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ABSTRACT OF THE DISCLOSURE

A foil type drainage apparatus for paper making machines having replaceable drainage foils. Each drainage foil has a generally T-shaped recess and is slidably mounted on a generally T-shaped rail so that it can be mounted and removed by longitudinal sliding movement along the rail and when mounted retained in accurate angular relationship with the forming wire of the paper making machine.

This invention relates to a drainage apparatus for web-forming machines, and in particular, to a readily replaceable foil type drainage device for a paper machine such as a Fourdriner machine.

Although foils have been used as means for draining water from paper making slurries, maintenance or replacement of the foils has always presented a problem in that this necessitated partial dismantlement of the paper making machine, thus requiring that the machine be shut down. This problem is particularly serious where multiple foils are being used, since the replacement of even one such foil would result in delay in production. It has, therefore, been proposed to provide an arrangement in which the foil blades are readily replaceable. This is accomplished by mounting each of the foil blades on a supporting rail in a slidably removable manner.

One of the problems encountered in providing such a readily replaceable drainage head is that of maintaining an accurate angular relationship between the working surface of the drainage foil and the undersurface of the forming wire due to the tendency of the foils to vibrate under the influence of friction and suction forces generated by the passage of the wire over the drainage head at high speed. For narrow paper machines, the foil can be sufficiently tight-fitting with respect to the supporting rail to maintain an accurate angular relationship between the upper surface of the foil and the forming wire, while enabling the foil to be slid on and off the supporting rail. However, if such a close fit between the foil and the rail is provided, it becomes increasingly difficult to slide the foils onto the supporting rail, as the width of the paper machine is increased.

It is, therefore, an object of this invention to provide a readily replaceable drainage foil which can be maintained in accurate relationship with the forming wire.

A further object of this invention is the provision of a foil blade of plastic material or plastic and metal having improved wearability.

A still further object of this invention is the provision of a foil which will compensate for unequal longitudinal expansion of the foil with respect to the supporting rail.

Accordingly, the present invention provides a drainage apparatus for use with a web-forming machine having a forming wire, said apparatus comprising a foil and a rail for supporting said foil, said foil including a bearing portion and a suction creating trailing portion and a recess terminating in the lower surface of said foil to receive said supporting rail, said rail having means adjacent the leading edge thereof to maintain firm contact during use with the associated surface of the recess and said supporting rail having a lateral projection extending in the direction of intended movement of the forming wire to mate with a corresponding portion of said recess, said recess in said foil being shaped to provide a tolerance between the trailing edge of said projection and the opposed surface of said recess and to provide a flange extending beneath the lateral projection of said rail to form an abutment opposing the moment due to suction forces.

In the drawings which illustrate the preferred embodiments of this invention:

FIGURE 1 is a side elevational view illustrating the relationship between the drainage apparatus and the paper making machine;

FIGURE 2 is a detailed plan view of the drainage apparatus shown in FIGURE 1;

FIGURE 3 is a sectional view on the line 3—3 of FIGURE 2 and is an elevation sectional view of the drainage apparatus;

FIGURE 4 is a sectional view of the line 4—4 of FIGURE 3;

FIGURE 5 is a sectional view on the line 5—5 of FIGURE 2;

FIGURE 6 shows a drainage foil in detail;

FIGURE 7 is a top plan view of a portion of a supporting rail;

FIGURE 8 is a side elevational view of the supporting rail of FIGURE 7;

FIGURE 9 is a sectional view on line 9—9 of FIG. 7 including a sectional view of a drainage foil mounted theron;

FIGURE 10 shows a cross-section of an alternative embodiment with a modified supporting rail;

FIGURE 11 shows a cross-section of a further alternative construction of the supporting rail;

FIGURE 12 is a sectional view taken along the line 12—12 of FIG. 11, and

FIGURE 13 shows a cross-section of a laminated drainage foil.

