April 14, 1959 R. J. THOMAS 2,881,676

PAPER OR BOARD MACHINE AND METHOD

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Fig. 1

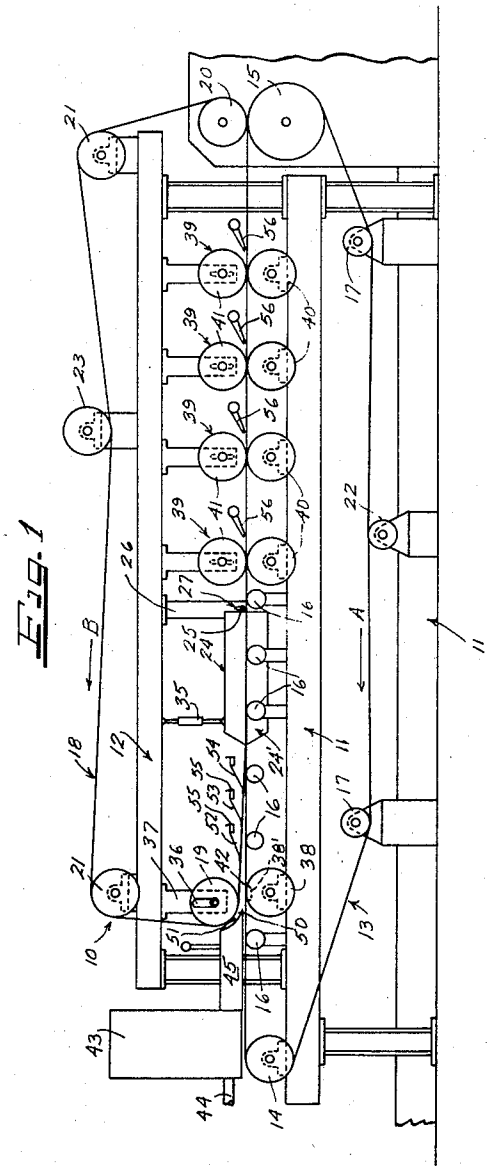


Fig. 2

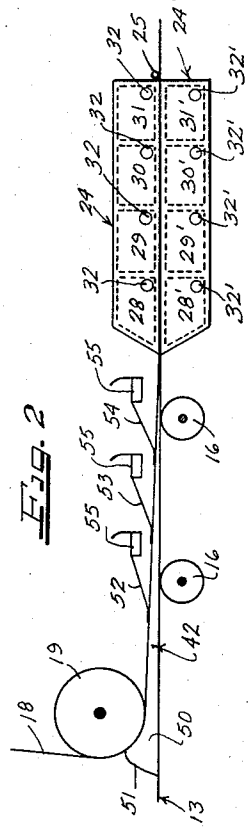
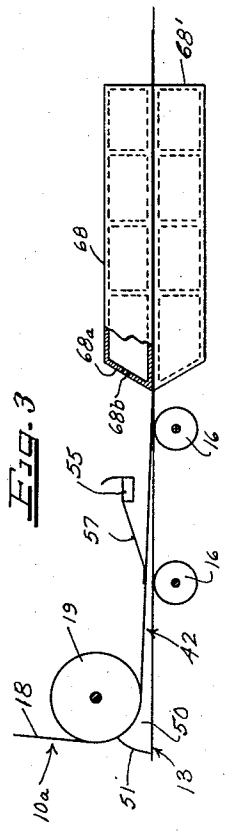


Fig. 3



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PAPER OR BOARD MACHINE AND METHOD

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Claims priority, application Great Britain May 18, 1955

3 Claims. (Cl. 92—44)

This invention relates to method and apparatus for de-watering pulp or stock between opposed forming wires wherein the de-watering is expedited at a plurality of longitudinally spaced areas. More specifically, this invention relates to a top wire-equipped Fourdrinier type of paper or board-making machine wherein upward de-watering of stock occurs at a plurality of localized pressure points provided by doctors, slices, or the like devices acting on the top wire and is further expedited by suction.

This application is a continuation-in-part of my co-pending application, Serial No. 493,376, filed March 10, 1955, entitled "Method and Apparatus for De-watering Aqueous Pulp or Stock in the Manufacture of Paper or Board."

