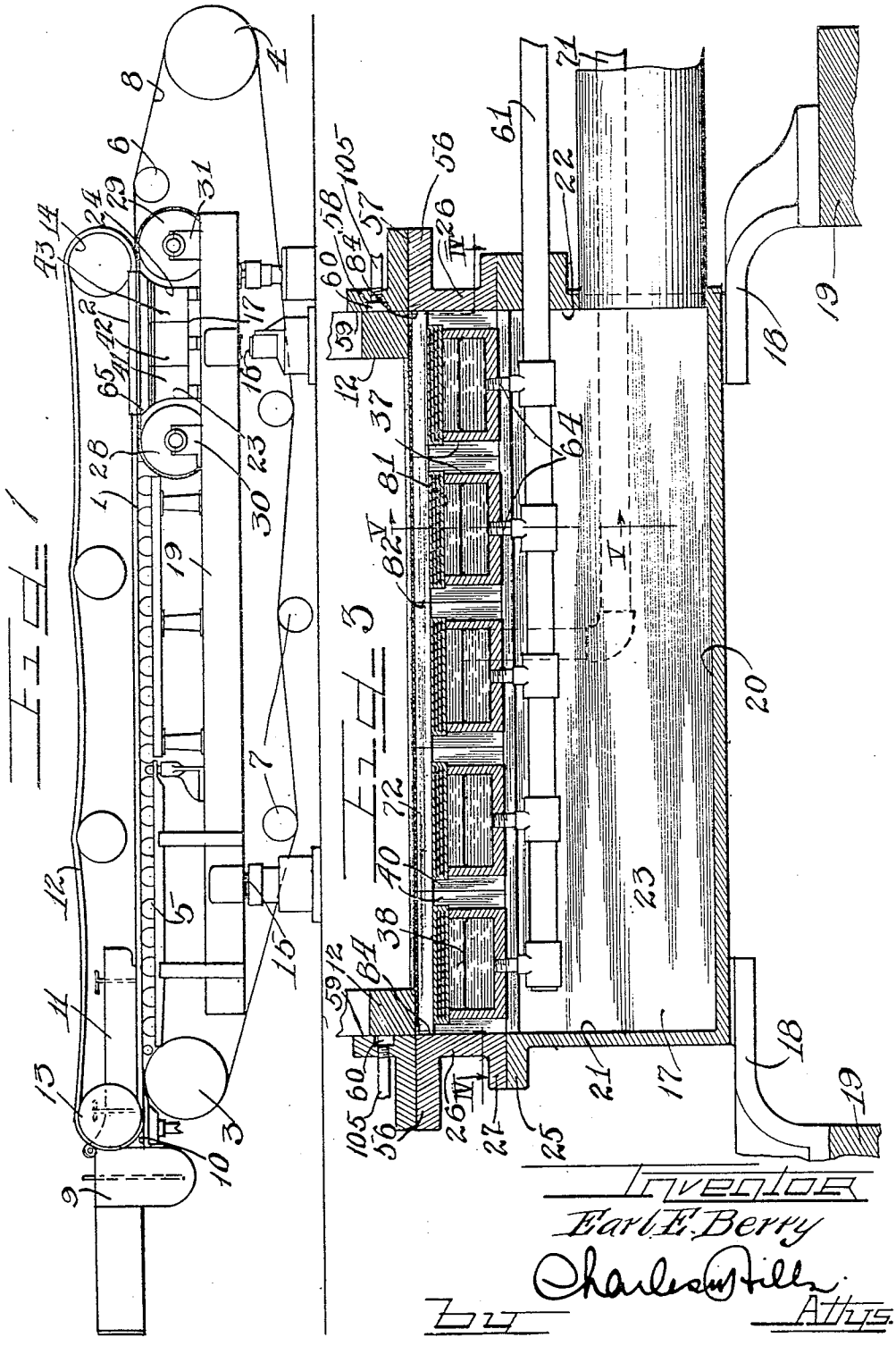
Nov. 24, 1931. E. E. BERRY 1,833,350

PAPER MAKING MACHINE