Referring now to the drawings, FIGURE 1 illustrates a papermaking machine in which there is an endless forming wire 10 which travels around rolls 11 and 12. A drainage apparatus 13 is located beneath the upper run 10a of forming wire 10.

The drainage apparatus generally indicated at 13 is shown in further detail in FIGURES 2, 3 and 5. The supporting structure for the drainage apparatus includes side plates 14 to which are secured laterally extending flanges 15 which are reinforced by webs 16. Flanges 15 are mounted on supporting members 17 by posts 18 which have nuts 19 and 20 engaging threaded member 21 to provide for adjustment of the height of the drainage apparatus. Front channel member 24 and rear channel member 25 extend between side plates 14 and extend substantially the width of the forming wire 10. A series of beams 26 are joined to members 24 and 25 and are in alignment with the direction of travel of wire 10.

Beams 26 supports straps 27, the upper ends 28 of which are bent over to provide a flange portion to which a supporting rail 30 is secured by bolt 29. Prior to fastening rail 30 to flange portions, the flange portions are machined flat and level across the width of the frame. Rail 30 shown in FIGURES 3 and 6 is provided with laterally projecting portions 31 at its leading edge and 32 at its trailing edge to cooperate with a drainage foil 33. The drainage foil 33 has a T-shaped recess 34 which mates with the rail 30 including mutually opposed inwardly extending flanges 37 and 38 at the leading and trailing edges respectively thereof. The flanges 37 and 38 of the foil 33 are adapted to engage the rail 30 and prevent the foil 33 from being dislodged from the rail 30 in the direction of movement.
movement of the trailing portion 43 is limited by engagement of projecting portion 52 of rail 50 and the flange 38 of the foil 33'.

In this embodiment, were it not for the particular arrangement of the springs 53 and 54 described above, it would be necessary to provide much stronger springs, as the foil 33' would then be restrained against rotation by the springs. Springs of the necessary strength would interfere with the ease of easily removing the foil 33' from the rail 50.

In the alternative construction shown in FIG. 10, a rail 160 supported in a manner identical to rail 30 described above, is provided with superimposed plates 161 and 162 secured to the upper surface thereof. The rail 160 has a rectangular cross-section and laterally projecting portions 63 and 64, similar to projections 51 and 52 on rail 50, which are provided by overhanging portions of the plates 161 and 162 respectively.

Springs 65 are provided along the length of the rail 160. The flat central portion of each spring 65 is retained between the plates 161 and 162. The springs 65 preferably have curved portions 66 and 67 extending beyond the sides of rail 160 adjacent projecting portions 63 and 64 respectively, spring portion 66 being at the lower surface of projection 63 and spring portion 67 being at the upper surface of projection 64.

Countersunk machine screws 68 received in suitable apertures in the plates 161 and 162, the springs 65 and suitable threaded apertures in the rail 160 secure the plates 161 and 162 and the springs 65 to the rail 160.

A drainage foil 70 for use with the guide rail 160 has a slightly different configuration than that of drainage foil 33 due to projecting portion 64 having been spaced from upper surface 69 of the plate 161, thereby providing a recess to receive the spring portion 67. Whereas, the spring 54 of rail 50 extends above the upper surface thereof necessitating a decrease in the thickness of the trailing portion of the foil 33'.

In the further alternative construction of FIGS. 11 and 12, a solid supporting rail 80 is provided with a cross-section substantially the same as that of rail 160 described with reference to FIG. 10 including projecting portions 81 and 82. Leaf springs 83 and 84 similar to springs 53 and 54 of the embodiment shown in FIGS. 7, 8 and 9 having their ends 85 anchored in holes 86 are provided on the rail 80. The rail 80 having the same cross-section as rail 160 is thus used in conjunction with the drainage foil 70.

