drained from both faces of the stock layer in a controlled manner with the passages or pores provided by the belts conducting the water away from the stock and containing the excess water which cannot be rapidly handled and disposed of by the suction boxes. The water which is contained in the passages, while it may be held therein by any means known to the art against feedback or reabsorbtion into the stock, in the preferred form of the invention is drawn away from the stock by vacuum until the belt is separated from the wires.

It should be mentioned that, while vacuum means are preferred for drawing the water from the stock into the passages, in some embodiments of the invention pressure, gravity or similar means may be utilized.

The gap between the couch roll 22 and the presser roll 24 is adjusted to suit the caliper of the formed sheet. The slice opening and the breast roll gap as well as the surfaces of the suction boxes may be adjusted in relation to the gap between couch and presser roll so as to dispose the wires and the forming zone at a converging angle in the downstream direction. The convergence of the forming zone is suited to the rate of dewatering, and its

length is sufficient to set the sheet as it emerges therefrom to a dryness of 5 to 12%.

The suction in each suction box may be adjusted individually so that gradually increasing suction may be applied by subsequent boxes in the direction of travel of the sheet as it is being formed.

As it emerges from the forming zone 31 the set sheet is held to the face of the wire 26 on the left hand side by the suction exerted by couch roll 22 and is then taken up by the suction pick-up holl 40. In this interval the sheet dryness is further raised to 17 to 23%.

The sheet is subsequently conveyed to the face of any conventional wet felt or transfer roll (not shown) and thence to a wet press section (not shown) for further dewatering and processing of the sheet according to conventional practices.

Thus, among others, the various objects and advantages of the invention as aforenoted are achieved. Obviously numerous changes may be resorted to without departing from the spirit of the invention as delned by the claims.

I claim:

1. In a paper making machine, a pair of opposed travelling wires defining therebetween an elongated tapered forming zone wherein a fibrous stock mixture is received and formed into a unitary web, porous means operably adjacent the remote surfaces of each of said wires and travelling with said wires, foraminous means for rigidly supporting at least one of said wires and its respective porous means throughout its length in the forming zone, said wires and porous means insulating said web from said foraminous supporting means, a slice, said slice including jet nozzle means for thoroughly mixing the fibers of said stock mixture to obtain an even distribution of the fibers therein and adjustable means thereafter feeding a controlled nonvarying amount of said mixture from said mixing means directly into engagement with said opposed wires in said forming zone at a velocity substantially equal to the velocity of said wires, means for simultaneously progressively removing water from opposite sides of the stock mixture in the forming zone at substantially the same rate, said porous means freely conducting substantially all of the water removed from the stock mixture at any given instant away from the forming zone at such given instant and being adapted to hold substantially all of such removed water without impeding the flow of water from the stock mixture, whereby the surface of said web is maintained substantially free of removed water, and means for removing water from said porous means at a rate to enable said porous means to continuously receive substantially all of such removed water from said mixture.

2. In a paper making machine, a pair of opposed travelling wires defining therebetween an elongated tapered forming zone wherein a fibrous stock mixture is received and formed into a unitary web, a foraminous belt operably adjacent the remote faces of each of said wires and travelling with said wires at least through the forming zone, said foraminous belts each providing a plurality of pores extending substantially transversely of the length of the forming zone and opening therein, foraminous means for rigidly supporting at least one of said wires and its respective belt throughout their length in the forming zone, said wires and belt insulating said web from said foraminous supporting means, a slice, said slice including jet nozzle means for thoroughly mixing the fibers of said stock mixture to obtain an even distribution of the fibers therein and adjustable means thereafter feeding a controlled nonvarying amount of said stock mixture from said mixing means directly into engagement with said opposed wires in said forming zone at a velocity substantially equal to the velocity of the wires, means for simultaneously progressively removing water from opposite sides of the stock mixture in the forming zone at substantially the same rate, said pores of said foraminous belts being of such a size whereby they cooperatively hold substantially all of the water removed from said stock mixture at any given instant without impeding the flow of water from the stock mixture so that the surface of said web is maintained substantially water free, and means for removing water from said pores in said foraminous belts at a rate to enable said pores to continuously receive substantially all of such removed water from said mixture.

