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POURDRINIER PAPER MACHINE  

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INVENTOR  

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My invention relates to improvements in Fourdrinier paper machines and the like and has particular reference to the first section of a paper machine where the paper web is formed and commonly called the "wet end". An important object of my invention is to provide a new and highly efficient means for supporting and traveling the Fourdrinier wire in a manner which relieves it of the injurious tension under which it operates in the present system of driving it. Another equally important object is to eliminate the present type of suction boxes which are largely the cause of the high operating tension in the Fourdrinier wire and which are so destructive to it not only because of this high operating tension but also because of the enormous amount of friction due to dragging the Fourdrinier wire across the suction box covers causing an abnormal abrasion of both the wire and the suction box covers. This destructive action can best be understood and appreciated in view of the fact that it requires a constant pull of one ton to draw the Fourdrinier wire of a 200 inch paper machine across but one suction box in which there is a vacuum of only seven inches. This requires a considerable amount of power which is also eliminated in my invention. As there are several suction boxes used in high speed machines it will readily be seen why the wire on a Fourdrinier paper machine has a relatively short life of only two to three weeks. To combat this destructive action paper manufacturers have resorted to coarser mesh wires and less suction in the boxes, both very undesirable alternatives since the coarser mesh leaves still more pronounced wire marks on the paper and the lower suction sends the paper to the presses with a much higher moisture content. The use of the expensive and somewhat complicated suction couch roll and suction presses however, supplement the suction boxes to a certain extent but their value in this respect is limited due to the fact that the suction chamber is only a few inches wide and in high speed machines the exposure of the paper web to suction may be only one thirtieth of a second. In contrast to this, my invention makes it possible to extend a greater degree of vacuum influence under the wire throughout the entire area covered by the paper stock simultaneously and in this case each unit of area of the wire would be exposed to suction for a period approximately fifty times the length of exposure in passing over a suction couch roll. While it may not be practical or desirable to extend the vacuum influence under the entire area covered by the paper stock because of the advisability of allowing time for the formation of the sheet before extracting the water, yet it illustrates further objects of my invention which are to give both a progressive regulation of the vacuum degree and control of vacuum area, making it possible to use finer mesh wires, shorter Fourdrinier sections, higher speeds with less power and at the same time greatly extend the life of the Fourdrinier wire.

In eliminating the present type of suction boxes I substitute therefor a series of suction pockets or chambers, under the Fourdrinier wire, which are formed by a new and original arrangement of the specially constructed co-acting table rolls in conjunction with means for closing, lubricating and sealing the ends of the suction chambers and vacuum forming means for removing the air and water from the suction chambers.

Other objects and advantages will appear in the following specifications and are shown in the accompanying drawings in which similar reference numerals refer to similar parts in all the views.

Fig. 1 is a vertical longitudinal section of my invention on a line 1—1 of Fig. 2.

Fig. 2 is a plan view of the Fourdrinier section embodying my invention.

Fig. 3 is an elevation of one of the chambered side plates showing the inner surface with the lubrication orifices. The view is taken on a line 2—2 of Fig. 2.

Fig. 4 is an enlarged partial sectional view of the specially constructed table rolls taken on a line 4—4 in Figs. 1, 2 and 3.

Fig. 5 is an enlarged partial sectional view on a line 5—5 of Fig. 4.

Fig. 6 is an enlarged partial sectional view similar to Fig. 4 and is taken on a line 6—6 of Figs. 1, 3 and 7.

Fig. 7 is an enlarged partial sectional view similar to Fig. 5 and is taken on a line 7—7 of Fig. 6.

Fig. 8 is an enlarged partial sectional view similar to Fig. 6 and is taken on a line 8—8 in Figs. 1, 3 and 9.

Fig. 9 is an enlarged partial sectional view similar to Fig. 7 and is taken on a line 9—9 of Fig. 8.

Fig. 10 is a partial longitudinal sectional view of one of the lower co-acting rolls enclosed within the suction chamber. In this view the trunnion bearings are omitted. It also illustrates a slight modification in the method of removing air and water from the suction chamber.

Fig. 11 is a cross sectional view of the lower
co-acting roll shown in Fig. 10 and is taken on a line 11-11 of that figure. Fig. 12 is an enlarged partial plan view of one edge of the perforated carrier web or belt shown 5 in the several views. Fig. 13 is an enlarged sectional view of one edge of the perforated carrier web or belt and is taken on a line 13-13 of Fig. 12. Fig. 14 is an enlarged partial sectional view of one edge of the enveloping web and is similar to the view shown in Fig. 13.

