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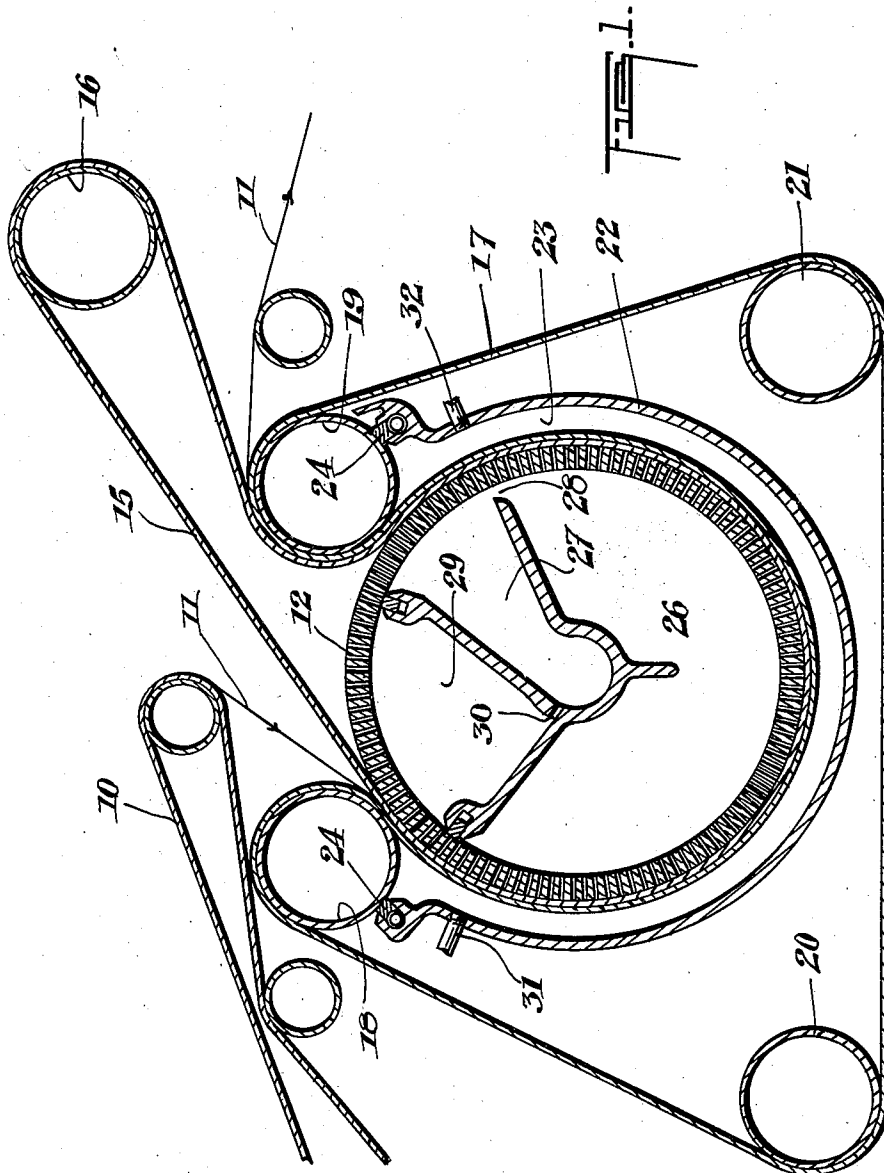
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2,174,744

