United States Patent [19]

Pleines

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[54] DEVICE FOR APPLYING A SELECTED MOISTURE CONTENT TO A WEB MADE OF A FIBROUS MATERIAL

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[52] **U.S. Cl.** **239/341,** 239/416, 162/310

[51] **Int. Cl.** **B05b 7/32**

[58] **Field of Search**.....162/265, 310; 118/325; 239/303–308, 424, 341, 405, 406, 416; 134/64, 122

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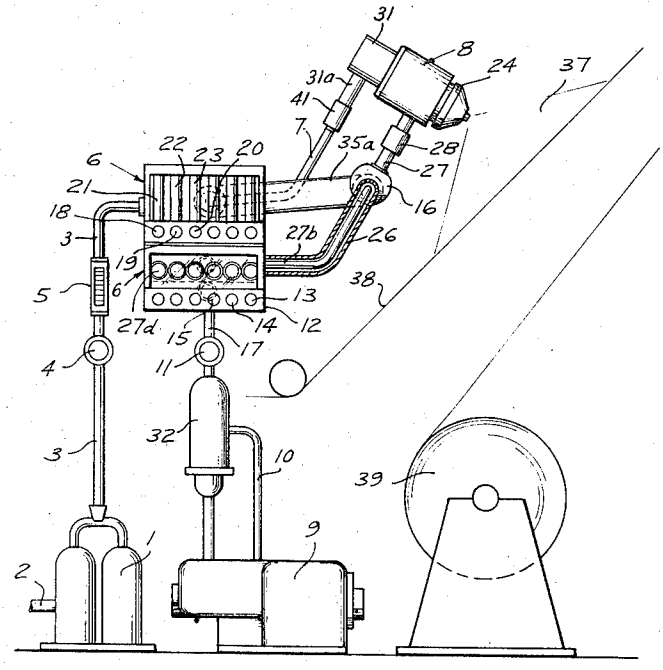
[57] **ABSTRACT**

A dampening device applies a selected moisture content to a fibrous web such as a paper or textile web by spraying liquid in nebulized form upon the web. Solid, liquid or gaseous additives may be included in the stream of nebulized liquid at selected proportions. The liquid and the additives, if any, are nebulized by feeding flows of liquid plus additives, if used, and air to spray nozzles which nebulize the liquid by the action of the air flows and direct cones of nebulized liquid upon the web in uniform distribution and at a minimum impact pressure thereby effectively avoiding spotting, discoloration and excessive moistening of the web material.

