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3,392,919

WATER KNIFE

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FIG. 1

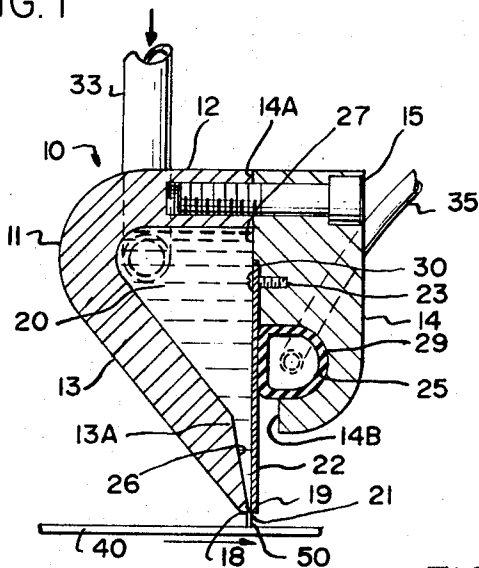


FIG. 2

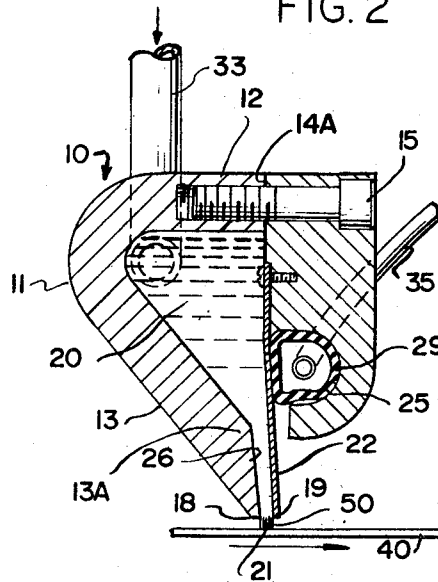


FIG. 3

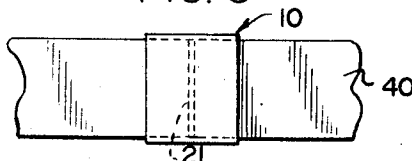


FIG. 4

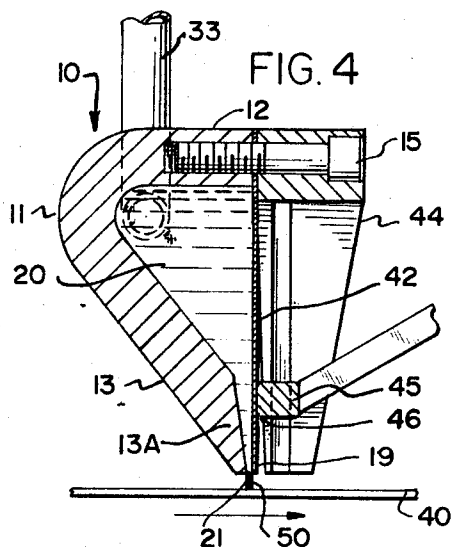
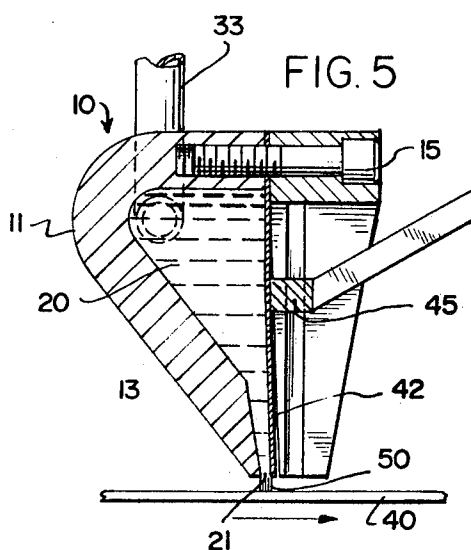


FIG. 5



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1

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WATER KNIFE

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ABSTRACT OF THE DISCLOSURE

A water knife having an elongated chamber for receiving liquid under pressure, a throat section with two spaced lip portions on the throat section wherein one of the lip portions is formed by a flexible blade, the improvement which comprises providing an adjustment means for positioning the flexible blade by means of a pressure bar movable along the blade in a select spacial relationship relative to the free edge of the blade such that the bar is movable along a guide way substantially parallel to the blade to provide an adjustable fulcrum for said blade.

The present invention relates to an apparatus adapted to deliver a stream of water or other liquid, and more particularly to an improved form of water knife or nozzle capable of delivering a uniform, relatively thin, elongated stream or sheet of water or other liquid of relatively non-divergent form.