APPARATUS FOR PRESSING A MOVING WEB IN PAPER MAKING MACHINES

Filed Feb. 3, 1937

4 Sheets-Sheet 1



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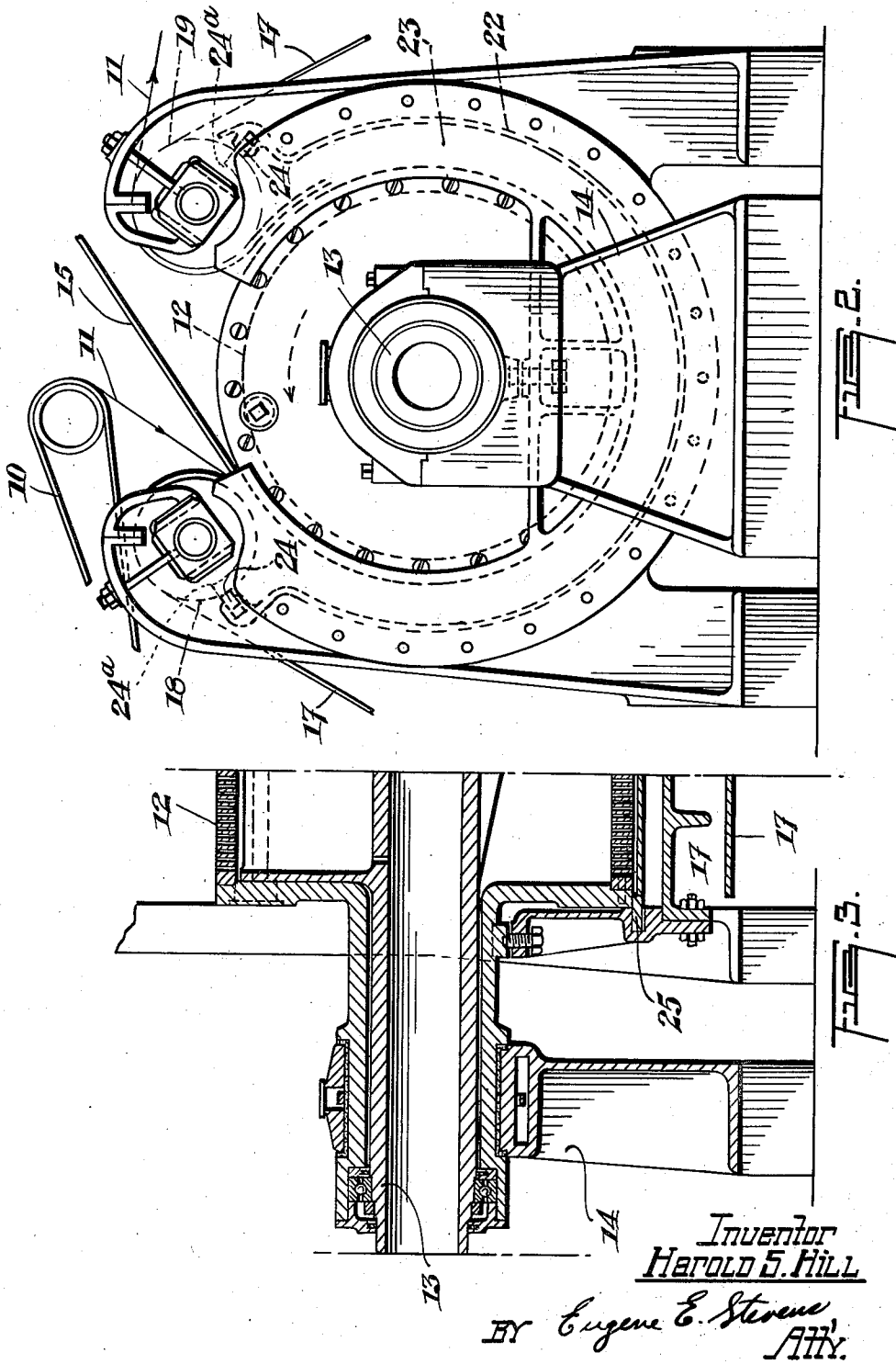
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4 Sheets-Sheet 3

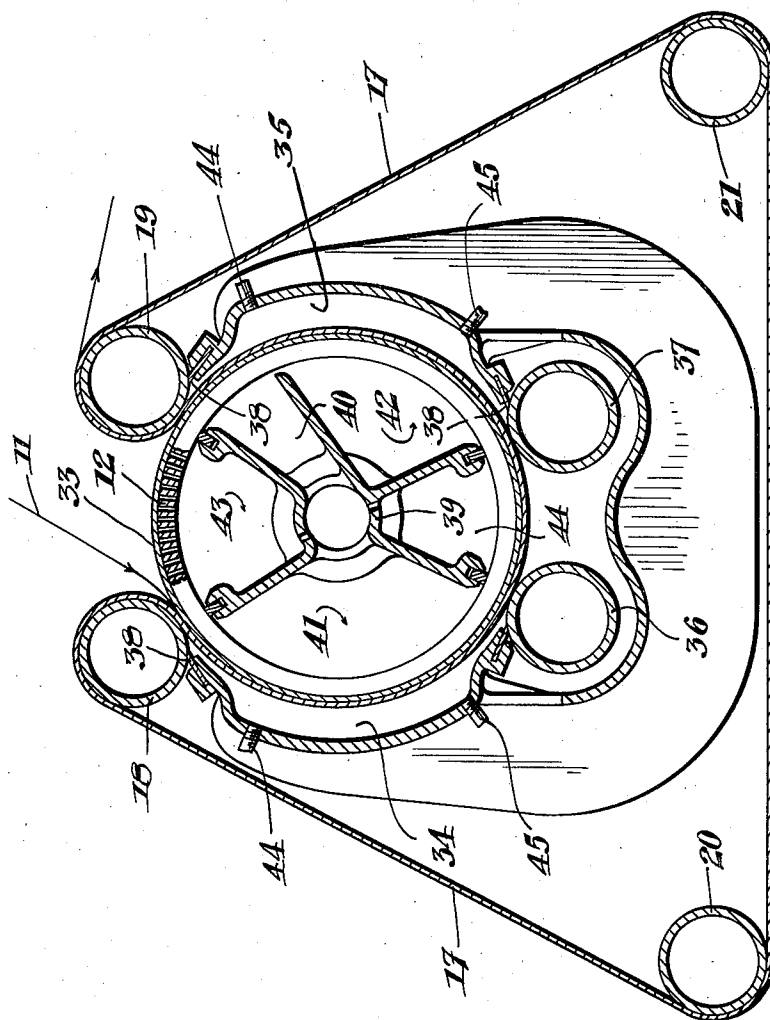


FIG. 4.

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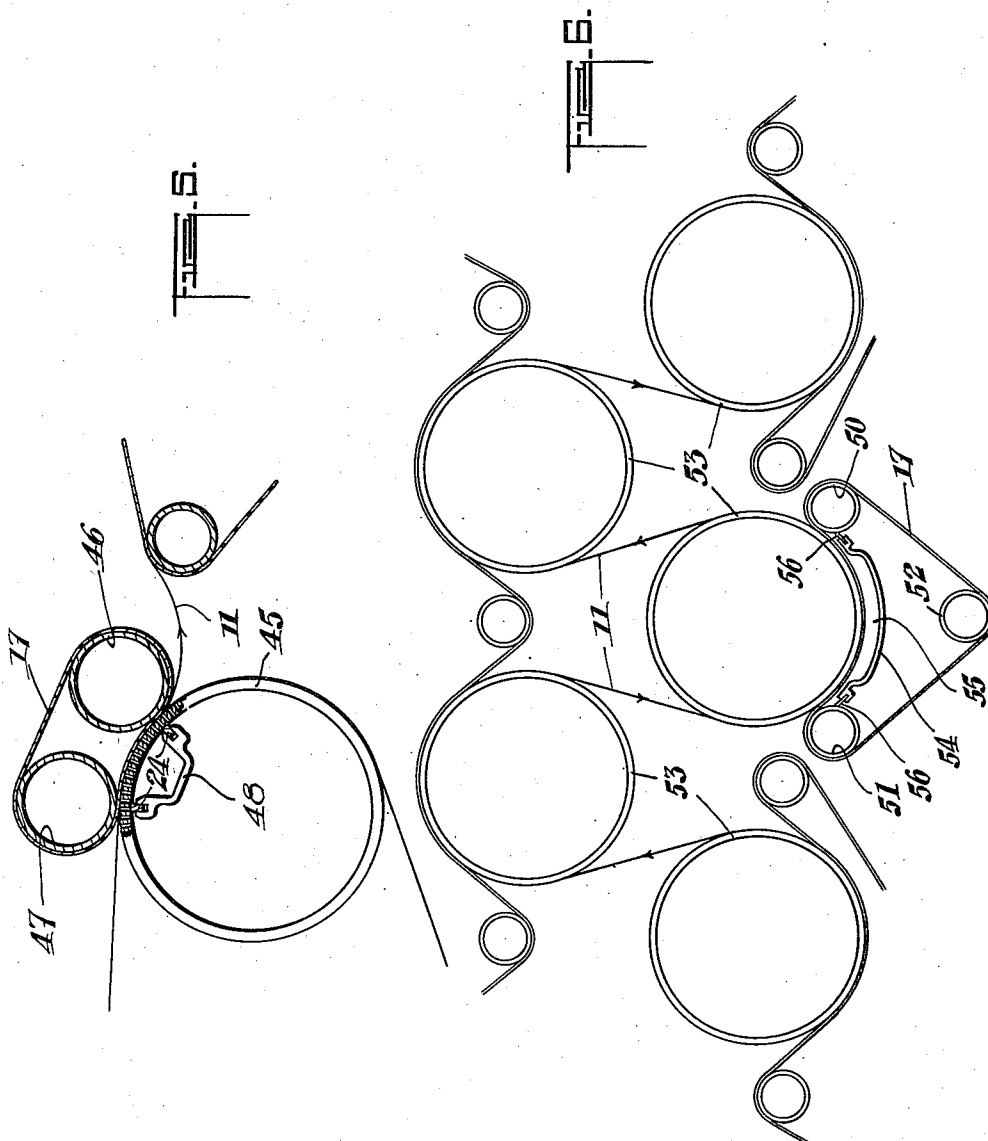
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Filed Feb. 3, 1937

