Dec. 31, 1968 J. W. AMEND, JR 3,419,203

HIGH SPEED PAPER MAKING MACHINE

Filed March 20, 1967 Sheet 1 of 2

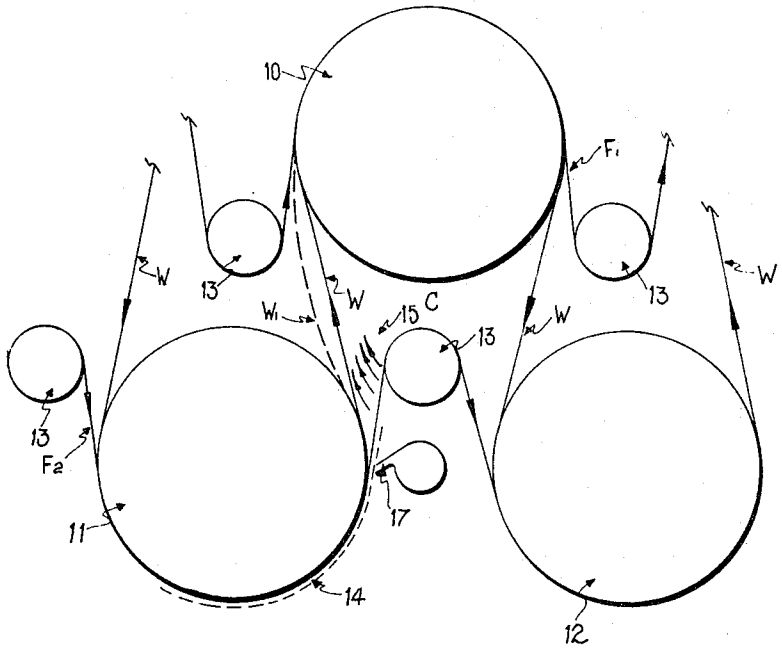

FIGURE 1

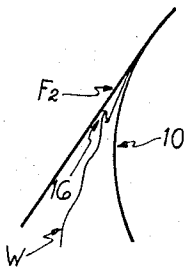

FIGURE 1A

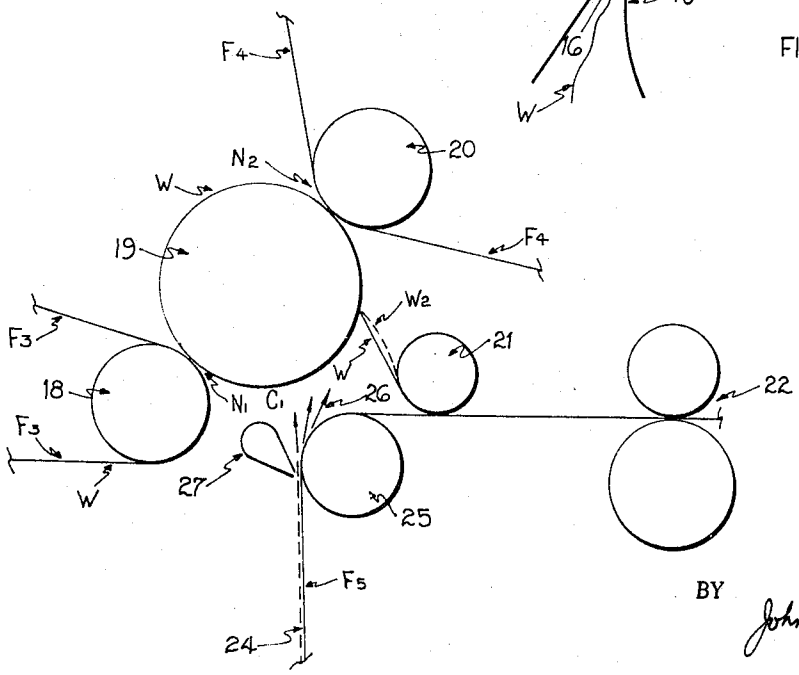

FIGURE 2

INVENTOR.
JOHN W. AMEND JR.