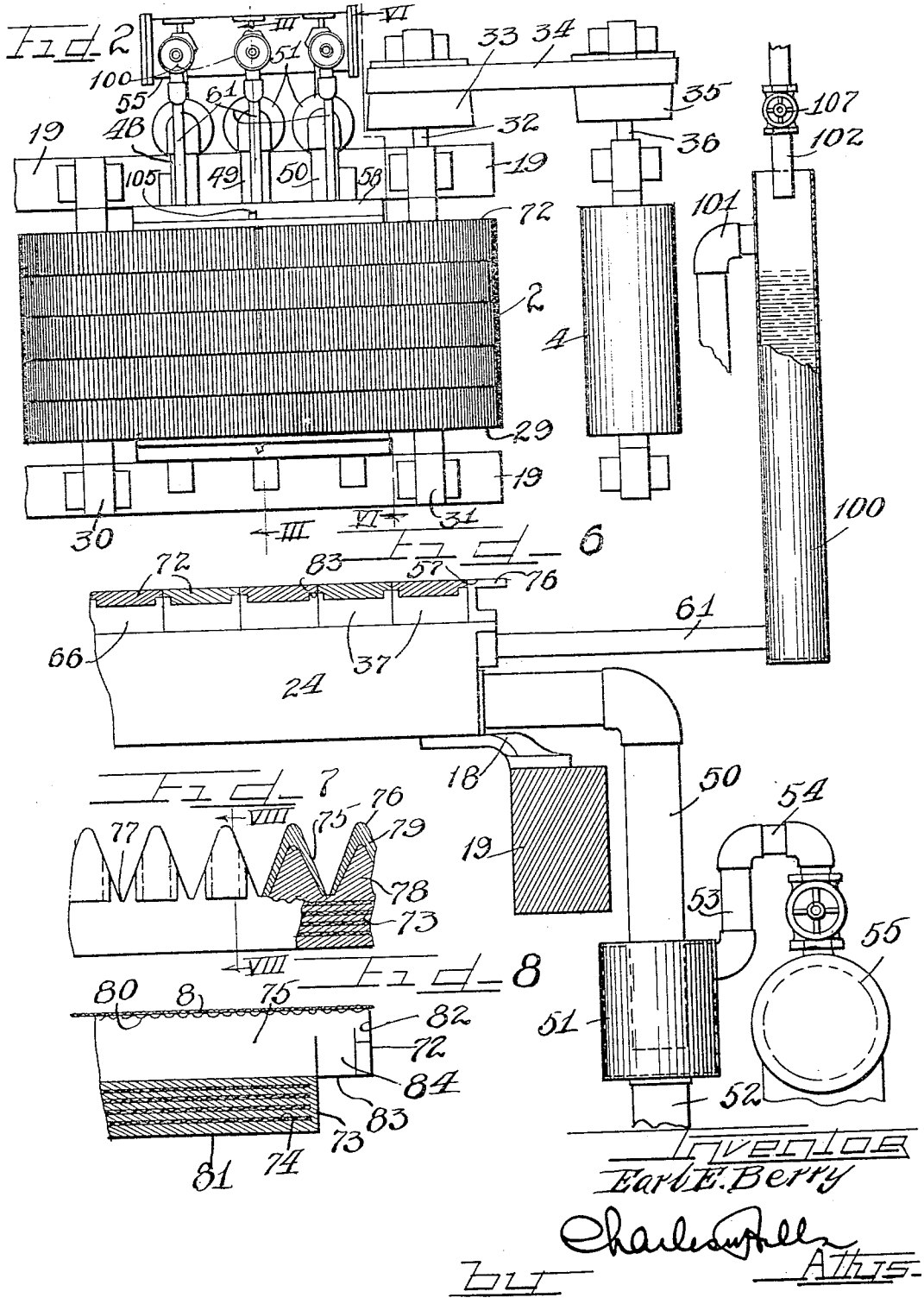
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Fig. 4