In my invention I take advantage of the well known fact that water is an excellent lubricant for rubber. Bearings with rubber linings, when properly supplied with water, have given entire satisfaction in pumps, propeller and thrust bearings and in other equipment where there is no objection to the use of water as a lubricant. There can be no objection to the use of water as a lubricant in the Fourdrinier section of a paper machine where water is about 99% of the material handled by it.

In carrying out my invention I employ a plurality of table rolls R in an upper series and a plurality of co-acting rolls R1 in a lower series and mount them in a novel arrangement which will be fully explained hereinafter. By reference particularly to Fig. 1 it will be seen that I show the rolls R and R1 arranged in three groups A, B and C respectively. The preferred construction of all of the rolls in the three groups is substantially the same and comprises an anti-corrosive metal cylindrical shell 1 in each end of which is a spider 2 mounted to revolve on anti-friction bearings 3 supported by the flanged studs or trunnions 4 projecting through solid bosses 5 in the chambered side plates 15 whose function will be described later. The rolls R and R1 are removable by simply withdrawing the flanged trunnions 4 leaving the bearings 3 in the hubs of the spindles 2.

Referring to the rolls R and R1 in group A in Fig. 1 and in the detail views in Figs. 4 and 5, it will be seen that the cylindrical shells 1 are individually covered preferably with a suitable rubber compound 7 which may be vulcanized on and thereby become a part of all of the rolls in this group. In groups B and C shown in Fig. 1 and also in detail views in Figs. 6, 7, 8, and 9, the rubber cover for all of the rolls R and R1 takes the form of continuous endless enveloping belts or webs 8 which pass alternately over and around the table rolls 1 and under and around the co-acting rolls R1 and thus enclose the suction chambers S in which the co-acting rolls R1 are included. The endless enveloping webs 8 return under the idler rolls 9 which may also be used as take-ups to adjust the tension in the endless enveloping webs 8. In group C the rolls R and R1 and the endless enveloping web 8 are identical with group B but I show the endless porous or perforated carrier web 10 surrounding the entire group and travelling by frictional contact with the endless enveloping web 8. The endless perforated carrier web 10 returns under idler roll 11 by means of which its operating tension is adjusted. This carrier web 10 is preferably constructed of suitable rubber compound properly reinforced to give it the necessary strength to perform its function of relieving the Fourdrinier wire 12 of all operating stresses due principally to the high vacuum which may be carried in the suction chambers in this group.

The Fourdrinier wire 12, hereinafter referred to as the "wire", is made endless and passes around the three groups A, B and C as clearly shown in Fig. 1 where it is represented by the dotted line 12. The comparatively slight operating tension in the wire 12 is adjusted by means of an idler roll 13. The wire 12 travels by contact with the endless enveloping web 8 in group B and with the endless carrier web 10 in group C, being held firmly in contact with them by the suction in the chambers underneath. In practice the enveloping webs 8 in groups B and C are driven by a roll R in each group. The forward roll R in group A may also be driven as the rolls are held firmly in contact with each other by the suction in chambers S formed by them. In Figs. 1 and 2 I show the forward rolls R in the three groups mounted on shafts 14 which may be driven in any approved manner. Thus it will be seen that there is absolutely no driving tension in the wire 12.

A suction chamber S previously referred to is formed by a grouping of the rolls,—two of the table rolls R and one of the co-acting rolls R1 in a triangular arrangement which encloses the pocket or chamber S which I call a suction chamber. This is the simplest form of my invention. It will readily be seen that this arrangement of the rolls R and R1 may be progressively varied, one roll R being common to two suction chambers S. Other arrangements of the rolls R and R1 may be made but I consider the arrangement shown and described to be the most advantageous.

It will be noted in the arrangement of the rolls R and R1 forming the suction chamber S as above described, that the tops and both ends of the suction chambers S are not yet closed. However it will be seen that the tops of the said suction chambers are closed by the paper stock on the wire 12 as it travels over them.

