June 6, 1967 H. W. HILL 3,323,982

ADJUSTABLE DRAINAGE ELEMENT FOR FOURDRINIER PAPER MACHINES

Filed Sept. 14, 1964 3 Sheets-Sheet 1

Fig. 1.

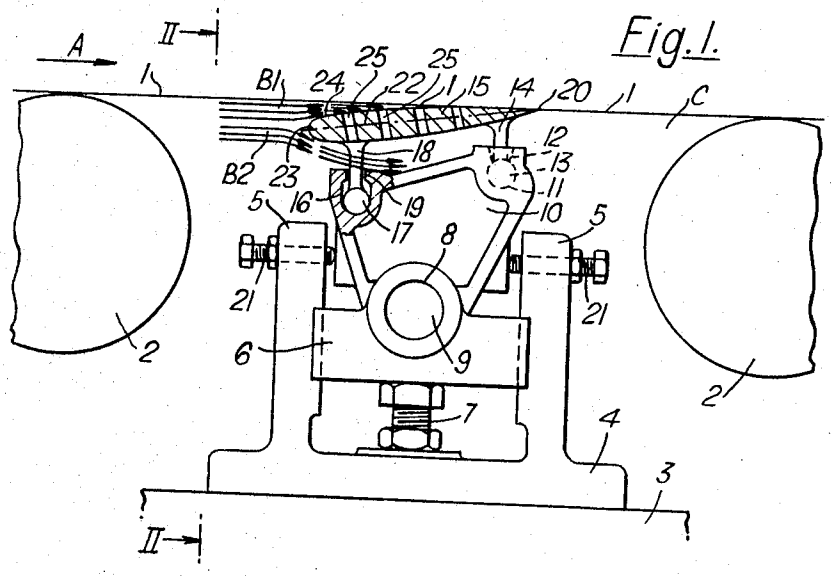


Fig. 2.

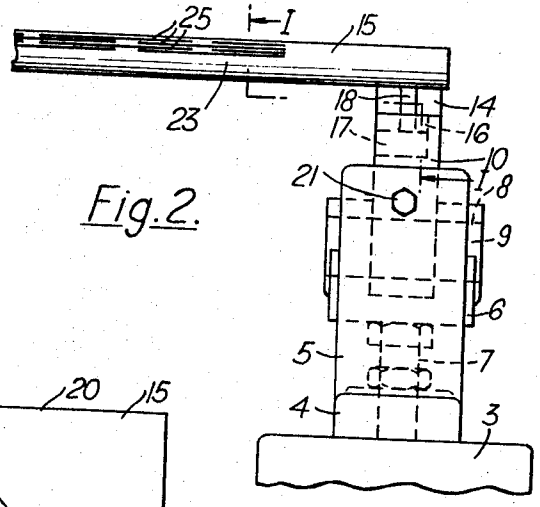
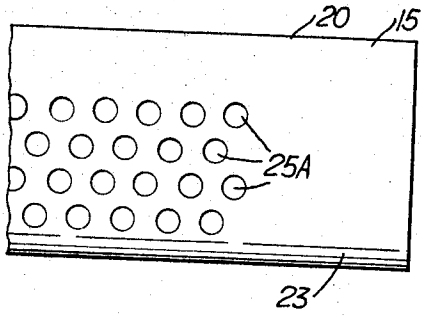


Fig. 4.



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Filed Sept. 14, 1964 3 Sheets-Sheet 2

Fig. 3.