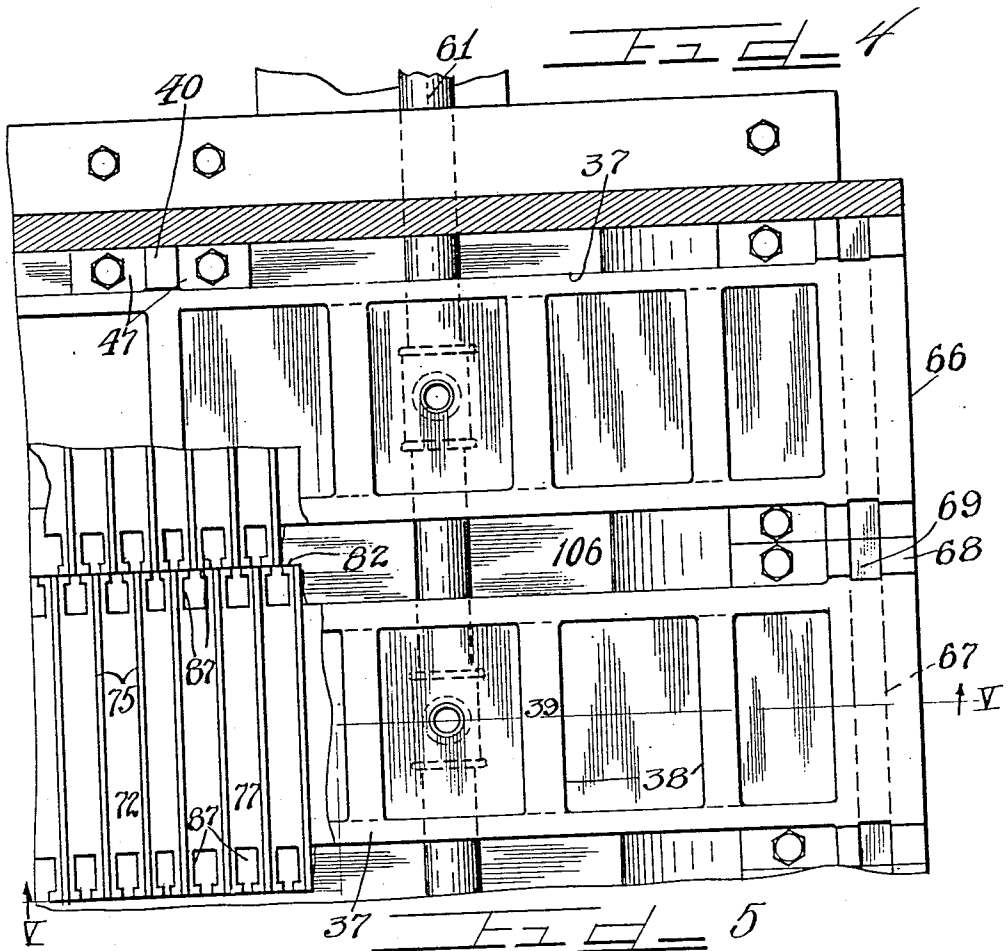
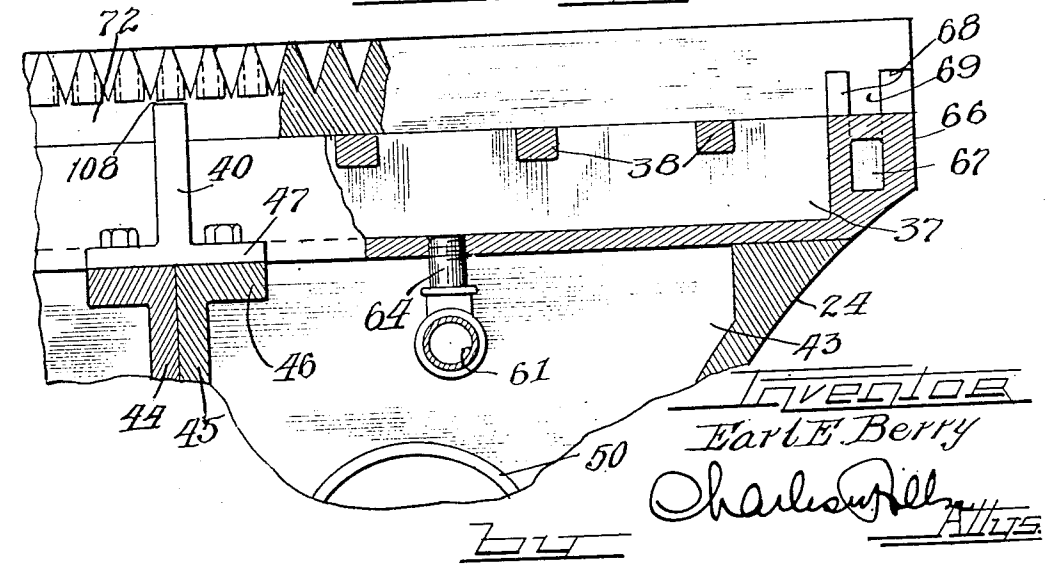


Fig. 5



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1,833,350

UNITED STATES PATENT OFFICE

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PAPER MAKING MACHINE

Application filed June 18, 1929. Serial No. 370,500.