In my aforesaid parent application, Serial No. 493,376, pneumatic means in the form of suction boxes are mounted in the loop of a top wire with the bottom face thereof overlying the bottom run of the top wire to draw water through the top wire. The suction box assembly is adjustable to guide the bottom run of the top wire along an inclined path so as to maintain a gap between the top and bottom or main wires which diminishes in height downstream from a directing roll. Paper stock is fed into the wide end of this gap and is formed into a web on both the top and main or bottom wires with the suction boxes assisting the de-watering of the stock through the top wire.

In accordance with this invention, a plurality of pressure points are created at spaced intervals along the inclined path of the top wire and water projecting through the top wire is removed at these points. The pressure points are created by inclined doctor blades providing water ways or chutes over which the water flows to removal means. Suction boxes can be provided in the loop of the top wire to augment the doctors in the de-watering of the stock.

It is then an object of this invention to enhance the upward de-watering of stock on a top wire-equipped paper-making machine with a plurality of successively spaced water removal means.

A still further object of this invention is to enhance the de-watering of stock through the top wire of a top wire-equipped Fourdrinier type of paper or board-making machine by the use of suction boxes and the like in cooperation with inclined doctors forming pressure points at spaced successive transverse areas along the forming run of the top forming wire.

Another object of this invention is to provide a paper-making machine of the type disclosed and claimed in my parent application, Serial No. 493,376, with one or more slices in the loop of the top wire in advance of or trailing the suction box assembly.

A specific object of this invention is to provide a top wire-equipped paper-making machine with a plurality of slices or doctors in the loop of the top wire to press the bottom run of the top wire against the main wire and to provide a plurality of paths over which water from the

stock between the wires can pass to be separated from the stock fibers.

Other and further objects of this invention will be apparent to those skilled in this art from the following detailed description of the annexed sheet of drawings, which, by way of preferred examples, illustrates several embodiments of the invention.

On the drawings:

Fig. 1 is a somewhat diagrammatic side elevational view of the wet end of a paper or board-making machine according to this invention.

Fig. 2 is an enlarged diagrammatic view of a portion of the machine of Fig. 1 illustrating the plurality of slices and the suction boxes arranged according to this invention.

Fig. 3 is a view similar to Fig. 2, but illustrating another arrangement of slices and suction box according to this invention.

As shown on the drawings:

In Fig. 1 the reference numeral **10** designates generally the wet end of a top wire-equipped Fourdrinier type paper or board-making machine. The machine **10** includes a base frame **11** and an overhead frame **12**.

An endless main permeable carrier band or bottom forming wire **13** is looped around a breast roll **14**, a couch roll **15**, over a plurality of table rolls **16** and under guide rolls **17** so as to have an elongated substantially horizontal upper run between the couch and breast rolls.

An upper permeable pressing member or top forming wire **18** is trained around an adjustable oncoming directing roll **19**, an offgoing roll **20** and guide rolls **21** supported from the frame **12**.

Tension rolls **22** and **23**, respectively, cooperate with the guide rolls **17** and **21** for holding the wires **13** and **18** in taut open loops.

The rolls **19** and **20** hold the top forming wire **18** to provide a bottom run over the top run of the forming wire **13**. A suction box assembly **24** is mounted over the bottom run of the top forming wire **18** immediately downstream from the adjustable oncoming roll **19**. This assembly **24** has its rear downstream end mounted on a pivot **25** carried from columns such as **26** suspending from the overhead frame **12**. The pivot **25** can be raised or lowered by means of an adjusting screw device **27**.

As best shown in Fig. 2, the suction box assembly **24** is composed of a plurality of suction boxes **28, 29, 30** and **31** and each box has a perforated or slotted bottom run beneath which passes the under run of the top forming wire **18**. Drain conduits **32** are provided for each suction box compartment, and these conduits discharge into a header which is connected to a suction pump (not shown) for evacuating the suction boxes. Each conduit can be provided with a valve to control the degree of vacuum in each suction box compartment. The valve can be independently regulated to provide a regulated pressure, as, for example, a progressively increasing degree of vacuum in successive boxes.

