Oct. 14, 1969 S. G. HOLT 3,472,733

PAPER-FORMING SUCTION CYLINDER ROLL WITH ARCUATE STOCK DELIVERY NOZZLE AND POROUS BELT IN WRAPPED ENGAGEMENT THEREWITH

Filed April 18, 1966

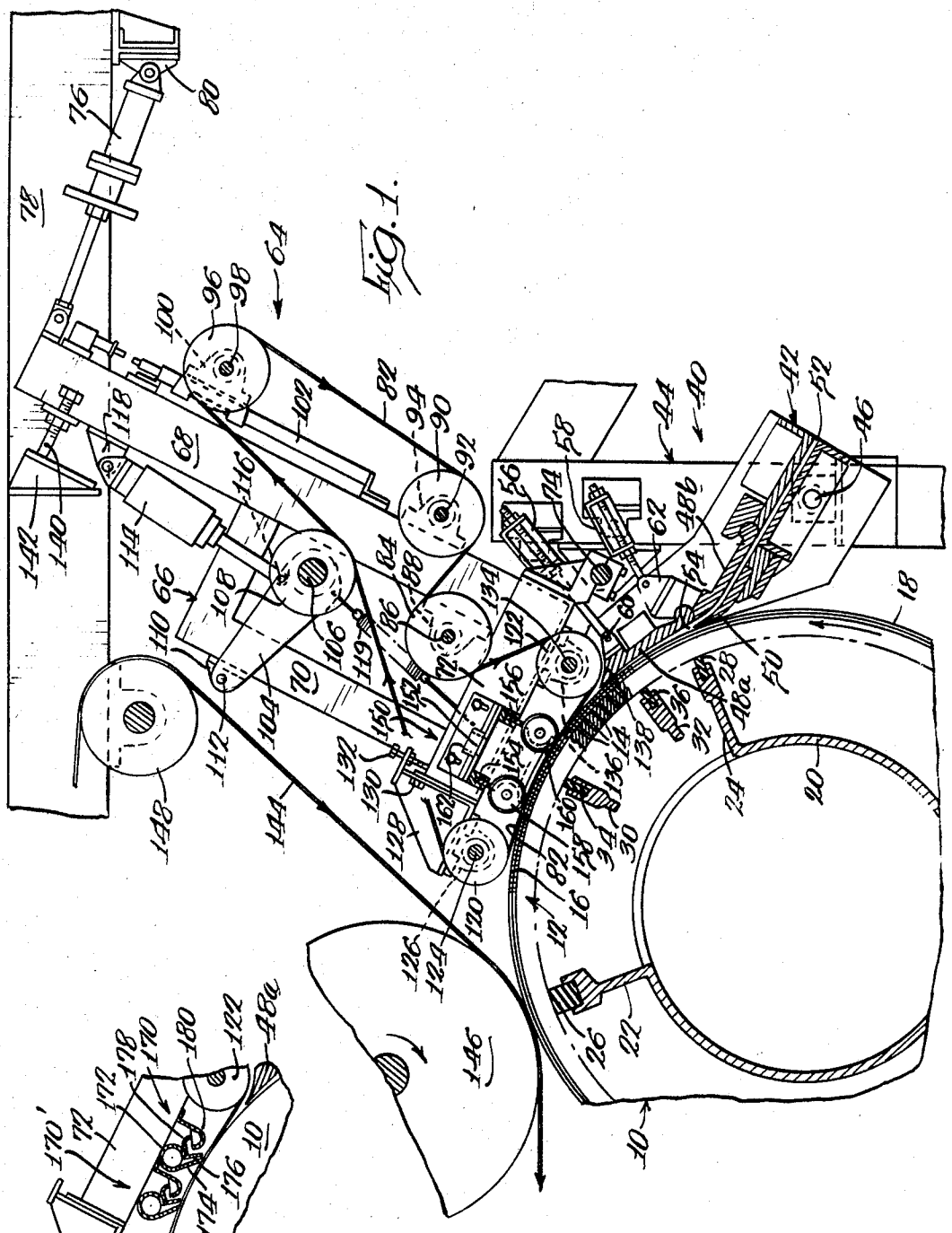


FIG. 1.

FIG. 2.

