

[54] **LARGE ROLL HYDRAULIC PRESS WITH PRESSURIZED FLUID SUPPORTS**

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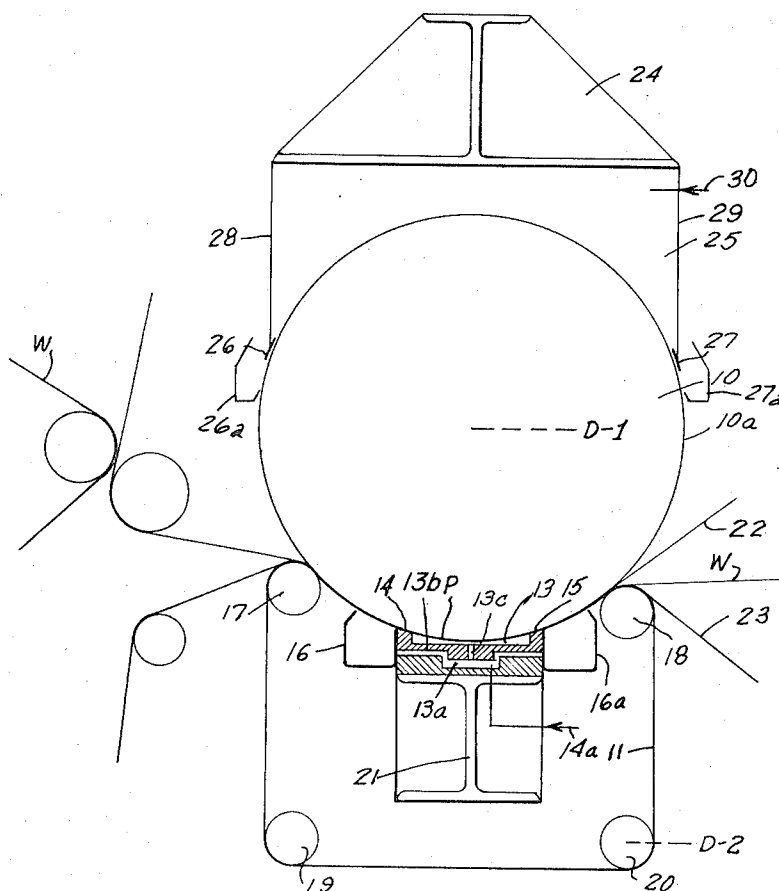
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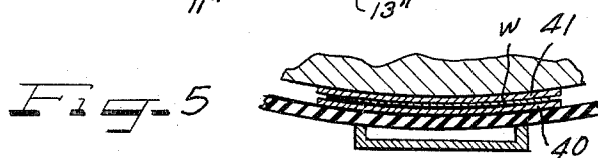
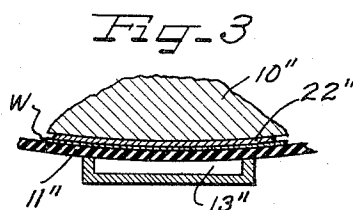
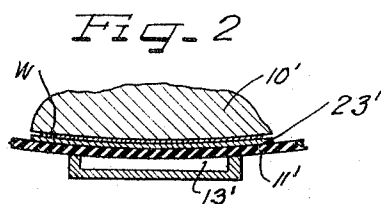
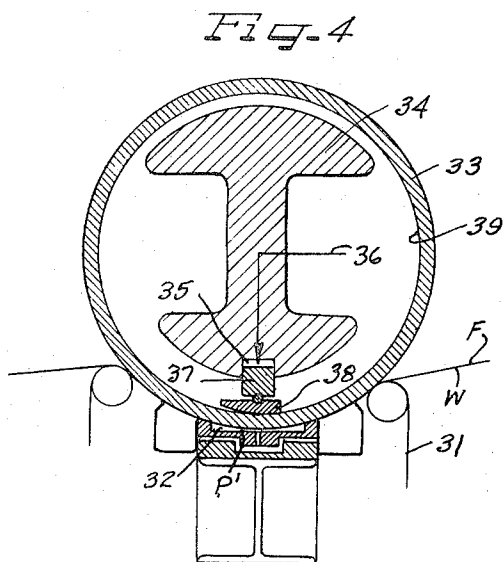
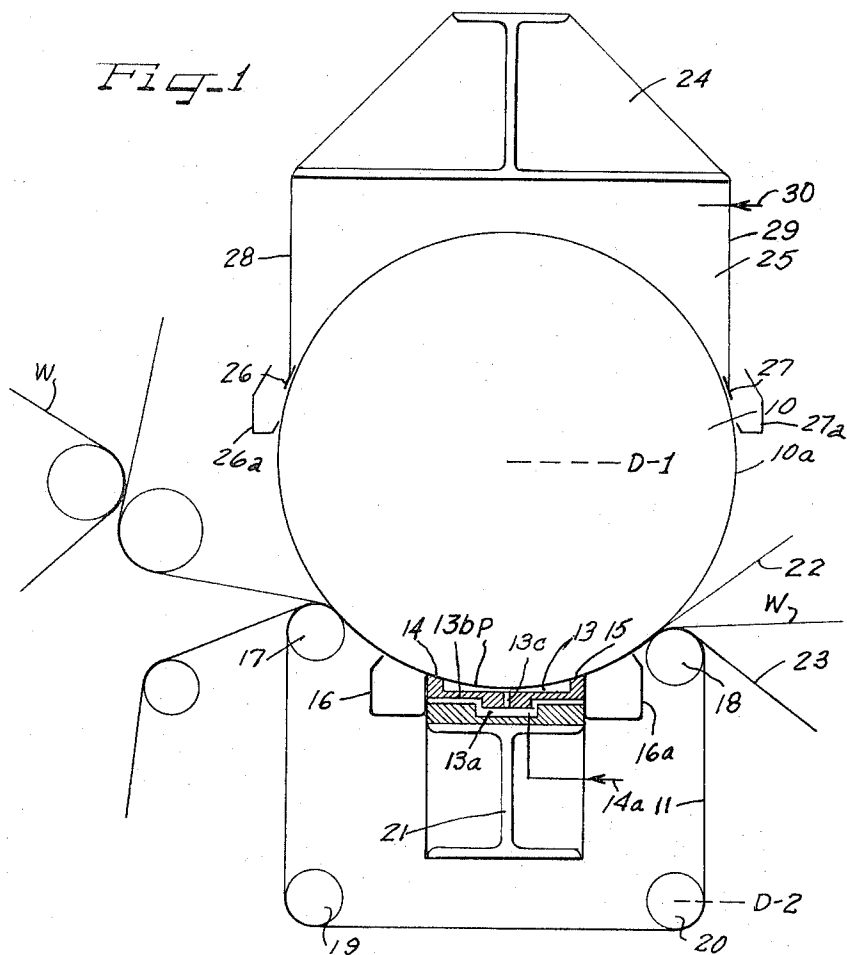
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[57] **ABSTRACT**

A press structure performs a dewatering operation on a traveling web such as that received from the forming section of a paper making machine. The press structure includes an elongate rotatable roll with a cylindrical outer pressing surface and an endless looped belt wrapping a portion of the circumference of the roll and forming an arcuate elongate pressing zone with the roll, with a felt passed along in the pressing zone to receive water pressed from the web, and a sealed fluid pressure chamber opposite the belt along the pressing zone applying a pressure to the web with the pressure chamber carrying seals to prevent the leakage of fluid as the belt passes therealong.

7 Claims, 5 Drawing Figures





LARGE ROLL HYDRAULIC PRESS WITH PRESSURIZED FLUID SUPPORTS

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.

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, preferred embodiments 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 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 preferably forms the entire press section and takes the place of other types 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 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 per centwet basis moisture (ratio of water to fiber plus water) and leaves the press section with approximately 60 per cent 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 increased to reduce the water content from 60 per cent to 50 per cent, the length of the dryer section can be reduced by one-third. This is significant in a typical 3,000 feet per minute newsprint machine which employs 100 dryer drums. This significance can be appreciated in considering that the dryer drums take a considerable amount of space, 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 only a single pressing nip of a unique elongated or extended nature which does not have the performance limitations of conventional roll couple presses and which requires far 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 length and 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 rewetting the web as it leaves a plurality of nips are avoided.

A factor which presently limits water removal from paper by mechanical web 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 residence in the nip, 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 have 46 per cent dryness rather than 40 per cent 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 1,300 pound per square inch pressure on a web for 5 minutes, a moisture level of less than 30 per cent 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 per cent.

It has been found that significant losses in dryness occur at higher speeds and that a loss in dryness of over 5 per cent is experienced in going from 300 feet per minute to 1,000 feet per minute with typical press load-

ings 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 and prevent the moisture from being squeezed from the web. The exact value of hydraulic pressure is difficult to determine either by direct measure or analysis 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 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 moisture removal while retaining high bulk in the pressed sheet and with minimum crushing effects with a mechanism capable of operating at high speeds.

A further object of the invention is to provide a press employing a roll combined with an opposed belt having a structure so that uniform pressure can be applied to a web over the length of the roll, and the roll does not deflect away from the pressing zone.

A further object is to provide a press of the type described utilizing a belt for the pressing zone and wherein pressure can be applied to the belt with a viscous fluid thereby reducing the leakage of the fluid and decreasing the pumping capacity necessary to maintain the fluid pressurized. An opposing upper chamber is employed which can use a lower pressure fluid such as air or water which will not contaminate the moving web and the lower chamber is arranged such that viscous fluids which offer higher pumping efficiency (such as hydraulic fluid) can be used and because of the gravity drainage orientation and thus no serious danger of contaminating the moving web exists.

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 a somewhat schematic end view of a press structure embodying the features of the present invention;

FIG. 2 is an enlarged fragmentary view showing the pressing zone;

FIG. 3 is an enlarged fragmentary view also showing the pressing zone in another form;

FIG. 4 is a schematic end view in section showing another form of the invention; and

FIG. 5 is an enlarged fragmentary view showing another form of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As illustrated in FIG. 1, the structure includes an elongate cylindrical large diameter press roll 10. The roll is shown as being solid and has a diameter of 5 or 6 feet. The outer surface 10a of the roll is smooth and cylindrical so that it may be engaged by a felt 22, or by a web W where no felt is used between the web and roll as in the form illustrated in FIG. 2. The roll may be solid and heavy as of cast iron, or may be a granite roll. In some instances a hollow roll may be used as may be explained in connection with the embodiment of FIG. 4.

An endless looped belt 11 is arranged to wrap a portion of the surface of the roll 10 to form a pressing zone P. The pressing zone extends from the location of a seal 14 to the location of a seal 15 along the surface of the roll 10, so that the web W will be subjected to a pressing force for an extended period of time. This period of time, as will be observed, is substantially longer than the time that a web is subjected to pressure when passing between two opposed rolls of a normal press couple.

For obtaining the dewatering pressure, the belt 11 is backed by a pressure chamber 13 opposite the pressing zone P. A pressurized fluid, such as oil or other viscous liquid, is directed to the pressure chamber 13 through a pressure line 14a. By using a viscous liquid such as oil, the amount of leakage as compared with a fluid such as water is substantially reduced thereby reducing the necessary capacity of a pressure pump. As previously stated, the arrangement enables the use of viscous fluids which offer higher pumping efficiency (such as hydraulic fluid) and these can be used because of the gravity drainage orientation and thus no serious danger of contaminating the moving web exists. The opposing upper chamber can use a lower pressure fluid such as air or water which will not contaminate the moving web. The belt 11 is an imperforate belt such as formed of nylon or rubber, and a viscous oil can be used in the pressure chamber 13 without contaminating the web passing through the pressure zone. At the edges of the chamber 13 are the seals with the seal 14 being located on the oncoming side of the zone P, and the seal 15 being on the offrunning side. To catch the amount of liquid that leaks by the seals 14 and 15, outboard sa-veall pans 16 and 16a are provided. Suitable conduits are provided for conducting away excess liquid from these pans.

The pressure chamber 13 extends for the full length of the roll 10 beneath the belt 11, and by Pascal's Law, the belt is subjected to uniform pressure throughout the extent of the chamber 13. The chamber is carried in the

piston 13b and liquid under pressure is delivered to a line 14a to a chamber 13a beneath the piston, and the chamber 13a is in free communication with the chamber 13 through a passage 13c. Chamber 13a is carried on a support beam 21. The pressure beneath the piston 13b holds the seals 14 and 15 against the traveling belt 11. A pressure in excess of 100 pounds per square inch is necessary, and optimum results have been obtained with pressures of 600 pounds per square inch or more.

The belt 11 is supported on rolls such as 17 and 18 which guide it into its arc or wrap over the roll 10, and additional rolls 19 and 20 support the looped belt.

Either or both of the roll 10 or the looped belt may be driven, and a drive is shown schematically at D-1 for driving the roll in rotation and another drive is shown schematically at D-2 for driving the belt 11.

Means are provided in the pressure zone P for receiving water squeezed from the web. These means may be in the form of a felt 22 between the roll 10 and the web or a felt 23 between the belt and the web, or if desired in the form of a double felted arrangement with the web sandwiched between the water receiving felt members. FIG. 5 shows the web W between felts 40 and 41, with the other elements being the same as in FIGS. 2 and 3. In some constructions, it may be desired to provide a plurality of circumferentially extending small fine grooves in the outer surface 10a of the roll to help in the transfer of water from the web to the felt. Also, in some cases it may be desired to groove the belt 11, although because of the required flexible nature of the belt, it is less desirable to groove its surface. The grooving will appear on the side contacted by the felt so as to avoid marking on the web W.

For preventing excessive deflection of the backing roll 10, a support is provided along its length at the top in opposition to the forces encountered by the roll along the pressure zone P. This support is in the form of a structural load bearing frame 24 carrying a roll pressure chamber 25. The roll pressure chamber is provided with side walls 28 and 29 and seals 26 and 27 which seal against the outer surface 10a of the roll so that the chamber 25 may be pressurized such as by fluid pressure line 30, and savealls 26a and 27a are positioned outwardly of the seals 26 and 27. Because of the large size of the pressure chamber 25, a relatively lower pressure fluid may be used, such as air or water to counteract the large forces from the pressure chamber 13. The weight of the large backing roll 10 also acts counter to the force from the high pressure chamber. If a liquid fluid, such as water, is used in pressure chamber 25, savealls are required to collect leakage at seals 26 and 27. As previously stated, since the belt 11, and hence the web W in the pressure chamber P sees only the pressure caused by the fluid in the pressure chamber 13, it will be subjected to a uniform pressure along its length. Deflection of the roll 10, however, should be maintained at a minimum to prevent distortions in the belt 11 along the length of the pressure zone and to prevent leakage of the seals 14 and 15.

Another form of deflection preventing means may be provided for a roll 10 such as shown in FIG. 4 wherein the roll takes the form of a hollow roll shell 33. The pressure zone is provided beneath the roll shell which is wrapped by a belt 31 backed by fluid pressure chamber 32.

Within the hollow roll shell 33 is a stationary axle or beam 34 having a downwardly facing channel or cylin-

der 35 formed therein. A piston 37 seats in the channel which is, in turn, pressurized by pressure line 36. The beam supports a tilting bearing shoe 38 that slides against the inner surface 39 of the roll shell, and the shoe and piston 37 is sufficiently flexible so that the roll shell is supported equally by fluid pressure along its length. A lubricating film within the shell builds up on the sliding surface of the shoe. Pressure applied normal to the surface of the web along the pressing zone P' is caused by the pressure in the chamber 32, and in accordance with the principles of Pascal's Law, the pressure applied to the web will be uniform at all locations along the roll length.

In the arrangement shown in FIG. 2, a press similar to FIG. 1 is employed with the roll 10' being wrapped by a belt 11' and a pressure chamber 13 positioned behind the belt. In this arrangement a felt 23' passes between the belt and web so that the web is pressed directly against the outer surface of the roll 10'. In the arrangement of FIG. 3, the felt 22'' is positioned between the web W and the roll 10''. A belt 11'' is pressed against the web by pressure chamber 13''.

With the use of a relatively large diameter roll, the pressing zone P turns through an arc of a large radius for minimum disturbance of fiber arrangement. Pressure in the pressing zone can readily be altered for use with webs of different basis weights or for webs or different types of paper. The pressure in the pressure zone 13 may be changed manually or automatically by changing the pressure output of a pump, in accordance with the moisture contained in the web as it leaves the pressing zone. Automatic or manual change can also be made in the counteracting pressure in the roll chamber 30 above the roll to match the pressure of the chamber 13.

There is a power consumption saving with the provision of a single elongate nip over an arrangement having a plurality of roll nips, and with the use of higher viscosity fluids in the pressure chamber 13, a power consumption is attained inasmuch as these fluids require pumps of smaller capacity.

The large area fluid bearing on top of the roll avoids structure which otherwise would be necessary at the bearings at the ends of the roll. The pressure in the supporting chamber above the roll can be arranged so that the roll bearing never has to carry more load than the weight of the roll or the bearing can be arranged to carry substantially zero pressure. By the use of opposing pressure chambers, loading or unloading can be done simultaneously to avoid damage to the mechanism.

The roll can be covered with a material such as chromium, or plastic, which attains good release properties relative to the web without affecting the satisfactory operation of the press.

This large roll concept embodying the present invention is particularly readily adaptable for converting conventional press arrangements to the extended nip press principle.

I claim as my invention:

1. A press structure for performing a dewatering operation on a traveling web in the steps of the formation of the web comprising in combination, a rotatable roll having a cylindrical outer pressing surface,

a fluid impervious belt wrapping a portion of the circumferential surface of the roll forming an arcuate elongate pressing zone with the roll,
 a first deflection preventing support having a chamber positioned outside of and coextensive with said roll and supporting said roll on pressurized fluid opposite the pressing zone so that said roll is supported by uniform pressure along its length preventing said roll from bending from forces in the pressing zone,
 means defining a confined fluid pressure chamber facing the belt and opposite said pressing zone so that a web traveling through said pressing zone is subjected to a pressing force normal to the surface, said first support and said pressure chamber being on different sides of said pressing zone,
 a second deflection preventing support supporting said pressure chamber having a chamber coextensive with said pressure chamber supporting said pressure chamber on pressurized fluid opposite the pressing zone so that said pressure chamber is supported by uniform pressure along its length for preventing said pressure chamber from bending from forces in the pressing zone,
 means in advance of said pressing zone for guiding said belt and web onto said roll surface,
 means positioned after said pressing zone for guiding the web and belt away from said roll surface,
 and means in said pressing zone receiving the water pressed from said web.

2. A press structure for performing a dewatering operation on a traveling web in the steps of the formation of the web, constructed in accordance with claim 1 wherein said means receiving the water pressed from the web includes a looped felt passing against the web in said pressing zone.

3. A press structure for performing a dewatering operation on a traveling web in the steps of the formation of the web constructed in accordance with claim 1 wherein said structure includes porous felts passing through said pressing zone on each side of the web sandwiching the web therebetween and receiving moisture from the web.

4. A press structure for performing a dewatering operation on a traveling web in the steps of the formation of the web, constructed in accordance with claim 1: wherein said second deflection preventing support for said pressure chamber includes a rigid elongate beam extending along the length of the pressure chamber and means for maintaining a predetermined constant pressure in said chamber, seals at the incoming and outgoing edge of said confined fluid pressure chamber relative to the travel of the web, and liquid receiving savealls positioned outwardly of the seals receiving liquid leaking from the

pressure chamber past the seals.

5. A press structure for performing a dewatering operation on a traveling web in the steps of the formation of the web in accordance with claim 1: wherein said first deflection preventing support for said roll includes said chamber being positioned externally of said roll with means for supplying pressurized fluid to said chamber and seals at the edge of the chamber in close-running sealing engagement with the outer surface of said roll.

6. A press structure for performing a dewatering operation on a traveling web in the steps of the formation of the web constructed in accordance with claim 1: wherein said second deflection preventing support has a backing chamber coextensive with said confined fluid pressure chamber and in communication therewith through a conduit.

7. A press structure for performing a dewatering operation on a traveling web in the steps of the formation of the web comprising in combination,
 a rotatable roll having a cylindrical outer pressing surface,
 a fluid impervious belt wrapping a portion of the circumferential surface of the roll forming an arcuate elongate pressing zone with the roll,
 a first deflection preventing support, said roll being a hollow roll shell with said first deflection preventing support being positioned inside of said roll shell and coextensive therewith and supporting said roll shell opposite the pressing zone so that said roll shell is supported by uniform pressure along its length preventing said roll shell from bending from forces in the pressing zone,
 means defining a confined fluid pressure chamber facing the belt and opposite said pressing zone so that a web traveling through said pressing zone is subjected to a pressing force normal to its surface, said first support and said pressure chamber being on different sides of said pressing zone,
 a second deflection preventing support supporting said pressure chamber having a chamber coextensive with said pressure chamber supporting said pressure chamber on pressurized fluid opposite the pressing zone so that said pressure chamber is supported by uniform pressure along its length for preventing said pressure chamber from bending from forces in the pressing zone,
 means in advance of said pressing zone for guiding said belt and web onto said roll surface,
 means positioned after said pressing zone for guiding the web and belt away from said roll surface,
 and means in said pressing zone receiving the water pressed from said web.

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