4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,174,744

APPARATUS FOR PRESSING A MOVING WEB
IN PAPER MAKING MACHINES

Harold S. Hill, Quebec, Quebec, Canada

Application February 3, 1937, Serial No. 123,908

3 Claims. (Cl. 92-49)

This invention relates to a method and apparatus of pressing a continuously moving web in paper machines or the like.

A desired improvement in paper machinery is to reduce the water content of the web prior to its passage through the drying stages of the machine, and the present invention relates particularly to the extraction of water from a moving wet web of paper pulp, although it has application also in the drying stages of the machine where this is found desirable.

It has been the common practice in paper making to subject the web, after it has passed from the forming wire, to the usual "wet press", of which there are several for each paper machine, consisting of two rotating rolls bearing together usually with added weight in order to press as much water as possible from the wet web. The web is carried through the area of contact between the pressing rolls, commonly known as the "nip", on an endless woolen felt suitably stretched and guided which, in addition to serving as a carrying medium, provides a medium through which the water pressed from the web may be filtered and removed from the zone of pressure. It is obvious, however, that there is obtained little more than line contact between the pressure rolls and up to the present time this has been a fundamental limitation operating against efficient water removal. Several attempts have been made to increase the water extraction at this point in the machine and suction presses have been employed wherein the bottom roll is in the form of a hollow cylinder whose shell is perforated and suction is applied to the interior of this roll in a suitable zone which is at or near the "nip" so that the water pressed from the wet sheet is largely pulled through the shell of the roll instead of being forced back through the "nip" to flow as best it may over the outside roll.

The suction press effected some improvements over the old style of press but has not overcome the fundamental limitation inherent in the use of roll "nip" pressure for the extraction of water from a moving sheet, wherein the time of actual pressing is necessarily very short. Moreover, the increase in speed in modern paper machines has reduced the time of active pressure on the wet sheet as it passes through the "nip" to an exceedingly minute period. Under these conditions, the problem of overcoming the inertia and viscosity of the water, in combination with the limited filtering capacity of both the wet sheet and the felt, presents a great obstacle to obtain more

efficient water extraction with the present type of press.

Attempts to increase water extraction by means of increasing the roll pressure, quickly reach a practical limit because too high a "nip pressure" will reduce the wearing life of the woolen felt beyond the economic point, and because too high a pressure will injure and mark the wet sheet, and finally because too high a pressure will defeat its very purpose for water extraction by compressing the sheet and the felt so heavily that their filtering capacity is reduced beyond that necessary for the time that is available during the press of the "nip".

The use of "nip pressure" for increased water extraction, therefore, presents certain serious and fundamental difficulties which become accentuated at higher speeds of operation, due largely to the excessively short time of effective action on the sheet during its passage through the nip.

According to the present invention, an entirely novel and improved method of extracting water from a moving wet sheet is provided which greatly reduces and eliminates the main objections associated with the present use of "nip pressure" for this purpose and provides for a substantial increase in the percentage of water extraction. Moreover, the invention is also applicable to the preliminary extraction of water from the web as it passes over the couch roll, to obtain a greater reduction in the water content of the web prior to its passage to the press, and to provide for a stronger web as it is fed to the press. The invention also is applicable in a practical manner to the drying stages of a paper machine, that is in hot pressing the web of paper to produce a desired type of surface, increase in strength, etc., effected through pressure over a greater or lesser time limit, as desired. Of course, the latter application of the invention may be extended to include similar hot pressure treatments to a sheet of paper after it has left the paper machine, as a secondary finishing operation carried out during rewinding of a roll of paper.