The front end of the suction box assembly **24** is suspended from the top frame by adjustable supports such as a turnbuckle support **35** which is adapted to raise end lower the front end of the assembly **24**, thereby swinging this assembly about its hinge or pivot **25**.

Screw rod adjustments such as **36** are provided on supporting columns **37** for the oncoming roll **19** so that this roll can be raised and lowered with and in front of the suction box assembly **24**.

A relatively large diameter support roll **38** is mounted in the loop of the bottom wire **13** under the upper run thereof to have contact with this upper run at the oncoming end of the suction box assembly **24**. Downstream from the large roll **38** there is provided a box as-

sembly 24' under the upper run of the bottom forming wire 13 in substantially opposing relation to the assembly 24. This assembly can contain some of the table rolls 16 therein, if desired, and, like the assembly 24, may be divided into sub-compartments 28', 29', 30', and 31', each of which can be maintained under controlled pressure from drain conduits 32'. The assembly 24' has a slotted top like the slotted bottom of assembly 24, and as the bottom forming wire 13 passes ocer this slotted top, it is subject to the controlled conditions existing in the boxes or compartments 28' to 31'. If desired, some or all of these boxes can be maintained under positive pressure for forcing more of the stock upwardly through the top wire 18. Alternately, of course, the boxes 28' through 31', or some of them, can be subjected to suction for augmenting the drainage through the bottom wire 13.

The two assemblies 24 and 24' thus provide a pneumatic means for removing water from stock between the wires 13 and 18 and can be regulated relative to each other to augment, decrease or modify white water discharged through either wire.

A plurality of press roll assemblies 39 are provided downstream from the suction box assembly 24, and each assembly 39 includes a bottom roll 40 in the loop of the bottom wire 13 and a top roll 41 in the loop of the top wire 18. The rolls 40 and 41 cooperate to form a horizontal pressure nip squeezing the wires 13 and 18 toward each other. If desired, these presses 39 can be suction presses with suction boxes in either the roll 40 or 41 or in both of the rolls as desired.

The oncoming roll 19 and the suction box assembly 24 are adjusted so that the bottom run of the top wire 18 will cooperate with the top run of the bottom wire 13 for forming a wedge gap 42 which diminishes in height to the pivot 25 for the suction box assembly 24. Thus, the gap has an entrance mouth determined by the roll 38 and a convergent run from the oncoming roll 19 to a pivot 25 determined by the box assembly 24. The rear end of the suction box assembly 24 serves as a pressure line at the terminal end of the converging wedge gap 42.

A stock inlet or head box 43 is mounted adjacent the breast roll 14 to supply stock to the open topped upper run of the main forming wire 13. Stock is supplied to the head box through the conduit 44 and is fed from the head box under any suitable slice arrangement onto the wire 13 between deckle boards such as 45 arranged above the edges of the wire. The deckle boards 45 do not extend down to the edges of the wire to have any rubbing or wearing action thereon. A layer of stock deposited on the wire 13 has its free flow restricted under the oncoming roll 19 and forms a pond 50 extending from in front of the oncoming roll 19 where the impounded stock builds up as a wave 51 into the gap 42 as far as the pivot 25. Thus, the stock impounded between the converging wires takes the form of a turbulent pond. According to the present invention, the turbulence of stock in this pond affords the simultaneous formation of a fibrous web on the main wire 13 and the top wire 18 with the fibers extending in all directions.

As the wires 13 and 18 are advanced in the direction of the arrows A and B, the stock advances into the diminishing gap 42 and water drains through the bottom wire 13 and is drawn upwardly through the top wire 18 into the suction boxes 28 to 31. If desired, the bottom suction box assembly 24' can be regulated to flow air at least from some of the compartments 28' to 31' thereof through the bottom wire 13 to augment the upward flow of water into the top suction compartments. Alternately, of course, the bottom assembly 24' can be subjected to suction or can have some of its compartments subjected to suction and some subjected to pressure for controlled white water flow.

If desired, the large roll 38 in advance of the assembly 24' in the loop of the wire 13 can be equipped with a suction box or with a blower box 38' to control flow of white water through the wire in advance of the assembly 24'.