This invention relates to a paper making machine and more particularly to the forming part of the machine including a suction device having a traveling cover upon which the forming wire is adapted to be supported.

It has heretofore been suggested that the stationary suction boxes in common use in connection with the forming wire of a Fourdrinier paper machine be replaced by traveling suction boxes to prolong the life of the wire by reducing the abrasion between the wire and the top surface of the suction boxes. Suction boxes that travel with the wire, however, have not gone into general use because of the cumbersome and impractical nature of the structures previously proposed.

It is therefore an object of this invention to provide a practical suction device for use in extracting water from a traveling web wherein the member through which suction is applied to the web travels with the web and is hydraulically balanced against the pneumatic pressure resulting from the suction applied thereto.

It is a further object of this invention to provide a suction device to replace the present stationary flat boxes in general use on Fourdrinier paper machines of such construction that abrasion of the wire by the passage of the wire over the suction device will be reduced to a minimum.

It is a further object of this invention to greatly reduce the power required to drive the forming part of the paper machine and also to greatly prolong the life of the expensive making wire.

It is a further important object of this invention to provide a novel and improved construction of a suction device having a hydraulically and pneumatically balanced traveling surface for supporting the making wire.

Other and further important objects of this invention will become apparent from the disclosures in the specification and the accompanying drawings.

This invention (in a preferred form) is illustrated in the drawings and hereinafter more fully described.

On the drawings:

Figure 1 is a front side elevational view of the forming part of a Fourdrinier paper machine equipped with a suction device of my invention.

Figure 2 is an enlarged top plan view of the suction device showing the driving mechanism, with parts removed.

Figure 3 is an enlarged sectional view taken on line III—III of Figure 2 with parts in elevation.

Figure 4 is a fragmentary enlarged view taken substantially on the broken line IV—IV of Figure 3 with parts in section and parts removed.

Figure 5 is a fragmentary sectional view taken substantially on the broken line V—V of Figure 4.

Figure 6 is a fragmentary enlarged sectional view taken substantially on line VI—VI of Figure 2 with parts in elevation and parts omitted.

Figure 7 is an enlarged detail view of a suction belt partly in section.

Figure 8 is a sectional view taken substantially on line VIII—VIII of Figure 7.

The reference numeral 1 indicates as a whole a table structure or forming part of a Fourdrinier paper machine equipped with a suction device, also indicated as a whole by the reference numeral 2, embodying the principles of my invention. While said suction device 2 is here illustrated in connection with a Fourdrinier paper machine as replacing the usual stationary or oscillating flat suction boxes, it will be understood that my suction device is equally applicable to other parts of a paper machine as for instance in connection with a press felt or the like, or, in general, in connection with any type of apparatus for drying or de-watering a flowing stream of stock, or any kind of wet web material.

The table structure 1 comprises the usual breast roll 3, couch roll 4, table rolls 5, wire guide roll 6 and wire supporting and tensioning rolls 7 over and around which is trained the forming wire 8. Stock is introduced onto the table structure 1 from a head box 9 provided with an apron 10 extending out over the breast roll. The usual apron side boards 11 serve for confining the flow of stock.

Deckle straps 12 mounted upon deckle pulleys 13 and 14 determine the width of the web or paper formed upon the Fourdrinier table and extend out over the suction device 2 for a purpose that will later appear.

The table structure 1 is shown as being of the laterally removable type adapted to be rolled out over transfer track members 15 and 16 or in any other standard fashion. It will be understood, however, that my suction device may be installed upon a stationary Fourdrinier structure or upon any type of Fourdrinier.

The suction box device 2 (Figure 3) comprises a box-like member 17 extending transversely of the table structure and supported upon brackets 18 from the side beams 19 forming a part of the table structure. Said box-like member 17 comprises a plurality of vertically divided sections, 41, 42 and 43, with bottom walls 20, side walls 21 and 22, and outer end walls 23 and 24, flanges 25 being formed upon the top of the side walls 21 and 22 for supporting upper side beams 26, which have corresponding lower flanged edges 27 resting upon and secured to the flanges 25.

The outer transverse walls 23 and 24 (Figures 1 and 5) are curved to conform with the contours of a pair of rolls 28 and 29, journaled in bearings 30 and 31, respectively, and supported from the side beams 19 of the table structure 1. The shaft of roll 29 is extended upon the rear side of the machine, as at 32 (Figure 2) and provided with a conical pulley 33 over which is trained a belt 34 for driving said roll 29 from a similar conical pulley 35 on the extended end 36 of the couch roll 4. Any other suitable type of driving mechanism may be employed for revolving the roll 29.

A plurality of longitudinally arranged open troughs 37 are positioned upon said box-like member 17 extending the full length thereof between the side beams 26. Each of said troughs 37, as best shown in Figures 3 to 5 inclusive, is of rectangular cross section and is provided with a plurality of spaced transverse webs 38 joining the upper edges of the side walls of the trough. The top surfaces 39 of said webs 38 as well as the top surfaces of the side walls of the troughs 37 are machined and all lie in the same horizontal plane. Adjacent troughs 37 are spaced from each other intermediate their ends by means of separating webs 40 formed at spaced intervals upon the side walls of said troughs.

The bottom or main body of the box-like suction member 17 may, as previously stated, suitably be formed in a plurality of sections 41, 42 and 43 (Figure 1), having adjacent walls 44 and 45 (Figure 5) said walls being provided with upper flanged edges 46 for connection with flanges 47 (Figure 5) formed on the transverse webs 40. There may, of course, be any number of such sections 41, 42, and 43 or the box-like member 17 may be undivided into sections.

As best shown in Figure 2, each of the sections 41, 42 and 43 is provided with an individual suction pipe connection 48, 49 and 50, said pipes extending downwardly (Figure 6) into a separator 51. Said separator 51 comprises a closed vessel having a lower barometric leg 52 and a pipe 53 extending from near the top thereof in a bend 54 to an accumulator 55, or the like. A suction pump (not shown) is connected to said accumulator 55 for creating a partial vacuum within the sections 41, 42 and 43.

The front and rear side beams 26 are provided with broad top flanges 56 on the upper faces 57 of which are secured angle plates 58. The inner vertical faces 59 of said angle plates serve as guides for the deckle straps 12 and are provided with lengthwise extending channels 60 adapted to be supplied by means of pipes 105 with water for sealing the joints formed against loss of suction.

Headers 61 supply water through connecting nipples 64 (Figure 3) to each of the troughs 37, said nipples 64 being threaded into the bottom of said troughs 37. The water supply for the header 61 is provided by a stand pipe 100 having an overflow 101 and a valve controlled feed pipe 102.

The transverse end walls 65 and 66 of the troughs 37, (Figures 4 and 5) corresponding to the end walls 23 and 24 of the lower suction member sections 41 and 43 are likewise provided with passages 67 for containing a liquid such as water. Said passages 67 are formed with communicating vertical passages 69 opening through the tops of the abutting webs 68 between the ends of adjacent troughs 37. A liquid such as water is supplied to said passages 67 through a pipe 71.

A plurality of endless belts 72 are adapted to be trained around the rolls 28 and 29 to lie in closely abutting relation between the side rails 26. Actually, a very small space is left between adjacent belts 72 to prevent excessive friction. Each of the belts 72 is formed with a base portion 73 (Figures 7 and 8), preferably comprising built up layers of rubber and fabric 74, and an upper transverse series of integral ribs 75 having crests 76. Troughs 77 are formed between successive ribs 75. The ribs 75 have preferably a soft rubber core 78 formed integrally with the base 73 and an outer hard rubber or metal covering 79 vulcanized directly to the core 78. Where metal coverings are used, manganese bronze, aluminum bronze, stainless steel or the like may be employed and these may be locked directly to the rubber core or riveted or otherwise secured thereto. The upper edge of the hard rubber or metal

crests 76 is further corrugated, as at 80, to present a wavy contour for a purpose that will later appear.

The base 73 of each of the belts 72 is slightly wider than a trough 37 and is provided with a smooth lower surface 81 for resting upon and sliding over the machined top surfaces 39 of said troughs 37 and connecting webs 38. The transverse ribs 75 extend beyond the sides of the base 73 of said belt 72 for a distance equal to very slightly less than one half the width of the webs 40 (Figure 3), so that the end faces 82 of the ribs on adjacent belts 72 lie in very nearly abutting relation to each other. Between the bottom faces 83 of the ends of said ribs 75 and the machined top faces of the webs 40 and 68 is provided a slight running clearance 108 (Fig. 5).

In the case of the two outside belts 72, the ends 84 of the ribs 75 closely abut the inside surfaces of the side rails 26 with the crests 76 extending to the plane of the top surfaces 57 of said side walls. The endless deckle straps 12 (Figures 1 and 3) overlie the ends of the ribs 75 adjacent the side rails 26. The liquid in the channels 60 affords a liquid seal for the joints thus formed and also lubricates the adjacent surfaces. In a similar manner the liquid in the passages 67 in the end walls of the troughs 37 rises through the vertical passages 69 to afford a liquid seal between the abutting ends 82 of the ribs 75 of said belts 72.

Owing to the fact that the base 73 of each of the belts 72 is narrower than the transverse ribs 75, openings 87 are formed along the edges of said belts 72 in communication with the belt troughs 77. Said openings 87, as will hereinafter more clearly appear, serve as drains for water extracted from a web on the forming wire 8 and also for the application of suction through said belts 72 to the wire 8 and web thereon. The forming wire 8 contacts the ribs 75 of the belts 72 at the crests only of the transverse corrugations 80. The wire 8 may thus be said to be supported in substantially point contact with the minute crests along the tops of the ribs 75. It is thus apparent that said corrugated belt portions 75 will have little if any tendency to form areas of low suction upon the wire.

In operation, any suitable vacuum is created within the hollow sections 41, 42 and 43, the effect of such vacuum being transmitted through the openings 87 in the belts 72 to the under surface of the forming wire 8. The vacuum is thus effective to draw water from a web of paper traveling upon the wire 8, and, after the water has largely been removed, to draw a large volume of air through said traveling web and wire. The water and air pass through the openings 87 and through passages 106 between adjacent troughs 37 into the box-like sections 41, 42 and 43, and are thence discharged through the pipes 48, 49 and 50, respectively, to the individual separators 51, where the water and air are separated, the air being pulled from the upper portion of said separators 51 by means of a vacuum pump or blower connected to the accumulator 55 and the water passing down through the barometric legs 52.

As will be apparent, the belts 72 are driven in unison by means of the roll 29, pulley 33 and belt 34 from the pulley 35 on the end of the couch roll shaft 36.

There is no relative movement between the contacting surfaces of the belt 72 and wire 8, so that there can be no appreciable friction therebetween or wearing of the wire or belt surfaces.

It will further be apparent that the pneumatic pressure upon the top surfaces of the belt 72 due to the partial vacuum underneath said belt can be, and is, in practice, automatically balanced by the hydraulic pressure of the liquid filling said troughs 37. This is a particularly important feature of my invention, since it eliminates binding and friction between the belts and supporting surfaces. A static head is maintained upon the liquid within said troughs 37 by the height of the liquid within the standpipes 100. When the pneumatic, or atmospheric pressure is greater than the then static head, the level of the water in the standpipes rises automatically until the static hydraulic pressure balances the atmospheric pressure. Similarly if the pneumatic pressure for any reason drops below the static hydraulic pressure, the water lifts the belts 72 slightly from the tops of the troughs 37 and leaks over into the suction box compartments, thereby reducing the static head. In effect, the rubber belts act as regulating valves when provided with a sufficient volume and head of water to automatically balance the pneumatic and hydraudic pressures acting against said belts. It is obvious that the hydraulic head may also be varied semi-automatically by controlling the height of the water in the standpipes 100 by means of the valve 107, to maintain a practically constant head slightly in excess of the pneumatic pressure.

The end channels 67, however, are merely kept filled with water under little or no static head to seal the joints between the under surfaces of the belts 72 and the supporting edges therefor of the troughs 37.