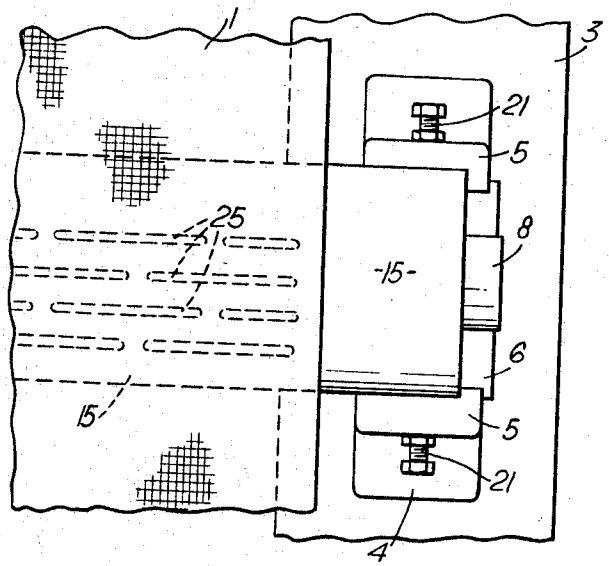
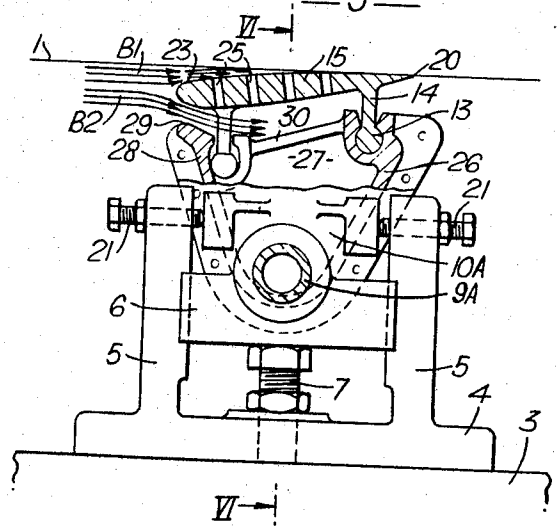


Fig. 5.



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Filed Sept. 14, 1964 3 Sheets-Sheet 3

Fig. 6.

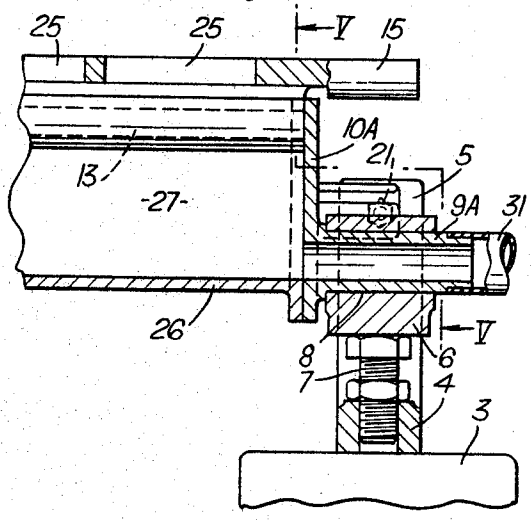


Fig. 7.

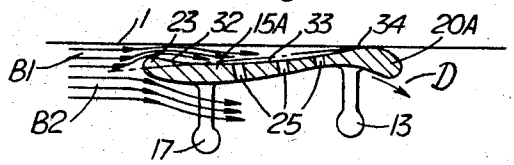


Fig. 8.

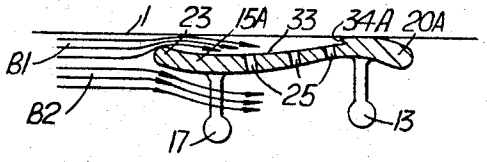
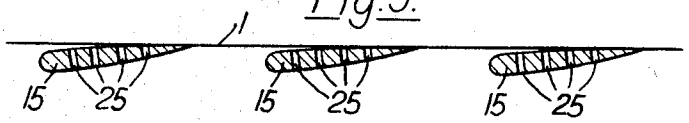


Fig. 9.



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3,323,982

ADJUSTABLE DRAINAGE ELEMENT FOR FOURDRINIER PAPER MACHINES

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Claims priority, application Great Britain, Sept. 14, 1963, 36,262/63
9 Claims. (Cl. 162—352)

This invention relates to paper-making machines of the type in which a paper web is formed on an endless wire, and is directed to the removal from the forming wire of such a machine of water drained from the layer of stock carried by the wire.

Although much of the very high content of water in the stock drains progressively through the wire in the passage of the latter from the forming end to the couch end, a significant amount of the water remains entrained on the underside of the wire. With very considerable linear speeds of the wire in a high speed machine, the wire brings this entrained water to the table rolls that are under the wire towards the couch end along with such a flow of air resulting from the wire movement that the water is forced into the ingoing nip between the wire and each table roll and upwardly through the wire to the paper mat being formed. Moreover, although the capillary attraction of the surface of a table roll assists in the draining of water through the wire, water remains attracted to the surface of the roll and some of it is also carried round with the roll and into the ingoing nip. Moreover, water is sprayed from one roll to an adjoining roll. All these factors contribute to the disruptive effect on the paper mat of upwardly forced water, and disturbance to the formation of the web, even if not so weakening it as to lead to actual rupture in the following sections of the machine.

The object of the invention is to effect removal of water entrained on the underside of the wire, and to utilise in that removal the flow of air induced by the movement of the wire itself.