The table rollers 16 and the faces of the suction boxes 24 and 24' hold the respective runs of the wires 13 and 18 rigidly so that the portion of the forming gap 42 between these runs will withstand the load of stock thereon.

In accordance with his invention, there is provided between the oncoming directing roll 19 and the suction box assembly 24 in the loop of the top wire 18 one or more slices sloping upwardly and rearwardly from the bottom forming run of the top forming wire to provide one or more pressure points transversely across the top wire and to receive water thereover for effecting the upward removal of water through the top wire. As shown in Figs. 1 and 2, three sloping slices 52, 53, and 54 are provided. Each of these slices has its forward bottom edge directed toward the pool of watery pulp in the gap 42 between the wires 13 and 18. The pressure in the gap created by the pool of stock therein tends to bow the wire 18 upwardly between the roll 19 and the suction box 24 while the slices resist this upward bowing of the wire. Each slice forms a water way receiving the water from the wire 18 thereover and directing to water removal trough means 55 at the upper ends of the slices.

The slice 53 is set to press more heavily on the top wire 18 than the slice 52 so that more water is separated upwardly and flows up this slice 53. Likewise, the slice 54 is still more heavily biased downwardly on the wire 18 than the slice 53 and consequently, still more water flows up this slice and is removed.

After passing under the plurality of slices, it is difficult to separate more water by pressure alone, and the pulp between the wires then comes under the action of the pneumatic water removing assemblies 24 and 24'.

Controlled drainage thus occurs both upwardly and downwardly from the stock in the wedge gap 32 and the stock forms simultaneously on both wires 13 and 18. After the stock passes under the hinge or pivot 25, the presses 39 squeeze the pulp that is formed on the wire to remove further water therefrom. The squeezed-out water passing through the lower run of the top wire 18 adjacent each press can be removed by suction slices 56 which may be provided on the downstream of each press 39.

The gap 42 can be changed in accordance with pulp conditions. This is accomplished by merely raising or lowering the oncoming roll 19 and by similarly adjusting the turnbuckle 35 to raise or lower the forward end of the suction box 24. Likewise, the constricted end of the wedge gap 42 can be adjusted in height by shifting the hinge 25 to raise and lower the rear end of the suction box assembly 24.

It will be understood that the machine 10 can be arranged in tandem with similar machines and the bottom wire 13 can be extended to pass under a plurality of top wires. A multi-ply paper-making machine is thereby provided with secondary stock being introduced in front of each wedge gap provided between the common bottom wire and the successive top forming wires.

In the modified arrangement of Fig. 3, the machine 10A has parts identical with parts described in connection with Figs. 1 and 2, and these identical parts have been marked with the same reference numerals. As shown in Fig. 3, a single slice 57 is used in combination with a suction box assembly 68 and a bottom suction box assembly 68'. The suction box assembly 68 is divided into four sections as illustrated and has an upwardly and backwardly sloping front wall 68A which acts as a slice to separate water from the wire 18 similarly to the slice 57. This sloping wall 68A is provided with slots such as 68*b* about one-half to two-thirds of the way up so that water flows up this end wall or nose and will be drawn into the foremost section of the assembly 63.

The slice 57 discharges into a trough or water way 55 and successive pressure points along the gap 42 are provided at the slice 51 and at the forward end of the sloping wall or nose 68A.

From the above description, it will, therefore, be understood that this invention provides a paper or board-making machine and a process wherein a layer of pulp from a stock inlet is flowed onto a main forming wire and is carried thereby under a converging top wire having a wedge-shaped forming gap relationship with the main wire that decreases in height so as to provide a restriction that maintains a turbulent pond of stock between the wires. Suction and/or pressure mechanism is provided to act through one or both of the wires to create a pneumatic augmentation of de-watering stock in an upward direction. While kinetic energy is imparted to the water in the stock pond by the advancing forming wires and will assist in the de-watering, the pneumatic control makes possible the running of the machine at sufficiently slow speeds so that this kinetic energy is not solely relied upon. After the stock passes beyond the convergent end of the gap provided at the pivot 25 of the suction box assembly, it is sufficiently formed so that it will not flow off of the wires, and it can be pressed between the wires for further water removal.