Under the conditions present in the use of my device, the belts 72, formed of rubber or similar resilient material, are subject to but little wear and deterioration, since they practically run in water continuously.

It will thus be appreciated that in providing a pneumatically and hydraulically balanced suction device adapted to travel with the forming wire and at the same rate of speed, my invention constitutes an important

improvement and advance in the art of paper making.

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

I claim as my invention:

1. A suction device, comprising a stationary suction member, a traveling member associated therewith through which suction is adapted to be applied and hydraulic means for balancing pneumatic pressure above said traveling member.

2. In a suction device, a traveling member through which suction is adapted to be applied and hydraulic means acting against one surface of said member for balancing air pressure against the other.

3. In a suction device, a web supporting member subjected to air pressure upon one surface and hydraulic means acting directly against the opposite surface of said member for balancing said air pressure.

4. A suction device, comprising a stationary suction member, an endless belt traveling thereon and having openings thereinto, means for partially evacuating said member and means for hydraulically balancing the air pressure against said belt.

5. A suction device, comprising a stationary suction member, an endless belt traveling thereon and having openings thereinto, means for partially evacuating said member and means for hydraulically balancing the air pressure against said belt and means for effecting a liquid seal between said member and belt.

6. A suction device, comprising a hollow suction member open at the top, a traveling cover for said member having openings therethrough, means for applying suction to said hollow member and means for hydraulically balancing the pneumatic pressure against said cover.

7. A suction device, comprising a hollow suction member open at the top, a plurality of spaced trough-like receptacles within said member, an endless web carrying member supported above said receptacles and having openings into the interior of said hollow suction member and means for supplying a liquid to said receptacles to balance the downward pull of suction against said endless member.

8. A suction device, comprising a hollow suction member open at the top, a plurality of spaced trough-like receptacles within said member, an endless web carrying member supported above said receptacles and having openings into the interior of said hollow suction member and an automatically maintained head of liquid connected to said receptacles to balance the downward pull of suction against said endless member.

9. A suction device, comprising a hollow suction member, an endless traveling cover therefor having openings thereinto through which suction is applied and means for automatically balancing pneumatic pressure against said cover.

10. A suction device, comprising a hollow suction member, an endless traveling cover therefor having openings thereinto through which suction is applied and means for hydraulically balancing pneumatic pressure against said cover and supplying a liquid to effect a seal between said cover and hollow suction member.

11. In combination with an endless foraminous belt carrying a web to be dried, a stationary suction member and a traveling cover therefor supporting said foraminous belt and having openings into said suction member for the application of suction therethrough to said web.

12. In combination with an endless foraminous belt carrying a web to be dried, a stationary suction member, a traveling cover therefor supporting said foraminous belt and having openings into said suction member for the application of suction therethrough to said web and means for hydraulically balancing the pneumatic pressure against said cover.

13. In combination with an endless foraminous belt carrying a web to be dried, a stationary suction member, a traveling cover therefor supporting said foraminous belt and having openings into said suction member for the application of suction therethrough to said web and means for hydraulically balancing the pneumatic pressure against said cover and for effecting a liquid seal between said cover and suction member.

14. In a paper machine including a forming wire, a stationary suction device associated with said forming wire in place of the usual suction boxes comprising a hollow suction member, a traveling cover therefor supporting said forming wire and means for hydraulically balancing the pneumatic pressure against said cover.

15. In a paper machine including a forming wire, a stationary suction device associated with said forming wire in place of the usual suction boxes comprising a hollow suction member, a belt therefor having a corrugated surface serving to support said forming wire and means for hydraulically balancing the pneumatic pressure against said belt.

16. In a paper machine including a forming wire, a stationary suction device associated with said forming wire in place of the usual suction boxes, comprising a box-like suction member open at the top, troughs within said member extending longitudinally of the machine, endless flexible belts for

supporting said forming wire passing over the open top of said box-like member and means for supplying a liquid under pressure to said troughs to balance the air pressure on the upper surface of said belts.

17. In a paper machine including a forming wire, a stationary suction device associated with said forming wire in place of the usual suction boxes, comprising a box-like suction member open at the top, troughs within said member extending longitudinally of the machine, endless flexible belts for supporting said forming wire passing over the open top of said box-like member, means for supplying a liquid under pressure to said troughs to balance the air pressure on the upper surface of said belts and means for effecting a liquid seal between said belts and the upper edge of said box-like member.

