Nov. 11, 1969 D. A. ELY, SR 3,477,907

PRESS ARRANGEMENT FOR PAPERMAKING MACHINE

Filed March 9, 1966 3 Sheets-Sheet 1

FIG. 1

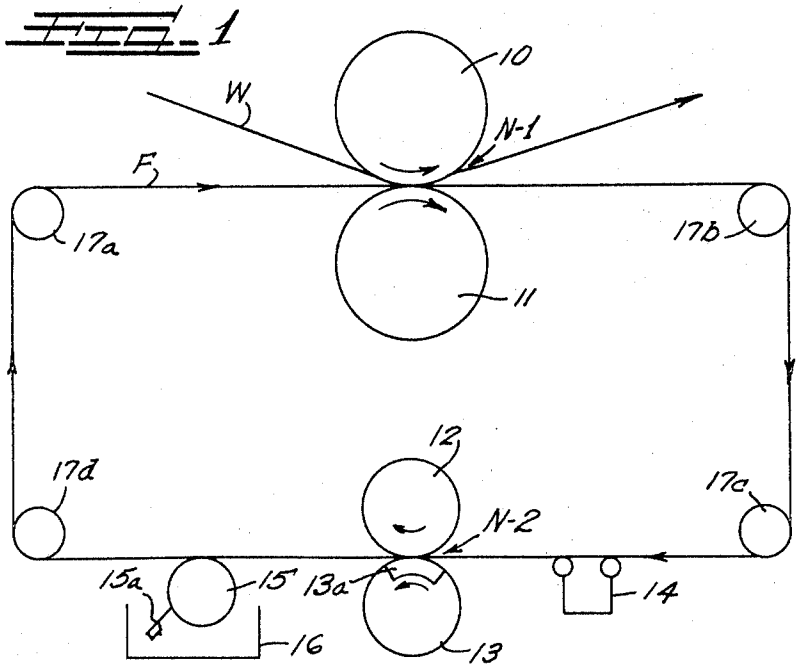


FIG. 2

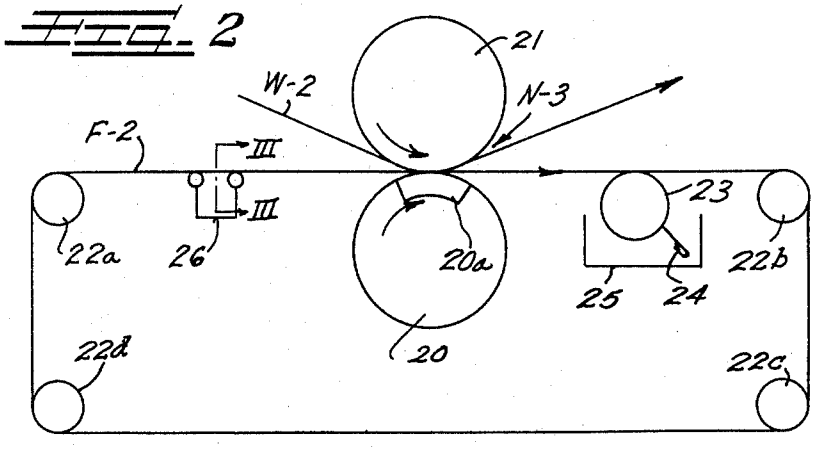
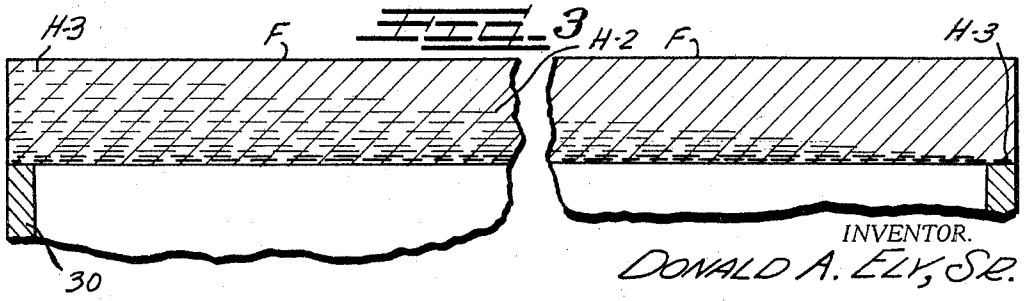