According to the present invention, a de-watering device for the forming wire of a paper-making machine comprises an element of aerodynamic shape to be mounted transversely below the forming wire with its upper face at a slight inclination downwardly and opposite to the direction of wire travel so that the leading edge of the element is spaced from the underside of the wire, with contact between the underside of the wire by the upper face towards the trailing edge of the element, the section of the element being formed with apertures extending from its upper face to its lower face. The apertures, whether simple holes or transverse slots, preferably incline rearwardly from their inlets in the upper face.

The leading edge of the element is encountered by the stream of air drawn along the underside of the wire, and the stream is divided into flows over the upper and lower faces of the element, that over the upper face having a greater velocity (because of its closer proximity to the wire) than has that over the lower face. This leads to a state of lower pressure below the element than above it, so that water drawn with the wire over the upper surface of the element is carried to and induced to flow through the apertures by reason of the reduced pressure below the element, which reduction is pressure is augmented by the excess of pressure above the element, as compared with below the element, resulting from the action of the element of aerodynamic shape on the stream that encounters it. The rearward inclination of the apertures assists in smooth flow of the water into the holes.

The water is thus taken progressively from the underside ofthe wire by the apertures distributed over the

bottom of the wedge like space converging to the position of contact between the wire and the upper surface of the element. Consequently, not only is the pressure of the water in that space relieved by the apertures, but the effect of the pressure in the space is distributed over the distance in front of the contact position corresponding to the extent of the leading edge of the element from that position. There is in consequence a substantial area of paper web on the wire above the mass of water that is being diverted from the underside of the wire by the interposition of the de-watering element, and the web is thus not subjected to disruptive kick-up localised at any narrow strip extending across its width.

The water directed away from the underside of the wire through the apertures in the element of aerodynamic shape may simply drain downwardly, for collection in the usual manner with the water otherwise draining from the wire and the table rolls. However, the element of aerodynamic shape may be disposed above a collector channel, the channel being provided with a drain outlet for collected water. For use with a wire travelling at very high speed, the collector channel may be substantially closed, the drain outlet enabling it to be connected to a source of sub-atmospheric pressure. This produces a reduced pressure inside the channel, to augment the action of the aerofoil itself in directing water from the underside of the wire.

Several embodiments of the invention, including the cases of a free-draining element and an element having a closed channel below it, will now be described with reference to the accompanying drawings, in which:

FIGURE 1 is a side elevation of part of the wet section of a paper-making machine, the section embracing two table rolls, between which a de-watering element of aerodynamic shape is mounted; the element itself being shown in section taken on the line I—I of FIGURE 2;

FIGURE 2 is a view of one end of the element and its mounting at that end, taken in the direction II—II of FIGURE 1;

FIGURE 3 is a plan view of FIGURE 2, showing slots providing the apertures in the element;

FIGURE 4 is a plan view of an element of aerodynamic shape with round holes providing its apertures;

FIGURE 5 is a view similar to that of the element of FIGURE 1, but of an element mounted on a closed channel, the element and related parts being shown in section taken on the line V—V of FIGURE 6;

FIGURE 6 is a view of one end of the element and channel of FIGURE 5, taken in the direction VI—VI of FIGURE 5;

FIGURE 7 is a sectional view of a modified element;

FIGURE 8 is a sectional view of an element as in FIGURE 7, but with a further modification; and

FIGURE 9 is a diagrammatic longitudinal elevation of a length of forming wire supported only by de-watering element of aerodynamic shape.

In FIGURE 1, the forming wire **1** if a paper-making machine is shown passing over two table rolls **2**, the bearing brackets by which the rolls are supported from the frame **3** of the machine being omitted. The movement of the wire is in the direction of the arrow A, i.e., from left to right. On the frame **3** at each side of the machine a bracket **4** is disposed between the positions of the two rolls **2**. Parallel upright members **5** of the bracket **4** guide the ends of a bearing block **6**, the height of which is adjustable by means of a screw **7**. The block **6** has a bore **8** to provide a journal for a trunnion **9** projecting outwardly from a support plate **10** (see also FIGURE 2) extending upwardly towards the wire **1**.

