Feb. 4, 1969 J. M. KOFFSKEY, JR 3,425,901

PAPER MILL SUCTION BOX COVER

Filed Jan. 18, 1965 Sheet 1 of 2

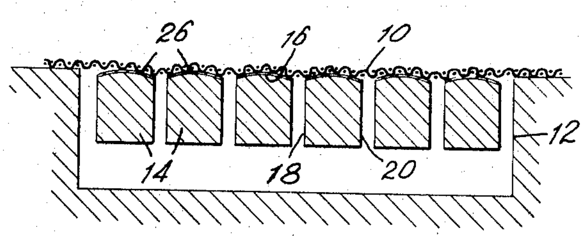

Fig. 1.

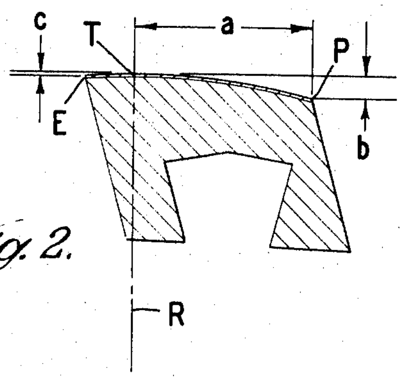

Fig. 2.

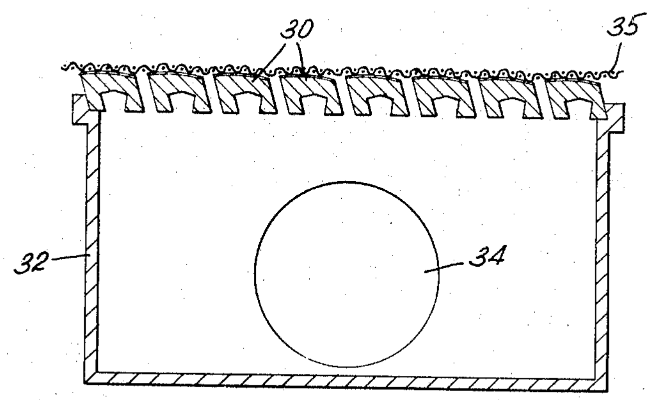

Fig. 3.