FIG. 3



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FIG. 4

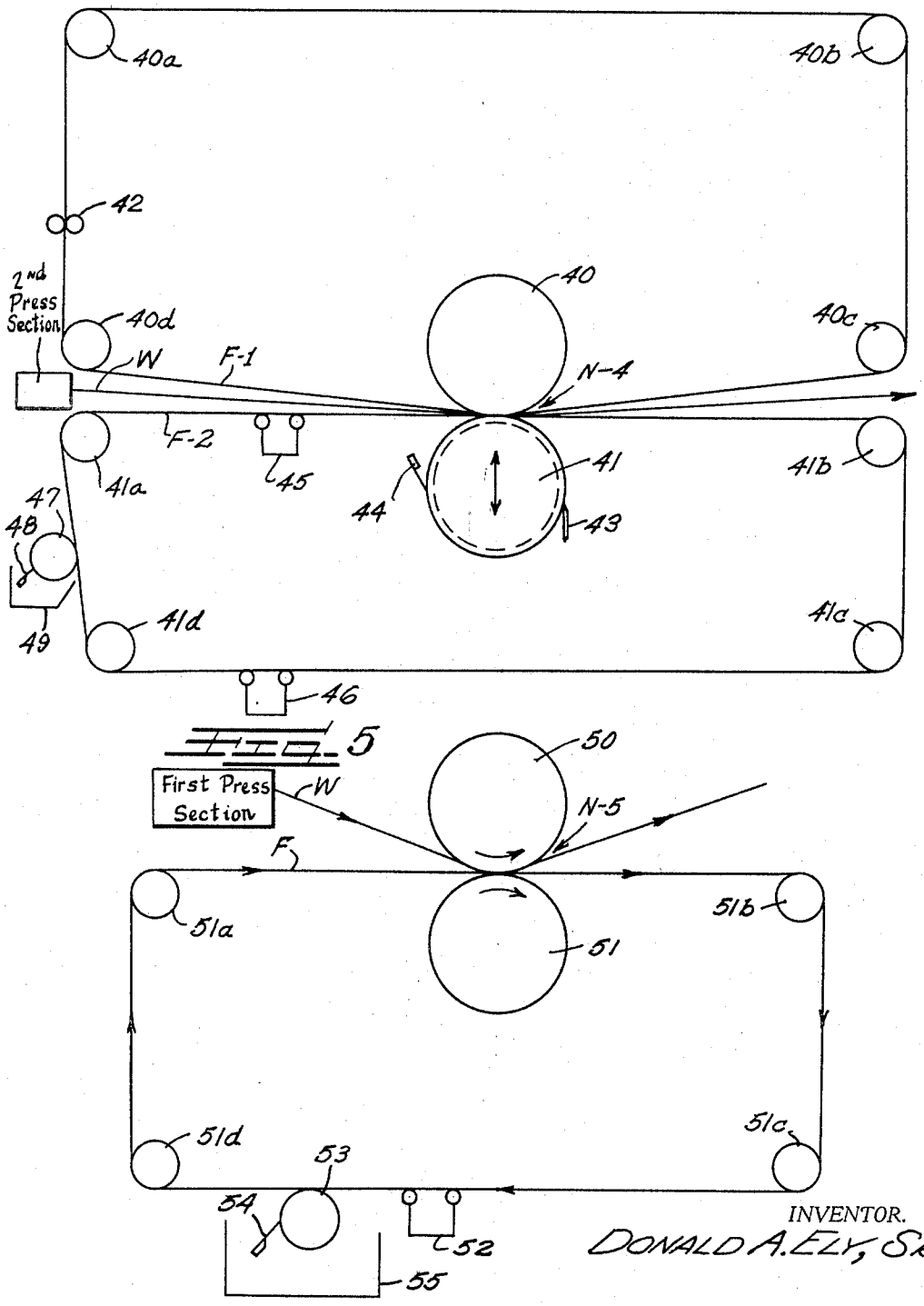


FIG. 5

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FIG. 6

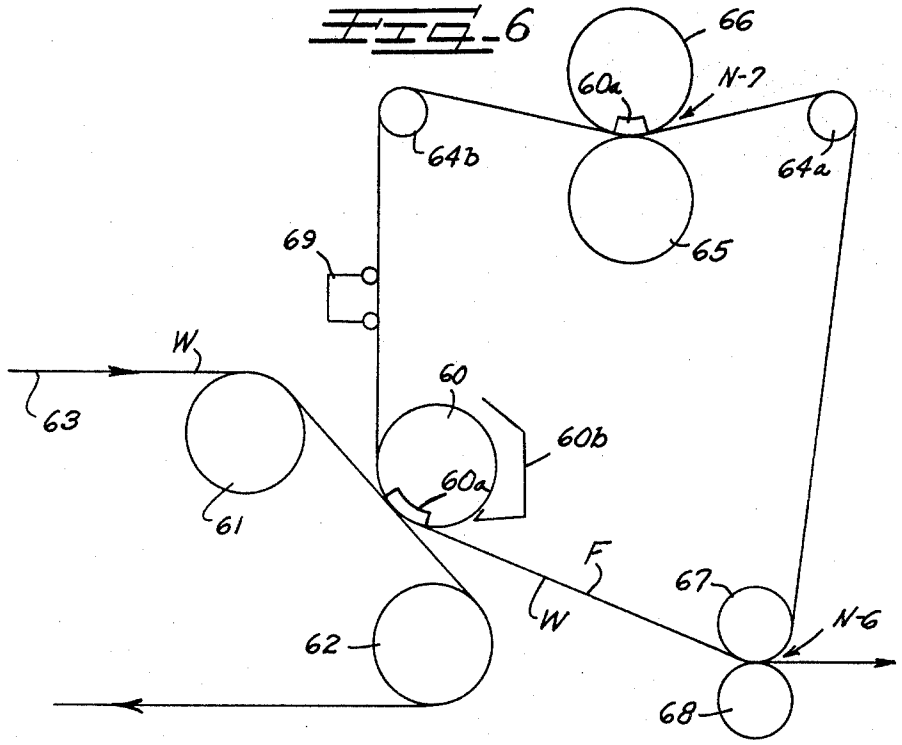
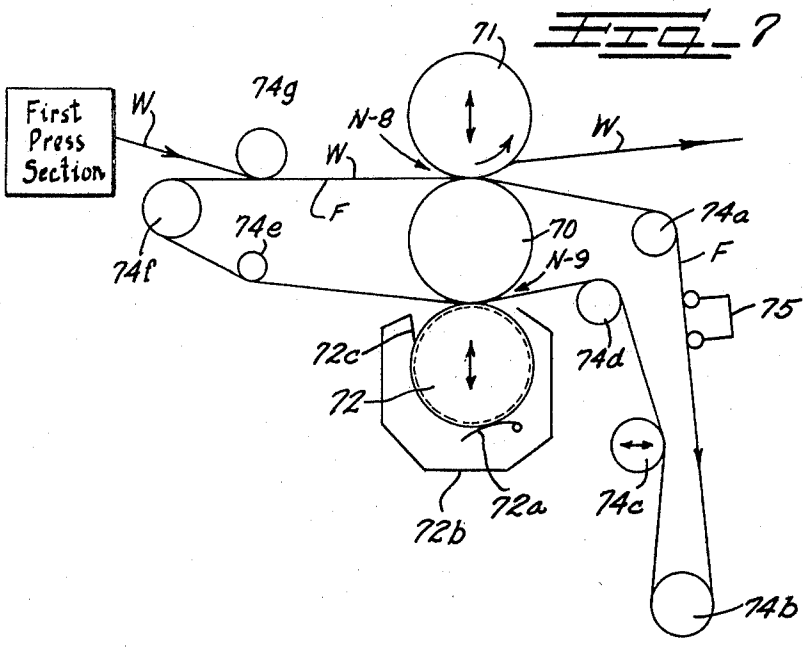


FIG. 7



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3,477,907

PRESS ARRANGEMENT FOR PAPERMAKING MACHINE

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U.S. Cl. 162—358 5 Claims

ABSTRACT OF THE DISCLOSURE

A press arrangement in a papermaking machine wherein a stationary suction means (Uhle box) is associated with a press nip receiving a looped travelling felt with or without a moist travelling web carried thereon, so that the felt has an increased water capacity at the press nip by reason of its changed water profile effected by the stationary suction means.