The ends of the suction chambers S are closed in the following manner: I provide two oppositely disposed hollow or chambered side plates 15, which are mounted on the side frames of the Fourdrinier section represented at 16 in Figs. 4, 6 and 8. These chambered side plates 15 are shown adjustable on the Fourdrinier frame 16 by means of slotted holes in the brackets 17 shown integral with them. Water or other lubricant enters the interior of the chambered side plates 15 under pressure through the pipes 18 connected to any suitable source of supply. The inner faces of the adjustable chambered side plates 15 about the ends of the rolls R and R1 in group A and both edges of the endless enveloping webs 8 in groups B and C and also both edges of the carrier web 10 in group C. By reference particularly to Fig. 3, it will be seen that I provide a relatively large number of orifices 19 in the inner faces of the chambered side plates 15, which are spaced along the path of travel of the ends of rolls R and R1 in group A and the edges of the endless enveloping web 8 and carrier web 10 in groups B and C. These orifices 19 communicate with the interior of the chambered side plates 15 and thus permit a supply of water or other lubricant to be forced out between the inner faces of said chambered side plates 15 and the abutting ends of the rolls R and R1 in group A and the edges of the endless enveloping web 8 and endless carrier web 10 in groups B and C. The path of travel of the abutting surfaces just described is indicated by the dotted line 50 in Fig. 3. The areas 21 on the inner faces of the chambered side plates 15 are slightly recessed where it is not necessary for the ends of the rolls R and R1 and the edges of the webs 8 and 10 to contact with the side plates 15.
The ends of the rubber covers 7 on rolls R and R1 in group A and also the edges of the endless enveloping web 8 and endless carrier web 10, are specially designed and constructed with friction edges 2 which will properly receive and distribute the lubricant coming under pressure through the orifices 19 in the abutting inner walls of the chambered side plates 15. These friction edges 22, shown in the several views and particularly in the enlarged partial sections in Figs. 13 and 14, are somewhat enlarged on the contacting edges and are preferably provided with lubrication distributing grooves 23 extending longitudinally in the outer edges which contact with the inner walls of the chambered side plates 15. As before stated the orifices 19 in the inner faces of the chambered side plates 15 are located so as to register with the path of travel of the distributing grooves 23. The lubricant will then enter these distributing grooves and after building up sufficient pressure, will be forced out laterally on both sides with respect to the distributing grooves 23 and will maintain a perfect lubricating and sealing film throughout the entire contacting area of the abutting surfaces, thus minimizing friction and preventing air infiltration into the suction chambers S.

As before stated the paper stock on the wire, from which the water is to be removed, closes the tops of the suction chambers S. However it will be seen that the edges of the wire in groups A and B do not effectively seal the suction chambers at the edges. I therefore provide special deckle straps 24 with friction edges and distributing grooves 23 which function exactly like the edges of webs 8 and 10, and thus close the area on the wire 12 not covered by the paper stock. The deckle straps 24 are held in contact with side plates 15 by the flanged idlers 32.

Air and water are removed from the suction chambers S in the following manner: I provide a perforated tube 25 for each suction chamber. These tubes project outwardly through solid bosses in one of the side plates 15 and are connected to headers 26, preferably one header for each group A, B, C and as shown in Fig. 2. Each of these headers 26 is connected to a suitable separator and vacuum pump usually located in the basement and not shown in the drawings. This arrangement of the headers 26 permits individual regulation of the vacuum degree for each group, or any one or more groups may be shut off by means of valves 27 in the suction pipes 28.

In the detail views in Figs. 10 and 11 and in the assembly views in Figs. 6 and 7, I show a slightly different way of installing the lower co-acting rolls R1 and of extracting air and water from the suction chambers S. In all of the other views and as previously described, the lower co-acting rolls R1 are mounted on trunnions 4. Obviously this construction is necessary in group A but in groups B and C it will be seen that the suction rolls R1 are enclosed within the lower co-acting suction chambers S and are held firmly in contact with the two corresponding upper rolls R by the endless enveloping webs 8 and by the suction in the chambers S which will hold them still more firmly. For this reason it is entirely practical to omit the trunnions 4 and bearings 3 and permit rolls R1 in groups B and C to revolve independently, being nested within the enveloping webs 8 and limited in endwise movement by permitting the rolls R1 to take the form of simple headless cylinders. In Figs. 10 and 11 and also in Figs. 6 and 7, I use perforated cylinders R2 which are exactly like the cylinders above described except for the perforations. The perforations in the co-acting cylinders R2 admit air and water from the suction chamber S into their interiors and instead of the perforated tubes 25 extending into the suction chambers S, I provide suction pipes 29 projecting through solid bosses in the chambered side plate 15 into the interior of the perforated cylinders R2 as clearly shown in Figs. 10 and 11. The suction pipes 29 are connected to headers 26 in groups B and C only.