At the rear of the plate **10**, a pivot hole **11**, with a narrower slot **12** opening to the top of the plate, provides a bearing for a short transverse pivot **13** at the bottom

end of a stem **14** depending from towards the rear of the underside of a de-watering element **15** of aerofoil section, with both its upper and lower surfaces concave. Another pivot hole **16** at the front of the plate **10** is somewhat elongated upwardly, to allow some freedon of vertical movement for a transverse support **17** at the bottom of a stem **18** depending from towards the front of the element **15** and extending through a clearance slot **19** in the plate **10**. Because of its freedom to rock at its rear pivot **13** (and the corresponding pivot at the other side of the machine), the element **15** is initially supported at its front end by the resting of the support **17** on the bottom of the pivot hole **16**.

The element **15**, or at least the surface of it to contact the wire **1**, may be formed of bronze, stainless steel, or synthetic plastics material, which latter may be fabric- or fibre-reinforced.

The screw **7** is adjusted so that the trailing edge **20** of the element **15** is in contact with the underside of the wire **1**. The disposition of the element **15** can be further adjusted by rocking of the plate **10** on the bracket **4** by means of two screws **21**. The chordal plane **22** of the element **15** may therefore be caused to assume any desired inclination, say in the range 2° to 6°, with respect to the plane of the wire **1**, forwardly from the position of contact of the trailing edge **20** with the wire, so that the rounded leading edge **23** is spaced from the wire. The upper surface **24** of the element **15** thus converges with respect to the wire towards the trailing edge **20**. Apertures **25** extend completely through the element **15**, at an angle inclining rearwardly with respect to the chordal plane **22**, to provide free drainage into the space between the side frames **3** of the machines.

The apertures **25** may be parallel slots, as shown by FIGURE 3, or round holes **25A**, as shown by FIGURE 4.

The free-draining arrangement of FIGURES 1 and 2 is suitable for the removal of water in the high speed range of 1200 to 2500 feet per minute. The moving wire **1** not only carries with it water entrained on its underside (no attempt being made to show this water in the drawings) but also a flow of air, the air nearer to the wire (arrows **B1**) having a higher velocity than that of the air that is not so near to the wire (arrows **B2**). The faster-moving air is directed by the rounded leading edge **23** to the upper side of the element **15**, where it establishes a pressure zone in the converging space extending to the trailing edge **20**. The slower-moving air is directed to the underside of the element **15**, where it establishes a zone of pressure lower than that above the element.

The water carried by the wire **1** into the converging space passes over the apertures **25** and, because of the lower pressure existing at the underside of the element **15**, is encouraged to flow through the apertures, i.e., away from the wire, progressively as the trailing edge **20** is approached. In addition, the pressurised condition of the water finding itself between the wire **1** and the element **15** is distributed over the whole area of the element, and therefore over the whole area of the paper web (not shown) lying on the wire at any time immediately above the element. Thus, any communication of pressure through the wire of the web is well distributed over an area of the web, so that localised disruption of the web is avoided.

Because of the relatively free mounting of the front pivot **17** in its slot **16**, the element **15** is not rigidly constrained but can adjust the inclination of its chordal plane **22** to suit the aero-dynamic and hydro-dynamic conditions that it actually encounters below the wire **1**.

The element **15** may, by suitable adjustment of its brackets **4** along the frames **3**, be brought closer to the succeeding table roll **2** than is shown in FIGURE 1, so as to lessen the span of the wire **1** between the trailing edge **20** and the ingoing converging nip space C between the wire and that roll **2**. In this way, the amount of water carried by the wire **1** to the roll **2** may be further reduced.

In FIGURE 5, an element **15** of aerodynamic shape

is essentially the same as in FIGURE 1, but it is mounted on the top of an enclosed collector channel **26**, the space **27** inside which receives water extracted through the apertures **25**, and also air (arrows **B2**) passing to the low-pressure underside of the element **15**, as well as air passing with the water through the apertures. The rear pivot **13** and its stem **14** extend completely along the element **15**, and thus close the rear portion of the top of the channel **26**. The front portion **28** of the channel extends over the leading edge **23** of the element **15**, but clear of the element, and has a smoothly curved top edge **29** over which lower-velocity air (arrows **B2**) passes to the underside of the element, which therefore behaves in the manner of the element **15** in FIGURE 1. The ends of the channel **26** are closed by plates **10A** (one only shown in FIGURE 6), having a hollow trunnion **9A**, mounted in the same manner as the plate **10** and trunnion **9** of FIGURE 1, with similar adjustment for height and angularity.