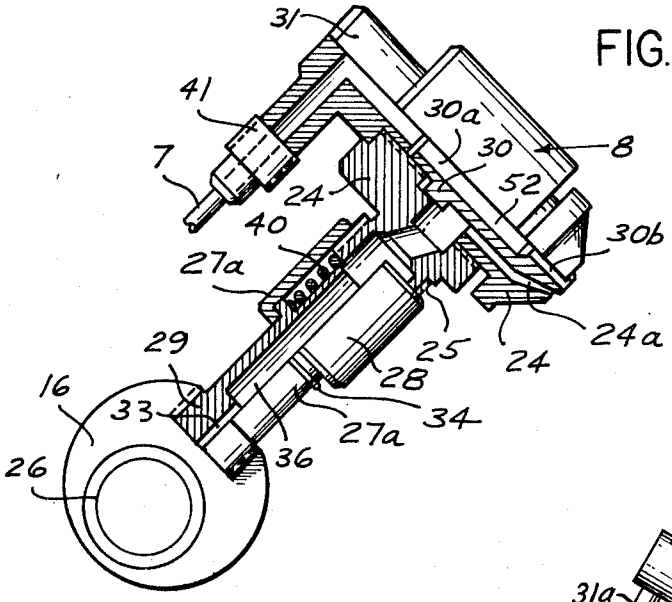
6 Claims, 6 Drawing Figures



Patented May 29, 1973 3,735,929

2 Sheets-Sheet 1

FIG. 1



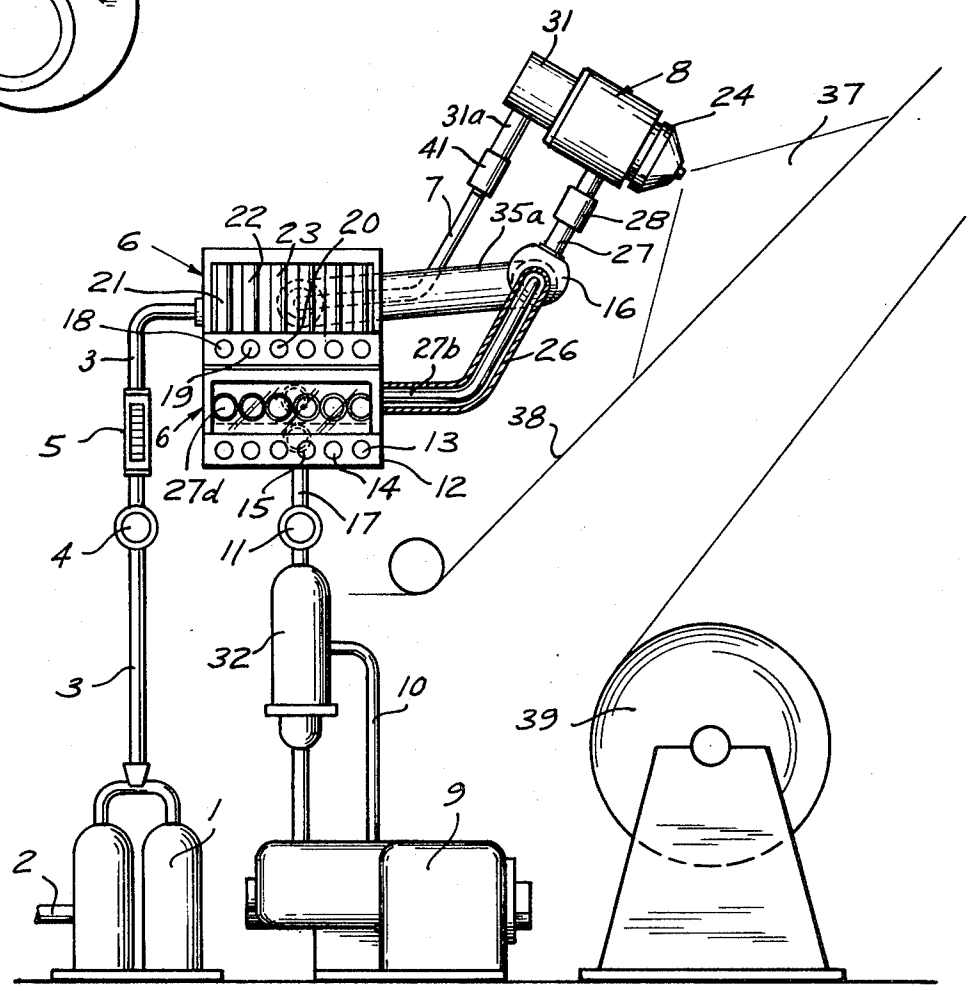


FIG. 2

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FIG. 3

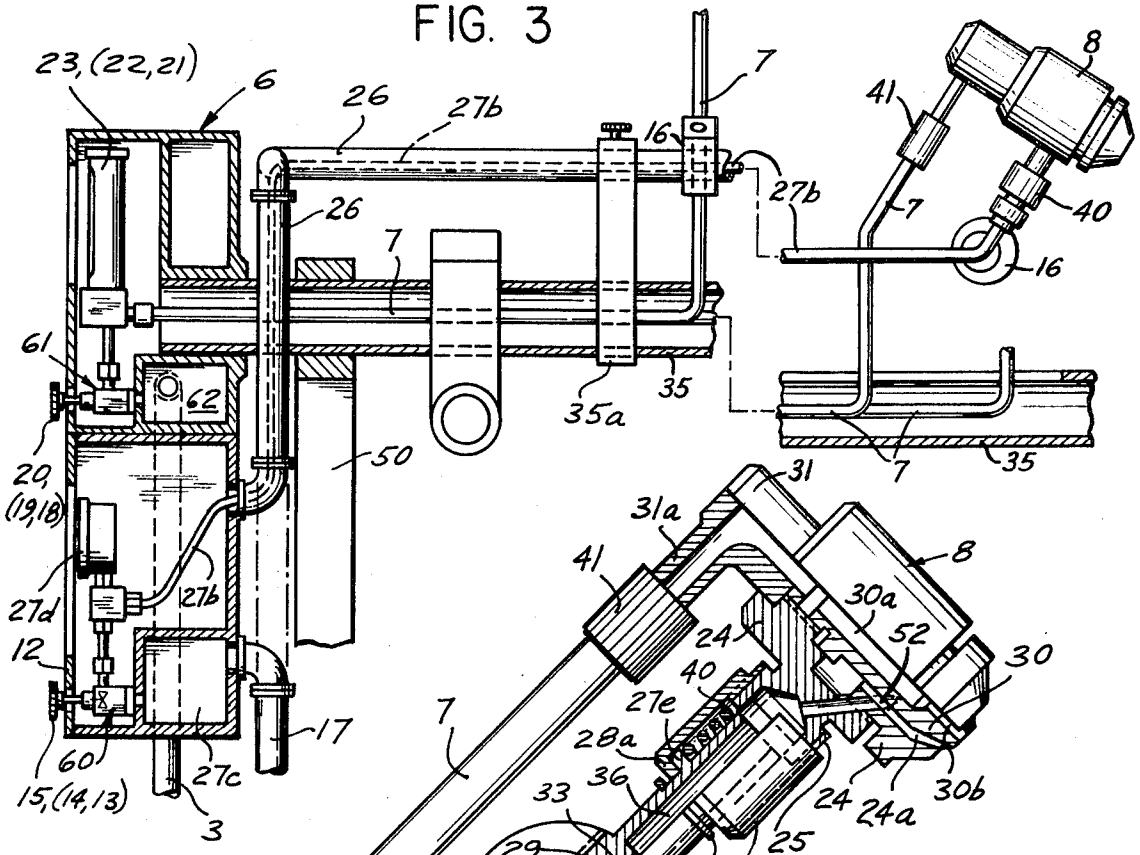

FIG. 4

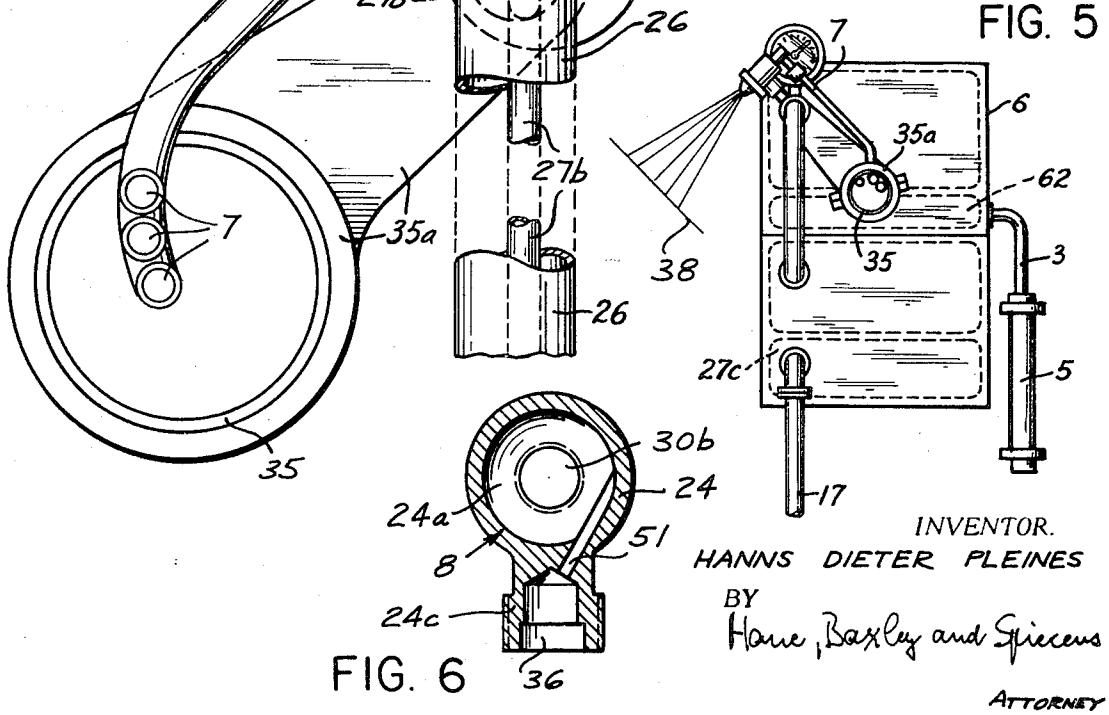

FIG. 5

FIG. 6

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DEVICE FOR APPLYING A SELECTED MOISTURE CONTENT TO A WEB MADE OF A FIBROUS MATERIAL

The invention relates to a dampening device for applying nebulized or atomized liquid upon a web made of fibrous material such as paper, cardboard, textiles, etc., and more particularly, to a dampening device of this kind for applying a selected moisture content to a web conveyed along a path intersecting sprays of nebulized liquid. The term "web" as used herein is intended to encompass a continuous web and also a web formed by successive sheets.

BACKGROUND

There are known dampening devices of the general kind above referred to which comprise two or more spray nozzles which are disposed in a row transverse of the conveying direction of the web to be moistened. The purpose of devices of this kind is to control the moisture content of the web, such as a paper web, so that the tendency of such webs to become more or less wavy, especially along the edges, is counteracted or