18. In a paper machine including a forming wire, a stationary suction device associated with said forming wire in place of the usual suction boxes, comprising a box-like suction member open at the top, troughs within said member, endless flexible belts for supporting said forming wire passing over the open top of said box-like member, said belts having a corrugated upper surface with openings through the bases thereof into the interior of said box-like member and means for supplying a liquid under pressure to said troughs to balance the air pressure on the upper surface of said belts.

19. In a paper machine including a forming wire, a stationary suction device associated with said forming wire in place of the usual suction boxes, comprising a box-like suction member extending the width of the machine and open at the top, a plurality of spaced troughs within said box extending longitudinally of the machine with their upper edges below the upper edges of said box-like member, an endless flexible belt passing over each of said troughs, said belts abutting each other and being provided on their upper surfaces with corrugations on the crests of which the forming wire is adapted to be supported, said belts having openings near their respective edges for draining from the bottoms of said corrugations into said box-like member and means for supplying water under constant head to said troughs to balance the air pressure on the upper surface of said belts.

20. In a paper machine including a forming wire, a stationary suction device associated with said forming wire in place of the usual suction boxes, comprising a box-like suction member extending the width of the machine and open at the top, a plurality of spaced troughs within said box extending longitudinally of the machine with their upper edges below the upper edges of said box-like member, an endless flexible belt passing over each of said troughs, said belts abutting each other and being provided on their upper surfaces with corrugations on the crests of which the forming wire is adapted to be supported, said belts having openings near their respective edges for draining from the bottoms of said corrugations into said box-like member, the outside belts closely abutting the sides of said box-like member, deckle straps sealing the joints thus formed, channels formed in said sides, means for supplying water under static head to said troughs to balance the air pressure on the upper surface of said belts and means for supplying water to said channels to seal said joints.

21. An endless flexible belt for a suction device having a smooth lower surface and an upper transversely corrugated surface, the crests of said corrugations being of hard rubber and having a wavy contour.

22. An endless flexible belt for a suction device having a smooth lower surface and an upper transversely corrugated surface extending laterally beyond said lower surface, the crests of said corrugations being of hard rubber and having a wavy contour.

23. An endless flexible belt having a smooth lower surface and an upper transversely corrugated surface, the crests of said corrugations being of metal.

24. An endless flexible belt having a smooth lower surface and an upper transversely corrugated surface, the crests of said corrugations being of metal and having a wavy contour.

25. An endless flexible belt having a smooth lower surface and an upper transversely corrugated surface extending laterally beyond said lower surface, the crests of said corrugations being of metal and having a wavy contour.

26. In a removable Fourdrinier paper machine, the combination with an endless foraminous belt carrying a web to be dried, of a stationary suction member, a traveling cover therefor supporting said foraminous belt and having openings into said suction member for the application of suction therethrough to said web, means for hydraulically balancing the pneumatic pressure against said cover and means for laterally removing said Fourdrinier as a unit.

27. An endless flexible belt for use with a suction device, having a smooth solid base and a transversely corrugated upper surface extending laterally beyond said base, the extended portion of said upper surface having openings therethrough between said corrugations for the application of suction.

28. An endless flexible belt for a suction device, having a smooth lower surface and an upper transversely corrugated surface extending laterally beyond both sides of said lower surface, the crest of said corrugations being of metal and having a wavy contour, the extended portions of said upper surface

having openings between said corrugations for the application of suction.

29. In a paper machine including a forming wire, a stationary suction device comprising a box-like member open at its top, a plurality of laterally spaced troughs extending longitudinally of the top of said member, a plurality of endless flexible members supporting said forming wire and passing over said troughs, said flexible members abutting each other beyond the sides of said troughs, recesses in the end walls of said troughs, having recesses therein said recesses opening into vertical passages located between said troughs and under the joints between said flexible members, means for supplying a liquid under pressure to said troughs for hydraulically balancing the pneumatic pressure against said flexible members, and means for supplying liquid to said recesses to seal the joints between said flexible member.

In testimony whereof I have hereunto subscribed my name at Beloit, Rock County, Wisconsin.

EARL E. BERRY.