# United States Patent [19]

**Ely**

[11] **3,840,430**

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[54] **TWIN-WIRE PAPERMAKING MACHINE WHEREIN THE FORMING WIRES PASS THROUGH THE SLICE CHAMBER WHICH CONTAINS FLEXIBLE TRAILING ELEMENTS**


[75] Inventor: **Donald A. Ely,** Rockton, Ill.

[73] Assignee: **Beloit Corporation,** Beloit, Wis.



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[52] **U.S. Cl.**..... **162/275,** 162/203, 162/211, 162/301, 162/343, 162/351

[51] **Int. Cl.**..... **D21f 1/00,** D21f 1/02

[58] **Field of Search** ..... 162/203, 303, 343, 301, 162/313, 211, 275, 351



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*Primary Examiner*—S. Leon Bashore
*Assistant Examiner*—Richard H. Tushin
*Attorney, Agent, or Firm*—Hill, Gross, Simpson, Van Santen, Steadman, Chiara & Simpson



[57] **ABSTRACT**

A twin-wire papermaking machine wherein the forming wires are guided into and through an elongate tapered slice chamber prior to entering a dewatering run. The slice chamber is formed in part by imperforate plates over which the wires move, and non-porous backing belts are guided to pass with the forming wires over the plates to control dewatering. Within the slice chamber are located flexible elements in sheet or filament form to control large scale turbulence. Clear or white water is supplied between the forming wires and the outermost elements in the slice chamber for lubrication purposes.


**8 Claims, 2 Drawing Figures**

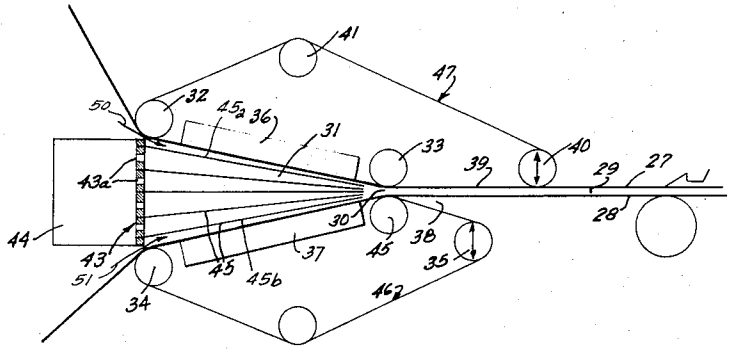

Fig. 1

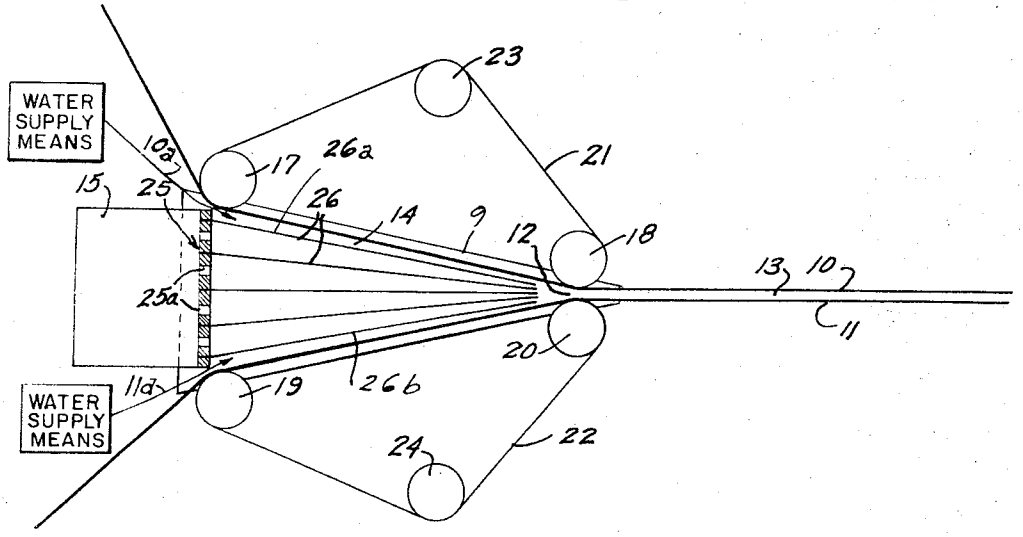
WATER SUPPLY MEANS
WATER SUPPLY MEANS
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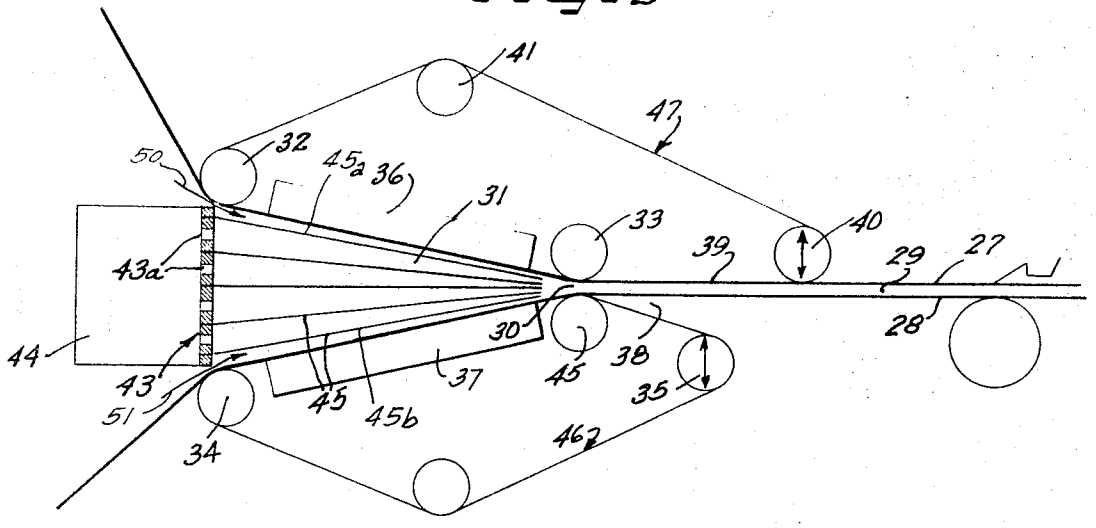
Fig. 2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45a
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# TWIN-WIRE PAPERMAKING MACHINE WHEREIN THE FORMING WIRES PASS THROUGH THE SLICE CHAMBER WHICH CONTAINS FLEXIBLE TRAILING ELEMENTS