In general, the invention provides a means of applying a uniform pressure on a moving web or sheet which may be varied according to requirements and is effective over a very much longer period of time than in the case of "nip pressure". Under such conditions it is possible to obtain not only a greater degree of water extraction but also a more uniform water extraction with less injury to the wet sheet and its carrying felt and, therefore, with less operating

difficulties. It also provides for water extraction with the inclusion of a practical heating operation, in the wet end of a paper machine, thus increasing the possibilities of a substantial water extraction. The invention therefore necessarily results in lower manufacturing costs, improved quality of product and improved operation.

Dealing first of all with the method followed in extracting water from the web in the wet press section of a paper machine, the wet web from which water is to be extracted is passed around a substantial part of the circumference of a cylindrical rotating roll having a foraminous drainage surface. Between the surface of the roll and the wet web, a filtering medium is disposed in the form of an endless wet felt or a felt jacket shrunk on the roll. A flexible, impervious, endless belt is disposed on the outside of the roll to engage and enclose the outer surface of the web throughout the latter's contact with the filtering medium on the roll, the impervious belt moving with the web as it passed around the roll. Fluid pressure is then caused to act on the web as it passed around the surface of the roll, the fluid pressure being applied through the medium of the flexible belt, either by means of a positively applied external pressure or a pressure effected through suction from the interior of the roll, although both methods are preferably employed simultaneously. Consequently as the roll rotates, the wet web as it moves is continuously pressed against an extended, moving, foraminous surface, or in other words is squeezed between the impervious belt and the filtering medium on the surface of the roll while passing over a substantial part of the circumference of the roll, so that, apart from providing for the application of a variable pressure according to requirements, for pressing or squeezing the water from the web, the method provides for a pressing time many times greater than is practicably possible with the usual type of "nip press" roll, which time of pressing may be varied to a considerable degree, depending upon the size of roll selected and on the amount of its circumference which is utilized.

Similar factors apply for water removal as the web passes over the couch roll, and also in hot pressing. In the first case the outer surface of the web as it passes over a selected area of the couch roll is covered with an impervious endless belt and pressure is obtained on the belt through the effect of suction operating from within the roll, whereas in the case of hot pressing the impervious belt is disposed to cover the web disposed in contact with a desired area of one of the drying rolls or a specially heated roll and a positive pressure is applied to the outer surface of the belt, thereby subjecting the moving web simultaneously to both heat and pressure.

It is apparent from a consideration of the foregoing that the method generally involves passing the web over an extended surface moving with the web, confining the outer side of the web with an impervious covering overlying the surface, and subjecting the web to fluid pressure applied through the medium of said covering for the purpose of extracting water from the web, or in the case of hot pressing, to impart a desired type of surface to the web, increase its strength, reduce its thickness, or impart a predetermined design.

The method also includes a special heating operation which is particularly applicable in the case of water extraction, and may also be ap-

plied in hot pressing. This consists in heating the pressure fluid which may readily be maintained at a desired temperature to heat the web simultaneously with the pressing operation, to increase the possibilities of substantial water extraction or to provide additional heat during hot pressing if required.

In order more clearly to illustrate the invention, reference is made to the accompanying drawings.

In the drawings:

Figure 1 is a transverse section taken through a water extracting roll according to the present invention, illustrating the manner in which the web is fed to and confined on the surface of the roll by the impervious belt, as well as an example of the structure which may be employed for exerting a substantial, external uniform pressure on the belt.

Figure 2 is a side elevation of the apparatus disclosed in Figure 1 with some of the rolls omitted.

Figure 3 is a fragmentary sectional view of the water extracting roll and its mounting.

Figure 4 is a view similar to Figure 1, showing an alternative type of construction.

Figure 5 is a fragmentary sectional view of a suction couch roll of a paper machine, showing the application of the impervious belt to obtain improved water extraction, and

Figure 6 is a schematic view showing the application of my invention to one of the paper machine drying rolls, for the purpose of hot pressing the web.

Referring more particularly to Figures 1 to 3, 10 indicates an endless felt conveying the web 11 to the press section of the paper machine. According to the invention, instead of the usual press rolls, there is provided a drainage roll 12 provided with suitable shafts 13 which may be journaled in any suitable manner on the standards or pedestals 14. Passing around the roll 12 is an endless felt 15 which also passes over the tension roll 16 and forms the base and filtering medium upon which the web lies as it passes over the drainage roll 12. Confining the web 11 as it passes over a portion of the surface of the drainage roll 12, is an endless impervious belt 17 which is disposed upon the pairs of guide rolls 18 and 19, 20 and 21, the latter pair being adjustable, if desired, to maintain required belt tension.

Around the outside of the cylinder 12, a suitable casing 22 is positioned to form a chamber 23 between the exterior of the impervious belt 17 and the casing, for receiving fluid under pressure. The casing may be of any desired form, such as, for instance, part of a reinforced vat structure, as illustrated in Figure 2, the chamber 23 being suitably sealed to confine the pressure medium to the area of applied pressure. In Figure 1, an illustration of one type of seal which might be employed is shown wherein the sealing members 24 are disposed to engage the rolls 18 and 19 at the top of the structure, side seals being also provided for the ends of the rolls, as indicated at 24a, see Fig. 2. In Figure 3 sealing members 25 are shown disposed in the sides of the casing to engage with the edge of the impervious belt, the belt projecting beyond the foraminous surface of the roll and the web being disposed so that its edges preferably terminate short of the defining edges of the foraminous surface, leaving part of the latter at the edges exposed so that if any leakage occurred between the seal 25 and

the belt this would be drawn through the foraminous surface without entering the web.

Hydrostatic or water pressure may conveniently serve to supply the fluid pressure on the outer surface of the impervious belt. Of course, other liquid or gas pressure would serve a similar purpose. The desired fluid pressure may be maintained in the sealed chamber in well known manner, such as by pump, reservoir, valves etc. suitably connected to the chamber.

It will be apparent that, with this construction, a variable degree of pressure may be applied to the exterior of the impervious belt over that area of the latter which is disposed on the roll 12. It is clear, therefore, that as the cylinder rotates, the wet sheet is continuously pressed or squeezed between the impervious belt 17 and the felt 15 disposed over the cylinder 12, which results in squeezing water out of the web through the felt into the roll in a continuous and uniform manner. Moreover, by reason of the fact that the pressing action occurs throughout the passage of the sheet over a substantial part of the circumference of the roll or, in other words, during its passage over an extended drainage surface, there results, in comparison with usual practice, an extended pressing time.

In the construction shown the chamber 27 is subjected to a high degree of suction which is directed to that portion of the roll where the web finally leaves the roll, while a substantially similar degree of suction is applied to a remaining larger portion of the roll around which the web passes, this being effected from the chamber 27 through the space 28 between a wall of the chamber 27 and a peripheral wall of the roll.

In chamber 29 a lower degree of suction is applied through the opening 30 connecting it with chamber 27, chamber 29 being illustrated as operating upon the balance of the peripheral wall of the roll in that area principally where the roll is free of the web and felt, to extract any moisture that may still be retained in the peripheral wall. The degree of suction and the zones to which it is applied may, of course, be varied to meet with requirements.

By subjecting the interior of the roll to partial vacuum two purposes are served. The first is facilitating the removal of water which has been pressed from the web through the felt, into the holes or orifices of the foraminous surface of the roll, as above referred to, and the second purpose is to increase the external pressure exerted on the belt and for this purpose suction is applied at a zone embracing a part or all of the roll circumference which is covered or wrapped by the impervious belt. Obviously the increased pressure obtained on the belt will vary with the degree of vacuum which is maintained, the total theoretical increase being limited to full atmospheric pressure. This increase in pressure on the belt due to vacuum is in addition to the positive fluid pressure that may be applied to the belt through the pressure medium in the chamber 23 and is also in addition to the radial pressure exerted by the belt due to its tension.

It will be apparent, therefore, that pressure for water extraction may be obtained by means of an external positive fluid pressure on the belt or a pressure of this character supplemented by suction from the interior of the roll. On the other hand, due to the fact that the invention provides for the extraction of water from the web in one long continuous pressing stage, improved results in extracting water from the web can be obtained

by merely subjecting the foraminous surface to suction applied from the interior of the roll, which in fact does create atmospheric fluid pressure on the belt. It will be realized, therefore, that the expression "subjecting the web to fluid pressure" or reference to "fluid pressure" occurring in the appended claims of this application may embrace either or both of these two modes of applying fluid pressure.

The amount of water which is extracted from the wet sheet will depend largely on the total pressure exerted on and by the belt, but the usefulness of the present invention is in no wise limited to any particular total pressure, nor to the relative magnitudes of the three above mentioned component pressures, namely externally applied pressure, external pressure created by suction and the lesser pressure resulting from belt tension, nor indeed is it limited to the necessity of using all three of these component pressures, as has been clearly indicated.

In those cases where suction is used, either alone or in conjunction with a positively applied external pressure, a partial vacuum is created in the interior of the cylinder in any suitable manner, such as by means of a combined water and vacuum pump connected with the interior of the roll through one or both shafts. In this way the surface of the roll is subjected to suction which may be applied through the use of a stationary but adjustable suction box divided into compartments, if desired, or a number of suction boxes may be employed at different points within the roll as found necessary. In Figure 1 there is illustrated one form of construction 26 which might be employed for applying suction to the peripheral wall of the roll.

To increase the possibilities of substantial water extraction in the pressing operation, heat may be applied in a practical manner, according to the present invention, by heating the pressure fluid in chamber 23, and to this end a fluid inlet 31 and a fluid outlet 32 may be included to permit circulation of the water and consequently the maintenance of a substantially uniform heat throughout the area under pressure. Consequently the belt and underlying web may be subjected directly to a substantial degree of heat which may be maintained within a reasonable range.

In Figures 4 to 6 other forms of construction are illustrated to which the principle of the invention is readily applicable. In Figure 4 a similar construction to that described is illustrated which employs the cylinder 12, the rolls 18 and 19, and 20 and 21 and the impervious belt 17. In this structure the cylinder is shown with a felt jacket 33 which is shrunk on the cylinder.

Furthermore, instead of employing a continuous chamber surrounding the cylinder, two chambers 34 and 35 are employed, one disposed on each side of the cylinder to avoid upward thrust on the roll, in the case where it might be necessary to exert a great radial pressure on the impervious belt and web of paper, and to provide for a balanced pressure. In this structure two additional rolls 36 and 37 are added, similar to rolls 18 and 19, to provide for the two equal and oppositely disposed sealed fluid chambers, sealing members 38 being provided in connection with the casing surrounding the chambers to engage the rolls 18, 19, 36 and 37. A slightly different sealing member of suitable material is here illustrated and so arranged and adjusted to touch the surfaces of these rolls, the contact be-

tween the sealing members and the rolls, to provide a seal, being maintained by virtue of the fluid pressure itself.

Any suitable suction box construction may be employed within the roll 12, one construction 39 being illustrated wherein the chambers 40 and 41 are subjected to a high degree of suction and chamber 42 subjected to a slightly lesser degree of suction. The chambers 40, 41 and 42, it will be noted, are positioned in zones where the web is subjected to pressure from the chambers 34 and 35, the chamber 40 being so positioned that the web, just prior to the point where it leaves the roll 12, is subjected to a high degree of suction. The chambers 43 and 44 are subjected to a low degree of suction which may operate to clear the orifices in the foraminous surface of the roll of any moisture that they may carry. In the showing of Figure 4, chamber 43 is disposed so that a low degree of suction will operate on the web just as it leaves the roll and just as it commences to pass over the roll.

The chambers 34 and 35 are provided with inlets 46 and outlets 45 to provide for circulation of the pressure fluid to maintain a substantially even heat in the case where the fluid is heated to provide for a heating operation simultaneously with the pressure.

The effect of the structure shown in Figure 4 is substantially the same as that obtained in the case of Figure 1, except that instead of providing for one long continuous pressing stage, the water extraction is effected in two shorter separate pressing stages. However, the area of the belt under pressure is increased when the interior of the roll is subjected to vacuum in addition to the positively applied external pressure, since in this case that portion of the belt on the roll between the chambers 34 and 35 is then subjected to substantially full atmospheric pressure. On the other hand, similarly as in the case of Figure 1, when the interior of the roll is subjected to vacuum alone and no positive external pressure is applied, the web receives the effect of substantially full atmospheric pressure throughout the area of the roll over which it passes.