at least reduced. Moreover, moistening of the paper also serves to smooth the surface of the material by pressing loose and possibly protruding fibers into slight depressions normally present in the surface so that such fibers become embedded in such impressions and thus fill the same. In other words, it is desired that all the fibers of which the material is composed are within the surface plane of the material.

Moistening of fibrous webs is also an important part of the process steps used for calendering or glazing the surface. While moistening can be effected by using pure water as spray medium, it is often advisable to add special fillers and other substances to the water as it is well known in the art. Such additives produce on a fibrous web such as a paper web the glaze or gloss which is desired and often required in practice on paper, cardboard, packaging material, etc.

As it is well known, application of the moisture must be effected very carefully and in nebulized or atomized form, as otherwise finished paper or other fibrous material will show surface spotting or dulling. Excessive moistening also results in sponginess of the material and thus in correspondingly reduced strength. Moreover, application of moisture without sufficient nebulization or atomization of the spray medium may cause spattered surfaces and formation of stripes. As it is evident, all such surface defects reduce the market value of the finished product and may even result in waste of the produced paper.

It has been proposed to use very large calenders to prevent the afore described faulty application of moisture. However, the use of large calender units requires correspondingly large space and also accessories to an extent which is often not commercially acceptable. Wear and tear is increased: service and repair costs are also increased and the temporary stopping of a large unit causes a correspondingly large loss of production.

There are also known dampening devices which direct a forceful stream of liquid spray medium upon the web to be moistened. The resulting forceful impact of the liquid, often in the form of rather large drops, upon the web tends to cause the afore indicated surface detects and, hence is not satisfactory in practice.

THE INVENTION

It is a broad object of the invention to provide a novel and improved dampening device of the general kind above referred to by means of which the desired moisture content can be sprayed upon a fibrous web such as a paper, cardboard or textile web in finely nebulized or atomized form and at a minimum impact pressure, thereby avoiding the afore pointed out disadvantages of conventional devices which direct the liquid spray medium upon the web at considerable force.

Another important object of the invention is to provide a novel and improved dampening device of the general kind above referred to which permits inclusion of additives such as chemical additives in gaseous or liquid form at selected proportions in water sprayed upon the web in nebulized or atomized form.

Still another important object of the invention is to provide a novel and improved dampening device of the general kind above referred to which includes a plurality of spray nozzles arranged in a row transverse of the path of travel of the web to be moistened and individually controllable, thereby assuring that the entire width of the web is continuously and uniformly moistened to the selected extent.

SUMMARY OF THE INVENTION

The afore pointed out objects, features and advantages, and other objects, features and advantages which will be pointed out hereinafter, are obtained by providing a dampening device which comprises one or more spray nozzles each including a first duct for a spray medium in liquid form and a second duct for a spray medium in gaseous form. Each of the ducts terminates at one end in a nozzle opening, the nozzle opening of the second duct encompassing the nozzle opening of the first duct so that liquid emanating from the nozzle opening for the liquid is mixed with the air flow emanating from the second nozzle opening thereby forming a solid spray cone of finely nebulized liquid.

Liquid and pressurized air are supplied to the ducts for each nozzle through conduits connected to suitable sources of supply. Chambers included in the conduits connected to the spray nozzles for supplying liquid thereto serve to provide a supply of liquid in substantially pressure-free condition so that the moisture forming the streams of nebulized liquid reach the web at a minimum pressure.

A plurality of spray nozzles is preferably arranged in a row transverse of the path of travel of the web to be moistened, and a control panel is provided by means of which the streams of nebulized liquid emanating from the nozzles can be individually regulated. The control panel further includes means for supplying suitable and conventionally used additives to the streams of nebulized liquid at selected and adjustable proportions.

DETAILED DESCRIPTION OF THE INVENTION

In the accompanying drawing, a preferred embodiment of the invention is shown by way of illustration and not by way of limitation.

In the drawings:

FIG. 1 is a lengthwise view, partly in section, of a spray nozzle as included in the dampening device according to the invention;

FIG. 2 is an elevational diagrammatic view of the dampening device:

FIG. 3 is a sectional elevational view of a control panel for supplying additives at selected proportions;

FIG. 4 is an enlarged view, partly in section, of an assembly for supplying liquid to the spray nozzles;

FIG. 5 is a diagrammatic view of an assembly for supplying air to the spray nozzles; and

FIG. 6 is a sectional fragmentary view of a nozzle.

Referring now to the figures more in detail, it should first be pointed out that while only one spray nozzle and the conduits connected thereto are shown in detail, the device generally includes several such spray nozzles disposed in a row across the path of travel of a paper web to be moistened and each connected to the necessary conduits, the flow of spray media to the nozzles being individually controllable, as will be more fully described hereinafter.

The dampening device as exemplified serves to apply the desired moisture content, with or without the use of additives, to a web such as a paper web **38** continuously withdrawn from a supply drum **39** at a required and substantially constant speed. The web is guided past spray nozzles **8** of the device, as it is clearly shown in FIG. **2**. The transport and the guidance of the web do not constitute part of the invention, and are hence not shown in detail.

Turning now to the dampening device itself, the device comprises a filter **1** to which liquid, usually water, is supplied through a pipe **2** which should be visualized as being connected to a suitable source of water. Filter **1**, which is presumed to be conventional, is connected by a pipe **3** including a manometer **4** and a flow meter **5** to a control panel **6**, which will be more fully described hereinafter. The panel, in turn, is connected by pipes **7** to spray nozzles **8** for supplying liquid thereto. As previously stated, and as also shown in FIG. **4**, several such pipes **7**, which may be made of rubber or plastic, extend from the control panel, one for each nozzle in the row.

The dampening device further comprises an air compressor **9**, which is connected by a pipe **10** to a collector **32**, which may and generally does include an air filter.

A tubular bracket **35** is secured to the frame structure **50** of the device. The bracket supports control panel **6** and an arm **35***a* which in turn, mounts a connector **16** for each of the spray nozzles.

The collector **32** is connected to a pipe **17** which, in turn, is connected to an air chamber **27***c* in control section **12** as is clearly shown in FIG. **2**. The chamber is connected via pipes **27***b* and a manometer **27***d* to spray nozzles **8**. The flow of pressurized air and gaseous additives, if any, through pipes **17** is controlled by means of control buttons **13, 14** and **15** and valves **60** associated therewith.

Water and liquid additives are supplied to spray nozzles **8** via pipe **3**, a chamber **62** and pipes **7**. The flow of water and liquid additives is controlled by means of buttons **18, 19** and **20** on control panel **6**. These buttons and associated valves **61** individually controllable by the buttons for each nozzle selectively direct the flow of the water into gauges **21, 22** and **23** of the kind permitting visual observation of the level of liquid therein. While the air supplied to the spray nozzles is under pressure the spray water and liquid additives are practically without pressure. Accordingly, distribution of liquid as sucked off by the pressurized air in pipe **17** and directed by the spray nozzles **8** upon paper web **38** is at minimum pressure, as desired.

The respective end of each expansion sleeve is threaded into a threaded bore **29** of the respective connector **16**. Each nozzle **8** comprises an inner member **30** which defines a duct **30***a*. One end of this duct is connected by an extension **31** and a threaded sleeve **41** to the respective liquid carrying pipe **7** while the other end terminates in nozzle opening **30***b*. An outer member **24** encompasses inner member **30** and defines in conjunction therewith a nozzle opening **24***a* for pressurized air and gaseous additives, if any. Nozzle opening **24***a* which has a circular cross section coaxial with nozzle opening **30***b* for liquid, encompasses nozzle opening **30***b* and is connected with a space **36** within an expansion sleeve **27***a* via one or more tangentially directed grooves **51** in the inner wall of outer spray nozzle member **24** as it is best seen in FIG. **6**. As a result, a rotational movement is imparted to the gaseous media as the same emanate from nozzle opening **24***a*.

As stated before, each spray nozzle **8** is mounted on a connector **16** by means of the expansion sleeve **27***a* which, in turn, is secured to a threaded extension **25** of outer member **24** of the respective spray nozzle by a threaded sleeve or cap **28**.

Air pipe **17** and pipes **27***b* for additives as supplied from control section **12** connect to a tubular carrier **26** supported by arm **35***a*. Pipes **27***b*, which may be hoses made of rubber or a pliable plastic, are disposed within carrier tube **26** as it is clearly shown in FIG. **3**. Tube **26** is connected to expansion space **36** through a narrow bore **33**. The volume of the expansion space can be reduced or enlarged by screwing cap **28** more or less upon threaded extension **25** of outer member **24** of spray nozzle **8** as it is best shown in FIG. **6**. A spring **40** disposed between cap **28** and sleeve **27***a* biases a shoulder **27***e* against a flange **28***a* of the cap so that the expansion space has the desired volume.

The device of the invention can also be operated without providing control section **12** in which case the air operated components therein and pipes **27***b* may be omitted. The air pipe **17** is then arranged as it is shown in FIGS. **2** and **3** in dotted lines, that is, it is directly connected to connector **16**. A simplified arrangement of this kind is sufficient for many purposes.

As it is now apparent, the spray nozzles are supplied with liquid spray medium and also with pressurized air with or without the admixture of additives. The location of the nozzle openings **24***a* and **30***b* relative to each other can be adjusted by axially displacing the outer nozzle member **24** relative to the inner member **30**. A screw connection **52** is provided for the purpose.

The connectors **16** are preferably disposed in a row mounted for instance, on tube **35**. The spray nozzles should be spaced so that the spray cones **37** emanating from the nozzle openings fully cover the area of web **38** but without marginal overlap as such overlap would cause the formation of larger drops.