Inventor:
Sherwood G. Holt

By
Parker, Juettner & Sullivan
Attys

United States Patent Office 3,472,733
Patented Oct. 14, 1969

3,472,733

PAPER-FORMING SUCTION CYLINDER ROLL WITH ARCUATE STOCK DELIVERY NOZZLE AND POROUS BELT IN WRAPPED ENGAGEMENT THEREWITH

Sherwood G. Holt, Wisconsin Rapids, Wis., assignor to Consolidated Papers, Inc., Wisconsin Rapids, Wis., a corporation of Wisconsin

Filed Apr. 18, 1966, Ser. No. 543,268
Int. Cl. D21f 1/60
U.S. Cl. 162—301 12 Claims

ABSTRACT OF THE DISCLOSURE

A paper making machine including a stock nozzle the upper lip of which is arcuate with a rotatable suction forming cylinder and defines a first forming zone, and an endless flexible stock control member which is partially held in wrapped engagement with the cylinder periphery to form a second forming zone with dewatering means thereover.

The present invention relates to paper-forming apparatus, and particularly to apparatus which utilizes a cellular suction forming cylinder or roll to form a continuous paper web from liquid stock suspension or furnish delivered to the periphery of the roll for a nozzle.

It is known to provide a cellular suction forming roll in place of the extremely long Fourdrinier section conventionally used in paper-making machines. Such a suction forming roll comprises a rotatable cylindrical shell having a plurality of radial openings therein. A nozzle is employed to supply the stock suspension to a predetermined forming area on the surface of the rotating suction roll, and the major part of the water in the stock suspension is removed by suction means disposed inside of the forming roll, such water being largely discharged outwardly from the forming roll by centrifugal force after the portion of the roll containing the water has passed beyond the forming area and beyond the effect of the vacuum section within the roll. In this manner, a continuous web of paper is formed on a Fourdrinier wire on the surface of the suction forming roll and is subsequently removed by a suction pick-up or couch roll over which a pick-up felt is trained. One type of cylinder sheet forming apparatus is shown in Ostertag et al. Patent 2,418,600 wherein a traveling Fourdrinier wire is trained over a suction forming roll and the stock suspension is delivered to the wire at an area where the latter is directly supported by the forming roll. Another type of cylinder sheet forming apparatus is disclosed in my copending application Ser. No. 315,033, filed Oct. 9, 1963, now Patent No. 3,321,360, and assigned to the assignee of the present invention. In my copending application there is described a suction forming roll including a Fourdrinier wire in the form of a sleeve which is intimately engaged over the periphery of the roll.

One of the major problems which has been encountered in the use of cylinder forming devices of the type described hereinabove has been caused by the nozzle for delivering the stock suspension to the periphery of the forming roll. Thus, in order to have the stock under complete control until the paper web is formed or "set," it has been necessary to provide an upper nozzle lip which extends for several inches over the periphery of the forming roll and has a tip which is disposed in extremely close proximity to the forming roll wire surface. The clearance between the metal tip of the upper nozzle lip and the forming roll wire surface has usually been between 0.010 inch and 0.040 inch. Due to such close proximity of the metal nozzle tip to the surface of the Fourdrinier wire,

there has been a serious problem created due to the possibility that small pieces of hard material flowing through with the stock suspension will be caught under the tip and cause damage to the Fourdrinier wire. While careful screening of the stock suspension may tend to reduce such a problem, it has nevertheless been one of the major shortcomings of the cylindrical suction forming roll.

It is therefore an object of the present invention to provide improved sheet-forming apparatus including a cylindrical forming member where the above-described difficulty caused by small pieces of hard material in the stock suspension is substantially eliminated.

It is a further and important object of the invention to provide paper-forming apparatus as last abovementioned which permits formation of a high quality continuous paper web at unusually high speeds and with relatively simple and inexpensive equipment.

The foregoing and other objects and advantages of the invention will be apparent from the following description thereof.

Now in order to acquaint those skilled in the art with the manner of practicing and utilizing my invention, I shall describe, in conjunction with the accompanying drawings, certain preferred embodiments of the invention.

In the drawings:

FIG. 1 is a side elevational view, partly broken away, illustrating a cylindrical paper-forming device constructed in accordance with the present invention; and

FIGURE 2 is a fragmentary side elevational view illustrating an alternative form of suction apparatus for dewatering from the top side of a continuous paper web being formed on the cylindrical forming roll of FIGURE 1.

