United States Patent

[11] 3,589,031

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[54] **PAPER CONDITIONING APPARATUS**
1 Claim, 4 Drawing Figs.

[52] **U.S. Cl.** **34/122,** 34/114, 162/207
[51] **Int. Cl.** **F26b 11/02**
[50] **Field of Search** 162/359, 207, 290, 270; 34/148, 149, 151, 155, 161, 122

[56] **References Cited**
FOREIGN PATENTS
1,366,646 6/1964 France 162/207

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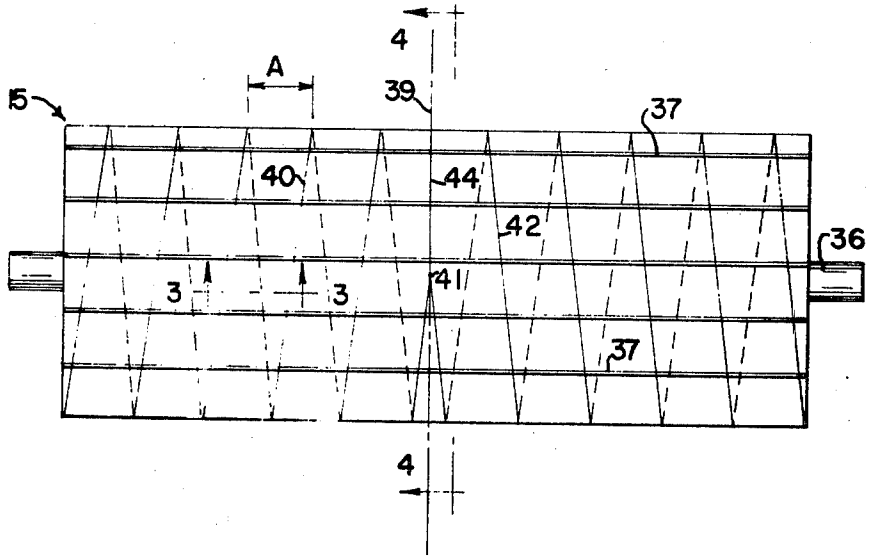
ABSTRACT: A drum, around which a paper web is passed in the paper conditioning apparatus, has its periphery defined by two wires wound helically outwardly in both directions from the center of the drum, the pitch of each helix being one-half inch. The diameter of each wire is three-sixteenths inch. This pitch and diameter relationship materially improves the efficiency of the conditioning apparatus when handling paper having a weight in the range of 30 grams per square meter to 200 grams per square meter.



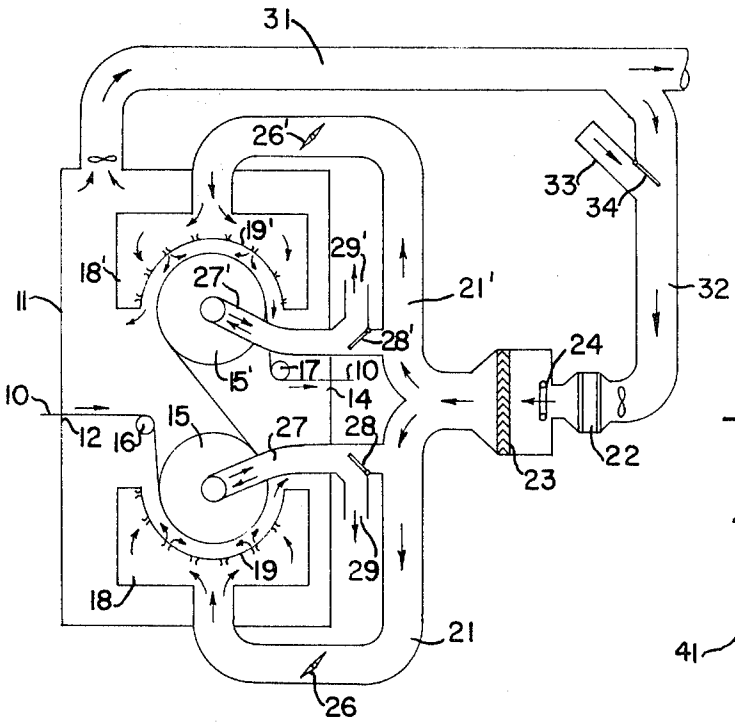


FIG. 1

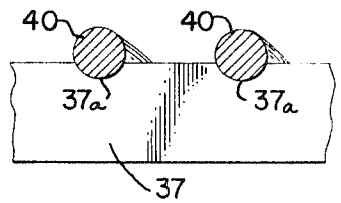


FIG. 3

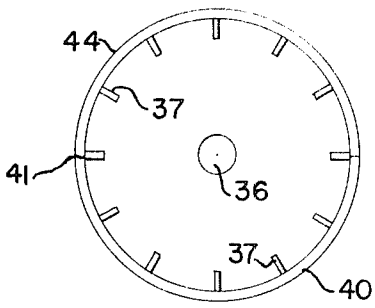


FIG. 4

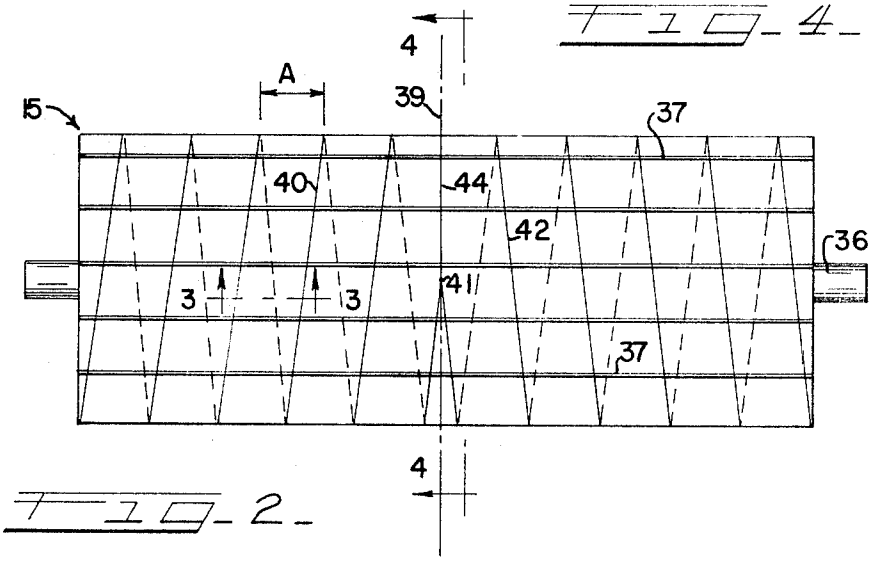


FIG. 2

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PAPER CONDITIONING APPARATUS

BACKGROUND OF THE INVENTION

In the process of making paper, it is generally known that as the paper web leaves the calender rolls of the paper-making machine, the web has an inherent tendency to curl. It is generally accepted that this inherent curl arises from stresses caused by differential shrinkage in the two sides of the web. This curl may be apparent immediately as the web leaves the paper machine, or it may be latent, occurring only when the web or sheet is later subjected to atmospheric conditions different from those of the manufacturing environment.

One means to relieve the paper web of its tendency to curl is the provision of a conditioning apparatus which receives the paper immediately after it passes from the calender rolls of the paper-making machine and which subjects the paper to controlled humidity conditions. The principle under which this conditioning apparatus functions may be analogized to that used in stress relieving of metal.

The paper conditioning apparatus includes one or more drums around which the paper web is passed. Associated with each drum adjacent the periphery thereof is a hoodlike structure through which air under pressure and at a predetermined moisture content is passed. The hood has an arcuate surface concentric with the drum, such surface including a plurality of apertures to direct the passage of the humidified air to the surface of the web as it is drawn over the drum. Preferably, at least two drums are employed and each driven such that the web is not under longitudinal stress as it passes from one drum to the other.

Subjecting the paper web to a controlled humidity condition for a given period of time encourages the web to expand in longitudinal and transvers e directions. After leaving the conditioner the paper is dimensionally stable in both directions for a given ambient air condition and therefore less susceptible to curl when late subjected to different atmospheric conditions.

The peripheries of the drums used in the aforementioned paper conditioning apparatus have been formed by helically wound wires. Unexpectedly, it has been found that the efficiency of the paper conditioning apparatus can be materially improved by providing each drum with a wire size and wire spacing having a certain dimensional relationship with each other depending on the weight of the paper being treated by the conditioning apparatus.

OBJECTS OF THE INVENTION

A primary object of the present invention is to provide a new and improved drum for a paper conditioning apparatus of the type described.

Another object of the invention is to provide a drum for a paper conditioning apparatus of the type described, wherein the periphery of the drum is formed by wires wound around the drum thereby defining a double helix, with the pitch of each helix and the diameter of the wires being of a certain dimensional relationship such that the efficiency of the associated paper conditioning apparatus is markedly improved.

Still another object of the present invention is to provide a new and improved drum of the type described for handling paper web with a weight in the range of 30 grams per square meter to 200 grams per square meter, wherein the periphery of the drum is formed by wires defining a double helix with the pitch of each helix being in the range of one-fourth to three-fourths of an inch and with the diameter of the wire being in the range of three thirty-seconds to nine thirty-seconds of an inch, thereby to encourage lateral spreading of the web for improved conditioning thereof.

These and other objects and advantages of the invention will become apparent from the following specification disclosing a preferred embodiment shown in the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic view of a paper conditioning apparatus in which the present invention is incorporated;

FIG. 2 is an elevational view (largely diagrammatic) of one of the drums embodying the present invention;

FIG. 3 is an enlarged section taken along line 3–3 of FIG. 2; and

FIG. 4 is a section taken along line 4–4 of FIG. 2.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring to FIG. 1, a paper web **10** passes directly from the calender rolls of a paper-making machine (not shown) and passed into the chamber **11** forming part of the paper conditioning apparatus. This chamber has an inlet **12** and an outlet **14** for the

Two drums **15**, **15'** of identical construction and adapted to be rotated at the same peripheral speed as the speed of the web **10** leaving the paper-making machine are mounted in the chamber **11**, one above the other, the web traveling around the lower part of the drum **15** and then around the upper portion of the drum **15'**. The web is guided from the inlet **12** to the drum **15** by a guide roller **16** and from the rum **15'** to the outlet **14** by a guide roller **17**.

Humidified air is applied to the surface of the web **10** as it passes around the drums **77** **15'** by respective pressure vessels **18** and **18'**. The pressure vessel **18** supplies humidified air to the bottom portion of drum **15** by being mounted in close relation with the lower peripheral surface of the latter. The vessel **18** has a semicylindrical, perforated surface **19** which is concentric with the drum and spaced a short distance therefrom. The humidified air under pressure is forced through these perforations and into contact with the web on the lower portion of the drum.

Similarly, the pressure vessel **18'** supplying the humidified air to the top drum **15'** surrounds the upper part of the peripheral surface thereof and has a semicylindrical, perforated face **19'** through which the air is blown.

The humidified air is supplied to the pressure vessels **18** and **18'** by suitable ducts **21**, **21'** from a common pump **22** and humidifying device **23** which may be provided with a heater **24**. Valves or dampers, such as the dampers **26**, **26'** are arranged in the ducts **21** and **21'**, respectively, for regulating the supply of humidified air to the pressure vessels.

Any air which passes through the web **10** is collected in ducts **27**, **27'**, connected to the interiors of respective drums. Dampers or valves **28**, **28'** are provided in these ducts to allow any air from the interiors of the drums to be recirculated through respective ducts **21**, **21'** or to be passed to atmosphere through ducts **29**, **29'**.

The humidified air which is collected in the chamber **11** passes outwardly therefrom to a duct **31**, the latter opening to atmosphere and also communicating with a duct **32** leading to the inlet of the pump **22** so that some of the air is recirculated to the latter. Fresh air is supplied to the duct **32** through another duct **33** controlled by a valve adapter **34**.

As mentioned above, the present invention has to do with the construction for forming the periphery of the drums around which the paper is passed in the paper conditioning apparatus. As the drums **15**, **15'** are of identical construction, only one drum, namely the drum **15**, will be described in detail.

Turning now to FIGS. **2** through **4**, the drum **15** will be seen to include a central shaft **36** and suitable framework (not shown) for supporting a plurality of axially extending bars **37** in circumferential spaced relation. A plane perpendicular to the longitudinal central axis of the drum and equidistant from the opposite ends of the latter is represented at **39**. The portion of the drum which contacts the paper web is defined by a first wire **40** wound helically toward one end of the drum from a point **41** contained in the plane **39** and on the periphery of the drum. In the embodiment shown for purposes of illustra-

tion, the wire **40** forms a helix with a pitch of one-half inch, this pitch being designated "A" in FIG. **2**.

The drum **15** is symmetrical with respect to the central plane **39**. Therefore, another wire **42** is wound helically outwardly toward the other end of the drum from the same starting point **41** as the wire **40**; the pitch of the helix formed by this wire is also one-half inch. Assuming certain conditions are met as will be explained below, the double helix arrangement just described tends to stretch the web laterally outwardly as it passes over the surface of the drum (as viewed in FIG. **2** the web would pass from top to bottom over the near portion of the drum).

It will be appreciated that after the wires **40**, **42** have progressed almost through 360° from the starting point **41**, the spacing between adjacent wire portions will be nearly 1 inch. In order to reduce the spacing between the wires at the central portion of the drum, a separate semicircular wire **44** is secured to the drum in the central plane **39** thereof, which wire starts at the point **41** and extends through 180° as best shown in FIG. **4**.

As noted in FIG. **3**, the bar **37** shown is provided with arcuate cutouts **37***a* for receiving the wire **40** obliquely thereto, i.e., obliquely with respect to an axial element of the drum. The notches serve to maintain various turns or windings of the wire **40** in uniform spaced relation. It will be understood the outer surfaces of the wire **40** are spaced outwardly from the outer portion of the bars **37** so that only the former come into contact with the paper web. It will further be understood that the connections between the bar **37** and wire **40** illustrated in FIG. **3** are typical of the other connections between the bars **37** and the wires **42**, **44**. Only opposite ends of the wires **40**, **41** and **44** need be fastened to the drum, as by welding for example. A single wire in the form of a helix therefore constitutes a preferred form as it results in a minimum number f such welded connections.

Practically all of the paper handled by the conditioning apparatus has a weight in the range of 30 grams per square meter to 200 grams per square meter. For paper web in this weight range, optimum results are achieved by the conditioning apparatus when the drum wires have a diameter of three-sixteenth of an inch with a helix pitch of one-half inch. When a drum having this wire size and this pitch relationship is used to handle paper in the weight range just mentioned, the paper, as it is subjected to a blast of humidified air when passing around the drums **15**, **15'** sags between adjacent wire portions sufficiently that high tensile stresses are not built up in the paper but the paper does not sag to such an extent that permanent creases are formed at the areas of contact between the wires and the paper web. It is believed that maintaining these two conditions contributes significantly to the improved results achieved when using a drum constructed in accordance with the present invention. It should be understood that the paper does not sag to an extent where it comes into contact with the axially extending bars **37**. It is believed this sag allows the drum to "bite" into the web for urging the same laterally and that this lateral spreading of the web is at least partially responsible for the improved results when using the drum according to the present invention.

It has been found that satisfactory results can be achieved in handling paper in the weight range of 30 grams per square meter to 200 grams per square meter by varying the wire pitch from one-fourth inch to three-fourth inch and by varying the diameter of the wires from three thirty-second inch to nine thirty-second. The space between adjacent wire portions depends of course not only on the helix pitch but also on the diameter of the wire. As suggested above, this spacing must be such that the web is allowed to sag between the wires to permit effective lateral spreading, but the amount of sag must be maintained within certain limits to prevent creasing and undesirable stress concentrations. Therefore, the pitch and wire diameter relationship is critical within the range mentioned for paper web in the 30—200 grams per square meter weight range with optimum results achieved with a one-half inch pitch and a three-sixteenth inch diameter.

While the invention has been shown in but one form, it will be obvious to those skilled in the art it is not to be so limited. On the contrary, the invention is susceptible of various forms and modifications without departing from the spirit and scope of the appended claims.

We claim:

1. In combination with an apparatus for conditioning paper web having a weight in the range of —30 grams per square meter to 200 grams per square meter, wherein the apparatus is of the type including at least one drum around which the web is passed, a pressure vessel mounted adjacent the periphery of the drum for forcing humidified air onto the web as it passes around the drum, the improvement comprising said drum having its periphery formed by wires wound helically around the drum from its center toward its opposite ends such that the drum is symmetrical with respect to a plane at the midpoint of the drum and perpendicular to the longitudinal central axis thereof, the pitch of each helix in respect to said longitudinal central axis being approximately one-half inch whereby said wires advance helically around said drum in opposite directions from its center so that with each revolution thereof said wires advance approximately an additional one-half inch from said center in a direction along the longitudinal axis of said drum, said wires each having a diameter approximately three-sixteenth of an inch.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,589,031 Dated June 29, 1971

Inventor(s) Whittaker et al

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 17, after the word "the" insert --web.--.

Column 2, line 24, the word "rum" should be --drum--.

Column 2, line 27, delete "77" and insert --15--.

Column 2, line 34, the word "lower" should be --lowermost--.

Column 3, line 34, "f" should be --of--.

Signed and sealed this 25th day of January 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

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