INVENTOR
JOHN M. KOFFSKEY, JR.
BY Dominic J. Ammirato
ATTORNEY

Feb. 4, 1969 J. M. KOFFSKEY, JR 3,425,901

PAPER MILL SUCTION BOX COVER

Filed Jan. 18, 1965 Sheet 2 of 2

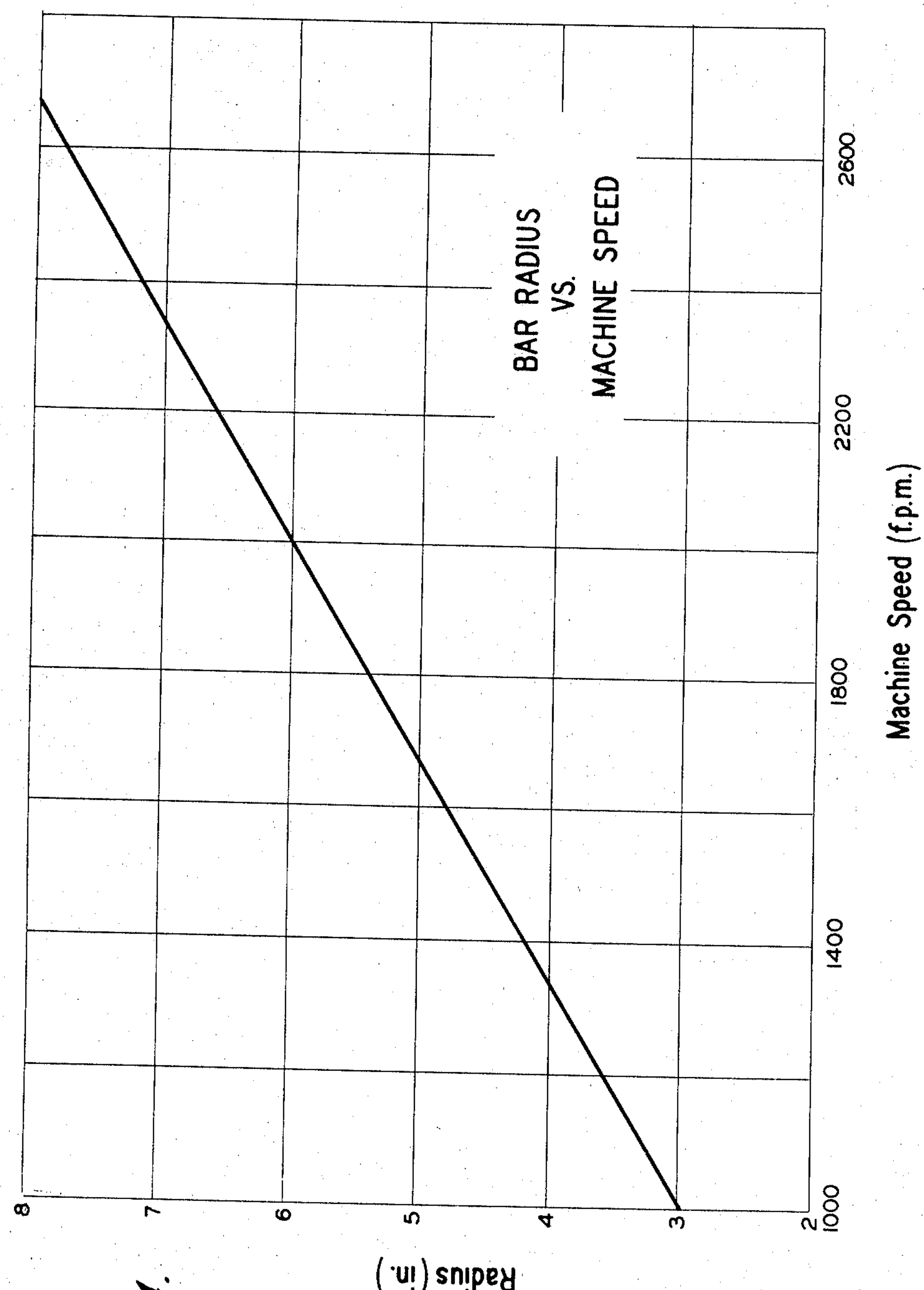

Fig. 4.

INVENTOR
JOHN M. KOFFSKEY, JR.
BY Dominic J. Termunello
ATTORNEY

United States Patent Office

3,425,901
Patented Feb. 4, 1969

1

3,425,901

PAPERMILL SUCTION BOX COVER

John M. Koffskey, Jr., Indianapolis, Ind., assignor to Union Carbide Corporation, a corporation of New York

Continuation-in-part of application Ser. No. 338,243, Jan. 16, 1964. This application Jan. 18, 1965, Ser. No. 426,112

U.S. Cl. 162—352 7 Claims
Int. Cl. D21f *1/48*

ABSTRACT OF THE DISCLOSURE

A stationary drainage element for use in a Fourdrinier papermaking machine is provided. The drainage element is fashioned with a curved surface having a radius of curvature ranging from 1 to 15 inches. In addition, the surface of the drainage element is asymmetrical with respect to the radius of curvature drawn to the highest point on the curved surface with the major portion of the curved surface being the trailing portion and the remaining surface being the leading portion when it is used to support the Fourdrinier wire in a papermaking machine.

This application is a continuation-in-part application of application Ser. No. 338,243 filed Jan. 16, 1964, now abandoned.

This invention relates to apparatus for improving and regulating the drainage of water from the wood pulp through a Fourdrinier wire in a papermaking machine. In another aspect, this invention relates to an improved suction box cover for use in papermaking machines.

In the preparation of wood pulp for ultimate use in paper, water has an important function in all the steps of pulp treatment from the moment that pulps are made until they are ready to be used in the finished product. Water acts as a conveyor for the fibers, holding them in suspension as the pulps are pumped from place to place while being sorted and treated. Finally, when no longer needed as a conveyor, the water is extracted in various ways.