It is obvious that the endless enveloping webs 8 must be impervious to both air and water so that a vacuum can be maintained in the suction chambers S which they enclose. The opposite, however, is true of the carrier web 10 which must readily allow the passage of both air and water to the suction chambers S. In the drawings I show the carrier web 10 as being perforated. It can of course be made of any suitable porous or woven material as its function is solely to support the wire 12 and relieve it of the high suction stresses which will obtain in group C. In order that air and water may readily escape from underneath the wire 12 I show the top surface of the carrier web 10 with knobs 30 but any other type of surface deformation would do as well for the purpose which is merely to hold the wire 12 slightly off the flat surface of the carrier web 10.

In the operation of my invention the three groups A, B, and C are started up simultaneously and the wire 12 will then begin to move with the rolls in group A and with the webs 8 and 10 in groups B and C respectively. Paper stock is allowed to flow on the wire from the flow box 31. The valves 27 are then opened and suction is thus established in the chambers S under the wire 12, which will draw the water from the paper stock on the wire into the suction chambers S from which it will be removed through the suction tubes 25 or suction pipes 29 by the same suction means which maintain the vacuum in the suction chambers S.

In the drawings I show the carrier web 10 in group C only but it will be understood that it may be omitted if only a light suction is required in which case group C would merely be a continuation of group B. On the other hand if a high suction is required over a greater area than group C, the carrier web 10 may be extended over group B in which case group B merely becomes an extension of group C. The carrier web 10 therefore, progressively supports the Fourdrinier wire 12 and relieves it entirely of all driving and suction stresses as well as all abrasive wear of any kind. The life will thus be greatly lengthened and the possibility of the highest vacuum in group C will avoid the use of the ex-pensive suction couch roll.

In the foregoing I have described and referred to the chambers S as suction chambers with vacuum connections for use under the Fourdrinier wire of a paper machine. However it is obvious that the reverse may be made for other purposes that is, as pressure chambers in which case air or other fluid would be forced into them through the connecting pipes 33 and headers 36 which may be connected to any suitable pressure source. Having thus described my invention I claim as new and desire to secure by Letters Patent:

1. In a Fourdrinier paper machine a series of suction chambers formed under the Fourdrinier 153.
wire by the grouping of a plurality of individually covered co-acting rolls, means abutting the ends of said rolls to close the ends of said suction chambers said closing means comprising oppositely disposed side plates chambered to receive a lubricant under pressure. ports communicating with the lubrication chambers in said side plates and registering with the abutting ends of said co-acting rolls to supply lubrication thereto and means adapted to be connected to vacuum creating apparatus for maintaining suction in said suction chambers.

2. In a Fourdrinier paper machine, a plurality of individually covered rolls co-acting to form suction chambers under the Fourdrinier wire, adjustable side plates abutting the ends of said co-acting rolls to close the ends of said suction chambers said side plates being chambered to receive a lubricant under pressure, orifices in the inner walls of said chambered side plates for supplying lubrication to the abutting surfaces and means adapted to connect the chambered side plates to a source of lubrication under pressure.

3. In a Fourdrinier paper machine, the combination with the Fourdrinier wire, of a plurality of individually covered co-acting table rolls grouped in progressive triangular arrangement to form a series of suction chambers under said wire, oppositely disposed adjustable side plates abutting the ends of said co-acting rolls to close the ends of said suction chambers said side plates being chambered to receive a lubricant under pressure, a series of orifices in the inner walls of said oppositely disposed chambered side plates registering with the abutting ends of said co-acting rolls and supplying lubrication thereto, and means adapted to connect the said oppositely disposed chambered side plates to a lubrication source under pressure.

4. In a Fourdrinier paper machine the combination with the Fourdrinier wire of an endless impervious web having reinforced wearing edges, said web member being movably supported to form suction chambers under said wire, oppositely disposed side plates against which the said reinforced wearing edges abut, said side plates being chambered to receive a lubricant under pressure and means for introducing a lubricating fluid between the abutting surfaces.