Referring now to the drawings, there is shown a rotatably mounted cylindrical suction forming roll indicated generally at **10** comprising a cylindrical shell **12** having a plurality of closely spaced radial holes or cells **14** formed therein. A plurality of circumferentially spaced longitudinal spacer strips **16** extend along the outside of the cylindrical shell **12** and support a foraminous surfacing material or the like (not shown in detail) over which a wire sleeve **18** is mounted. If desired, a traveling Fourdrinier wire could be trained over the forming roll **10** as shown in the above-mentioned Ostertag et al. patent, but it is preferred that the wire comprise a sleeve which thus constitutes the peripheral surface of the forming roll.

Within the rotatable cylindrical shell **12** there is positioned a stationary tubular member **20** which together with a pair of radial partition walls **22** and **24** defines a pressure differential controlling box assembly or chamber to assist in and control the rate of the dewatering of the stock suspension which is supplied to the wire surface **18** of the suction forming roll. The hollow member **20** need not of course be tubular, and may be of any desired configuration. The radial partitions **22** and **24** extend the full length of the forming roll **10** and are provided at their radially outer ends with sealing strips **26** and **28**. Additional partition walls **30** and **32** having sealing strips **34** and **36** may also be provided, the latter partitions being circumferentially adjustable and serving to divide the pressure differential controlilng chamber in several compartments which may be subjected to varying pressures as desired, such pressures normally being below atmospheric pressures. For a more detailed description of the cellular suction forming roll **10**, reference is made to my earlier-mentioned copending application Ser. No. 315,033, now Patent No. 3,321,360.

A nozzle assembly **40** comprises a nozzle **42** and associated supporting framework **44**. The nozzle assembly **40** is pivotally mounted on a pair of trunnions, one of which is shown at **46**, the trunnions **46** in turn being supported

on a stationary frame (not shown). The nozzle assembly is supported and held in a predetermined pivotal position by means of jacks (not shown) which extend between the movable framework **44** and the fixed frame member, such jacks being adjustable to control the spacing between the nozzle lips and the periphery of the suction forming roll **10**. The nozzle **42** comprises adjustable upper lip sections **48***a* and **48***b*, and a fixed lower lip **50**, there being also shown a nozzle inlet **52** and a nozzle throat portion **54**.

A pair of jacks **56** and **58** each have one end connected to the nozzle framework **44** and their other ends connected to lugs **60** and **62** respectively on the adjacent pivotal sections **48***a* and **48***b* of the upper nozzle lip, whereby through adjustment of the jacks **56** and **58** the position of the upper nozzle lip sections **48** relative to the lower lip **50** and the forming roll **10** may be accurately adjusted. The stock nozzle **42** is supplied at its inlet **52** with stock suspension through the usual supply pipes and through transition pieces which spread out the flow into a wide thin pattern of uniform dimensions and density across substantially the entire axial length of the roll **10**. The nozzle inlet **52** converges or tapers inwardly somewhat so as to maintain the stock suspension under pressure and complete the flow transition, and it feeds the stock suspension to the nozzle throat portion **54** from which it is delivered to the wire surface **18** on the forming roll. The foregoing nozzle assembly **40** is also described in greater detail in my copending application Ser. No. 315,033, now Patent No. 3,321,360.

It is an important feature of the present invention that the upper nozzle lip section **48***a* is relatively short, and a stock control member in the form of a movable top wire or fabric is provided to function somewhat as an intension of the nozzle lip and thereby control the stock during formation of the continuous paper web. Thus, there is shown a top wire assembly **64** including a supporting frame **66** comprised of interconnected frame elements **68**, **70** and **72**, the frame **66** being pivotal about a pair of trunnion shafts such as shown at **74**. The pivotal position of the frame **66** on the trunnions **74** is determined by one or more adjustable jacks **76** which extend between the upper end of the frame element **68** and a fixed support beam **78**, the latter including a lug **80** for connection with the jack member.