In Figure 5 the application of the principle of the present invention is shown on a couch roll 45 wherein the impervious belt 17 is disposed on two rolls 46 and 47 and caused to press against the web as it passes over a surface of the couch roll. The suction box 48 is disposed within the couch roll and positioned so that the effect of the suction is directed to that area of the roll over which the web and belt pass. Consequently, the web, during its passage over the couch roll, will be subjected to a steady uniform pressure effected through the medium of the belt in one continuous operation and for a period of time whose maximum is controlled by the maximum portion of the circumference of the roll over which the web may be caused to pass. This use of the belt renders it possible to subject the web to a greater degree of pressure exerted over a longer period of time as the web passes over the couch roll, providing for a greater percentage of water extraction at this point with consequent strengthening of the web.

In Figure 6 the application of the principle of the invention is shown in conjunction with the drying rolls of the paper machine, wherein the impervious belt 17 is arranged on rolls 50, 51 and 52 and caused to pass over a substantial part of the circumference of one of the drying rolls 53 around which the web passes. A casing 54 form-

ing a pressure chamber 55 is disposed below the drying roll 53 so that the impervious belt and the web, as they pass around the roll, are confined between the latter and the chamber while suitable sealing members 56 are associated with the casing 54 to engage the rolls 51 and 50 and thus seal the chamber 55. In this manner a substantially uniform pressure can be applied through the impervious belt to the web.

Normally the drying rolls of the machine are heated from the interior, the web being carried into contact with the rolls under slightly radial pressure by means of the usual felts. In the showing of Figure 5 the felt is omitted in connection with drying roll 53 and replaced by the impervious belt 17, through which the desired pressure is applied to the web, along with heat, to provide for a desired type of finish, an increase in its strength, reduction in its thickness, or the imparting of a predetermined design.

The drying roll or rolls to which this pressing arrangement may be applied can be heated to a degree most suited for the particular treatment involved. In this connection, however, it will be realized that the desired limited amount of heat required, or in some cases additional heat, could be applied to the web by heating the pressure fluid in chamber 55, as described in connection with the other forms of construction illustrated in the present application.

It is apparent that, in providing for a heat and pressure treatment of the paper web, the heated roll might be employed before or after the web has passed the drier section of the machine, whereas such treatment may be employed as a subsequent finishing operation for treating the web of paper after it has passed from the machine, for instance as it is being unwound from rolls.

From the foregoing it is clear that one of the essential features of the present invention is the use of the endless, flexible belt through which pressure is applied to the sheet. This belt besides having the necessary running qualities must be flexible enough to readily and efficiently transmit the hydrostatic or fluid pressure to the wet sheet, and must also be essentially impervious to the fluid which is used to exert the pressure, whether it be a liquid such as water or a gas such as air. This necessitates a belt made of an impervious material such as rubber, impregnated canvas, thin, high strength steel or the like, but the present invention is not limited to any particular material provided that the belt fulfils the above described requirements.

The filtering felt which passes between the wet sheet and the roll in the present invention serves essentially the same purpose as the wet felt on the usual two roll, nip press and obviously its specification may vary considerably depending on the particular product and operation for which the invention is used. In general, however, a finer and closer weave and texture of wet felt than is commonly employed for nip presses will be preferable for use with this new method of pressing.

It is, of course, to be understood that the design is in no sense limited to the particular arrangements and details shown in the accompanying drawings by means of which the invention is illustrated. Various arrangements are obviously possible, all incorporating the basic idea of a flexible, impervious belt in contact with and exerting a desired radial pressure on a paper web or sheet travelling at high speed to obtain the desired results described in the foregoing.

Various modifications may be made in this in-

vention without departing from the spirit thereof or the scope of the claims, and therefore the exact forms shown are to be taken as illustrative only and not in a limiting sense, and it is desired
5 that only such limitations shall be placed thereon as are disclosed in the prior art or are set forth in the accompanying claims.

I claim:

1. In the manufacture of paper, apparatus for
10 pressing the paper web comprising a rotatably mounted roll over which the web passes, a casing enclosing that part of the roll over which the web passes and forming at least one fluid pressure chamber extending around a portion of the sur-

face of the roll, an impervious belt disposed around the roll engaging and confining the web as it passes over the roll and sealed against the casing, and means for introducing a fluid under pressure to said chamber to exert pressure on
5 said belt.

2. The device as claimed in claim 1 in which the roll has a foraminous drainage surface and suction is applied from the interior of the roll.

3. The device as claimed in claim 1 in which
10 opposed fluid pressure chambers are provided, one on each side of the roll.

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