5. In a Fourdrinier paper machine the combination with the Fourdrinier wire, of an endless impervious web having reinforced wearing edges with lubrication grooves in the wearing faces thereof, said web being movably supported to form suction chambers under said wire, and adjustable side plates against the inner walls of which said reinforced wearing edges abut, said side plates having lubrication chambers and a plurality of orifices in their inner walls disposed along the paths of the said lubrication distributing grooves in the reinforced wearing edges of said impervious web.

6. In a Fourdrinier paper machine the combination with the Fourdrinier wire and an endless impervious web movably supported to form suction chambers under said wire, of reinforced wearing edges attached to said endless impervious web, adjustable chambered side plates abutting the said reinforced wearing edges, said chambered side plates being adapted to receive a lubricant under pressure, orifices in the inner walls of said chambered side plates said orifices being disposed along the paths of contact between the abutting surfaces and piping means adapted to be connected to a pressure source for supplying a lubricating fluid to said chambered side plates.

7. In a Fourdrinier paper machine the combination with the Fourdrinier wire and an endless impervious web movably supported to form suction chambers under said wire, of reinforced wearing edges having lubrication distributing grooves in their outer wearing faces said reinforced rubber wearing edges being carried by the edges of said endless impervious web, oppositely disposed chambered side plates receiving a lubricant under pressure and abutting the said reinforced rubber wearing edges, said chambered side plates having a series of orifices in their inner walls registering with the lubrication grooves in the wearing faces of said reinforced rubber wearing edges and means adapted to connect the said chambered side plates to a lubrication source of supply under pressure.

8. In a Fourdrinier paper machine the combination with the Fourdrinier wire carrying the paper stock, of a plurality of supported table rolls in an upper series co-acting with a plurality of independent unsupported cylinder rolls in a lower series to form suction chambers under said wire, an endless travelling impervious web member, having reinforced wearing edges, passing alternately over a supported roll in the upper series and under an independent unsupported cylinder roll in the lower series to enclose said suction chambers, said independent cylinder rolls being operably positioned with respect to the cc-acting rolls in the upper series by said impervious web member, oppositely disposed side plates chambered to receive a lubricant under pressure said chambered side plates abutting the reinforced wearing edges of said impervious web member to close the ends of said suction chambers, ports in said side plates communicating with the lubrication chambers and registering with the path of travel of the reinforced wearing edges of said impervious web member to supply lubrication thereto and means adapted to connect the said chambered side plates to a lubrication source.

9. In a Fourdrinier paper machine the combination with the Fourdrinier wire carrying the paper stock, of a plurality of revolvable rolls in an upper series supporting said wire and operating with a plurality of independent perforated cylinder rolls in a lower series to form suction chambers under said wire, a travelling impervious web member, having reinforced wearing edges, passing alternately over a roll in the upper series and under an independent coacting perforated cylinder roll in the lower series to enclose a plurality of suction chambers under the Fourdrinier wire said independent perforated cylinder rolls being operably positioned by said travelling impervious web member, oppositely disposed side plates abutting the reinforced wearing edges of said endless impervious web member said side plates being chambered to receive a lubricant under pressure, ports in said chambered side plates registering with the path of travel of the reinforced wearing edges of said impervious web member and supplying lubrication thereto, and means adapted to be connected to vacuum creating apparatus for removing air and water from the interior of said independent perforated cylinders.

10. In a Fourdrinier paper machine the combination with the Fourdrinier wire, of a series of suction chambers under said wire formed by
the grouping of a plurality of co-acting rolls, an endless impervious web member travelling alternately over and under said co-acting rolls to enclose said suction chambers said impervious web member having reinforced wearing edges, an endless perforated wire-supporting web member travelling around all of said suction chambers as a group and supporting said wire over the said suction chambers said perforated wire-supporting web member having reinforced wearing edges, oppositely disposed side plates abutting simultaneously the ends of said co-acting rolls and the reinforced wearing edges of said wire-supporting web member, said side plates being chambered to receive a lubricant under pressure, ports in said chambered side plates communicating with the lubrication chambers and registering respectively with the paths of travel of the said co-acting roll ends and the reinforced wearing edges of the perforated wire-carrying web member to supply lubrication there-to and means adapted to connect the said chambered side plates to a lubrication source under pressure.

12. In a Fourdrinier paper machine, an endless impervious web member having reinforced rubber wearing edges with lubrication distributing grooves in the wearing faces thereof.

13. In a Fourdrinier paper machine, an endless perforated wire-supporting web member having reinforced rubber wearing edges with lubrication distributing grooves in the wearing faces thereof.

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