In the further alternative construction of FIGURE 13, a composite foil 90 is provided with a rigid plastic or metal base 91 having a T-shaped recess 92 therein on which a top or cap 93 of tough flexible plastic material is molded in place. The outer dimensions of the foil 90 including those of the recess 92 are substantially the same as the foils described above.

The base 91 has lateral projections 94 and 95 extending from the side walls thereof to provide a dovetailed joint when the cap 93 is molded thereon. In addition spaced apart countersunk holes 96 are provided along the upper surface of the T-shaped recess 92 and extend therethrough. Thus, the plastic material of the cap 93 flows into the holes 96 during the molding of the cap 93 on the base 91 to provide an additional bond between the members.

The base 91 may be made of metal. However, if the base 91 is made of plastic material, a rigid plastic such as a melamine-formaldehyde resin should be used.

Regarding the material used for the cap 93, it has been found that a tough flexible plastic such as polyurethane is good wear resistance and causes less wear to the Fourdriner than a metal foil.

A construction in accordance with this invention resolves a further problem in that the temperature variations during use are such that conventional doctors are liable to buckle, due to longitudinal expansion whereas
in the structure in accordance with the invention, the ends of the drainage heads are free to move longitudinally with the consequence that the drainage foils will compensate for expansion or contraction by sliding movement relative to the rails instead of buckling.

We claim:

1. A drainage foil for use in a paper making machine having a forming wire and a T-shaped supporting rail by being slidable mounted upon the upper portion of said T-shaped rail, said foil having: an upper surface including a substantially flat wire bearing portion and a suction creating diverging portion, said suction portion being disposed at an angle to said forming wire when operationally installed in said paper making machine; and said foil defining a T-shaped longitudinally extending recess terminating in the lower surface of said foil, the width of said T-shaped recess being greater than the corresponding width of said T-shaped rail to be received in said T-shaped recess to provide a clearance between the side edges of the upper portion of the T-shaped rail and the opposed side walls of said T-shaped recess, and said T-shaped recess further including an upper wall surface substantially parallel to said forming wire when said foil is operationally installed in said paper making machine and inwardly projecting flange means at the leading and trailing edges thereof extending from said opposed side walls of said T-shaped recess for undergirding and slidably engaging the underside of the upper portions of said T-shaped rail to be received in said T-shaped recess, and the vertical spacing between said upper wall surface of said T-shaped recess and the opposed upper surfaces of said inwardly projecting flange means being such that when said foil is operationally mounted upon said T-shaped rail at least said upper surface of the inwardly projecting flange means at the trailing edge of said foil will be flushed with the trailing edge of the upper portion of said T-shaped rail and said upper wall surface of said T-shaped recess will be firmly interengaged with the upper surface of said T-shaped rail so as to maintain the angle between the forming wire and the upper surface of said drainage foil.

2. The structure defined in claim 1 wherein the inwardly projecting flange means at the leading and trailing edges of the drainage foil each have an upper surface substantially parallel to the upper wall surface for slidably engaging the underside of the upper portion of the T-shaped rail member to be received in the T-shaped recess.

3. The structure defined in claim 1 wherein the upper wall surface of the T-shaped recess defines a longitudinally extending groove so as to reduce the area of contact between the foil and the T-shaped rail and thereby facilitate relative longitudinal sliding movement between said foil and said T-shaped rail.

4. The structure defined in claim 3 wherein the opposed side walls of the T-shaped recess in the foil extend substantially normal to the upper wall surface of said T-shaped recess.

5. The structure defined in claim 1 wherein the plastic material is high density polyethylene.

6. The structure defined in claim 1 wherein the drainage foil is of laminated construction comprising a base formed of a first material defining the T-shaped recess and a cap formed of a second material secured to and carried by said base and defining the upper surface of the foil.