One of the principal methods of extracting the water is to pass the pulp over a collecting conveyor so that the water can either fall or be "sucked" from the pulp. This conveyor normally consists of a wire belt or screen fabricated from copper wires, and is usually referred to as the Fourdrinier wire. This wire passes over hydrofoil elements and suction boxes at various designated points. A suction box is kept under a vacuum so that water in the pulp being carried by the wire can be readily "sucked out of" the pulp through the wire and cover of the box which has a multiplicity of holes or openings over which the wire passes. A hydrofoil can be essentially the same as a suction box but is usually placed at points where the water content is high so that a vacuum need not be applied to suck out water.

One of the major problems in papermaking machines of the Fourdrinier type is that the wire wears away and is deteriorated as it passes over the hydrofoil and suction box sections.

Under normal operation, the wire needs to be changed after about from 14–21 days due to the frictional forces imposed on such wire. When the pulp consists of ground wood (mechanical pulp) the life of the wire is reduced to 7–10 days because of the pressure exerted by the hard, sharp Al_2O_3 and SiC particles picked up by the pulp. Thus, much time is lost in either replacing the wire belt or repairing it.

Another factor, and perhaps the most important, in causing wear of the wire conveyor is the effect of the

2

vacuum tending to pull the wire into the holes or openings of the cover. This causes the wire to be bent over and to rub against the relatively sharp corners of the openings. To "round-off" these corners presents a very difficult if not impossible fabrication problem.

Various solutions have been presented in an attempt to solve this problem of conveyor wire deterioration. For example, the cover of the suction box has been fabricated of wood (end of grain maple). This has, for the most part, been unsuccessful because the wood rips and wears away. As another example, the cover has been made from a sintered SiC section. While this has been fairly successful, the cost of such sections is quite high.

The object of this invention is to provide a stationary drainage element which may be used as hydrofoils or form a cover for a suction box whereby drainage capacity is improved without increased damage to the Fourdrinier wire.

Another object is to provide a novel suction box including such elements.

A further object is to provide a cover for suction boxes used in papermills that will give a longer life to the wire belt that passes over the cover.

In the drawings:

FIGURE 1 is a vertical section showing drainage elements in a suction box;

FIGURE 2 is a cross section of a preferred drainage element;

FIGURE 3 is a schematic cross-sectional diagram of a suction box; and

FIGURE 4 is a graph of preferred radii of curvature vs. machine speed.

Generally speaking, the objects of the invention are accomplished by a stationary drainage element for a paper machine disposed in supporting relationship to the Fourdrinier wire and extending across the machine transversely of the direction of travel, said drainage element having a wear resistant coated curved surface with a radius of curvature of from about 1 to about 15 inches for speeds of such wire up to about 5000 feet per minute said curved surface being asymmetrical with respect to the radius of curvature drawn to the point of tangency between the wire and the surface which is the highest point on said surface such that the major portion of said surface is the trailing portion and the remainder being the leading portion.

It has been proposed to use cylindrical rods for suction box covers, but such rods have not been widely used. The principal reason for this lies in the fact that with round bars, a large percentage of the water being pulled from any given section of the pulp is sucked back into the wire and pulp as the section moves to the next bar. By having a properly radiused top surface, only so much water as is needed to lubricate the wire will be sucked back into it.

Another reason why the industry has not used the round bars lies in the required open area of the cover to the vacuum space beneath it. Ideally, a completely open top box is desired. This, however, cannot be achieved. In reality a 50% open area, although not the best, would be satisfactory. However, to achieve this with round bars leads to the problem of having the bars spaced quite far apart. This causes undue sagging of the wire. Again this leads to the problem of sucking the water back-in. In addition, because of the inherent steep gradient of the wire as it passes over the round bar, there is a strong tendency for the wood pulp to leave the wire as the wire passes over the bar.

The radius of curvature of the upper surface of the drainage element has been found to be critical. The primary function of the Fourdrinier machine is to form a sheet of paper by removing water from the stock placed on the Fourdrinier wire by the lead box. The perennial demand for greater production and reduced costs have required the paper industry to continuously increase the speed of their machines to remain competitive. This increase in speed is accompanied by two problems:

(1) Water drainage from the stock; and

(2) Wear of the Fourdrinier wire.

The water drainage problem can be solved on new machines by increasing the length of the machine but this is expensive and does not lead itself to the conversion of existing equipment. It is therefore necessary to increase the efficiency of the water drainage elements. It is the purpose of the curved top drainage element to accomplish the required efficiency, because it is known that for a given length of trailing portion given machine speed and given stock condition the volume of drainage is proportional to the trailing wedge between the wire and surface of the drain element. Although maximum water drainage is important, care must be taken not to cause turbulence in the stock which will disturb the formation of the sheet and cause poor quality paper. The radius of curvature of the top of the element is the determining factor in obtaining maximum drainage without turbulence and is dependent on several variables such as machine speed, element spacing, wire tension, stock consistency and, in the case of suction boxes, vacuum.

Thus, it has been found that at wire speeds of from 1000 feet per minute up to 5000 feet per minute the radius of curvature should be from 1 up to about 15 inches. As an example, at speeds of about 1000 feet per minute with stock consisting of about 3%, the radius of curvature of the drainage elements should preferably be about 3 inches when such elements are used on a suction box with the vacuum varying between 1 and 6 inches of mercury.

In addition to having a curved surface, the drainage elements should be asymmetrical with respect to the radius of curvature drawn to the point of tangential contact between the surface and the wire; this point should also be the highest point of the curved surface. See point T in FIG. 2. The trailing portion of the surface, that is where the wire leaves the surface, should be the major portion of the curved surface so that water turbulence is kept to a minimum. As is known in the art, the length of the trailing portion and the magnitude of the angle of divergence between the wire and the trailing portion are both critical. However, I have found that the surface must be curved as opposed to a straight surface because a curved surface provides continuous acceleration of the water which permits greater water removal withous causing turbulence. I have found further that the leading portion also should not be angular but should be curved so as not to contact the wire causing undue wear.

In the preferred embodiment of the drainage element for a wire traveling at 1000 feet per minute over a suction box, I have found that dimension *c* (see FIG. 2) should be preferably about .004 inch and can be up to about .006 inch, dimension *a* should be about .375 inch and *b* should be .06 x .375 or .0225 inch. Dimension *a* is the distance from the radius of curvature line R and the lowest point P on the trailing portion. Dimension *b* is the vertical distance between point T and the lowest point P on the trailing portion. The radius of curvature should be 3 inches as mentioned above and the distance between the radius of curvature line R and the edge E of the leading portion should be about ⅛ of an inch. The ratio of dimensions *b* and *a* should be $b/a=$ to .06 with this dimension being less as the speed of the machine increases.

FIGURE 3 shows a plurality of drainage elements **30** of the invention in a suction box **32**. The box **32** is connected to a vacuum by outlet **34**. The Fourdrinier wire **35** passes over the drainage elements from left to right as shown.

As shown in FIGURE 1, a wire **10** passes over a suction box **12** provided with supporting bars **14**. The bars

14 are substantially rectangular in cross section, with a curved upper surface **16**, and substantially parallel flat sides **18** and **20**. These bars are spaced apart to retain at least 50% open area therebetween.

Bars **14** are fabricated from any material that can be flame plated and which is also corrosion resistant. Stainless steel is preferred.

The bars **14** can be ground so as to yield the curved surface **16**. This curved surface can be formed by using a suitable grinding wheel for example. The curved surfaces are plated with a suitable coating **26** to a thickness of from about .006 inch to .010 inch. This coating is then ground by a diamond wheel and lapped to a 2–3 micro finish.

Generally speaking, the coatings should be hard and wear resistant. Examples of suitable coatings are: (1) alumina, (2) chromium, nickel, tungsten, and carbon, (3) chromium and aluminum, and (4) chromium carbide and Nichrome. Such coatings have been found to be very hard and wear resistant so as to be able to maintain the required finish. The thickness of the coating should be such that it is sufficient to withstand the wear imposed by the conveyor belt passing over it.

In order to achieve a good coating with these coating materials, it is preferred that the surface **16** be plated by a detonation gun process or the arc torch plating process. These processes are completely described in U.S. Patents 2,714,563 and 3,016,447, respectively. The application by the detonation gun is preferred because a satisfactory tungsten carbide-chromium carbide-nickel coating cannot be achieved by ordinary torch spraying.

After the bars with their hard, wear resistant, curved surfaces have been formed, they are suitably mounted at the top of the suction box. This is shown in FIGURES 1 and 3. In the preferred form of the invention, the bars are mounted on pins at their ends such that they can be rotated slightly so as to adjust the pitch of the curved surfaces. By thus adjusting the pitch, the angle of tangency with the conveyor can be easily varied. Such angle would vary from machine to machine and is affected by the vacuum in the box, the tension in the conveyor belt, etc.

While a particular embodiment of the invention has been described, it should be understood that the invention need not be so limited. Thus, the bars could take the form of T-sections or angle irons mounted on rods. The latter form would result in better water drainage by preventing water from being forced back into the conveyor.

As another alternative, tubes having a suitable diameter could be used instead of the bars. The tubes could be sliced along their axis, plated and ground, and then positioned in the box.

What is claimed is:

1. A stationary drainage element for a paper machine disposed in supporting relationship to the Fourdrinier wire and extending across the machine transversely of the direction of travel, wherein said Fourdrinier wire is adapted to travel at a speed of from 1000 to about 5000 feet per minute, said drainage element having a wear resistant coated curved surface with a radius of curvature selected from the range of 1 to 15 inches, said surface being asymmetrical with respect to said radius of curvature drawn to the highest point on said curved surface the major portion of said surface being the trailing portion and the remaining surface being the leading portion.

2. A drainage element according to claim **1** wherein the distance from the highest point on said curved surface to the lowest point on the leading portion of said curved surface is greater than 0 and up to about .006.

3. A drainage element according to claim **1** wherein the distance between the highest point of said curved surface and the lowest point on the leading portion is about .004 and the horizontal distance from said lowest point to the radius of curvature line is about ⅛ of an inch.

4. A stationary drainage element for a paper machine disposed in supporting relationship to the Fourdrinier wire and extending across the machine transversely of the direction of travel, wherein said Fourdrinier wire is adapted to travel at a speed of about 1000 feet per minute, said drainage element having a wear resistant coated curved surface with a radius of curvature of about 3 inches, said surface being asymmetrical with respect to the radius of curvature drawn to the highest point on said curved surface the major portion of said surface being the trailing portion and the remaining surface being the leading portion and the horizontal distance between the lowest edge of the leading portion and the radius of curvature being about ⅛ of an inch and the horizontal distance between the radius of curvature and the lowest edge of the trailing portion being about .375 inch and the vertical distance between the highest point of said curved surface and the lowest edge of said leading portion being about .004 inch and the vertical distance between the highest point on said curved surface and the lowest point on said trailing portion being about .023 inch.

5. A suction box for a Fourdrinier paper machine comprising in combination with means for creating a vacuum in said box, a plurality of stationary drainage elements secured in said box in supporting relationship to the Fourdrinier wire and extending across the machine transversely of the direction of wire travel, wherein said Fourdrinier wire is adapted to travel at a speed of from 1000 to about 5000 feet per minute, said drainage elements having a curved wear resistant coated surface with a radius of curvature selected from the range of 1 to about 15 inches, said surface being asymmetrical with respect to said radius of curvature drawn to the highest point of said curved surface, the major portion of said surface being the trailing portion and the remaining surface being the leading portion.

6. Papermill suction box cover over which a pulp conveyor passes, comprising a plurality of spaced bars disposed transversely to the path of the conveyor, wherein said conveyor is adapted to travel at a speed of from 1000 to 5000 feet per minute, said bars having upper surfaces convex in cross section with a radius of curvature of from one to fifteen inches, said surfaces being coated with a thickness of .006 to .008 inch of a wear resistant fine finished material, said bars having flat side walls substantially parallel and substantially normal to the path of said conveyor and spaced apart to retain at least 50% open area therebetween.

7. Papermill suction box cover as claimed in claim **6**, in which said coating material is tungsten carbide-chromium carbide-nickel.

References Cited

UNITED STATES PATENTS

3,017,930	1/1962	Dunlap	162—352
3,027,940	3/1962	Dunlap	162—352
3,165,440	1/1965	Jordanson	162—352
2,928,465	3/1960	Wrist.	
2,928,466	3/1960	Burkhard.	

DONALL H. SYLVESTER, *Primary Examiner.*

A. C. HODGSON, *Assistant Examiner.*

U.S. Cl. X.R.

162—363