A plurality of rolls of pulleys are rotatably mounted on the supporting frame **66** in order to support and drive an endless fabric or wire stock control member **82** which is trained over a portion of the periphery of the forming drum **10** adjacent the end of the upper nozzle lip section **48***a* and thereby controls the stock during formation of the continuous paper web. Thus, a drive roll **84** is rotatably mounted on a shaft **86** supported by bearings **88** extending from the lower end of the frame element **68**. The drive roll **84** engages the outside of the endless wire **82**, and the roll **84** is driven by a variable speed motor (not shown) so as to drive the wire **82** at a desired speed, preferably at approximately the same speed as the peripheral speed of the forming roll **10**. A wire turning or support roll **90** is rotatably mounted on a shaft **92** supported in bearings **94** which also project from the lower end of the frame element **68**, and the roll **90** engages against the inside of the endless wire **82** to support the same. Above the support roll **90** there is mounted a wire turning or support roll **96** which is rotatable on a shaft **98**, the latter being supported on a carriage **100** which is slidable along one or more guide rods **102**. The support roll **96** is engaged against the inside of the endless top wire **82**, and the carriage or slide **100** may be adjustably positioned on the guide rods **102** in order to apply a predetermined desired tension to the wire.

A pivotally mounted arm **104** serves to support one end of a shaft **106** on which an adjustable wire control roll or guide roll **108** is rotatably mounted. The other end of the shaft **106** is mounted in a universal spherical bearing or the like (not shown), and the pivot arm **104** has one end pivotally mounted to a bearing **110** by means of a pin **112**, the bearing **110** being fixed to the frame element **70**. Accordingly, movement of the arm or lever **104** about its pivot pin **112** will cause the roller shaft **106** to pivot about the one end thereof which is universally mounted. An air cylinder **114** has one end connected to the arm **104** at **116**, and its other end connected to a lug **118** supported near the upper end of the frame element **68**, and a tension spring **119** extends between the arm **104** and the frame element **72**. Thus, by controlling the pressure of the air supplied to the air cylinder **114**, and thereby varying the extension of such air cylinder and of the coacting spring **119**, it is possible to vary the position of the arm **104** and in this manner control the orientation of the shaft **106** and wire control or guide roller **108**.

The guide roller **108** engages against the outside of the endless stock control member or wire **82**, and the position of the roll **108** is continuously adjusted as required by means of the air cylinder **114** in order to control or guide the movement of the stock control member **82**. More specifically, a movable feeler or sensing member (not shown) engages the moving stock control member **82** and senses lateral or transverse movements of the latter. The feeler or sensing member is associated with valve means (not shown) so as to control the pressure of the air supplied to the air cylinder **114** in accordance with the lateral position of the stock control member relative to the roll **108**. Thus, whenever the stock control member **82** tends to move from a centered position on the roll **108**, the orientation of the roll is varied in order to maintain the member **82** in a centered position on the roll. In this manner, as is known in the art, the moving endless stock control member or wire **82** is continuously maintained in a proper centered position on the roll **108** and on the various other support rolls over which it travels.

Reference is now made to a pair of adjustable wire turning or support rolls **120** and **122** which are supported from the lower frame element **72** in close proximity to the periphery of the forming roll **10** in order to cause the stock control member or endless wire **82** to partially wrap or engage on a portion of the forming roll wire surface **18**. The support roll **120** is rotatably mounted on a shaft **124** supported by a pair of bearings **126** which project downwardly from a mounting bracket **128**. The mounting bracket **128** is secured to one end of the frame element **72** and its position may be adjusted toward or away from the forming roll **10** by loosening the nuts **130** and varying the position of the threaded stop pin **132**. The wire turning or support roll **122** is rotatable on a shaft **134** supported on bearing blocks **136** depending from the underside of the frame element **72** and the rotatable support roll **122** is disposed in close proximity to the forming drum **10** and to the end of the upper nozzle lip member **48***a*. At the end of the upper nozzle lip element **48***a* the top surface thereof is generally arcuate as shown at **138** so as to conform approximately to the configuration of the roll **122**. The roll **122** is positioned quite close to the arcuate upper surface **138** of the nozzle lip, and in this manner it locates the endless wire **82** so that the latter runs through a narrow slot between the roll **122** and the top lip **48***a* and constitutes an approximate extension of the upper nozzle lip. The right hand support roll **122** is preferably mounted so as to be adjustable toward and away from the left hand support roll **120**. Due to the adjustability of the two wire turning or support rolls **120** and **122**, it is possible to effect variable pressing or convergence of the paper web between the forming roll **10** and the endless top wire or fabric **82**.

It will be understood from the foregoing that the drive roll **84**, the several turning or support rolls **90**, **96**, **108**, **120** and **122**, and the endless stock control member or

wire 82, all extend for substantially the full length of the suction forming roll 10, and the portion of the endless wire 82 between the two turning rolls 120 and 122 is held against a portion of the sheet being formed on the wire surface 18 of the forming roll 10 so as to control the paper web being formed thereon from the stock suspension supplied by the nozzle 42. The variable speed drive roll 84 is preferably driven so as to drive the wire 82 at the peripheral speed of the forming roll 10. The pivotal position of the entire top wire assembly 64 relative to the pivot shaft 74 is controlled by the jacks 76 and also by a threaded adjustable stop member 140 which is mounted on the frame element 68 and is engageable against a fixed frame element 142. As previously stated, the wire turning roll 120 is adjustable toward and away from the forming roll 10, and the wire turning roll 122 is preferably adjustable in a transverse direction toward and away from the turning roll 120. After the paper web is formed on the wire surface 18 of the suction forming roll 10, the web is couched off of the forming roll by a pick-up felt 144 which is trained over a pick-up roll 146 and a support roll 148.

As stated earlier herein, and as described more fully in my copending application Ser. No. 315,033, now Patent No. 3,321,360, the suction forming roll 10 effects dewatering of the stock suspension and resulting paper web due to the suction applied at the wire side or bottom side of the web. However, in accordance with the present invention it is possible to effect additional dewatering through utilization of suction means or foils or the like which act upon the felt side or top side of the web. For example, in the embodiment shown in FIGURE 1 there is provided a suction or vacuum box indicated generally at 150 and comprising a top wall 152, longitudinal side walls 154 and 156, and a pair of rolls 158 and 160 which are in a sealing relationship with the longitudinal side walls 154 and 156 and in engagement with the top surface of that portion of the endless wire 82 which is partially wrapped on the periphery of the forming roll 10. The suction box 150 is connected at 162 to a vacuum source, and the suction box is supported on the lower frame element 72 and is adjustable thereon toward and away from the forming roll 10. In this manner, the paper web being formed on the forming roll 10 may be dewatered not only from the wire side by the suction means within the forming roll, but also from the top or felt side of the web by means of the suction box 150 which withdraws the water moving up through the wire 82.

FIGURE 2 shows an alternative embodiment of the invention including apparatus 170, comprising one or the other and preferably both of a narrow suction lip or doctor and a scraper foil for the top wire or fabric, which may if desired be substituted for the vacuum box shown at 150 in FIGURE 1. The apparatus 170 in its preferred form comprises a suction tube 172 connected to a vacuum source and having an inlet defined by the longitudinal edges of a pair of plates 174 and 176 which extend the length of the suction forming roll 10 and project downwardly into very close proximity to the inside surface of the wire 82. Accordingly, water is drawn up from the top or felt side of the paper web through the endless wire 82 and into the inlet between the edges of the two plates 174 and 176. In addition, the forward plate member 176 acts as a scraper and scoops up water from the top of the wire, the water then being discharged via a guide member 178 into a drainage pan or trough 180. Thus, the suction tube assembly may be mounted at the underside of the frame element 72 in place of the vacuum box 150, and such assembly will draw off water from the top side of the web by either or both of a suction action and the scooping effect of the forward plate member 176. A second suction tube assembly 170' which is substantially identical to the assembly 170 described hereinabove may if desired be mounted immediately adjacent the unit 170 as shown in FIGURE 2. In some applications it may be desirable to utilize foils above the moving top wire 82 in place of the suction doctors described hereinabove.

One of the important advantages of the paper-forming apparatus described herein is that it substantially eliminates the problem heretofore created due to the extremely small clearance required between the wire surface of the forming roll 10 and the tip of the upper nozzle lip 48*a*. That is, the clearance between the forming roll wire surface 18 and the end of the metal nozzle lip 48*a* has heretofore been in the approximate range of 0.010 inch to 0.040 inch, it being necessary to have the tip of the top lip in such close proximity to the forming roll in order to maintain the stock under complete control until the sheet is formed or set. However, with such small clearances solid particles would tend to catch under the nozzle lip and cause damage to the paper web and/or the wire surface 18. In accordance with the present invention, the upper lip 48*a* of the nozzle is relatively short and does not run as close to the wire surface 18 of the forming roll 10, and the control over the stock heretofore afforded by the long end of the upper lip is now provided by the moving stock control member or endless wire 82 which moves at approximately the peripheral speed of the forming roll 10 and can accommodate solid particles without causing any damage.

While the left hand wire turning roll member 120 may be in close proximity to the forming roll wire surface 18, the roll 120 is covered with a soft cellular or porous cover which positions the endless wire 82 but is sufficiently resilient to permit local indentation when a foreign object passes beneath it. The wire turning roll 120 may comprise a metal roll which is covered with a layer of resilient rubber over which is attached a honeycomb rubber structure, or in the alternative the roll 120 may constitute a metal roll which is jacketed with a synthetic sponge material having an open pore structure. The right hand wire turning or support roll 122 is positioned adjacent the nozzle upper lip 48*a* so as to train the endless wire 82 in such a way that it becomes an approximate continuation of the top lip profile. The latter roll 122 may constitute a solid metal roll member, or if desired it may be provided with a rubber cover or the like. The endless top wire or fabric 82 constitutes a stock control member and serves to maintain the stock under control after it leaves the nozzle and until it has been formed or set. The movable stock control member 82 may be made from conventional Fourdrinier wire, or if desired it may be made from various types of porous fabric, for example a synthetic fiber fabric.

Where the movable stock control member 82 is used in combination with the nozzle upper lip 48*a* in accordance with the present invention, the tip of the upper nozzle lip may be spaced from the forming drum wire surface 18 by at least approximately 0.040 inch, and in many applications clearances of 0.060 inch or greater will be quite satisfactory. The clearance between the tip of the bottom lip 50 and the forming roll wire surface 18 may be in the approximate range of 0.010 inch to 0.030 inch. The length of the upper lip section 48*a* may be approximately 12 inches or less, and in many applications optimum results may be achieved where the upper lip section 48*a* is only approximately 4 inches or less in length.

It has been found that the apparatus described hereinabove, including the moving top wire or stock control member which engages or wraps on a segment of the forming roll periphery and moves at the approximate speed of the latter, is highly effective as a high speed publication sheet forming device, and is particularly useful in the production of lightweight publication grades of book paper. It can produce merchant grades of book paper of excellent quality at unusually high speeds and with greater forming consistencies. In particular, speeds well in excess of 2000 feet per minute are possible with the sheet forming apparatus of the present invention. One of the prin-

cipal reasons for the higher speeds which can be achieved is due to the use of the moving top wire or fabric **82** which in effect replaces the end of the upper nozzle lip and thereby permits use of a shorter upper lip member which need not extend as close to the forming drum wire surface as would otherwise be necessary. As speed is increased, the drainage effect of the top wire **82** on the forming sheet effects improved water removal, thereby maintaining the required pick-up consistencies at the pick up point with higher speed operation. Moreover, one of the principal advantages of the moving top wire or stock control is its action in freezing the forming sheet structure in opposition to the centrifugal force which tends to lift it from the forming roll wire surface **18**.

With respect to dewatering of the stock, the stock suspension delivered by the nozzle **42** may for example constitute approximately 1% solids, whereas the stock must be dewatered to approximately 15% solids by the time the web reaches the pick-up roll **146**. Accordingly, if it be assumed that the apparatus is running at approximately 1900 feet per minute, then in the embodiment being described the sheet must be dewatered from 1% solids to 15% solids in less than 0.13 second, which is roughly equivalent to removing 43 gallons per minute per square foot of forming surface. Another of the important advantages of the sheet forming apparatus of the present invention is that it permits a certain amount of dewatering to be accomplished from the top side or felt side of the web between the two guide rolls **120** and **122**, such dewatering being effected through the moving stock control member **82** which comprises a porous member fabricated from Fourdrinier wire or a porous fabric or the like. Consequently, it is possible to accomplish more complete fixing of the newly formed web than would otherwise be possible in the same length of time.

It is believed that at the lip clearances described herein, and when operating at high speed and consistency, the lip profile and its settings are less significant than satisfying the requirements of (a) minimum drag on the web as it leaves the pressure forming area, and (b) dewatering rates such as to avoid creating a partial vacuum under the lip. Both of these factors favor a short upper nozzle lip **48***a* and are believed to partially account for the success of the present system. One of the purposes of a short top lip is to provide high pressures under the lip without effecting excessive drainage, since high pressures under the top lip section are desirable for good formation of the web. Pressures of 2 to 3 p.s.i. have worked satisfactorily, but in many applications it may be desired to provide higher pressures in the range of 5 to 6 p.s.i. in order to achieve higher formation levels.

The foregoing sheet forming apparatus is not only relatively simple and inexpensive, but it results in a highly improved method for the manufacture of lightweight publication and other types of paper having increased uniformity, both in the machine and cross direction, as well as more equalized wire and felt side properties. It is possible with such apparatus to maintain the stock under complete control until the sheet is formed or set, and yet it eliminates the problems which would otherwise be encountered if it was necessary to provide a long upper nozzle lip which extends in very close proximity to the forming roll wire surface.

I claim:

1. In a paper making machine, in combination, a suction forming roll, a stock nozzle extending to the periphery of the roll for delivery of stock suspension thereto, said nozzle comprising an upper lip member and a lower lip member, said upper lip member extending substantially beyond said lower lip member in closely spaced relationship to the suction forming roll periphery to define a first forming zone, and said upper lip member being arcuate so as to conform to the configuration of said suction forming roll, a stock control member disposed immediately adjacent the tip of the upper lip member in wrapped relation to a segment of the suction forming roll periphery so as to function substantially as a continuation of said upper lip member and thereby define a second forming zone, said stock control member comprising an endless flexible member which is perforate and accommodates dewatering of the stock therethrough, guide means for supporting said stock control member and for maintaining an operative portion of its length in wrapped engagement with a segment of the periphery of said rotatable forming roll, pick-up means spaced circumferentially from said stock nozzle on the opposite side of said stock control member for removing the resulting web from said forming roll, and drive means for continuously moving said stock control member in the same direction as said roll periphery.

2. The device of claim **1** in combination with water removal means, operatively associated with said endless flexible member at the side thereof opposite the roll.

3. In a cylinder-type device for forming a continuous paper web, in combination, a rotatable suction forming roll, nozzle means arranged in close proximity to said forming roll for delivery of stock suspension to a forming area on the periphery thereof, the nozzle means comprising an upper lip member and a lower lip member, said upper lip member extending substantially beyond said lower lip member and in closely spaced relationship to the suction forming roll periphery to define a first forming zone, and said upper lip member being arcuate so as to conform to the configuration of said suction forming roll, pick-up means circumferentially spaced from said nozzle means for removing the resulting web from said forming roll, an endless stock control member made of a flexible material and having a width approximately equal to the width of said nozzle means, said stock control member being disposed immediately adjacent the tip of said upper nozzle lip member so as to function substantially as a continuation of said upper nozzle lip member, guide means for supporting said stock control member and for maintaining an operative portion of its length in wrapped engagement with a segment of the periphery of said rotatable forming roll between said nozzle means and said pick-up means to define a second forming zone, and drive means for effecting continuous movement of said stock control member about said guide means and in the same direction of movement as the peripheral segment of said rotatable forming roll with which it is engaged, whereby said stock control members serves to control said stock and apply pressure thereto thereby assisting in the formation of said web after the stock has passed beyond the control of said upper nozzle lip member and before the web is removed by said pick-up means.

4. In a cylinder-type device for forming a continuous paper web, in combination, a rotatable suction forming roll, nozzle means arranged in close proximity to said forming roll for delivering stock suspension to a forming area on the periphery thereof, the nozzle means comprising an upper lip member and a lower lip member, said upper lip member extending substantially beyond said lower lip member and in closely spaced relationship to the suction forming roll periphery to define a first forming zone, and said upper lip member being arcuate so as to conform to the configuration of said suction forming roll, pick-up means circumferentially spaced from said nozzle means for removing the resulting web from said forming roll; an endless stock control member made of a flexible material and having a width approximately equal to the width of said nozzle means, said stock control member disposed immediately adjacent the tip of said upper nozzle lip member so as to function substantially as a continuation of said upper nozzle lip member, support means for supporting said stock control member and for maintaining an operative portion of its length in wrapped engagement with a segment of the periphery of said rotatable forming roll between said nozzle means and said pick-up means to define a second forming zone, said

support means including a first rotatable support roll positioned in close proximity to the periphery of said forming roll and to the tip of said upper nozzle lip member and a second rotatable support roll positioned in close proximity to the periphery of said forming roll intermediate said first support roll and said pick-up means, said endless stock control member being trained over said first and second support rolls and thereby held in partially wrapped engagement with said segment of the periphery of said forming roll, and drive means for effecting continuous movement of said stock control member about said support means and in the same direction of movement as the peripheral segment of said rotatable forming roll with which it is engaged, whereby said stock control member serves to control said stock and apply pressure thereto thereby assisting in the formation of said web after the stock has passed beyond the control of said upper nozzle lip member and before the web is removed by said pick-up means.

5. The device of claim 4 including an upper nozzle lip member which is formed with an arcuate upper surface at its tip so as to conform approximately to the configuration of said first support roll.

6. The device of claim 4 wherein said second support roll is provided with a soft outer cover which is sufficiently resilient to permit local indentation when a foreign object passes beneath it.

7. The device of claim 1 wherein said soft outer cover is made of a porous material.

8. The device of claim 4 including means for adjusting the positions of said first and second supoprt rolls to permit variable pressing of the paper web between the stock control member and the periphery of the forming roll.

9. In a cylinder-type device for forming a continuous paper web, in combination, a rotatable suction forming roll, nozzle means arranged in close proximity to the forming roll for delivering stock suspension to a forming area on the periphery thereof, the nozzle means comprising an upper lip member and a lower lip member, said upper lip member extending substantially beyond said lower lip member and in closely spaced relationship to the suction forming roll periphery to define a first forming zone, and said upper lip member being arcuate so as to conform to the configuration of said suction forming roll, pick-up means circumferentially spaced from said nozzle means for removing the resulting web from the forming roll, an endless stock control member made of a flexible material and having a width approximately equal to the width of said nozzle means, said stock control member being disposed immediately adjacent the tip of the upper nozzle lip member so as to function substantially as a continuation of said upper lip member and define a second forming zone, support means for supporting said stock control member and for maintaining an operative portion of its length in wrapped engagement with a segment of the periphery of said rotatable forming roll between said nozzle means and said pickup means, drive means for effecting continuous movement of said stock control member about said support means and in the same direction of movement as the peripheral segment of said rotatable forming roll with which it is engaged whereby said stock control member serves to control said stock and apply pressure thereto thereby assisting in the formation of said web after the stock has passed beyond the control of said upper nozzle lip member and before the web is removed by said pick-up means, and means for removing water from the top side of said web, said water removal means being located immediately above that portion of the stock control member which is in engagement with said forming roll.

10. The device of claim 9 wherein said water removal means comprises a vacuum box.

11. The device of claim 9 wherein said water removal means comprises a suction tube having scraper scoop means associated therewith.

12. In a cylinder-type device for forming a continuous paper web, in combination, a rotatable suction forming roll, nozzle means arranged in close proximity to said forming roll for delivering stock suspension to a forming area on the periphery thereof, the nozzle means comprising an upper lip member and a lower lip member, said upper lip member extending substantially beyond said lower lip member and in closely spaced relationship to the suction forming roll periphery to define a first forming zone, and said upper lip member being arcuate so as to conform to the configuration of said suction forming roll, pick-up means circumferentially spaced from said nozzle means for removing the resulting web from said forming roll, an endless stock control member made of a flexible porous material and having a width approximately equal to the width of said nozzle means, said stock control member disposed immediately adjacent the tip of the upper nozzle lip member so as to function substantially as a continuation of said upper nozzle lip member; support means for supporting said stock control member and for maintaining an operative portion of its length in wrapped engagement with a segment of the periphery of said rotatable forming roll between said nozzle means and said pick-up means, said support means including a first rotatable support roll positioned in close proximity to the periphery of said forming roll and to said tip of the upper nozzle lip member and a second rotatable support roll positioned in close proximity to the periphery of said forming roll intermediate said first support roll and said pick-up means, said endless stock control member being trained over said first and second support rolls and thereby held in partially wrapped engagement with said segment of the periphery of said forming roll, drive means for effecting continuous movement of said stock control member about said support means in the same direction of movement as the peripheral segment of said rotatable forming roll with which it is engaged and at approximately the peripheral speed of the latter whereby said stock control member serves to control said stock and apply pressure thereto thereby assisting in the formation of said web after the stock has passed beyond the control of said upper nozzle lip member and before the web is removed by said pick-up means, and means for removing water from the top side of said web, said water removal means being located between said first and second support rolls and immediately above that portion of the stock control member which is in engagement with said forming roll.

References Cited

UNITED STATES PATENTS

2,911,039	11/1959	Hornbostel et al.	162—369 XR
3,321,360	5/1967	Holt	162—317 XR
3,056,719	11/1962	Webster	162—212 XR

S. LEON BASHORE, Primary Examiner

R. H. TUSHIN, Assistant Examiner

U.S. Cl. X.R.

162—210, 214, 217, 318, 344, 364