## BACKGROUND OF THE INVENTION

The invention relates to improvements in a paper making machine and more particularly to improvements in machines of the type known as twin wire formers wherein looped foraminous wires are brought into opposed relationship for dewatering through both wires and forming a two-sided paper web. The invention relates to an improved construction of this type of machine capable of operation to achieve advantages in construction and in the formation of a paper web over structures heretofore available.

In the formation of a paper web from a slurry of stock, it has been found to be of significant importance to attain a homogeneous dispersion of the fibers in the stock up to the very point that dewatering begins, whether the web is formed on a fourdrinier type of machine or on a twin wire type of machine. If turbulence is attained and retained through the headbox, it must not be permitted to degenerate to permit flocculation and either cross-machine or machine direction orientation of the fibers just before they are delivered onto the forming wires. This has heretofore been difficult to achieve because of the necessity of providing space for the parts. The parts have to have sufficient strength to withstand the hydraulic pressures of the stock. The strength of the members requires that they have substantial size with the provision of space for the walls for the headbox and reinforcing members, and particularly for the slice up to the point of delivery through the slice lift. This space for the parts has made it difficult to construct a headbox wherein the stock is properly controlled to retain homogeneity and optimum design must be compromised to afford space for elements of sufficient strength.

It is accordingly an object of the present invention to provide an improved arrangement wherein certain requirements of space for parts are substantially eliminated and wherein homogeneity and dispersion of the fibers in the stock can be retained up to the point where dewatering begins and the stock is delivered onto the traveling forming wires.

A further object of the invention is to provide an arrangement embodying a unique type of headbox wherein the headbox provides a broad delivery area, and the slice chamber is actually defined by the opposed traveling forming wires themselves, and a structure is provided which accomplishes the retention of small scale turbulence and dispersion and non-orientation of the fibers throughout travel through a slice chamber onto the forming wires.

A still further object of the invention is to provide an improved twin wire paper web forming machine which is more compact and less expensive to construct than structures heretofore available.

A further object of the invention is to provide a headbox with a slice chamber for delivering stock between opposed forming wires wherein air entrainment is eliminated.

Other objects and advantages will become more apparent with the teaching of the principles of the invention in connection with the disclosure of the preferred



embodiments thereof in the claims, specification and drawings from which it will be apparent to those skilled in the art that various modifications and arrangements may be made within the spirit and scope of the invention.

## IN THE DRAWINGS

FIG. **1** is a schematic side elevational view of a paper making machine constructed in accordance with the principles of the present invention; and

FIG. **2** is another side elevational view shown in schematic form of a modified arrangement.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

As illustrated in FIG. **1**, a pair of looped endless forming wires **10** and **11** are arranged to accommodate the formation and dewatering of a web therebetween. The wires are of the foraminous type known to the art and used in twin wire forming machines.

The drawings illustrate the wires schematically and only a portion of the supports are shown therefore with the remainder of the supports for the wires and the remainder of the machine being known to those skilled in the art. Following the forming wires there will be provided additional web dewatering and drying mechanism for the completion of the finished paper web.

The wires are guided in parallel dewatering relationship through a dewatering run **13.** The wires are guided through an elongate tapering slice chamber or zone **14** leading to a pressure throat **12** immediately upstream of the dewatering run **13.**

For guiding the wires in their tapered approaching relationship of the slice zone, the wire **10** is supported at an upstream end of the slice zone by a roll **17** and at a downstream end of the slice zone by a roll **18.** The wire **11** is supported at the upstream end of the slice zone by a roll **19** and at the downstream end by a roll **20.** The rolls **18** and **20** support the wires forming the pressure throat **12.**

Preferably, sheets of water are delivered between the upper belt **21** and the outermost trailing member **26***a* and between the lowermost trailing member **26***b* and the lower belt **22.** These layers of water are delivered by water supply means shown schematically by the arrowed lines **10***a* and **11***a* which extend across the machine. The water may be clear water or white water and functions to lubricate and prevent frictional contact between the wires **10** and **11** and the self-positionable trailing elements **26***a* and **26***b*. Side plates such as shown at **9** are provided at each edge of the machine to seal the ends and to prevent the lateral escape of water from the edge of the machine.

The stock for the formation of the web flows from the headbox through the tapered slice zone **14** and into the pressure throat **12** to begin dewatering and formation of the web and a slight tapering together of the wires will occur immediately after the throat at the beginning of the dewatering run **13** after which the wires run parallel and dewatering will occur along the dewatering run. Additional means such as skimmers and auto slices will be provided for removing the water passing through the wires **10** and **11.**

To prevent the flow of water through the wires **10** and **11** while they are converging, means are provided within the wires to block the passages therethrough. These means are shown in the form of solid non-porous

belts **21** and **22.** The belts travel over the rolls **17** and **18** and **19** and **20** respectively, and have additional support rolls such as **23** and **24.**

The stock from which the paper web is to be formed is delivered by suitable stock delivery means including fan pumps to a headbox **15** having an open chamber. At the entry to the slice zone **14,** the head box is provided with a wall **25** having a plurality of flow dividing passages **25***a* therethrough.

The flow passages **25***a* divide the stock stream into a plurality of smaller flows. Within the headbox chamber the fibers of stock are homogeneously distributed therethrough, and the stock is under large scale turbulence as caused by the fan pump and equipment in advance of the headbox. This large scale turbulence is broken down and divided into fine scale turbulence, and the flow of the stock is divided into a plurality of relatively thin layers by flexible trailing self-positionable members **26.** These trailing members **26** are preferably in the form of continuous thin flexible plastic sheets which extend in a cross-machine direction parallel to the slice zone **14.** They also may be in the form of multiple flexible filaments dividing the flow between the filaments.

The flexible trailing members **26** are anchored at their upstream end only and are self-positionable subject solely to the pressures of the stock flowing past the sheets in the slice zone. It has been discovered that the layers of stock flowing between the sheets maintain their fibers in homogeneous random orientation while confined between the sheets.

It is an important objective of the structure of the invention to extend the sheets **26** completely to the pressure forming throat **12** so that the distance of stock flow past the sheets to the throat is very small. With the present structure, since there is no space required for the slice walls of the headbox, the trailing flexible sheets can extend fully to the pressure throat **12** and formation of the web can begin almost immediately after the stock comes in contact with the traveling wires. Also, there is no entrainment of air or disturbance of the stock flow such as occurs in the usual construction when the stock must be discharged across an air space from a slice opening onto the traveling wires. There is also no speed change such as can occur where a jet engages traveling wires because the stock is already traveling with the wires.

FIG. **2** illustrates another arrangement embodying the principles of the invention, and in this figure, traveling forming wires **27** and **28** are guided in a parallel dewatering run **29.** The looped wires **27** and **28** immediately upstream of the dewatering run are guided together in a pressure throat **30.** Immediately upstream of the throat they are guided in an elongate tapering path to form the walls of a slice zone **31.**

The stock is discharged from a headbox **44** into the slice zone. The headbox has a perforate wall **43** with passages **43***a*. Within the slice zone **31** are a plurality of trailing self-positionable flexible elements **45.** The elements **45** are anchored solely at their upper end to the wall **43** and downstream of their upper anchored end are self-positionable being located solely due to the forces of the stock flowing along their surfaces. The flow of stock is divided into a plurality of layers between the flexible trailing members and it has been discovered that a high degree of homogeneity and random orientation is maintained while the stock is retained between the trailing elements. Also, the trailing elements should extend fully to the pressure throat **30** so that the stock is not uncontrolled for any portion of its travel and is fully confined up to the time it begins to be dewatered to begin its formation as a web.

The wires are guided and supported so that they taper together to form the walls of the slice zone **31.** The wire **27** is supported upstream of the slice zone by a roll **32** and downstream by a roll **33.** The wire **28** is supported upstream of the slice zone by a roll **34** and downstream of the slice zone by a roll **45.**

Lubricating sheets of water are fed between the outermost trailing flexible elements **45***a* and **45***b*. These layers of water are supplied through supply means extending across the machine as indicated schematically by the arrowed lines **50** and **51.** Clear water or white water may be employed. The backing for the wires in this area is provided by solid slides **36** and **37** which are imperforate and prevent the escape of the sheets of water and in effect, provide a hydraulic support for the tapering slice. When the wires reach the ends of the imperforate plates **36** and **37,** the water will be permitted to escape through the wires.

The web begins formation as it reaches the end of the pressure throat **30** and dewaters through the wires **27** and **28** as they converge and press the layer of stock therebetween. However, in the arrangement illustrated in FIG. **2,** controlled differential dewatering is obtained by guiding the position of the imperforate belts **47** and **46** in their travel along the forming zone so that they aid in dewatering control.

The belt **37** after the pressure throat **30** is continued in a path parallel to the upper wire **27** for a predetermined distance. This will prevent dewatering through the upper wire and permit dewatering through the lower wire only for a portion of travel until the belt is guided upwardly over roll **40.**

To aid dewatering through the lower wire **28,** the perforate belt **46** is brought gradually away from the lower wire **28** in an acute angle of divergence to form the dewatering gap **38.** The angle **48** of divergence is preferably in the range of 0° to 5°. As will be appreciated, controlled dewatering can be accomplished by moving either the upper imperforate belt **47** or the lower imperforate belt **46** either toward or away from the wires on the off-running side of the pressure throat **30.**

The arrangement above described has been found to accomplish the formation of an improved web which does not have two-sidedness, and wherein the fibers are uniformly randomly dispersed so as to achieve a paper which has a uniform basis weight profile in a machine direction and a cross-machine direction. The resultant paper also has better receptivity to coating and better printability and attains more uniform tear strength in machine direction and cross-machine direction and improved appearance.

I claim as my invention:

**1.** In a machine for forming a web from a slurry of stock, the combination comprising,

a headbox with a main chamber for discharging stock and having a tapered slice chamber immediately downstream of the headbox chamber,

a pair of traveling forming wires guided to form the walls of said tapered slice chamber and leading into a pressure forming throat followed by a dewatering forming zone,

means for preventing the flow of liquid through the wires in said slice zone,

a plurality of flexible trailing elements in the slice chamber anchored at their upstream ends to a support means within their downstream ends free of attachment and self-positionable from stock flowing through said slice chamber, and

means for supplying sheets of water at the upstream ends of the trailing elements between the outermost elements and the forming wires to form a layer of water therebetween.

**2.** In a paper making machine for making a web from a slurry of stock constructed in accordance with claim **1** wherein said trailing members are in the form of sheets extending in a cross-machine direction parallel to the wires.

**3.** In a paper making machine for making a web from a slurry of stock constructed in accordance with claim **1,** the combination wherein said trailing members are in the form of individual filaments.

**4.** In a paper making machine for making a web from a slurry of stock constructed in accordance with claim **1,** the combination including a plurality of passages in the headbox in advance of the slice zone extending parallel to the flow of the stock toward the slice zone.

**5.** In a machine for forming a web from a slurry of stock, the combination in accordance with claim **1** wherein said means for preventing the flow of liquid through the wires is in the form of first and second nonporous support belts positioned outside of said wires opposite said tapered slice chamber preventing flow from the slice chamber through the wires.

**6.** In a paper making machine for making a web from a slurry of stock constructed in accordance with claim **5** wherein said support belts are supported on rolls positioned at the upstream end and downstream end of said slice chamber and the rolls at the downstream end define said throat.

**7.** In a paper making machine for making a web from a slurry of stock constructed in accordance with claim **5** wherein at least one of said belts diverges in an acute angle from the wire downstream of the throat aiding in dewatering of the web through the wire.

**8.** In a paper making machine for making a web from a slurry of stock constructed in accordance with claim **5** wherein one of said belts extends parallel to the dewatering zone along the wire for a distance following the throat.

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