Water and air pass freely into the space **27** of the channel **26**, the top of which is merely tied at intervals as indicated at **30**, and is withdrawn through the hollow trunnion **9A**. However, by a connection **31** leading from the trunnion to a blower or a vacuum pump (not shown), the degree of sub-atmospheric pressure below the element **15** can be augmented considerably. The arrangement shown in FIGURES 5 and 6 is therefore suitable for very high wire speeds, particularly above 2500 feet per minute, because the action of the aerodynamically shaped element **15** in producing conditions that lead to flow of water through the holes **25** is supplemented by the flow of air induced below the element by the sub-atmospheric pressure in the space **27**. Consequently, both water and air entrained below the wire **1** are quickly drawn into the channel **26** and thence through the trunnion **9A**.

In FIGURE 7, a de-watering element **15A**, suitable to replace the element **15** in FIGURE 1 or FIGURE 5, has its upper surface inclining downwardly at **32** immediately at the rear of the leading edge **23**, the whole surface **33** then being concave to the position **34** at which contact is made with the wire **1**. Beyond the position **34**, the trailing edge **20A** is enlarged to a bulbous section, its upper surface smoothly diverging away from the wire, and its lower surface serving to deflect away from the wire the flow of air (arrow **D**) below the element **15**.

In FIGURE 8, the element **15** has a bulbous trailing edge **20A** as in FIGURE 7, but the concave upper surface **33** meets the trailing edge portion at a transverse lip **34A** to effect a mechanical doctoring of water clinging to the underside of the wire **1**.

In FIGURE 9, three de-watering elements **15** are shown in close succession below the wire **1**, they providing the whole support for the wire.

What I claim is:

1. A de-watering device for the forming wire of a paper-making machine, comprising an element of aerodynamic shape, and a mounting on which the element is supported to extend transversely of the underside of the forming wire, the element being disposed with the leading edge of its aerodynamic shape directed opposite to the direction of wire travel and with a downward inclination towards the leading edge, and in contact by its upper surface adjacent its trailing edge with the under surface of the wire, and holes being formed through the aerodynamic shape from the upper surface of the element to the lower surface, inclined rearwardly with respect to the direction of wire travel.

2. A de-watering device for the forming wire of a paper-making machine, comprising a collector channel, an element of aerodynamic shape disposed at the top of the channel, and a mounting on which the channel is supported to extend transversely of the underside of the forming wire, the element being disposed with the leading edge of its aerodynamic shape directed opposite to the direction of wire travel and with a downward inclination towards the leading edge, and in contact by its upper sur-

face adjacent its trailing edge with the under surface of the wire, and holes being formed through the aerofoil section from the upper surface of the element to the lower surface, inclined rearwardly with respect to the direction of wire travel.

3. A de-watering device for the forming wire of a paper-making machine, comprising a substantially closed collector channel, an element of aerodynamic shape disposed at the top of the channel, and a mounting on which the channel is supported to extend transversely of the underside of the forming wire, the element being disposed with the leading edge of its aerodynamic shape directed opposite to the direction of wire travel and with a downward inclination towards the leading edge, and in contact by its upper surface adjacent its trailing edge with the under surface of the wire, and holes being formed through the aerofoil section from the upper surface of the element to the lower surface inclined rearwardly with respect to the direction of wire travel, the channel being provided with a drain outlet to provide for connection of the channel to a source of sub-atmospheric pressure.

4. A de-watering device for the forming wire of a paper-making machine, comprising an element of aerodynamic shape and a mounting on which the element is supported to extend transversely of the underside of the forming wire, the element having a transverse rearward pivot carried in the mounting and a forward support with freedom for vertical movement in the mounting, the pivot and the support causing the element to be disposed with the leading edge of its aerodynamic shape directed opposite to the direction of wire travel and with a downward inclination towards the leading edge, and in contact

by its upper surface adjacent its trailing edge with the under surface of the wire, and holes being formed through the aerofoil section from the upper surface of the element to the lower surface, inclined rearwardly with respect to the direction of wire travel.

5. A de-watering device as in claim 1, comprising means for vertical adjustment of the element relative to the mounting.

6. A de-watering device as in claim 1, comprising means for angular adjustment of the element relative to the mounting.

7. A de-watering device as in claim 1, wherein the element has a concave upper surface.

8. A de-watering device as in claim 1, wherein the element has a concave upper surface, and a trailing edge portion of bulbous section.

9. A de-watering device as in claim 1, wherein the element has a concave upper surface, and a trailing edge portion of bulbous section, there being a transverse doctoring lip where the concave upper surface reaches the trailing bulbous section.

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