During the processing of textile materials it is frequently necessary to apply a liquid in continuous, even, manner to a moving sheet of material. One purpose of providing liquid to such material is to uniformly wet the material prior to subjecting the material to heat or other material processing means, so that any shrinkage of the material may be uniform throughout the material.

Heretofore, known devices, so-called "air doctors," have provided means for applying a stream of air onto a moving sheet of material. However, such prior art devices are not entirely satisfactory for applying a stream of liquid to the moving material.

Accordingly, it is a principal object of the present invention to provide a nozzle or water knife yielding a thin stream of liquid of relatively wide width, which stream is relatively even in pressure and density along its width.

It has been found that the shape of the stream of liquid delivered by the nozzle or water knife is, in general, dependent in part upon the shape of the throat and orifice of the water knife, and upon the operating pressures.

Accordingly, it is another object of the present invention to provide a water knife having an improved throat and orifice for providing an even, controlled stream of liquid.

It is yet another object of the present invention to provide a nozzle wherein the opening of said orifice can be accurately and conveniently controlled to provide a thin, uniform stream of liquid.

The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of preferred embodiments of the invention, as illustrated in the accompanying drawings.

FIG. 1 is a view partly in cross section of a water knife in accordance with the invention showing the knife adjusted to provide a relatively thin stream of liquid;

FIG. 2 is a view partly in cross section of the water knife of FIG. 1 adjusted to provide a relatively broader stream of liquid;

FIG. 3 is a plan view of the water knife in position to provide a stream of liquid to an associated moving material;

FIG. 4 is another embodiment of the invention includ-

2

ing a movable bar for controllably positioning the blade and showing the blade adjusted to provide a thin stream of liquid; and

FIG. 5 is a view partly in cross section of the embodiment of FIG. 4 showing the blade adjusted to provide a relatively thick stream of liquid.

Referring to FIGS. 1 and 2, the present invention comprises an apparatus or assembly 10, herein referred to as a water or liquid knife, including a casing 11 which forms a plenum chamber 20. As seen in the cross sectional view of FIGS. 1 and 2, the casing 11 may be considered to have an inverted L-shape, as oriented in the figures, with the left-hand sidewall 13 of the L-shape being angled inwardly toward the opposite sidewall 14, and a top portion 12 being in a relatively horizontal plane. The opposite sidewall 14 extends substantially vertically downwardly and is relatively shorter in length than sidewall 13.

The upper edge 14a of the sidewall 14 is affixed to the top portion 12 by suitable bolts 15. The lower edge 14B of the sidewall 14 stands free, and in spaced relationship from the lower portion 13A of sidewall 13. The top portion 12, left sidewall 13 and right sidewall 14 form a relatively elongated plenum chamber 20 of a progressively decreasing cross sectional area forming a throat portion and terminating in complementary lips 18 and 19 which define a discharge orifice 21, as will be explained in more detail hereinafter.

The interior surface of sidewall 13 is beveled as at 26, and the edge of the beveled surface defines one lip 18; and, the other lip 19 is formed by a so-called "doctor" or "water" blade 22 affixed to the interior surface 27 of sidewall 14. The blade 22 is flexible under pressure for purposes to be described. Suitable bolts 23 engage the top edge 30 of the blade 22, and the blade extends downwardly along the interior surface 27 of sidewall 14. The blade 22 thus, in effect, forms a portion of one side of the plenum chamber 20. The lower edge of the blade 22 is positioned to be juxtaposed to, and even with, the lower edge of sidewall 13 to define the orifice therebetween. Note that the apparatus or assembly 10 has the same configuration throughout its width and that the assembly 10 extends completely across the width of the material 40 to be processed, as shown in FIG. 3. Thus, as best shown in FIG. 3, the orifice 21 extends across the width of the material 40 to provide a uniform stream of liquid 50, of uniform non-divergent character, across the material; an orifice 21 is indicated by the dotted lines labeled 21 in FIG. 3.

The sidewall 14 includes a recess 25 formed on its interior surface 27; an inflatable tube or hose 29 is inserted in the recess 25 and held therein by the blade 22 mounted on the sidewall 14, and may be secured therein as by suitable adhesive means.

A conduit 33 provides water or liquid under a selected pressure to the plenum chamber 20; while a single water inlet conduit 33 is shown, it will be appreciated that multiple inlets could likewise be conveniently provided. The liquid or water thus provides a pressure to the side of blade 22 contiguous to the chamber 20 and tends to flex the blade 22 relatively outwardly to form a relatively larger orifice 21. A conduit 35 provides air under pressure to inflate the hose 29 and provide pressure to the blade 22 on the side of the blade remote from said chamber and tends to maintain the blade 22 in position to form a relatively smaller orifice.