3. In a paper making machine, a pair of opposed travelling endless wires defining therebetween an elongated tapered forming zone wherein a fibrous stock mixture is received and formed into a unitary web, an endless foraminous belt travelling with said wires and operably adjacent the remote faces of each of said wires at least through a portion of the forming zone, said foraminous belts each providing a plurality of pores extending substantially transversely of the length of the forming zone and opening therein, foraminous means for rigidly supporting at least one of said wires and its respective belt throughout their length in the forming zone, said wires and belt insulating said web from said foraminous supporting means, a slice, said slice including jet nozzle means for thoroughly mixing the fibers of said stock mixture to obtain an even distribution of the fibers therein and adjustable means thereafter feeding a controlled nonvarying amount of said stock mixture from said mixing means directly into engagement with said opposed wires in said forming zone at a velocity substantially equal to the velocity of the wires, means for simultaneously progressively removing water from opposite sides of the stock mixture in the forming zone at substantially the same rate, said pores of said foraminous belts being of such a size whereby they cooperatively hold substantially all of the water removed from said stock mixture at any given instant without impeding the flow of water from the stock mixture so that the surface of said web is maintained substantially water free, and means for removing water from said pores in said foraminous belts at a rate to enable said pores to continuously receive substantially all of such removed water from said mixture.

4. In a paper making machine, a pair of opposed travelling wires defining therebetween an elongated tapered forming zone wherein a fibrous stock mixture is received and formed into a unitary web, porous means operably adjacent the remote surfaces of each of said wires and travelling with said wires, foraminous means for rigidly supporting at least one of said wires and its respective porous means throughout its length in the forming zone, said wires and porous means insulating said web from said foraminous supporting means, a slice, said slice including jet nozzle means for thoroughly mixing the fibers of said stock mixture to obtain an even distribution of the fibers therein and adjustable means thereafter feeding a controlled nonvarying amount of said mixture from said mixing means directly into engagement with said opposed wires in said forming zone at a velocity substantially equal to the velocity of said wires, vacuum means operably adjacent the remote surfaces of the porous means for simultaneously progressively removing water from opposite sides of the stock mixture in the forming zone at substantially the same rate, said porous means freely conducting substantially all of the water removed from the stock mixture at any given instant away from the forming zone at such given instant and being adapted to hold substantially all of such removed water without impeding the flow of water from the stock mixture, whereby the surface of said web is maintained substantially free of removed water, and means for removing water from said porous means at a rate to enable said porous means to continuously receive substantially all of such removed water from said mixture.

5. In a paper making machine, a pair of opposed travelling endless wires defining therebetween an elongated tapered forming zone wherein a fibrous stock mixture is received and formed into a unitary web, an endless foraminous belt operably adjacent the remote faces of

each of said wires and travelling with said wires at least through the forming zone, said foraminous belts each providing a plurality of pores extending substantially transversely of the length of the forming zone and opening therein, means for rigidly supporting at least one of said wires and its respective belt throughout their length in the forming zone, said wires and belt insulating said web from said supporting means, a slice, said slice including jet nozzle means for thoroughly mixing the fibers of said stock mixture to obtain an even distribution of the fibers therein and adjustable means thereafter feeding a controlled non-varying amount of said stock mixture from said mixing means directly into engagement with said opposed wires in said forming zone at a velocity substantially equal to the velocity of the wires, and vacuum means positioned adjacent said forming zone at remote sides of said foraminous belts for simultaneously progressively removing water from opposite sides of the stock mixture in the forming zone at substantially the same rate, said pores of said foraminous belts being of such a size whereby they cooperatively hold substantially all of the water removed from said stock mixture at any given instant without impeding the flow of water from the stock mixture so that the surface of said web is maintained substantially water free, said vacuum means removing water from said pores in said foraminous belts at a rate to enable said pores to continuously receive substantially all of such removed water from said mixture.

6. In a paper making machine, a pair of opposed travelling wires defining therebetween an elongated tapered forming zone wherein a fibrous stock mixture is received and formed into a unitary web, a foraminous belt operably adjacent the remote faces of each of said wires and travelling with said wires at least through the forming zone, said foraminous belts each providing a plurality of pores extending substantially transversely of the length of the forming zone and opening therein, a slice, said slice including jet nozzle means for thoroughly mixing the fibers of said stock mixture to obtain an even distribution of the fibers therein and adjustable means thereafter feeding a controlled nonvarying amount of said stock mixture from said mixing means directly into engagement with said opposed wires in said forming zone at a velocity substantially equal to the velocity of the wires, and vacuum means for simultaneously progressively removing water from opposite sides of the stock mixture in the forming zone at substantially the same rate, said vacuum means including a foraminous plate in engagement with the remote face of each of said foraminous belts for rigidly supporting said belts and their respective wires throughout their length in the forming zone, said pores of said foraminous belts being of such a size whereby they cooperatively hold substantially all of the water removed from said stock mixture at any given instant without impeding the flow of water from the stock mixture so that the surface of said web is maintained substantially water free, said foraminous plate providing means cooperating with said vacuum means for removing water from said pores in said foraminous belts at a rate to enable said pores to continuously receive substantially all of such removed water from said mixture.