The device of the invention permits application of moisture upon the web without or at least practically without pressure upon the surface of web **38**. The operation of the device is so simple that semi-skilled labor can be employed instead of highly trained correspondingly expensive specialists. The nebulization at a very low pressure of the sprayed water and the additives, if any, used for dampening the web produces, in effect a continuous film of water which prevents the formation

of stripes and dry area portions on the web. Moreover, the use of minute or even micro-sized water particles facilitates the penetration of the moisture into the web. It is well known in the art that spraying of comparatively large drops of water upon the web unavoidably results in a high percentage of wastage. Formation of comparatively large drops occurs when the spray cones are not oriented exactly in side by side relationship but overlap at the margins. Such overlap causes the droplets of adjacent cones to combine thereby becoming accordingly larger.

The carrier tube **26** and thus the pipes **17** and **27***b* therein and/or bracket **35** can be pivotally mounted so that the spray cones **37** can be conveniently adjusted for the operationally correct angle relative to the plane of web **38.**

Summing up, the water supply in gauges **21, 22** and **23** is practically without pressure. It is sucked out of the gauges by the rotation of the air flow as caused by grooves **51** when the air flow is forced through nozzle opening **24***a*. The sucked-on water is nebulized as it emanates from nozzle opening **30***b*. Due to the low air pressure in the spray nozzle the now nebulized moisture drops upon the web substantially only by gravity rather than by pressure, that is, the moisture floats upon the web. Moreover, the spray cones contain substantially the same percentage of moisture throughout their cross section while with dampening devices as now known the spray cone is a hollow cone. As is evident, the use of a cone containing substantially the same moisture content at its entire cross section produces the desired moistening of the web without formation of stripes or dry area portions thereon.

While the invention has been described in detail with respect to a certain now preferred example and embodiment of the invention, it will be understood by those skilled in the art, after understanding the invention, that various changes and modifications may be made without departing from the spirit and scope of the invention, and it is intended, therefore, to cover all such changes and modifications in the appended claims.

What is claimed is:

1. A dampening device for applying a selected moisture content to a web made of a fibrous material, said dampening device comprising in combination:

at least one spray nozzle including a first duct for a spray medium in liquid form and a second duct for a spray medium in gaseous form, each of said ducts terminating at one end in a nozzle opening, the nozzle opening of the second duct encompassing the nozzle opening of the first duct, said spray nozzle having an inner member defining said second duct and encompassing said inner member, said members being axially displaceable with reference to each other thereby correspondingly varying the stream of nebulized spray media as emanating from said nozzle openings;

first conduit means for connecting a supply of liquid spray medium to the other end of the first duct;

second conduit means for feeding a flow of gaseous spray medium to the other end of the second duct;

storage means included in the first conduit means for collecting therein a supply of the liquid spray medium substantially free of pressure;

control means included in said conduit means for controlling the supply of liquid in said storage means; and

an air expansion chamber included in the second conduit means for reducing in said chamber the pressure of gaseous spray medium passing through said second conduit to a pressure slightly above atmospheric pressure;

whereby the air flow emanating from the nozzle opening of the second duct sucks out liquid contained in said storage means and sprays the sucked-out liquid in nebulized form upon the web to be moistened.

2. The device according to claim **1** wherein said storage means comprise gauges providing for visible observation of liquid therein.

3. The device according to claim **1** wherein the second duct has a cross section encompassing the first duct and includes adjacent to its nozzle opening a portion tapered toward the juxtaposed portion of the first duct.

4. The device according to claim **3** wherein facing inner walls of said members include guide means imparting a rotary motion to the air flow emanating from the nozzle opening of the second duct.

5. The device according to claim **4** wherein said tapered duct portion has in a boundary wall an elongate groove slanted relative to the lengthwise axis of said tapered portion thereby imparting said rotary motion to the air flow emanating from the nozzle opening of the second duct.

6. The device according to claim **1** wherein adjustment means are provided for varying the volume of said expansion chamber, said adjustment means including members for selectively changing the distance between two boundary walls of said chamber.

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