FIGURE EIGHT CYLINDER PRESS DEFINING AN EXTENDED PRESS NIP

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Fig. 1

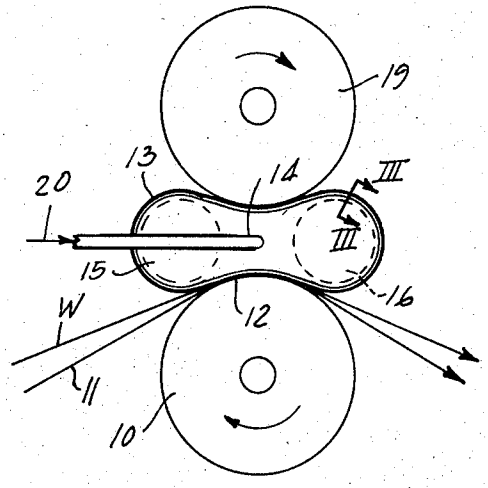


Fig. 3

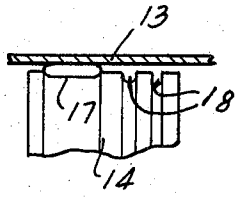


Fig. 2

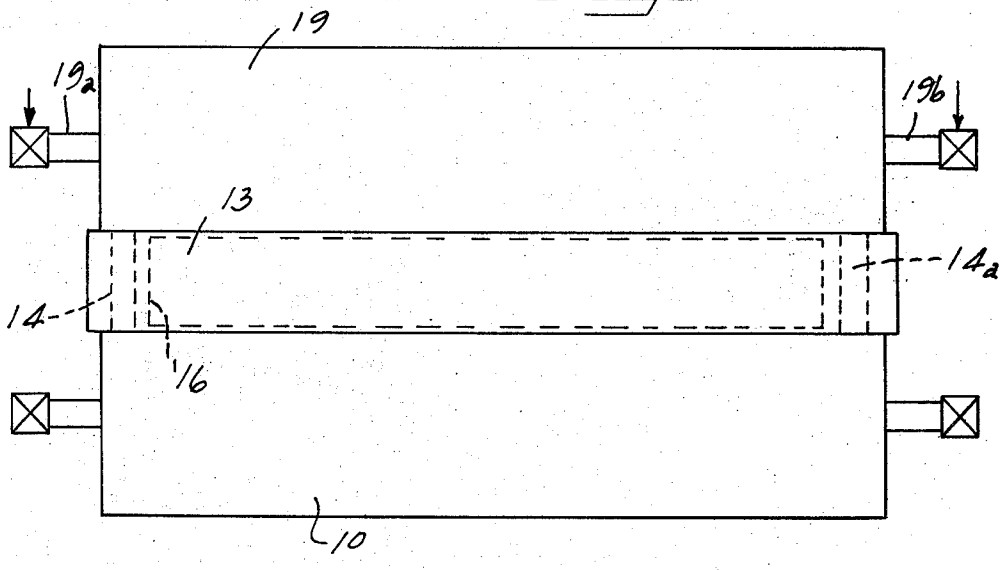


Fig. 4

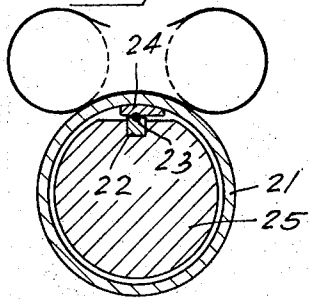
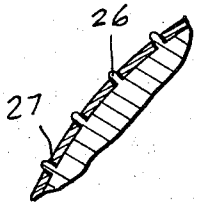


Fig. 5



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3,808,096

FIGURE EIGHT CYLINDER PRESS FOR DEFINING AN EXTENDED PRESS NIP

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U.S. Cl. 162—358 3 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus for pressing fluid from a traveling fibrous web such as used in a press section of a paper making machine including a rotary cylindrical press roll with an endless non-porous looped belt wrapping an arc of the press roll and defining an extended press nip through which one or more felts may run for carrying the paper web with the belt supported to travel with the roll and being filled with a pressurized fluid for applying pressure to the nip and having guide rolls at the ends of the looped belt drawing it over the extended nip and further including a support roll outside of the belt confining the belt between the rolls with a stationary end seal at the ends of the looped belt.

BACKGROUND OF THE INVENTION

The invention relates to improvements in presses for extracting water from a continuous traveling web such as a newly formed paper web in a paper machine, and particularly, the invention relates to a structure for providing an extended press nip which applies a pressing force to a web for a longer continuous time than structures heretofore available which merely pass the web through the nip of an opposed roll couple.

In the copending application of Busker and Francik, Ser. No. 193,272, the principles and advantages of pressing a paper web for an extended period of time, and the advantages thereof, are discussed. In the present structure the principles of an extended time nip are utilized in a structure affording advantages over prior art arrangements. The prior art has employed a large flexible bag draped over a press roll with the bag inflated with a pressurized fluid, but the stresses at the bag end have proven difficult to cope with, and the necessary flexure of material with such a bag have made operation over any practical length of time impossible without destruction of the bag. The prior art has also attempted to provide a belt drawn over a rotating cylinder with confined fluid pressure behind the belt, but this construction lacks the advantages of being able to apply relatively high nip pressures and lacks other advantages which will become more apparent with the following description.

As will be appreciated from the teachings of the disclosure the features of the invention may be employed in the dewatering of other forms of webs than a paper web in a paper making machine. However, for convenience, a preferred embodiment of the invention will be described in the environment of a paper making machine which conventionally forms a web by depositing a slurry of pulp fibers on a traveling Fourdrinier wire, transfers the web to a press section where the web passes through a number of press nips formed between roll couples, and the web then passes over a series of heated dryer drums and usually through a calender and then is wound on the roll. The present structure forms the entire press section and takes the place of other forms of press sections heretofore available. Many modifications can be made in this type of overall machine, as to the forming section, the press section, the dryer section, and the structure of the instant

disclosure may be employed in pressing webs of various of various synthetic fibers.

The present invention relates to improvements for the press sections of a paper making machine. In such a machine the web usually arrives at the press section with about 80 percent wet basis moisture (ratio of water of fiber plus water) and leaves the press section with approximately 60 percent moisture, with the remaining moisture having to be removed by thermal evaporation in the dryer section as the web passes over a series of heated dryer drums. Because of various inherent limitations in the operation of roll couples forming press nips for the press section in a conventional paper making machine, only a given amount of water can be removed in each nip and, therefore, in a conventional paper making machine, a series of three press nips are usually employed. It has been found impractical to attempt to remove a significant amount of additional water by increasing the number of press nips, although the further removal of water by pressing can greatly reduce the expense and size of the dryer section. It is estimated that if the water removed in the press section can be reduced from 60 percent to 50 percent, the length of the dryer section can be reduced by ⅓. This is significant in a typical 3000 feet per minute newsprint machine which employs approximately 70 dryer drums. This significance can be appreciated in considering that the dryer drums are each expensive to construct and to operate and require the provision of steam fittings and a supply of steam for each drum. The relative importance of the removal of water in the press section is further highlighted by the fact that one of the most important economic considerations in justifying a satisfactory return on investment in the operation of a paper making machine is to obtain the highest speed possible consistent with good paper formation and better pressing will shorten the necessary time in the dryer section and permit higher speeds.

It is accordingly an object of the present invention to provide an improvement in the press section of a paper machine which makes it possible to remove an increased amount of water in this press section and makes it possible to provide a press section having a single or double pressing nip of a unique elongated or extended nature which does not have the performance limitations of conventional roll couple presses and which requires less space in terms of requirements as to the overall length of the press section. By increasing the amount of water removed from the web in the press section, increased speeds are possible with existing equipment, i.e., a given length of dryer section can operate at higher speeds since it is required to remove less water. Also, new equipment can be constructed requiring less machine room and consequently lower building expense.

The present invention employs a principle which may be referred to as the extended nip concept wherein the time the web is subjected to a pressing action is greatly extended, i.e., a single pressing is provided having a residence time which exceeds that of the time of the web in a number of conventional roll couple press nips. With the reduction to a single pressing operation, the compound effects of caliper reduction of the web as it passes a plurality of nips are avoided.

A factor which presently limits water removal from paper by mechanical wet pressing is the flow property of water within the paper sheet. It has been found that other factors are not of dominant significance, for example, the effects of the moisture in the felt which travels with the web are small. It has been found further that the length of time that the web is in the nip, in other words the nip residence time, can have a significant effect in overcoming the difficulties created by the flow properties of the water

within the sheet. It has also been found that merely by increasing the residence time of the web in the nip, the water content of the sheet coming out of the press can be decreased so that the web will be 46 percent dryness rather than 40 percent dryness with other variables remaining constant. As is evident, the residence time of a web in a conventional roll couple press nip is limited and can only be increased by decreasing the speed of travel of the web, or can be increased slightly by increasing the diameter of the press rolls, but these factors are indeed limiting. It has been found, for example, that by applying a 1300 pound per square inch pressure on a web for five minutes, a moisture level of less than 30 percent can be attained. Yet, under the dynamic short term mechanical pressing of a paper machine press section using roll couples, even with a plurality of nips, a great deal of effort is required to maintain moisture levels below 60 percent.

It has been found that significant losses in dryness occur at higher speeds and that a loss in dryness of over 5 percent is experienced in going from 300 feet per minute to 1000 feet per minute with typical press loadings in a suction press. It has been found that a hydraulic pressure or wedge effect develops during the passage of the wet mat through the wet press nip. The hydraulic pressure that develops subtracts from the applied load and reduces the mechanical compacting pressure. The result is a loss in dryness. As the machine speed increases, the compacting rates are higher resulting in higher hydraulic pressures within the paper mat. These hydraulic pressures react against the pressure of the rolls. The exact value of hydraulic pressure is difficult to determine either by analysis or direct measure because of the space and speeds involved. It is believed, however, that hydraulic pressure predominately determines press performance on machines operating at high speeds. Accordingly, the instant invention relates to avoiding disadvantages encountered with high speed press nips of the conventional type used in most commercial applications today, and provides a substantial increase in residence time within a press nip to allow time for flow to occur within the mat and for the hydraulic pressure to dissipate. The principles of extended nip or extended time pressing are further reviewed in the aforementioned copending application.

It is accordingly an object of the present invention to provide a mechanism which will enable pressing a high speed traveling web over a relatively extended period of time so as to overcome counter-hydraulic pressures and to achieve improved water removal in the press.

A further important object of the invention is to provide an extended nip press utilizing a press roll with a flexible traveling surface pressing the web to the roll, and the flexible traveling surface being so constructed so as to enable long tension-free operating life.

A further object of the invention is to provide a press of the type above described wherein fluid pressure can be utilized for an extended nip press to achieve improved and higher pressures with a mechanism capable of operating at high speeds.

Other objects, advantages and features will become more apparent with the disclosure of the principles of the invention, and it will be apparent that equivalent structures and methods may be employed within the principles and scope of the invention in connection with the description of the preferred embodiment and the teaching of the principles in the specification, claims and drawings, in which:

DESCRIPTION OF THE DRAWINGS

FIG. 1 is an end view shown somewhat in schematic form of a structure constructed and operating in accordance with the principles of the present invention;

FIG. 2 is a side elevational view, also in somewhat schematic form, of the structure of FIG. 1;

FIG. 3 is a greatly enlarged fragmentary view showing the seal arrangement;

FIG. 4 is a schematic end elevational view of another form of a portion of the structure; and

FIG. 5 is a fragmentary view of an alternate arrangement.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As illustrated in FIGS. 1 and 2, the structure includes an elongate cylindrical press roll **10** having suitable end support bearings, not shown. The press roll extends for the width of the paper making machine in which the press section is installed and has a smooth polished outer surface. The press roll is of a substantial diameter and has a substantial strength because of the relatively high forces encountered due to the pressures in the press nip.

Forming the press nip, a relatively short looped endless nonporous belt **13** wraps a short arc on the press roll **10** to form an extended press nip **12**. Traveling through the nip is a felt **11** carrying a paper web W. The felt is a looped felt supported on rolls not shown and will receive water pressed from the web and have felt drying means at another location of the felt loop. In some instances the press roll may be grooved to aid in the transfer of water from the web to the felt and means will be provided to remove water from the grooves of the press roll after they have passed the nip. It also is contemplated to provide upper and lower felts so that the web is sandwiched between felts.

Within the belt loop and at the beginning and end of the extended nip **12**, are guide rolls **15** and **16**. These guide rolls extend parallel to the press roll **10**.

Outside of the belt **13** and opposite the extended nip **12**, is a support roll **19**. This roll extends parallel to the press roll **10** and is of relatively large diameter to avoid excessive deflection. This roll may also be used as a press roll and can form a second press nip if such is desired.

The interior of the looped belt **13** is pressurized with a pressurized fluid supplied through an inlet line **20**. The belt may be pressurized with air, water or other fluids.

To confine the fluid within the belt, end dams **14** and **14*a*** are placed within the ends of the looped belt **13**. These end dams have a general figure eight shape and are stationary. To aid in avoiding the leakage of fluid out of the ends of the belts, inflatable seals **17**, FIG. 3, may be provided and additional sealing means such as grooves **18** may be positioned outside of the inflatable seals to help retain fluid that leaks past the seals. By employing inflatable seals, the sealing pressure may be increased as the pressure within the looped belt **13** is increased to increase nip pressure.

The pressure in the nip **12** is a function of the pressure of the supplied fluid within the belt. This fluid pressure not only acts normal to the belt surface pressing it toward the press roll **10**, but tensions the belt so that linear tension in the belt pulls it tightly over the arc of wrap along the nip **12**. Bearings **19*a*** and **19*b*** on the ends of shafts on the support roll may be made movable. The bearing supports for the press roll may be stationary or also may be adjustable.

The guide rolls **15** and **16** will hold the belt in its proper operating position even at high operating speeds and will retain the shape of the belt so that it will conform to the shapes of the end seals and prevent leakage and retain the pressure therein.

While a certain amount of deflection of the press roll **10** can be tolerated inasmuch as the pressure within the belt will insure uniform pressure along the length of the extended nip **12**, in some circumstances where a very wide paper machine is used, it may be desirable to use a press roll which has deflection preventing mechanism. Such mechanism may take the form of support rolls outside of the press roll, or a roll such as shown in FIG. 4 may be employed. In the roll of FIG. 4, the press roll has a hollow cylindrical tube **21** with a stationary shaft **25** ex-

tending therethrough. The shaft is provided with a cylinder or recess **22** along the top for receiving a piston **23** which supports a sliding shoe of the Kingsbury thrust bearing type. The tube **21** is filled with oil so that a film of oil forms between the shoe **24** and the inner surface of the cylinder **21**. The bottom of the cylinder **22** is filled with pressurized oil to support the piston **23** so that forces against the cylindrical shell **21** are transferred through the hydraulic fluid within the cylinder **22**, and the force will be sustained by the shaft **25** which is supported at its ends and is free to bend. By applying the correct pressure in the hydraulic cylinder **22**, the roll shell **21** will remain straight and will not bend. A similar structure may be employed for the support roll **19** if desired.

The end dams prevent leakage of the fluid from within the belt and may also be arranged with support bearings for guiding the position of the guide rolls **15** and **16** within the belt. The support rolls are required to carry the very heavy loads which are present in the nip, and a nip pressure of at least as great, and preferably greater than, 100 pounds per square inch is preferred. With this arrangement, by varying the pressure as applied through the line **20**, varying desired nip pressures may be achieved for handling different webs and for different degrees of water extraction from the web.

Drives may be provided for the press roll **10** and, if desired, for the support roll **19**. The flexible belt may also be driven by gearing it to the press roll. One form of construction is shown in FIG. 5 wherein the belt is provided with a series of holes **27** at its edge, and a series of teeth or projections **26** are provided on the outer surface of the press roll to project into the holes and by placing an arrangement of this type at each end of the press roll, outside the ends of the end dams, this sprocket type of drive will keep the flexible belt from shifting in a cross machine direction.

We claim as our invention:

1. A press mechanism for pressing liquid from a traveling fibrous web comprising in combination:

a rotary cylindrical press roll;

an endless non-porous looped belt wrapping an arc of said press roll for defining an extended press nip between the belt and roll;

means supporting said belt in a position opposed to the roll to form said extended nip;

means for delivering fluid under pressure to fill the belt loop for pressing the belt against a web carried on the roll in said extended nip and for tensioning the belt;

stationary end dams positioned at the ends of the belt;

seal means between the end dams and belt;

a support roll extending parallel to the press roll with the belt positioned between said rolls;

and guide rolls being parallel to said press roll and being within the belt beyond the ends of the extended nip tensioning the belt over the press roll.

2. A press mechanism for pressing fluid from a traveling fibrous web constructed in accordance with claim **1** wherein:

the space between the press roll and the support roll is less than the diameter of said guide rolls.

3. A press mechanism for pressing liquid from a traveling fibrous web comprising in combination:

a rotary cylindrical press roll;

an endless non-porous looped belt wrapping an arc of said press roll for defining an extended press nip between the belt and roll;

means supporting said belt in a position opposed to the roll to form said extended nip;

means for delivering fluid under pressure to fill the belt loop for pressing the belt against a web carried on the roll in said extended nip and for tensioning the belt;

a support roll extending parallel to the press roll with the belt confined between said rolls;

stationary end dams positioned at the ends of the belt;

seal means between the end dams and belt, said belt having a series of holes in each end outwardly of said end dam seal means,

and means for gearing the ends of the belt to said press roll, said gearing means including projections on the ends of the roll engaging in said holes so that the belt will run parallel to the roll surface and will be drivingly connected thereto.

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U.S. Cl. X.R.

29—113 R; 100—118, 153, 211; 162—205