BY John L. Munday
Agent

Dec. 31, 1968 J. W. AMEND, JR 3,419,203

HIGH SPEED PAPER MAKING MACHINE

Filed March 20, 1967

Sheet 2 of 2

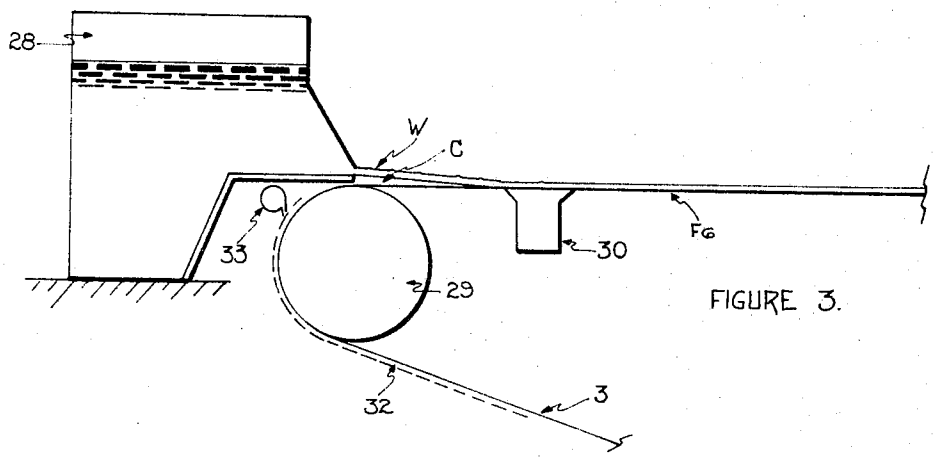

FIGURE 3.

INVENTOR.
JOHN W. AMEND JR.

BY John S Munday
Agent

United States Patent Office 3,419,203 Patented Dec. 31, 1968

3,419,203

HIGH SPEED PAPER MAKING MACHINE

John W. Amend, Jr., Beloit, Wis., assignor to Beloit Corporation, Beloit, Wis., a corporation of Wisconsin

Filed Mar. 20, 1967, Ser. No. 624,342
12 Claims. (Cl. 226—97)

ABSTRACT OF THE DISCLOSURE

This invention discloses an apparatus and method for preventing edge flutter of web like materials while such material is processed through a machine in generally unsupported spans. The apparatus is in the form of a fluid nozzle which forces a stream of high velocity fluid onto a web carrying member thereby disrupting and removing a layer of surface air carried by said carrying member into the general vicinity of the supported web span.

Background of the invention

The present invention relates to devices in which web like materials are processed at relatively high speeds and wherein the web like materials are from time to time unsupported over relatively long distances. When support for the web like material is again needed, a carrying member is again brought into contact with the web and, since such carrying member usually travels at substantially the same surface speed as the web, a film of air which travels with the carrying surface will continuously be pumped into a generally confined area formed by the web and the carrying member. With air thus being forced into this area its pressure will increase and cause the unsupported web span to deviate from its ideal path. Since this increase in pressure will not continue indefinitely the air will escape along the edges of the web at a substantial velocity thus causing the edges of said web to flutter. This edge flutter is particularly apparent over an edge width from approximately 3 to 6 inches. With ever increasing web processing speeds this problem becomes particularly pronounced.

In prior art devices, traveling at substantially lower speeds, the edge flutter problem was usually prevented by appropriate draw control between web supporting surfaces. However, at today's high operating speeds the webs are too tender to permit sufficient draw control to prevent edge flutter. Therefore, the flow of air to the web must be eliminated or drastically reduced.

A particularly pronounced disadvantage of edge flutter lies in the fact that when the web approaches its carrying surface the edge will tend to fold over. Such a fold, particularly at the edge of the web, drastically reduces the web's resistance to tear, particularly when one considers that tensions of up to forty pounds per lineal inch are not abnormal in today's web processing machines.

Furthermore, particularly with respect to papermaking machinery it is often necessary to subject a processed web to the action of a calender stack in which extremely high unit pressures are exerted on the web. When an edge fold is subjected to these extremely high pressures the edge of the web will invariably be cut at the fold. Such cuts can easily cause sheet breaks and other associated problems in subsequent finishing operations thereby resulting in inefficient operation due to loss of production.

Summary of the invention

The above enumerated problems associated with high speed web processing machinery are obviated by the present invention. The invention, therefore, proposes the utilization of a relatively high velocity fluid stream directed towards the carrying member at a point immediately adjacent to that point where the layer of air has its first opportunity to enter into an open ended chamber the walls of which are usually formed by the web and the web carrying member. It will, of course, be appreciated that for structural reasons the point of application of fluid pressure will not always be the theoretically desired location.

While the web flutter is mainly concentrated and apparent at the edges of the web the fluid pressure applicator should preferably extend for the full width of the web. With the application of fluid pressure restricted to the edges only, air will still be permitted to enter into the open ended chamber, since in most instances the web carrying surfaces are foraminous in nature, and while with edge application of fluid pressure air will be prevented from entering into the chamber at the edges, a substantial volume of air will also enter in the portion between the edges. The air thus entering the chamber must of necessity exit at the edges.

However, while the above is true in most instances it will hereafter be pointed out with particularity that the fluid pressure application devices need not always extend the full width of the web since it may be desirable, particularly in machinery where webs are processed under high temperature and humidity conditions, to evacuate the open ended chamber by causing a moderate amount of air to flow outwardly towards the ends of the chamber. If such a result is deemed desirable it is recommended that fluid pressure application devices be mounted at each edge of the web carrying member and be adjustable laterally so that air is permitted to enter into the open ended chamber and to exit at the ends in modulated quantities.

It is therefore an important object of the present invention to provide a web carrying member scavenging device which will substantially remove all of the surface air on the carrying member thereby preventing edge flutter of the web caused by a large quantity of air which would otherwise escape along the edges of the web.

Another object of the present invention is the provision of an appropriate fluid supply means located in close proximity to a web carrying member for forcing a stream of high velocity fluid onto said carrying member thereby disrupting and removing the boundary layer of air upon said carrying member and thereby preventing said air from disrupting the normal path of said web.

A further object of the present invention is the provision of an air scavenging device operatively associated with a web processing machine whereby the need for highly sensitive and expensive draw control mechanisms is substantially eliminated.

Description of the drawing

FIGURE 1 is an elevational view showing part of a web processing machine and depicting one embodiment of the present invention.

FIGURE 1A is an enlarged view of part of the embodiment shown in FIGURE 1.

FIGURE 2 is an elevational view of another typical web processing machine and showing a further embodiment of the present invention.

FIGURE 3 is an elevational view of part of yet another web processing machine and showing yet another embodiment of the invention.

Description of the preferred embodiments

While the principles of the present invention have application to a large and widely varying number of web processing machines, the preferred embodiment of this invention will be described with particularity in connection with their applicability to various sections of a papermaking machine. While the invention hereinafter will be

described in connection with its application to the papermaking machinery the skilled artisan will readily understand its applicability to other types of web processing machines.

FIGURE 1 shows a portion of a dryer section of a papermaking machine consisting of a plurality of cylindrical drying drums **10**, **11** and **12** arranged in upper **10** and lower **11**, **12** tiers of drying cylinders. Between each of the cylinders of the upper and lower tiers there is located a felt roll **13**. Felts **F1** and **F2** travel in serpentine paths between the upper and lower tiers respectively. A paper web W, travels in a serpentine path through the upper and lower tiers of drying cylinders alternating from the upper to the lower tier. The direction of travel of the felts **F1** and **F2** and of the web W is indicated by the respective arrows.

Referring now specifically to the drying cylinder **11**, it will be observed that this cylinder is partially wrapped by the web W and the felt **F2**, the web W being sandwiched between the outer periphery of the cylinder **11**, and the felt **F2**. The felt or carrying member **F2** carries on its surface a layer of air generally indicated by the numeral **14**. The layer of air **14** travels at substantially the same speed as the felt **F2**. If the layer of air is permitted to travel its natural course the porosity of the felt or carrying member **F2** will permit the air to enter into the open ended chamber C as indicated by the arrows **15**. In present day paper machinery the tendency is toward using rather porous or foraminous felts generally referred to in the trade as "open felts." It will thus be appreciated that the volume of air entering into the chamber C can be very substantial. These large quantities of air therefore, will increase the pressure in the chamber C and will cause the web W, which forms a wall of the chamber C, to deviate from its intended path as indicated by the dotted line **W1**. This deviation by the web W will create an unstable condition which becomes particularly pronounced at the laterally spaced edges of the web W because the unstable condition is aggravated and increased by the out-rushing air at the edges of the chamber. This grossly unstable condition at the edge of the web W will cause the edge of the web to move rapidly back and forth and this phenomena is usually referred to as web or sheet flutter. When the fluttering sheet approaches the next drying cylinder **10** it will be sandwiched between the outer periphery of the cylinder **10** and the upper felt **F1**.

An elevational view of the fluttering edge of the web W is schematically shown in FIGURE 1[A] from which it will be readily apparent that the rapidly closing gap between the felt **F2** and the drying cylinder **10** will cause the web edge W, to fold over on itself as indicated at **16**. This edge fold will drastically reduce the edge strength of the web W, and will result in tearing of the web either in the dryer section or during subsequent operations on the web.

In order to alleviate the above problem I have found it necessary to eliminate the layer of air **14** from the surface of the carrying member and I propose to eliminate this air layer by means of a stream of fluid under pressure preferably issuing from a nozzle indicated at **17**. The stream of fluid pressure appropriately directed at the carrying surface will disrupt and remove the layer of air from the carrying surface thus preventing its entry into the chamber C.

Once this principle of the invention is recognized it is obvious that other devices may be employed to remove the layer of surface air from the carrying member and one such modification which becomes immediately apparent is in the nature of a suction nozzle in the same location as the pressure nozzle which would remove the layer of air by suction prior to its entry into the chamber C. Therefore, when the term fluid pressure is used herein it should be understood this includes any pressure from absolute zero to any practical operating pressure and when specific reference is made to a stream of fluid pressure directed at the carrying surface this is intended to include a stream of fluid traveling away from the carrying surface.

While under most operating conditions a continuous full width fluid stream directed at the carrying surface will be sufficient, there are certain operating conditions which may occur, particularly in a dryer section of a papermaking machine, where it may be advantageous to have a plurality of spaced laterally adjustable fluid pressure streams directed at the carrying surface or felt F. With such an arrangement the layer of air will purposely be permitted to enter the chamber C at certain predetermined locations and in certain predetermined amounts. By thus regulating the air entering the chamber C we can also modulate the amount of air exiting from the ends of the chamber C and we can thus provide for a continuous ventilation of the chamber C which may be necessary and useful particularly where the air contained within the chamber C is humid and will thus detract from the drying of the web W.

In a practical application of the principles of the present invention I have successfully used air as the fluid pressure medium the temperature of which may vary from the temperature of the general environment to the destruction temperature of the web W or the felt F. Generally such temperatures will range from 140–180° F. to 350–400° F. and the air temperature used is preferably within the range of from 160–250° F. Air velocities through the nozzle may vary from 2000 f.p.m. to 15,000–20,000 f.p.m. while a preferred and practical velocity would lie within the range of from 4000 to 6000 f.p.m.

The fluid supply nozzle is preferably mounted for pivotal adjustment about a longitudinal axis so as to direct the fluid stream to the felt **F2** at an optimum angle of attack. Adjustment of the nozzle **17** will also facilitate felt changes and the like.

FIGURE 2 shows another embodiment of the present invention. In the structure as shown in FIGURE 2 the principles of the invention are applied to a press section of a papermaking machine in which the web W is carried on a felt **F3** around a roll **18** into the nip **N1** defined by the roll **18** and another roll **19**. The web then travels around the periphery of the roll **19** into the nip **N2** defined by the roll **19** and a third roll **20**. The web W continues to travel around the roll **19** for a short distance whereupon it is removed from the surface of the roll **19** and guided in a generally downward direction and deposited on a carrying felt **F5** by means of a lay-on roll **21**. The felt **F5** then carries the web W to another press generally indicated by the numeral **22**. The upwardly directed reach **23** of the felt **F5** carries on its surface a layer of air **24** which, as the felt travels around the felt turning roll **25**, will be generally directed towards the unsupported web span between the roll **19** and the lay-on roll **21**. The direction of air is generally indicated by the arrows **26**. As discussed in connection with the embodiment shown in FIGURE 1 the air will enter an open ended chamber **C1** defined by a peripheral portion of the roll **19**, the unsupported web span W and a portion of the felt **F5**. The increase in the pressure in the chamber will distort the intended path of the web W as indicated at **W2**. This will cause sheet flutter substantially in the same manner as described in connection with FIGURE 1.

To avoid the air from entering the chamber C, I have, in accordance with the principles of the present invention, provided for a fluid pressure supply means **26** in the form of a nozzle to disrupt and remove the layer of air **24** from the surface of the carrying felt **F5**. The removal of the surface layer of air **24** in the manner indicated in FIGURE 2 will effectively prevent edge flutter of the web W in its unsupported run between the roll **19** and the lay-on roll **21** with its attendant advantages substantially as described in connection with the embodiment shown in FIGURE 1.

FIGURE 3 shows a third embodiment constructed in accordance with the principles of the present invention and further illustrates the utility and usefulness of the

principles taught herein. The papermachine section as shown in FIGURE 3 is generally known as the Headbox-Fourdrinier section of the machine and this is a particularly critical section of the papermaking machine in that this section performs the initial web forming function. Any disturbances in this critical area of web formation will result in irreparable damage to the paper web and will remain prevalent in the paper web throughout the remaining stages of its manufacture.

As shown in FIGURE 3, a headbox **28** supplies a continuous stream of papermaking stock W to the upper reach of a foraminous forming surface **F6**. The papermaking stock consists of a highly diluted suspension of papermaking fibers in water and while the water is rapidly drained through the foraminous surface **F6** the papermaking fibers remain on the upper surface of the carrying member or Fourdrinier wire **F6** whereby a web of entangled fibers is formed. The foraminous carrying member **F6** is wrapped around a breast roll **29** and its horizontal reach may be supported by a variety of devices such as generally indicated at **30**. Again, the lower reach **31** of the carrying member **F6** carries a layer of air **32** on its surface which layer of air, if permitted to continue to travel with the carrying member **F6** will enter into an open like chamber generally indicated at C. The extreme right hand portion of the chamber is defined by the upper reach of the carrying member **F6** and the stock jet W and it will be immediately apparent to those skilled in the art that a substantial amount of pressure in the extreme right hand portion of the chamber C will cause the tender jet W to be disrupted thereby resulting in irreparable harm to the newly formed web W.

In order to prevent this undesirable disturbance I have, in accordance with the principles of the present invention provided for a fluid pressure supply means **33**, located at an appropriate location on the periphery of the breast roll **29**, to prevent the layer of air from entering into the chamber C.

While, in connection with the description of the embodiments shown in FIGURES 1 and 2 I have generally referred to edge flutter it is immediately apparent to those skilled in the art that this particular area of the papermaking process it is not only the problem of edge flutter which must be prevented but also the possibility of a complete disruption of the web W at any laterally spaced point along the width of the web. In other words, it is quite conceivable in this particular instance that the high pressure air may become so severe within the chamber C that in addition to attempting to escape along the edges it will also seek its way out through the sheet at a location anywhere between the edges of the web W.

While it has previously been proposed to seal off the incoming side of the chamber C as shown in FIGURE 3 by stationary baffle type members and the like, it has not been possible to construct a baffle capable of withstanding continuous contact with the fast traveling forming wire **F6**. Present day practical operating speeds may be as high as 6000 feet per minute and friction and wear problems with contacting type devices are, therefore, phenomenal. Furthermore, any stationary device which operates in close proximity to the web carrying member **F6** will still permit a substantial amount of air to enter into the chamber through the gap and, when considering operating speeds of up to 6000 f.p.m. and machine widths approaching 400 inches, it will readily be appreciated that the quantities of air with which we are here concerned are indeed substantial. This is particularly true when one considers the fact that practical papermaking considerations dictate that the headbox **28** should be located as close as possible to the upper part of the periphery of the breast roll **29** thus making the chamber C extremely small.

It will thus be seen that an improved air scavenging device has been provided which achieves the objects and advantages set forth above and which overcome the disadvantages associated with prior systems thereby obtaining a result heretofore unobtainable.

The drawings and specification present a detailed disclosure of the preferred embodiments of the invention, and it is to be understood that the invention is not limited to the specific form disclosed, but, covers all modifications, changes and alternative constructions and methods falling within the scope of the principles taught.

I claim as my invention:

1. In a web processing machine, the combination comprising:

an air pervious carrying member moving at relatively high speed and having a layer of air on its surface, said layer moving at approximately the same speed as said member, said carrying member forming a wall of an open ended chamber;

a relatively impervious web moving at relatively high speed and forming another wall of said chamber;

and fluid supply means located in close proximity to said carrying member for forcing a stream of high velocity fluid onto said carrying member thereby disrupting and removing said layer from said carrying member whereby said layer of air is prevented from entering said chamber.

2. Apparatus in accordance with claim **1** wherein said fluid supply means includes a nozzle.

3. Apparatus according to claim **2** wherein said nozzle is directed in a direction substantially opposite to the direction of movement of said layer of air.

4. Apparatus according to claim **2** wherein said nozzle extends substantially the full width of said carrying member.

5. Apparatus according to claim **1** wherein said fluid supply means includes a pair of nozzles located at the outer edges of said carrying member.

6. Apparatus according to claim **5** wherein said nozzles extend laterally into said chamber.

7. Apparatus according to claim **6** wherein said nozzles are adjustable in a lateral direction.

8. Apparatus according to claim **2** wherein said nozzle is pivotally mounted and adjustable with respect to the carrying member.

9. Apparatus according to claim **1** wherein said fluid is air.

10. Apparatus according to claim **9** wherein said air has a temperature within the range from 140–180° F. to 350–400° F.

11. Apparatus according to claim **9** wherein said air has velocity of from 2000 to 20,000 f.p.m.

12. In a web processing machine the combination comprising:

a carrying member moving at a relatively high speed and having a layer of air on its surface, said layer moving at approximately the same speed as said member;

a relatively impervious web moving at relatively high speed, said carrying member and said web approaching each other along intercepting paths whereby said layer of air is directed toward said web;

and fluid pressure supply means located in close proximity to said carrying member for forcing a stream of high velocity fluid onto said carrying member thereby disrupting and removing said layer from said carrying member whereby said air is prevented from approaching said web.

References Cited

UNITED STATES PATENTS

2,558,659	10/1941	Mosler	226—97 X
3,066,882	12/1962	Havens et al.	226—97 X
3,351,521	11/1967	Murray et al.	226—95 X

ALLEN N. KNOWLES, *Primary Examiner.*

U.S. Cl. X.R.

226—196