7. In a paper making machine, a pair of opposed travelling endless belts defining therebetween an elongated tapered forming zone wherein a fibrous stock mixture is received and formed into a unitary web, said endless belts each including a fine mesh wire providing a surface of said forming zone and a foraminous belt operably adjacent the remote faces of said wires and travelling with said wires at least through a part of the forming zone, said foraminous belts each providing a plurality of pores extending substantially transversely of the length of the forming zone and opening therein for communicating the forming zone to the remote surface of its respective endless belt, means for rigidly supporting at least one of said endless belts throughout their length in the forming zone, a slice, said slice including jet nozzle means for thoroughly mixing the fibers of said stock mixture to obtain an even distribution of the fibers therein and adjustable means thereafter feeding a controlled nonvarying amount of said stock mixture from said mixing means directly into engagement with said opposed fine mesh wires in said forming zone at a velocity substantially equal to the velocity of the endless belts, means for simultaneously progressively removing water from opposite sides of the stock mixture in the forming zone at substantially the same rate and depositing such removed water in the pores of said foraminous belts, said pores of said foraminous belts being of such a size whereby they cooperatively hold substantially all of the water removed from said stock mixture at any given instant without impeding the flow of water from the stock mixture so that the surface of said web is maintained substantially water free, and means for removing water from said pores in said foraminous belts at a rate to enable said pores to continuously receive substantially all of such removal water from said mixture.

8. The paper making machine according to claim 7, wherein the forming zone is vertically disposed.

9. The paper making machine according to claim 7, wherein the means for removing water from the stock mixture comprises vacuum means operably adjacent the remote surfaces of said endless belts at the forming zone.

10. The paper making machine according to claim 9, wherein said means for rigidly supporting said endless belts comprises a foraminous plate engaging each of said foraminous belts and forming part of said vacuum means, and in which said means for removing water from the pores of said foraminous belts includes surfaces provided by said foraminous plates for wiping the water from the pores of said foraminous belts, said endless belts insulating the web from said wiping surfaces.

11. The paper making machine according to claim 7, wherein said endless belts each include a course mesh wire disposed between said fine mesh wire and said foraminous belt at least in said forming zone for supporting the fine mesh wire.

12. The paper making machine according to claim 7, and means for relatively shifting said endless belts for controlling the contour of the forming zone.

13. The paper making machine according to claim 7, wherein the forming zone is vertically disposed and in which said endless belts are each carried by a breast roll, said rolls being adjacent one another and defining the upper edges of said forming zone.

14. The paper making machine according to claim 13, wherein said adjustable feeding means of said slice feeds the stock mixture directly into the nip between the breast rolls for engaging said fine mesh wires.

15. In a paper making machine, a pair of opposed travelling wires defining therebetween an elongated tapered vertical forming zone wherein a fibrous stock mixture is received and formed into a unitary web, porous means operably adjacent the remote surfaces of each of said wires and travelling with said wires, a foraminous plate adjacent and engaging each of said porous means at the remote side thereof for rigidly supporting said wires and their respective porous means throughout their length in the forming zone, said foraminous plates providing a plurality of passages inclined downwardly outwardly relative to said forming zone and opening toward said porous means for communicating said porous means with the remote sides of said plates, said wires and porous means insulating said web from said foraminous supporting plate, a slice, said slice including jet nozzle means for thoroughly mixing the fibers of said stock mixture to obtain an even distribution of the fibers therein and adjustable means thereafter feeding a controlled nonvarying amount of said mixture from said mixing means directly into engagement with said opposed wires in said forming zone at a velocity substantially equal to the ve-

locity of said wires, and vacuum means for opposite sides of removing water from the stock mixture in the forming zone directly into said porous means at substantially the same rate, said porous means freely conducting substantially all of the water removed from the stock mixture at any given instant away from the forming zone at such given instant and being adapted to hold substantially all of such removed water without impeding the flow of water from the stock mixture, whereby the surface of said web is maintained substantially free of removed water, said passages of said foraminous plates cooperating with said vacuum means so that gravity supplements said vacuum means for removing water from said porous means at a rate to enable said porous means to continuously receive substantially all of such removed water from said mixture.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,149,028 September 15, 1964

David E. Robinson

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 2, line 5, for "cooperativvely" read -- cooperatively --; line 6, for "sheets" read -- sheet --; column 5, line 10, for "holl" read -- roll --; column 8, line 21, for "removal" read -- removed --; line 48, after "said" insert -- breast --; column 9, lines 1 and 2, for "opposite sides of removing water from" read -- simultaneously progressively removing water from opposite sides of --; column 10, line 10, for "2,881,686" read -- 2,881,676 --; line 15, for "Barlyn" read -- Berlyn --.

Signed and sealed this 2nd day of February 1965.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents