June 12, 1973 A. F. KIENZL ET AL 3,738,911

PAPERMAKING MACHINE DEWATERING DEVICES HAVING DIVERGING TRAILING SURFACES WHICH INCLUDE WEAR-BEARING INSERT MATERIALS

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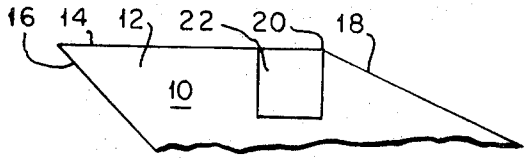

FIG. 1
PRIOR ART

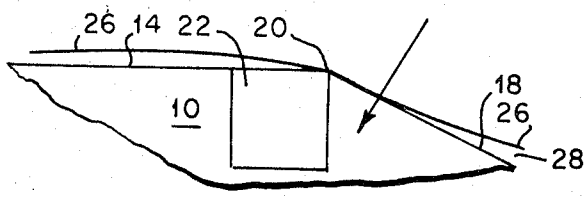

FIG. 2
PRIOR ART

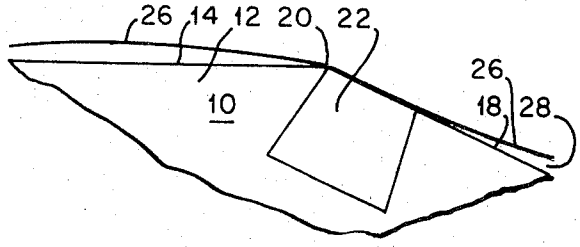

FIG. 3

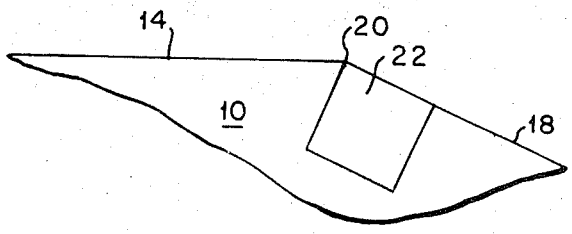

FIG. 4B

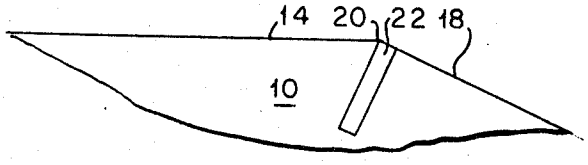

FIG. 4A

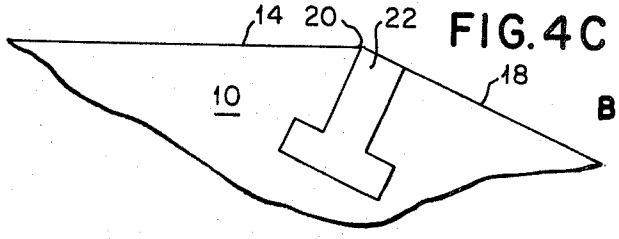

FIG. 4C

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PAPERMAKING MACHINE DEWATERING DEVICES HAVING DIVERGING TRAILING SURFACES WHICH INCLUDE WEAR-BEARING INSERT MATERIALS

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U.S. Cl. 162—374 8 Claims

ABSTRACT OF THE DISCLOSURE

This invention relates to dewatering devices for papermaking machinery and, more particularly, to hydrofoil blades which are characterized by having wear-bearing material forming the diverging trailing surface in the region of the crease line which forms its juncture between the trailing surface and the adjacent top surface.

BACKGROUND OF THE INVENTION

Hydrofoil blades and their use as dewatering devices in papermaking machinery are well known in the papermaking arts. In this connection, reference is made to the following U.S. patents: 2,928,465; 2,928,466; 3,140,225; 3,165,440; 3,239,409; 3,239,410; 3,337,394; 3,377,236; 3,017,930, and 3,027,940. It is also well known to make such hydrofoil blades of materials such as ceramics in order to render them more resistant to the extreme chemical, thermal, and abrasive conditions to which they are normally exposed in the forming section of a papermaking machine. In this connection, reference is made to Canadian Patents No. 838,974 and No. 840,719. However, due to the inherent brittleness and hardness of such materials and, therefore, the difficulties encountered in rendering them into the shapes desired and in keeping them from chipping or otherwise becoming unduly abrasive to the associated forming medium, and because of their inherent high cost, it is also known in the art to merely apply a surface coating of materials such as ceramics to impart to the blades the desired surface properties. In this connection, reference is made to U.S. Patents No. 3,351,524, and No. 3,352,749. It has also been proposed to make blades of materials which have the requisite physical, chemical, thermal abrasion resistance, friction, and wear characteristics, but at the same time, are easy to form and shape by machining and other known methods by incorporating into selected portions of their surfaces that are subject to contact with the associated forming medium isolated regions of materials such as ceramics which are characterized by having the desired wear-tolerant characteristics. In this connection, reference is made to U.S. Patent 3,446,702. To date, however, in the prior art falling within this last category, it has only been proposed that such isolated regions of wear-bearing materials be incorporated at the rear-most region of the top surface of hydrofoil blades; that is, immediately before and adjacent to the "crease lines," which is the line of juncture between the top surface of a hydrofoil blade and its trailing surface, on the theory that this is a region where wear is likely to be concentrated. The "trailing surface" herein referred to is the arcuate or flat planar surface which diverges from the underside of the forming medium in the direction of travel of the forming medium as the means to dynamically induce the desired amount of vacuum by which the hydrofoil blade effectuates water removal. The use per se of wear-bearing materials positioned past the crease line is not unknown, for such is disclosed, for example, in Klinger et al. U.S. Patent No. 3,393,124. But

in all such prior art disclosures, the hard surface portions past the crease line are integral with larger inserts forming all or substantially all of the associated top surface. This expedient is costly, difficult to produce, and otherwise generally undesirable because such large inserts usually present abrasive edges to the associated forming media that tend to wear the latter excessively and, therefore, shorten their useful life.

I have found, however, that the theory by which wear-bearing inserts positioned as disclosed in U.S. Patent No. 3,446,702 is not supported in fact. Thus, although it is said there that since the associated forming medium bears on the crease line, by positioning such wear-bearing materials at or ahead of the crease line as shown in U.S. Patent No. 3,446,702, the wear of the crease line and the consequent alteration in water removal characteristics of the hydrofoil blade will be precluded, tests show that, in fact, the wear which takes place at the crease line is from the leading edge of the trailing surface into the trailing edge of the top surface. Without intending to be bound by any theory, it appears that since a forming medium does not have an infinitely small bending radius, and because the vacuum which is dynamically induced by the trailing surface of the hydrofoil blade tends to cause the forming medium to "dip" or deflect downward as it passes the crease line, the forming medium actually follows the contour of the leading portion of the trailing surface of the hydrofoil blade for a short distance before it deflects upward and away from the trailing surface by virtue of the tension being applied on the forming medium. In view of this, the forming medium bows upward over the top surface and the plane of contact, and, therefore, the region critical to wear of the trailing portion of the hydrofoil blade, is actually the leading portion of the trailing surface rather than at the trailing portion of the top surface. Therefore, if one follows the prior art disclosure of incorporating wear-bearing material at the trailing region of the top surface, as the front region of the trailing surface wears, the forming medium increasingly becomes exposed to the sharp (trailing) edge of the wear-bearing insert with consequent abrasion of the underside of the forming medium by virtue of the very hardness and wear resistance which is the desired property of the insert. We have discovered that it is possible to reduce the wear in the wear-critical regions of a readily formable, structurally simple and inexpensive to build hydrofoil blade while, at the same time, avoid untoward abrasion of the forming medium, with consequent stabilization of its water extraction properties and the maintaining of reduced friction, by positioning a wear-bearing insert therein in a different location than has been proposed in the prior art so that it forms the front region of the trailing surface immediately adjacent to the crease line.

Thus, it is an object of the present invention to produce a hydrofoil blade having improved wear characteristics.

Another object of this invention is to produce a hydrofoil blade having improved wear resistance and a reduced tendency to abrade the associated forming medium.

Yet another object of this invention is to produce a hydrofoil blade having improved wear characteristics that is structurally more simple and less costly to produce than prior art devices.

SUMMARY OF THE INVENTION

The desired objectives may be achieved through use of the present invention in which a hydrofoil blade in a papermaking machine having a trailing surface which diverges downward from its top surface substantially along the crease line, which trailing surface is characterized by being formed from a wear-bearing material

at least throughout that portion that is adjacent said crease line. Other features and objects of the present invention will be apparent to those skilled in the art from the brief description which follows and from the accompanying drawings in which

FIG. 1 depicts a prior art device;

FIG. 2 depicts an enlarged view of a portion of FIG. 1;

FIG. 3 depicts one embodiment of the present invention; and

FIGS. 4A, 4B, and 4C depict other embodiments of the present invention.

Referring first to FIG. 1, there is illustrated a hydrofoil blade **10** which typically has a main body portion **12** made from plastic materials, such as high-density polyethylene or other easily formable material having the requisite thermal and chemical properties desired for use in the forming section of a papermaking machine. Hydrofoil blade **10** comprises a top surface **14**, and a leading surface **16** positioned at the front; i.e., toward the direction from which the forming medium comes when the machine is in normal use. The leading surface **16** usually is at an acute angle to the top surface **14** to perform a doctoring effect. Hydrofoil blade **10** also includes a trailing surface **18** which diverges from the top surface **14** along the crease line **20**. As proposed in the prior art, there is depicted in FIG. 1 a wear-bearing insert **22** positioned at the rear of the top surface **14** for the purpose of imparting improved wear properties primarily along the rear of the top surface **14**, up to the crease line **20**.

Referring next to FIG. 2, there is depicted an enlargement of a portion of the device shown in FIG. 1 in the region of the wear-bearing insert. In FIG. 2, there is also depicted a forming medium **26**, such as a fourdrinier wire or a forming fabric such as a Form-Fab® fabric as produced by the Formex Company Division of Huyck Corporation in Greeneville, Tenn. As shown in FIG. 2, the region of vacuum **28** between the trailing surface **18** and the underside of the forming medium **26** tends to cause the forming medium **26** to deflect downward past the crease line **20** and to "crown" or bow upward immediately in front of the crease line **20** in the rear region of the top surface **14**. Thus, as will be apparent from FIG. 2, where, as proposed in the prior art, a wear-bearing insert **22** of ceramic or other suitable material is positioned at the rear of the top surface **14**, the direction of wear induced by the abrasive effect of the associated forming medium will be such as to cause the front portion of the trailing surface **18** to "dish" progressively so that the forming medium **26** increasingly will be subjected to abrasion over the corner of the wear-bearing insert **22** forming the crease line **20**. It will be obvious from this that undesirable abrasion and deterioration of the forming medium will consequently result.

Turning now to FIG. 3, there is depicted an embodiment of the present invention. It should be noted in FIG. 3 that, in contra distinction to the prior art, in accordance with the present invention, a wear-bearing insert made from suitable materials such as ceramics, tungsten carbide, and the like, is so positioned that it forms the front region of the trailing surface **18** with its foremost edge forming the crease line **20**. In this context "wear-bearing" means any material having greater abrasion resistance and/or reduced friction properties than the material from which the main body of the hydrofoil blade is produced, in any of a variety of forms, including coatings, inserts, etc. Thus, it will also be apparent from FIG. 3 that deflection downward of the forming medium **26** by the dynamically induced suction in the region **28** will cause the forming medium **26** to address the region of the trailing surface formed by the wear-bearing insert **22** in a substantially contiguous planar relationship throughout the region of coextensive contact of one with the other. In view of this, it will be apparent that the wear-bearing insert **22** may, through the practice of the present invention, be utilized to maximum effectiveness to reduce wear and friction while at the same time minimizing exposure of any sharp corners of the wear-bearing insert **22**, such as that forming the crease line **20**, which will tend to abrade and, therefore, deteriorate the forming medium **26**.

Although in FIG. 3, the wear-bearing insert is depicted as having an inverted dovetail cross-section, it will be apparent from FIGS. 4A, 4B, and 4C that a wide variety of other shapes may be utilized to advantage in producing the wear-bearing inserts. Thus, for example, in FIG. 4A, there is depicted an elongated wear-bearing insert that may be accommodated in a slot in the hydrofoil blade that is made by the simple expedient of sawing or otherwise routing out. FIG. 4B depicts a wear-bearing insert that is somewhat wider than that shown in FIG. 4A which may be used advantageously where wider regions of wear are encountered. FIG. 4C depicts a wear-bearing insert in the form of an inverted "T" which, by virtue of the extended wings of the T, will tend to impart improved stability against "rocking" to the wear-bearing insert.

It is to be understood that the accompanying drawings and the foregoing description is by way of illustration and not of limitation and that the present invention may be practiced in a wide variety of ways other than those herein specifically enumerated without departing materially from the spread and scope of the invention. More particularly, it should be understood that in the practice of the present invention, the wear-bearing insert need not be positioned originally exactly at the crease line, but may be removed from it a short distance.

We claim:

1. A paper machine hydrofoil blade having a top surface, and a trailing surface which diverges downward from said top surface along a crease line, said hydrofoil blade being characterized by having a wear-bearing insert that forms said traling surface at least throughout that portion which is adjacent to said crease line; but forms no part of said top surface adjacent said crease line.

2. The device described in claim **1** wherein said insert in cross-section is elongated and the longest dimension extends in a direction normal to said trailing surface.

3. The device described in claim **2** wherein said trailing surface is flat planar.

4. The device described in claim **3** wherein said insert is ceramic.

5. The device described in claim **1** wherein said top surface is flat planar.

6. The device described in claim **5** wherein said insert in cross-section is elongated and the longest dimension extends in a direction normal to said trailing surface.

7. The device described in claim **6** wherein said trailing surface is flat planar.

8. The device described in claim **7** wherein said insert is ceramic.

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U.S. Cl. X.R.

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