The present invention relates to an improved paper machine and press assembly, and more particularly, to an improved arrangement and method of removing moisture from a press felt in press sections of a paper machine.

In a web press that is used in a paper machine, a "web" nip is formed between opposed press rolls on a traveling paper web in engagement with a drying felt and the felt and web are passed through the nip. The press roll may be plain or the roll on the felt side may have small size blind holes, or it may be provided with a fine porous structure in the form of a woven wire or fabric wrapped on the cover or surface portion of the roll close to the interior, or in certain instances, the felt covered roll may be perforated as in the case of suction roll shells for aiding in the removal of moisture from the web and into the felt; and yet in certain other instances it may be desirable to employ a grooved roll such as is disclosed by E. J. Justus in U.S. Patent No. 3,198,697. The drying felt is in the form of a loop or endless felt and after it leaves the web nip, moisture must be removed from the felt in most instances before it again enters the nip. Various means have been employed for removing moisture from the felt in such instances. The satisfactory removal of moisture is an important part of the moisture remover operation for the web, since the transfer of moisture from the web to the felt is largely dependent upon the condition of the felt as it enters the web nip. It is, therefore, important that moisture be satisfactorily and uniformly removed from the felt at relatively high machine speeds.

Various arrangements have been used for attempting to remove water from the felt at the web nip. Each of these arrangements has required an alteration of structure as compared with a plain press nip, either by incorporating additional materials in the nip or modifying the plain press roll couple which supports the felt in the nip, for example, by replacing one of the rolls with a suction roll. It is, however, advantageous in many respects to retain a plain web press nip (or at least one wherein the felt cover roll has relatively fine porosity) with the water being transferred to the felt at such nip. For example, plain press rolls obtain substantial saving over expensive perforated suction rolls, and in addition, plain press rolls avoid or minimize shadow marking on the paper web.

The present invention contemplates employing a stationary suction means to change the water profile in the felt, thereby increasing the water capacity of the felt at the press nip. This concept is equally well employed in felts passing through a felt only nip and in

felts passing through a web nip. It is to be understood that in the case of the present invention, although the advantages of the plain (web) press nip are obtainable, mechanisms may be employed for defining the first press nip using press rolls that are plain, blind drilled, porous sintered or ceramic rolls, grooved rolls, or even perforated suction rolls, depending upon such factors as the total water entering the nip, specifications for the final paper product (particularly with respect to shadow marking), felt weave and thickness, etc.

The present invention contemplates the provision of a stationary suction means with a press nip receiving a looped felt with or without a paper web wherein the felt has an increased capacity for water at the press nip by reason of its changed water profile at the stationary suction means. This stationary suction means is employed to advantage at any particular press nip, but is particularly advantageous if it is employed at the first, second and third press nips. The water transferred from the paper web to the felt may be either entirely carried away by the felt or a certain portion of the water may be transferred at the nip from the web to the felt and then to a further water removal means, as for example, a suction roll or a grooved roll which would form a part of the nip. Of course, if the felt carries away all the water that is transferred from the paper web to the felt at the press nip, the water is then removed from the felt at a location generally remote from the press nip.

Accordingly, it is an important object of the present invention to provide an improved mechanism and method for removing water from a press felt.

A further object of the invention is to provide a stationary suction means in working relationship with a looped felt wherein the stationary suction means substantially changes the water profile of the looped felt, increasing the water capacity of the felt at a press nip.

A still further object of the invention is to provide an improved mechanism and method for the removal of moisture from a traveling paper web after it has left the forming section of the paper machine, by employing a dryer felt.

Other and further objects, features and advantages or the present invention will become apparent to those skilled in the art from the following detailed disclosure thereof and the drawings attached hereto and made a part hereof.

On the drawings:

FIGURE 1 is an essentially diagrammatic side elevational view of a mechanism employing the principles of the present invention;

FIGURE 2 is another essentially diagrammatic view comparable to FIGURE 1, showing a modified form of the invention;

FIGURE 3 is a fragmentary detailed view taken substantially along the line III—III of FIGURE 2, showing the water profile of a looped felt that is used in the practice of the instant invention;

FIGURE 4 is another diagrammatic view comparable to FIGURE 1, showing another embodiment of the invention;

FIGURE 5 is an essentially diagrammatic side elevational view of a plain press section embodying the instant invention;

FIGURE 6 is an essentially diagrammatic side elevational view of a suction pick-up press arrangement embodying the instant invention; and

FIGURE 7 is an essentially diagrammatic side elevational view of a press mechanism showing the different embodiments of the present invention.

As shown on the drawings:

In FIGURE 1, a first nip N–1 is formed between first and second superimposed press rolls **10** and **11**. Through

the nip N–1 passes a traveling paper web W containing water and a press felt F. Since this nip N–1 is employed for the purpose of dewatering the web W, it is referred to as a "web" pressure or press nip (N–1). At the nip N–1, water is transferred from the web W to the felt F due to displacement of the water by pressing or squeezing the web W and also due to capillary action. The upper press roll **10** which actually contacts the web W is preferably a plain press roll, as shown, such as a granite roll or a rubber covered roll, which per se, will not impart any shadow marking to high quality and/or delicate paper webs coming into contact therewith at the nip N–1. It will be appreciated that in the case of paperboard production or in the case of production that does not involve extremely high quality paper webs that must be free from markings, it is conceivable that the roll **10** may have minute blind pores or may even be a suction roll, preferably having a woven wire wrap thereon to prevent direct contact between the suction roll perforations and the web; but one of the particular advantages of the instant invention resides in the fact that a plain roll, such as roll **10**, may be used here to afford maximum protection for delicate high quality webs.

The lower press roll **11**, is likewise, preferably a plain press roll as shown. Although it will be appreciated that in the case of a relatively high total volume of water entering the nip N–1, in the practice of the invention, the roll **11** may have relatively fine blind holes (e.g., as in Walker U.S. Patent No. 3,023,805), or the roll **11** may have grooves (e.g., as shown in Justus U.S. Patent No. 3,198,697), or the roll **11** may have some other type of cover or peripheral surface portion closing out fluid penetration to the interior of the roll, but may have a porous water-receiving surface in the form of a woven wire or fabric of relatively incompressible material on the surface of the roll, providing a myriad of fine water-receiving pores or cells on the surface thereof. In such porous surfaces, it is found in practice that the pores are capable of receiving an extra or excessive load of total water per unit of time entering into the nip N–1, so that the oncoming side of the nip N–1 is not overloaded. Such pores would generally tend to receive this extra water substantially only when subject to relatively high pressure at the nip N–1, as at the off-running side of the nip N–1, the felt F expands almost instantaneously and reabsorbs the water in the pores.

It will also be appreciated that the roll **11**, wrapped by the felt F at the nip N–1, may in certain circumstances be a conventional perforated suction roll with a suction gland opposite the nip N–1, so that droplets of water may be received in the perforation of the suction roll at the nip N–1 (primarily by virtue of squeezing the water out of the web W and the felt F). However, in a suction roll, a significant amount of water is ordinarily retained in the perforations, which extend clear through the shell or outer portion of the roll, at the off-running side of the nip N–1. Such water is ultimately thrown by centrifugal force from these perforations, after the suction roll has passed away from contact with the felt F and beyond the suction gland. The use of conventional perforated suction rolls, however, is preferred primarily in the case where excessive amounts of water are entering the nip N–1, shadow marking by the suction roll perforation is not necessarily undesirable (e.g., as in the case of low quality paperboard), and/or heavy felts may be used to minimize shadow marking.

Although the instant invention comprises an arrangement which is particularly useful for water removal, even in the case of the removal of substantial quantities of water, it will be appreciated that one of the particular advantages of the instant invention is that it permits the dewatering of a comparatively delicate web without the necessity of imparting shadow marking to such web, by the use of plain surface press rolls **10** and **11** (or the use of the roll **11** having only a very fine surface porosity).

The felt F is of the construction conventionally employed in web presses, and may be a needled felt, a duplex felt, or the like, of the type suitable for the particular paper and operation desired. The felt F is an endless loop and is carried on an idler guide roll **17***a*, **17***b*, **17***c*, **17***d*; any of which may be a stretch or tensioning roll, not shown, all of conventional construction.

It should be noted that the "oncoming" side of a nip is the side of the nip which the traveling web and/or felt approaches; whereas the "off-running" side of the nip is the side where the web and/or felt travels away.

At the off-running side of the nip N–1, the web is guided by any suitable means away from the felt F to minimize rewetting of the web W, and the felt F is then directed through a second pressure nip N–2 defined between an upper press roll **12** within the loop of the felt F and a lower press roll **13** outside the loop of the felt F. In the second press nip N–2, which is called a "felt only" nip for the reason that the only material that is dewatered therein is the felt F (and the web is not passed therethrough), the moisure will be forced out of the felt, at a predetermined rate, into suitable water removal means, as for example, a suction roll, a substantially incompressible porous belt, a grooved roll, or some other such suitable device. At the immediate oncoming side of the felt only nip N–2, a stationary suction means **14**, which may be a conventional suction box, Uhle box or other suitable mechanism creating an area of reduced pressure across the width, i.e., cross-machinewise direction, of the felt sufficient to produce a change in the water profile of the felt, is directed into contact with the working face of the felt.

The term "water profile" as used herein, is understood to mean water distribution in a felt as seen in a side view of the felt, which is schematically illustrated in FIGURE 3, which is a sectional view taken along line III—III of FIGURE 2, showing the felt F passing over a stationary suction means **26**, having an interior **30** wherein the water distribution within the felt at the immediate oncoming side of the stationary suction means is evenly distributed throughout the felt, as seen at H_3, and as the felt passes over the suction means, the water distribution is shifted gradually to H_2 and finally to H_3 so that after the felt F has passed the stationary suction means, the water is primarily concentrated on that side of the felt which was in direct contact with the stationary suction means. This concentration of water in the felt to the side wherein the stationary suction means is stationed, allows the felt only nip to remove a maximum amount of water from the felt without the necessity of using extremely high pressure nips, which has been the case in prior art structures. Thus, it will be seen in FIGURE 1, that as the felt F passes the stationary suction means **14**, wherein the water profile of the felt is substantially changed so as to concentrate the water on the "working" face of the felt F prior to its entrance into the nip N–2, thereby allowing suction roll **13**, having a suction gland **13***a*, to come into direct contact with that surface of the felt containing the concentration of water, thus allowing a maximum amount of water to be removed in the shortest amount of time, as the water has only a relatively short distance to travel from the surface of the felt F into the suction gland **13***a*. Any water left on the working face of the felt F is then removed by a small doctored roll **15**, which is preferably made of metal, but may be made of any other suitable material capable of being doctored, which removes water from the surface of felt F by a creation of a small wedge of water formed at the immediate off-running side of the doctored roll, so as to pull the water out by hydraulic effect, as by suction, and by surface tensioning effects, which may be characterized as a pump. Associated with the doctored roll **15** is a suitable doctor device **15***a*, around which total assembly is placed a save-all device **16** of conventional construction, where the water removed from the felt F by the roll **15** is ultimately

received and disposed of. The felt F, after passing the roll **15**, is in a dry condition, ready to enter nip N–**1** and again take on additional water from the web W, and thereafter the cycle just described is repeated.

Stationary suction means shown as **14** in FIGURE 1, are preferably positioned on the working face of the felt. The working face of the felt is understood, of course, to be that face of the felt which comes into direct contact with the paper web as it passes through the nip, as for example, N–**1**. By positioning the stationary suction means on the working face of the felt, it is possible not only to substantially change the water profile of such a felt but to also clean the felt of any foreign particles that may be embedded therein, as for example, loose fibers, clay, dirt, etc. This stationary suction means, which may be, for example, a Uhle box, brings water out to the surface in contact with it, as for example, the working face of the felt, while removing some of the water present in the felt. The amount of water removed at the stationary suction means, is dependent primarily upon the amount of water originally present in the felt and the amount of suction applied at the suction means. The amount of water in the felt F can readily be controlled by increasing or decreasing the pressure at the web nip N–**1** and, of course, the amount of suction applied at the stationary suction means can also be readily controlled with conventional vacuum equipment. This stationary suction means is preferably provided with a substantially frictionless surface to contact the felt so as to minimize wear thereon, for example, this surface may consist of rotating sealing surfaces or non-rotating smooth seals which produce what might be termed a washboard water removal effect. This type of smooth continuous surface suction means would tend to minimize any undue felt wear, while at the same time, cleaning, conditioning, and drying the felt. It has been found that as a general practice, it is preferably to employ approximately 10 to 15 inches of water vacuum at such stationary suction means. It will be understood, of course, that under particular circumstances, it may be desirable to operate under a relatively higher or lower pressure, and such operation is included within the scope of the invention.

Referring now to FIGURE 2, it will be seen that in the arrangement as shown therein, a web W passes through a press nip N–**3** defined between an upper plain press roll **21**, which has a structure of the type described in connection with roll **10**, and a lower press roll **20**, which may have the structure described in connection with roll **11**, but which is here shown (essentially diagrammatically) as a roll having a suction gland **20***a* opposite the nip N–**3** so that droplets of water may be received in the perforations of the suction roll at the nip N–**3**, primarily by virtue of squeezing the water out of the web W, and at least in a partial extent from the felt F. In this type of web press nip, N–**3**, where water is actually removed from the web-felt system, the press nip is capable of taking a rather substantial total load or volume of water. The roll **20** is wrapped by and positioned within the loop of the felt F which is supported on conventional idler or guide rolls **22***a*, **22***b*, **22***c*, **22***d*, any of which may be a stretch roll of conventional design to maintain a desired tension within the felt. The felt F contacts the paper web W immediately prior to the nip N–**3** to pass it together therewith through the nip wherein the water is squeezed from the web into the felt and the suction roll **20**. At the immediate off-running side of the nip N–**3**, the web W is guided away from the felt to minimize rewetting, as there is a tendency of the water in the felt to attempt to equalize the partial vacuum created at the off-running side of the nip N–**3** in the paper web, prior to ambient atmosphere equalizing this vacuum. Guiding away of the web on the immediate off-running side of the press nip may be accomplished by any conventional guide roll means. As the felt passes over the suction gland **20***a* of suction roll **20**, a substantial portion of the water from the web is drawn through the felt and within the suction gland and removed from the system, however, an appreciable amount of water is retained by the felt, primarily because of the high machine speeds under which it has been found economically necessary to operate paper machinery. This water which remains in the felt tends to be concentrated on the surface of the felt which was in direct contact with the suction gland. It has, therefore, been found advantageous to place a doctored roll **23** in contact with that surface of the felt which has been in contact with the suction gland, at the immediate off-running side of the nip N–**3**. Doctored roll **23** may be of any suitable construction, but is preferably a small diameter metal roll having doctor means **24** and a saveall **25** associated therewith to remove the surface water from the felt F at the immediate off-running side of the nip N–**3**. The felt F is then passed around the loop formed by the guide rolls **22***a*, **22***b*, **22***c* and **22***d*, and comes in contact with a stationary suction means immediately prior to contacting the paper web W and prior to entrance into the nip N–**3**. It has been found of great advantage in this particular embodiment to position the stationary suction means, which may be a Uhle box, a suction box, or some other such suitable device capable of creating a reduced pressure area across the width of the felt to change the water profile therein, immediately prior to the felt contacting the web as the suction means concentrates the water in the felt on the surface that is in contact with the suction means and generally away from the paper web W, thus allowing the opposite side, or working side of the felt, to be relatively dry when it comes into contact with the paper web W. Further, if the stationary suction means is positioned immediately prior to the entrance of the felt to the nip, it has been found by extensive experimentation, that the water present in the felt and the web will have a minimum distance to travel before being removed from the web-felt system.

It will thus be realized that it is quite important to position a stationary suction means in proper relation to the anticipated felt function, as for example, dewatering. If the stationary suction means is positioned at too great a distance from the point where it is desired that the felt be dewatered, or where the felt is to have its maximum water capacity, or some other such function, then in the interim between the felt passing over the stationary suction means and the point of function, the water will have sufficient time to redistribute itself within the felt so as to be evently distributed therein as the water was prior to the felt passing over the stationary suction means. Thus, it is desirable to have the felt enter its point of function with the water profile substantially changed so that one side of the felt is relatively dry while the other side of the felt is relatively wet.

Referring now to FIGURE 3, it will be seen that this is a sectional view taken substantially along line III—III of FIGURE 2, showing a side view of the felt F as it passes over the stationary suction means, having an interior **30**. It will be noted that as the felt approaches the oncoming side of the suction means, the water is substantially evenly distributed throughout the felt, as indicated at H_3, and that as it passes over the suction means the water is drawn downwardly to the surface contacting the suction means so that approximately midway between the entrance and exit of the suction means the water will be at a level of H_2 and at the off-running side of the stationary suction means the water will be at a level of H_3. This stationary suction means, as has previously been explained, may be a suction box, a Uhle box, or other like stationary suction means capable of creating reduced pressure along the width of the felt while providing a smooth non-wearing surface to support the felt. For example, if a suction box is used, it is preferable that it have a slot in the cross-machinewise direction, (i.e., the width of the felt) and be in the range of about 0.500 to 1.0 inch wide, with approximately 10 to 15 inches of water vacuum operating thereon. The web pasing over the slot is not covered

or compressed (as in a press nip), but fluid (ambient gas and water) drawn through the uncompressed felt creates the profile.

Referring now to FIGURE 4, it will be seen that the embodiment shown therein illustrates the principles of the invention as utilized in a two-felt arrangement passing through a common nip. This arrangement is particularly useful wherein extremely delicate paper webs W (approaching from a conventional second press section, diagrammatically indicated) are formed, as for example, tissue and the like. A nip N–4 is defined by upper roll **40** and lower roll **41**. Upper roll **40** may be a plain roll, similar to the roll described in conjunction with FIGURE 1, reference numeral **10**. The press roll **40** is wrapped by an upper felt F–**1** which is preferably of a very fine weave, thus presenting a substantially smooth surface to the paper web W. The felt F–**1** is in the form of an endless felt and is guided by idler rolls **40***a*, **40***b*, **40***c*, **40***d*, any of which may be a tensioning roll, all of conventional construction. There is provided, on the felt F–**1** a moisture detecting means **42**, at a position prior to the nip N–**4**, which is capable of detecting the amount of moisture in the felt F–**1** and in response to a predetermined standard will automatically increase or decrease the pressure at the nip N–**4** in order to increase or decrease the moisture content of the felt F–**1**. As this is a conventional construction and arrangement, it is not believed necessary to set forth specific details of operation of the schematic diagrams indicating the transmittal of the signal to the pressure means.

Lower roll **41** is a grooved roll, such as disclosed by Justus in U.S. Patent No. 3,198,697, and which patent is incorporated herein by reference. The grooved roll **41** has a plurality of alternating generally circumferentially aligned grooves and ridges of sufficient magnitude to receive water at the press nip. Such grooves prevent the phenomenon known as "crushing" wherein the excessive water in the web is forced back through and against the direction of travel of the paper web, disrupting the fiber formation, and being generally detrimental to paper. More specifically, the surface of the grooved roll **41** comprises a plurality of peripherally aligned land areas with relatively fine or narrow grooves between the land areas for receiving water from the felt at the nip, e.g., at the nip N–**4**, for the roll **41**. It will be appreciated that the land areas are of sufficient width and the grooves are sufficiently narrow to permit the felt to be readily supported at the nip N–**4**, so that the water may be expressed from the felt into the grooves, but the felt itself will not be pressed into the grooves to any significant extent, so as to cause substantial or significant shadow marking on the web W as a result of the land and groove pattern on the surface of the roll **41**. The generally circumferential alternating grooves and ridges are in the form of continuous spirals, as contrasted to exactly circumferentially aligned and axially spaced grooves and ridges throughout the entire roll periphery.

Referring specifically to the operation of the press roll **41**, it will be seen that the grooved press roll **41**, at a peripheral point remote from the off-running side of the nip N–**4** is first subject to a scraper **43** which may fit into the grooves to sweep and/or scrape fibers, fines, water, etc. out of the grooves. Scraper **43** operates in extremely close running relation with the grooves so as to effectively scrape or sweep aside all solid matter from the grooves. A doctor means **44** is peripherally spaced from the scraper to further assist in the removal of moisture from the grooves. This doctor, of course, may be an air jet or a mechanical doctor of conventional construction. For a more exact and detailed description of the grooved roll and auxiliary equipment operating in conjunction therewith, reference is made to Justus U.S. Patent No. 3,198,697 and Justus U.S. Patent No. 3,198,693. Wrapping the grooved roll **41** is a lower felt F–**2** which is guided through the nip N–**4** by idler rolls **41***a*, **41***b*, **41***c*, **41***d*, any of which may be a tensioning roll, all of conventional construction. The lower felt F–**2** is preferably of a more coarse construction in relation to the upper felt F–**1** as it is desired that the felt F–**2** be capable of taking on a relatively greater amount of the water load from the nip N–**4**. The felt F–**2** is provided with a first stationary suction means **46** on its working face at a point on the felt remote from the off-running side of the nip N–**4** which substantially changes the water profile in the felt F–**2** by concentrating the water on the working face of the felt, while at the same time removing foreign matter from the felt. Stationed immediately after the first suction means **46**, or as close thereto as is desirable, there is a small diameter roll **47** contacting that surface of the felt F–**2** which has the greatest concentration of water. This roll **47** effectively removes surface water from the felt F–**2** by the combined effect of surface tension and hydraulic effect, which water tends to cling to the peripheral surface of roll **47** and is removed by doctor means **48** into a saveall device **49**. The felt F–**2** is then guided over a second stationary suction means **45** which is positioned on the inside of the loop of felt F–**2** and on the opposite surface of the felt as was the first stationary suction means **46**. The second stationary suction means **45** reverses the water profile of the felt so that the relatively dryer side of the felt F–**2** contacts the paper web W and the water in the felt is drawn downwardly to the surface of the felt that comes in contact with the grooved roll **41**. This reversal of water profile in the felt has been found to substantially effect exceptionally good cleaning, dewatering, and conditioning of the felt prior to its entrance to a web nip and also to reduce wear of the felt. It will further be seen in FIGURE 4, that groover roll **41** is provided with a pressure differential means, indicated diagrammatically as a double headed arrow, which is responsive to the moisture detection means **42** stationed on felt F–**1**, which is conventional.

Referring now, generally, to FIGURE 5, it will be seen that the embodiment shown therein illustrates the principles of the invention as utilized in what might loosely be termed a two-roll divided press arrangement. In this arrangement, the web is dewatered at nip N–**5**, while the felt F is dewatered by the combination of the stationary suction means **52** and doctored roll **53**. The nip N–**5** is defined by an upper roll **50** and a lower roll **51**. Rolls **50** and **51** are preferably plain press rolls, however, lower roll **51** may, if desired, have on its peripheral surface a certain fine degree of porosity, as was defined in connection with press roll **11** of FIGURE **1**. Where fine tissue paper, or other light-weight paper is being pressed, it is preferable to have the rolls **50** and **51** both plain press rolls so as to avoid any problem of shadow marking. Further, it is preferable to employ a press of the configuration shown in FIGURE 5 at a second or third press position (and as indicated diagrammatically, receiving the web W from a conventional first press section). At such position, the felt is no longer heavily saturated with water and the nip N–**5** need not be capable of receiving excessively large loads of water, so that no "crushing," as by a back flow of water against the web travel direction will occur, and all of the water expressed from the web W will be absorbed by the felt F. The felt F is in the form of an endless loop carried by guide rolls **51***a*, **51***b*, **51***c*, **51***d*, any of which may be a tensioning roll for maintaining the proper amount of tension in the felt, and all are of conventional construction. On the off-running side of the nip N–**5**, the web and felt are separated to minimize rewetting of the web by the felt, and the felt is guided so as to pass over stationary suction means **52**. It will be seen that the stationary suction means is trained on the working face of the felt and thus effectively cleans, conditions, dewaters, and substantially changes the water profile of the felt F so as to concentrate the water on the working face which is then removed by doctored roll **53**. Roll **53** is preferably a small

diameter metal roll, however, it can be made of any other suitable hard material which is capable of being doctored. Associated with roll **53** are doctor means **54** and saveall device **55**, both of conventional construction, which cooperate with the roll **53** to permanently remove the surface water from the felt F out of the press section system.

The arrangement shown in FIGURE 5 affords the additional advantage of an investment in the total of only two press rolls **50** and **51** to define a single nip N–5 while at the same time allowing the felt to be dewatered without the necessity of using an additional press nip, but merely employing the stationary suction means **52** in connection with the doctored roll **53**. Also, the arrangement of FIGURE 5 affords additional versatility in that the two press rolls **50** and **51** may be constructed to substantially identical specifications, so that they are interchangeable and less investment for spare rolls would be required.

Referring now to FIGURE 6, it will be seen that the embodiments shown therein illustrate the principles of the invention as utilized in a suction pick-up press arrangement. A web W is initially formed on a forming wire **63**, traveling around couch roll **61** and a turning roll **62**. A traveling looped pick-up felt F is urged against the web W on the forming wire **63** by a suction pick-up roll **60**, having a conventional suction area **60***a* and a saveall device **60***b*, which picks up the web W and carries the same away from the wire along a downwardly inclined felt run, and into a first press nip N–6 which is defined by two press rolls **67** and **68**, which may both be plain press rolls or, if desired, water removal means, such as suction glands, grooves, or blind drilled holes may be incorporated in either roll **67** or **68**. The felt F then proceeds upwardly to guide roll **64***a*, which in turn directs the felt F into a nip N–7. It will be noticed that guide roll **64***a* is set above the plane of the nip N–7 so that the felt F wraps suction roll **66**. Suction roll **66**, with suction gland **66***a*, defines nip N–7 with a lower press roll **65**. Guide roll **64***b* guides the felt away from the nip N–7 in an upward direction so as to further wrap suction roll **66**. This wrapping by the felt F of roll **66** allows the suction gland **66***a* to form a better seal at the nip and extract more water from the felt. After passing the guide roll **64***b*, the felt F is directed downwardly in the general direction of the forming wire **63** and passes over stationary suction means **69**. It is to be noted that the stationary suction means **69** is trained on the working face of the felt, i.e., that face of the felt which comes into contact with the paper web. Stationary suction means **69** causes the remaining water in the felt F to be concentrated on the working face so that this face is relatively wet prior to contacting the newly formed paper web W. This additional wetness on the felt F, in conjunction with the suction roll **60**, materially aids in transforming the web W from the forming wire **63** to the felt F. The combination of the felt having a changed water profile so that the water is concentrated on its working face and the suction roll **60** effectively defines a highly efficient suction pick-up area, as the newely formed web W tends to adhere to the moist felt through capillary action and through the suction action of the suction roll. By the use of this arrangement, it is possible to obtain better suction pick-up, without unduly disturbing, as for example, by excesive suction at the roll **60**, the newly formed paper web.

Referring now to FIGURE 7, it will be seen that the embodiment shown therein illustrates a principle of the invention as utilized in a three-roll divided press arrangement. In this arrangement, the first and second nips N–8 and N–9 are formed of a series of rolls including a first roll **71**, a second roll **70** and a third roll **72**, with the second roll **70** serving each of the nips N–8 and N–9. The rolls **71**, **70** and **72** are arranged so their axial centers lie in substantially the same plane, which extends generally in an upwardly direction. In this arrangement, bending or deflection forces on the middle roll **70** due to nip pressures are substantially reduced since the pressures of the nips N–8 and N–9 are in circumferentially opposed positions with respect to the roll **70**.

With respect to the deflection problem, it will be noticed that the rolls **71** or **72** can have any of a number of known conventional "anti-deflection" constructions, so that they are capable of substantially resisting deflection forces applied across the nips N–8 and N–6, and the upper and lower rolls **71** and **72** can be mounted with separate and independent but conventional nip loading devices, shown diagrammatically as double headed arrows, so that the nip pressure at the felt only nip N–9 will be at least as great as the nip pressure at the web nip N–8, for the purposes of adequately dewatering the felt F at the felt only nip N–9.

Referring to the more specific aspects of FIGURE 7, it will be seen that the first nip N–8 is the web press nip in this arrangement, receiving the web W on the felt F. The nip N–8 is defined by the upper plain press roll **71**, having the structure previously described in connection with press rolls **10**, **21**, **50**, etc. and a middle press roll **70**, which is also shown as a plain press roll, although the middle roll **70** may have any of the various finely porous surfaces (in a suitable outer cover closing or sealing the pores against the flow of fluid into the interior of the roll **70**), such as have been described in connection with rolls **11**, **51**, etc.

On the off-running side of the nip N–8, the felt F is guided away from the paper web W by guide roll **74***a*, which is one of the guide rolls **74***b*, **74***d*, **74***e*, **74***f*, **74***g* and the tensioning roll **74***c* of generally conventional structure, mounting and guiding the felt F. The middle roll **70**, of course, is within the loop of the felt F, whereas the bottom roll **72** is outside the loop of the felt F and is thus in a position to act against the operating surface of the felt F which actually contacts the web W at the web nip N–8.

As the felt F passes around guide roll **74***a*, it passes over stationary suction means **75**, which is similar to that described in connection with stationary suction means **14**, **26**, **45**, etc. Stationary suction means **75**, which may be a suction box or a Uhle box, causes the water which is evenly distributed within the felt F to become concentrated on the working surface, i.e., that surface which not only contacts the paper web, but also, in this case, contacts the operative portion of the suction means **75**. The felt F is then guided around rolls **74***b*, **74***c* and **74***d*, which are guide rolls, as mentioned above, and into nip N–9. It will be noted that guide roll **74***d* is set in such a manner that the felt F in passing over it will be on a plane above the plane of the nip, thus causing the felt F to somewhat wrap middle roll **70**. The felt F is then passed through the nip N–9 wherein it is dewatered by the grooved roll **72**, which is similar to the grooved roll **41** described in FIGURE 4, but additionally has a wiper device **72***a* which consists merely of a generally flat sheet of moderately resilient material, such as a metal sheet secured to a transverse cross bar and urged as a continuously transverse sheet against the land areas on the periphery of the grooved roll **72**. The wiper **72***a* thus does not enter into the grooves but merely presents a surface that is actually continuous for the transverse peripheral dimension of the roll along the line of contact so as to effect, by pumping action, a drawing of the water in the grooves, which is actually swept out of the grooves by air rushing in to fill the partial vacuum created by the pumping action of the wiper. This mechanism is described in greater detail by E. J. Justus, in U.S. Patent No. 3,198,693, which patent is incorporated herein by reference. Further, grooved roll **72** has associated therewith, a saveall device **72***b* and a doctor means **72***c*, all of which mechanisms tend to act in unison to permanently remove the water from the felt press nip. The felt F is then guided away from the nip N–9 by guide roll **74***e* in an upwardly direction, so that the felt is in contact with grooved roll **72** for a minimum amount of time, primarily only at the

actual point of contact between rolls **70** and **72**. The felt nip is now in condition to absorb additional water from the paper web W (coming from a first press section, previously discussed and diagrammatically illustrated) and is guided upwardly by guide roll **74***f* to the plane of the paper web wherein the guide roll **74***g* causes the web and the felt to come together prior to the entrance to nip **N–8**.

In summary, the press arrangement and method of removing moisture from a felt in a press section of a paper machine provides unique, surprising and superior results in that economical stationary suction means may be utilized, in cooperation with certain other relatively simple dewatering mechanisms to properly condition a felt. Of particular interest is the unique cooperation and working relationship of the stationary suction means, the press couple, and the doctored dewatering roll. In the preferred embodiment shown in FIGS. 1 and 2, it is important to properly arrange these parts in the order shown, so as to achieve maximum benefit therefrom, under the particular operating condition there involved. As will be realized, the stationary suction means urges the water in the felt back to the same outer surface upon which it was first introduced by contact with the moist web. With the water concentrated at the outer surface of the felt, it can more readily be removed by a press couple, particularly if one of the press rolls has water removal means, as for example, a suction gland or a grooved roll shell of the type described. Finally, water which has been left on, or near the felt surface by the press couple is removed by the rotating contact of the doctored dewatering roll. Such a systematic and thorough water removal operation is unique and, therefore, preferred for many operations. Of course, in certain press arrangements considerations other than high water removing efficiency are important, as for example, in a suction pick-up arrangement one consideration of importance is presenting a felt having a moist face which contacts the newly formed web thereby more efficiently picking up the web.

It will be understood that modifications and variations may be effected without departing from the spirit and scope of the novel concepts of the present invention.

I claim as my invention:

1. In a paper machine press assembly, the combination comprising a first press roll, a second press roll defining a press nip with said first press roll, a looped travelling moist felt wrapping said second press roll and passing through said nip, a non-rotatable stationary suction means trained on a face of said moist felt concentrating moisture within said felt along said face at the on-coming side of said nip, and a water-removal means positioned in working relationship downstream from said suction means at such a distance that the moisture concentrated along said face has insufficient time to redistribute itself within said felt.

2. The paper machine press assembly as defined in claim **1** wherein the looped travelling moist felt carries a wet paper web through the press nip, said felt contacting said web downstream of the non-rotatable stationary suction means.

3. The paper machine press assembly as defined in claim **2**, wherein the water removal means comprises a felt only press defined by a third and fourth press roll positioned on the off-running side of the press nip and a suction roll within the looped travelling moist felt positioned intermediate the non-rotatable stationary suction means and the press nip, the moist paper web contacting the felt in the region of said suction roll and being transferred to said felt.

4. The paper machine press assembly as defined in claim **1**, wherein the water-removal means is a small diametered doctored metal roll.

5. In a paper machine press assembly, the combination comprising, a first press roll, a second press roll defining a press nip with the first press roll, a looped travelling moist felt wrapping the second press roll and passing through the press nip carrying a moist paper web, a non-rotatable stationary suction means trained on a face of said felt at the on-coming side of said press nip at such a distance that moisture within the felt does not have time to redistribute itself therein prior to the felt contacting the paper web, and a small diametered doctored roll contacting the felt at the off-running side of the press nip removing water from the felt.

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