Thus, the water knife of the invention applies a uniform, non-divergent stream of liquid 50 onto the material. The thickness of the stream 50 provided by the orifice, and hence the amount of water or liquid provided to the sheet of material, which should be applied to the material may be different for each operating condition and type of textile material. The flexible water blade 22

3

performs like a leaf spring and the water pressure within the plenum chamber 20 can be controlled or balanced by the air pressure within the hose 29. Since the pressure in the liquid is the same at all points, the flexible blade 22 provides an orifice 21 having a uniform opening or spacing over the entire width of the water knife assembly 10. The inventive apparatus thus enables the size of the orifice to be set to establish proper liquid flow conditions for each type of textile material, as well as providing a uniform stream of liquid across the entire width of the material.

The doctor blade 22 is arranged to be physically separated from the edge of the wall 13 at all water pressures. Accordingly, the gap or spacing between the blade and the edge of the wall 13, which forms the orifice, depends on the pressure differentials produced by the water pressure acting on one side of the blade 22 and the air pressure reacting on the opposite side of the blade 22. The required pressure may be empirically or mathematically established.

A second embodiment of the invention is shown in FIGS. 4 and 5. In this second embodiment of the invention a bar is moved along the guideway to exert a pivoting pressure on the water blade 42 at different positions on the blade to control the amount of pressure which the water blade is exerting against the water pressure at the orifice. The concept or principle of the embodiment of FIGS. 4 and 5 is similar to the embodiment of FIGS. 1 and 2. The principal difference in the two embodiments is the means for adjusting the reactive pressure. Similar numerical characters in FIGS. 4 and 5 refer to the similarly numbered elements shown in FIGS. 1 and 2. Note, for example, that the top portion 12 and sidewall 13 of FIGS. 4 and 5 are similar to the top portion 12 and sidewall 13 shown in FIGS. 1 and 2.

In FIGS. 4 and 5 a sidewall portion 44 is affixed to the top portion 12 in a similar manner as sidewall 14 is affixed to portion 12 in FIG. 1. In the embodiment of FIGS. 4 and 5, a doctor blade 42 is affixed to the top portion 12 by means of the bolts 15 passing through appropriate holes in the top edge of the blade 42. The blade 42 extends downwardly, similar to FIG. 1, to position adjacent the tip of the lower edge 13A of sidewall 13. The sidewall 44 includes a movable or vernier adjustable pressure bar 45 mounted on a guideway 46 formed on sidewall 44. The guideway 46 is substantially parallel to the blade 42, and the bar is movable along the guideway to any desired position. The inner edge of the bar 45 abuts against the doctor blade 42 and forces the blade away from the inner surface 47 of the sidewall 44 to a position tending to close the orifice 21. The bar 45 thus provides a fulcrum point about which the blade 42 may be flexed to determine the size of the orifice 21 opening.

As shown in FIG. 4, when the bar 45 is positioned

4

downwardly, to be close to the orifice 21, the bar 45 pushes the free end of the blade 42 to a close position tending to narrow the orifice opening, thus providing a relatively thin stream of liquid 50.

Accordingly, dependent on the position of the adjustable bar 45 and the pressure in the plenum chamber 20, the opening of the orifice 21 and size of the stream of liquid 50 can be adjustably controlled. Thus, when the bar 45 is adjusted to a position as shown in FIG. 5, the fulcrum point effected by the bar 45 will be spaced a greater distance from orifice 21 and the blade 42 can be flexed with less force or pressure and the relative size of the stream will be increased. The pressure bar 45 can be moved either manually or by pneumatic means to provide a different effective pressure at the orifice 21.

It should be noted that the structure of the invention can likewise be advantageously used for dispersing a powdered material onto the surface of material being processed.

While the invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention.

I claim:

1. An apparatus for producing a relatively thin, elongated, substantially non-divergent stream of liquid comprising, in combination:

- (a) an elongated chamber for receiving liquid under selected pressure;
- (b) a throat section coextensive with said chamber;
- (c) two spaced lip portions opposite throat section for providing a discharge orifice for said chamber;
- (d) at least one of said lip portions being formed by a flexible blade arranged to have relative movement with respect to said other lip portion whereby the size of the orifice may be adjusted; and
- (e) an adjustment means for positioning said flexible blade comprising a flexible bar movable along said blade to be in selected spaced relationship relative to the free edge of said blade, said bar being movable along a guide way substantially parallel to said blade to provide an adjustable fulcrum for said blade.

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