The machines of this invention may be used in tandem or several top wire assemblies can be provided on a single bottom wire machine, or several bottom wires can be provided on a single top wire machine whereby a web of any desired number of plies or layers can be produced. It should be understood that the resulting web will have its fibers so interlaced that the plies are inseparable.

Since de-watering takes place through the top wire or wires, the stock for any ply or layer may be so dense as to permit no drainage to take place through it or if desired, the bottom box assemblies can be pressurized to prevent white water drainage through the bottom wire at desired locations. Thus, it will be appreciated that pulp combinations of any desired types can be used. It is possible with the machines and methods of this invention to deposit a very dense impervious stock on the main wire and to then build up a superimposed layer or layers of any desired nature on this dense stock. The stock is pressed sufficiently between the forming wires so as to form a self-sustaining web before the support of the main wire is removed.

It will be thus understood that variations and modifications may be effected without departing from the scope of the novel concepts of this invention.

I claim as my invention:

1. The method of making fibrous web material which comprises depositing fibrous stock onto the top run of a looped bottom forming wire, covering the stock on said top run with the bottom run of a looped top forming wire while the stock is in a free flowing unformed condition, directing said bottom run of the top wire and said top run of the bottom wire to form therebetween a tapering wedge gap, advancing the top and bottom runs of said forming wires in the same direction, maintaining a turbulent pond of stock between said top and bottom runs in said tapering wedge gap, successively doctoring the bottom run of the top wire toward the top run of the bottom wire at a plurality of longitudinally spaced areas to provide localized pressure points for the stock in said wedge gap, increasing the pressure at the successive pressure points to decrease the height of the gap between the wires and to squeeze the stock in said gap between the wires, driving the advancing wires at sufficient speed to fling water through the bottom run of the top wire from the stock in said gap and thence over the successive means for doctoring the top wire, removing the water from said means for doctoring the top wire away from the stock between said wires, simultaneously forming fibers on both of said wires to build up a web between the wires from the turbulent pond of stock, and assisting the removal of water from said stock between the wires under the influence of a pneumatic differential pressure on opposite sides of the bottom run of the top wire.

2. The method of making a fibrous web which comprises depositing a lay of fibrous stock on the top run of a looped bottom forming wire, covering said layer of stock while it is still in a thin watery flowable condition with the bottom run of a looped top forming wire, said bottom run of the top wire and the top run of the bottom wire cooperating to form a tapering wedge gap therebetween, doctoring the top wire toward the bottom wire at a plurality of longitudinally spaced areas to provide localized pressure points for the stock in said wedge gap between the wires at spaced locations along said runs of the wires and to control the height of said gap in said areas, maintaining a turbulent pond of stock in said gap between the wires upstream from the first localized pressure point, driving the wires at sufficient speed to fling water upwardly through the top forming wire over the means for doctoring the wire and out of contact with the wire, simultaneously depositing webs from said pond on said wires and building up a web inwardly from the depositing fibers as the fibers advance to the pressure points created by the doctoring means, and increasing the pressure at the successive pressure points to successively decrease the height of the gap between the wires and to dewater and form the web.

3. A web forming machine which comprises a main looped forming wire having a substantially horizontal upper run, a stock inlet having means for depositing a lay of aqueous stock on said upper run, a looped top forming wire having a bottom forming run inclined toward and overlying the upper run of the main wire downstream from the means for depositing stock on said upper run, means directing said bottom run of the top wire and the top run of the bottom wire to form a tapered wedge gap therebetween, a plurality of doctors in the loop of the top forming wire pressing the bottom run of said wire toward the upper run of the main forming wire at spaced intervals to control the height of said gap at said pressed areas, said doctors sloping upwardly and rearwardly from the bottom run of the top forming wire, a directing roll in the loop of the top forming wire upstream from the first doctor and coacting with said doctor to guide the bottom run of the top forming wire along an inclined path between the directing roll and first doctor, and suction means in the loop of the top forming wire acting through the bottom run thereof for dewatering the stock between the wires upwardly through the bottom run of the top wire.

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