7. A drainage apparatus for use in a paper making machine having a forming wire, said drainage apparatus comprising: a supporting rail comprising an elongated body portion for extending transversely of and below the forming wire, a first laterally projecting member extending along the upper leading edge of said body having upper support surfaces, and a second laterally projecting member extending along the upper trailing edge of said body having upper and lower surfaces; and a drainage foil for bearing against the forming wire and defining at its lower surface a longitudinally extending generally T-shaped recess slidably receiving said supporting rail, said T-shaped recess including an upper wall surface, inwardly facing opposed side walls and inwardly extending flanges having upper surfaces underlying said first and second laterally projecting members, said side walls being spaced from the edges of said first and second laterally projecting members and the inner edges of said flanges being spaced from said elongated body to provide a lateral clearance which facilitates mounting and demounting of the foil by longitudinal sliding movement thereof along said rail, but said clearance being insufficient to permit dislodgement of the drainage foil in the direction of movement of said forming wire, said upper and lower surfaces of said laterally projecting members engaging said upper wall surface of said T-shaped recess and the upper surfaces of said flanges, respectively, at least one surface of each pair of interengaged surfaces being substantially parallel to said forming wire when said drainage apparatus is operationally installed in said paper making machine and the upper surface of the flange underlying the lower surface of said second laterally projecting member being firmly interengaged therewith and the upper wall surface of said first laterally projecting member being firmly interengaged with the upper surface of said first laterally projecting member whereby when said drainage apparatus is operationally installed in said paper making machine, an accurate angular relationship between the upper surface of said foil and the forming wire is maintained throughout the relative lateral movement between said rail and said foil which is permitted by said lateral clearance therebetween.

8. The structure defined in claim 7 wherein the upper and lower surfaces of the first and second laterally projecting members are each substantially parallel to the forming wire.

9. The structure defined in claim 8 wherein the upper wall surface of the T-shaped recess and the upper surface of each flange engaged by the lateral projecting members are substantially parallel to the forming wire.

10. The structure defined in claim 9 wherein the upper wall surface of the T-shaped recess defines a longitudinally extending groove which reduces the area of interengagement between the foil and the supporting rail and thereby further facilitates relative longitudinal sliding movement between said foil and said supporting rail.

11. A drainage apparatus for use with a paper making machine including a forming wire, said drainage apparatus comprising a drainage foil having an upper surface including a leading bearing portion and a trailing suction creating diverging portion disposed at an angle to said wire, a supporting rail for extending transversely of the forming wire of said paper making machine, said supporting rail including laterally projecting portions on opposed side walls thereof, and resilient means acting to urge said drainage foil in the same direction as the resultant of the moment of the suction between said foil and said forming wire and the friction between said foil and said forming wire.

12. A drainage device as claimed in claim 11 in which said resilient means comprises: a first leaf spring bearing on said inwardly extending flange at the leading portion of said foil, and on an underside of an associated one of said projecting portions of said rail, said leaf spring in said recess at the trailing portion thereof bearing against said foil and against the upper surface of an associated one of said projecting portions of said rail.
13. A drainage apparatus as claimed in claim 11 wherein a pair of superimposed plates extend along and are secured to said supporting rail, each said laterally projecting portion comprising a side edge of each said plate extending beyond a side wall of said rail, and wherein said resilient means is an elongated substantially flat spring member having resilient portions at the side edges thereof, said member being secured between said superimposed plates and having one said resilient portion of said spring extending beyond said side wall of said rail and adapted to engage said inwardly extending flange at the leading portion of said foil, and the other resilient portion extending beyond an opposed side wall of said rail and bearing against said foil to urge said foil away from said rail.

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S. LEON BASHORE, Primary Examiner.
UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION


William Sherman White et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the heading to the printed specification, lines 4 and 5, for "William Sherman White, Pointe Claire, Quebec, and John Gordon Buchanan, Montreal West, Quebec, Canada," read -- William Sherman White, Montreal West, Quebec, and John Gordon Buchanan, Pointe Claire, Quebec, Canada --.

Signed and sealed this 29th day of October 1968.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents