SUCTION ROLL CONSTRUCTION

FIG. 2

FIG. 3

FIG. 4

FIG. 5

FIG. 6

FIG. 7

FIG. 8

FIG. 9

3 Sheets—Sheet 2

PATENT DRAWINGS

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SUCTION ROLL CONSTRUCTION

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ATTYS.
This invention relates to a suction roll for a Fourdrinier or other type of paper making machine, and is particularly concerned with the structure of the suction box within the suction roll and its related and associated parts.

In the prior art, wear has been a considerable problem in the suction roll of the paper making machine. Wear has been particularly noticeable at the wiper members of the suction box which make the vacuum within the fixed internal box and the inner surface of the rotating shell of the roll. More important from the standpoint of replacement or repair cost is wear of the shell itself which, due to the action of the wiper members, is apt to be badly worn in a relatively short time. This is particularly serious when a wiper presses against the inside of the shell with uneven pressure over its length causing heavier wear at one place than at another. The overall wear, however, has been thought to be too severe even when wear is even. Although lack of adequate lubrication at the bearing surface of the wiper has been found to be an important cause of excessive wear, various ways of minimizing wear have been attempted without significant success.

The present invention is directed to improvements which tend significantly to minimize the wear in the suction roll of a paper making machine. An effort has also been made to make more wear-resistant the parts subject to wear. Moreover, the wear which must inevitably occur is concentrated at those parts of the device which can be easily and cheaply replaced, and those parts are made easily removable for such replacement.

In accordance with the present invention, the suction roll for a paper making machine is provided in which wear is minimized in several ways. First of all, wherever possible friction is minimized by making the wiper members and other bearing surfaces of a minimum friction material, such as tetrafluoroethylene, using either solid or coated members. "Teflon" is typical of a small group of resinous materials capable of providing its own lubricating effect, and it is itself an excellent wear-resistant yet resilient product which will maintain a vacuum seal and without excessive wear to itself or the shell even after long periods of use. Next, all unevenness in the pressure by which the wiper members are urged against the shell is eliminated. This may be done in at least two ways in accordance with the invention, to provide uniform spring means throughout its length, which length is approximately that of the wiper and, two, provide individual spring members each adapted to supply a pressure in accordance with predetermined requirements at the seal, which may be uniform along its length. In the latter case, these spring members are preferably arranged so that the spring members can transmit their force through the wipers to part of the supporting structure and to the shell of the suction roll.

Intimately tied in with the problems of wear is another improvement in accordance with the present invention which has to do with the construction of the wipers. As noted above the wipers are made of tetrafluoroethylene or similar low-friction material. They are also made with one or more channels extending the length of the wipers and open to the bearing surface which contacts the shell. These channels are connected with water or other lubricant-supplying conduits whereby in use lubricant can be fed continuously to the bearing surface. The feeding of lubricant to the bearing surface of the wipers has three important effects: first, it lubricates the surfaces and prevents wear by tending to space them apart by a film of lubricant, second, it seals the suction box to the shell in a barrier which prevents passage of water and air laterally into the suction box instead of through the shell; and, third, the film of lubricant reduces the noise of the suction roll by providing a buffer between the parts. Additionally, the wipers and their associated structure are designed to be readily removable from the suction roll assembly without tearing down so that they may be replaced as they wear. In this connection the lubricant supplying lines are provided with coupling means which permits removal and replacement of wipers such that whenever a wiper is in place a good seal prevents leakage of lubricant at the seal.

Finally, the drum itself is preferably composed of a resinous material which has long life and is wear-resistant and which also obviates need for a composite metal and rubber structure which has provided so much difficulty in the past by requiring the rubber and the metal to be bored in an expensive two-step procedure.

Each of these features is applied to the structure of the present invention which, in brief, involves, in a paper making machine, a suction roll construction. The suction roll consists of a hollow cylindrical perforated suction roll shell rotatably supported by end bearings. A fixed suction box internal of the suction roll shell is provided so that the shell rotates relative to it. This suction box has an opening on the side of the box most closely adjacent to the shell. Decking means is provided at the opening of the box adjacent the shell and is movable in the direction of elongation of the box and the shell so as to effectively adjust the length of opening of the suction box for different widths of paper. Finally, wiper members associated with the suction box and the decking means resiliently urged toward and into contact with the shell are provided.

For a better understanding of these and other features of the present invention, reference is made to the following drawings which illustrate one embodiment of the present invention:

Fig. 1a shows in section one end of the suction roll of a paper making machine embodying features of the invention;

Fig. 1b shows in section the other end of the suction roll of Fig. 1a;

Fig. 2 is a sectional view taken along line 2—2 of Fig. 1a;

Fig. 3 is an enlarged sectional view taken along line 3—3 of Fig. 1a showing one spring arrangement in connection with this particular type of structure;

Fig. 4 is a sectional view taken along line 4—4 of Fig. 1b;

Fig. 5 is a sectional view taken along line 5—5 of Fig. 2;

Fig. 6 is a detailed view showing specific construction of the wiper member;

Fig. 7 is another specific construction showing a preferred type of wiper member for use with the end closure arrangement;

Fig. 8 is an exploded perspective view showing the assembly of the top of the suction box;

Fig. 9 is a detailed view showing in cross-section modified form of one of the wiper members of Fig. 8;
Fig. 10 shows a modified form of wiper member in contact with the shell; and Fig. 11 shows a different view of the modified type of wiper member. As is well known to those skilled in the art, the suction roll is located in a paper making machine in position to receive the pulp after it has been partially dried, and it is a function of the suction roll to remove additional water from the continuous web as it passes over the roll. This is done by means of a suction box within the rotating shell of the suction roll located in such a position that it will apply a suction over a predetermined segment of the roll. Ordinarily, the suction box is closed on all sides but one, which one side is open adjacent the portion of the roll over which suction is to be applied, and the suction action is confined to a region defined by sealing means which provide a vacuum seal between the inside of the rotating shell and the suction box.

Referring first to Figs. 1a and 1b, the two drawings show a suction roll which is commonly provided on a paper making machine. Referring to Figs. 1a and 1b, for example, which show improved structure of the applicant's invention, it will be seen in this drawing that there is employed, at least in the region over which the paper stock passes, a rotatable shell 10 of solid phenolic, petro-chemical product, or other relatively rigid resinous material. The shell is perforated with a plurality of radial holes 11 through which water is drawn inwardly from the paper stock by the internal suction box. This solid shell construction eliminates the difficulty experienced with the conventional laminar shell of rubber covered metal. The two layer metal and rubber construction provides great difficulty in providing perforations since they had to be drilled in two separate operations. Holes were first drilled in the shell and thereafter the shell rubber cover was put in place. It was necessary to drill holes which registered with one another. Drilling holes through the composite structure was avoided lest it should endanger the bond between the metal and rubber. With integral construction of the present invention, perforations 11 through shell 10 are made by drilling clear through the shell in a one-step operation.

The cylindrical working region of the shell, in turn, is bored or otherwise suitably affixed at each end to hollow, generally cylindrical pieces 12 and 13 including bolt flanges 12a and 13a part of which is snugly received within the respective ends of tubular shell 10 and part of which bears against the end of the shell whereby bolts parallel to the axis may pass through the flanges into the ends of the shell. Smaller diameter parts of the castings provide hollow trunnions 15 and 16 for the bearings supporting the whole shell structure. The trunnions 15 and 16 as shown in Figs. 1a and 1b, are rotatably supported by roller bearing in supports 23 and 24 which are provided with pairs of sealing ring gaskets 18, 19, 20 and 21 designed to keep moisture out of and grease in the bearings. The bearing supports are connected by sturdy connection pieces 27 and 28 to the ground by whatever arrangement may be deemed appropriate. A prime mover (not shown) for rotatably driving the roll may be applied to the end of the shaft 30 in order to cause the perforated shell to rotate.

The suction box within the suction roll is generally designated 32 and has a bottom 33 and two sidewalls 34 and 35. Thickened portions 36 and 37 partially close the ends of the box and limit the opening to duct size. The ducts 38 and 39 are fixed by radial end flanges 38a and 39a to the suction box in position to effectively extend the suction box through the hollow trunnions. These ducts are closed at their end by walls (not shown). Toward its end duct 38 is provided with openings 40 into a housing 41 forming part of the connection to a vacuum pump or other suitable means (not shown) for reducing air pressure in the suction box. Tetrafluoroethylene or other suitable sealing gasket 41a together with gaskets at other critical locations keep the ductwork air tight. The ductwork extends from enclosure 36 within hollow trunnion 15, the tubular portion 38 is, of course, fixed in position and the hollow trunnion 15 of the shell rotates relative to it and about it. Separation of the relatively rotating parts is accomplished by a bearing 42 of tetrafluoroethylene or similar low frictional material. A similar arrangement may be provided by ring 43 between hollow trunnion 39 and stub duct 44 which is here terminated in a dead end but in other embodiments might be connected to a vacuum system like the other end of the machine. The suction box may vary in shape and arrangement within the scope of the present invention.

Completing the vacuum tight closure are a pair of axially arranged wiper members 47 and 48 and a pair of end wiper members 49 and 50 extending between them. As may be seen in Fig. 8, wiper members 47 and 48 lie in channels 51 and 52 which closely embrace their sides and are urged upwardly by springs 53 and 54 of corrugated form which underlie the members 47 and 48 in their respective receiving channels. Channels 51 and 52 are, in turn, fixed to the tops of sidewalls 35 and 34. Wiper members 49 and 50 extend between members 47 and 48. They have top surfaces curved with the inside surface of the shell and lie within axially movable channels 56 and 57 which overlie and contact cover plates 58 and 59 which close the top of the suction box at its ends. The slidable channel members 56 and 57 are part of the deckling means which permits effective adjustment of the width of the suction box, and hence the suction roll, to accommodate different widths of paper stock. As seen in detailed Fig. 7, the channel member 56 with its wiper member 49, like all other channels and associated wipers in the device, provide good air-tight sealing means. This is true provided spaced helical springs 60 urging the wiper 49 into contact with the shell, and the corresponding springs urging wiper 50 into contact with the shell, are effective. As seen in Fig. 8, the channel arrangement is such as to assure snug interfitting and air-tightness. Movement of channels 56 and 57 is accomplished by movement of cross bars 62, 63 and their associated connection brackets 64 and 65, respectively. Brackets 64 and 65 include internally threaded portions 64a and 65a which engage inner oppositely threaded sleeve portions 67a and 67b on shaft 67. Shaft 67 extends axially within the shell and is supported by a pair of brackets 69, and shafts 70a, 70b, 70c and 70d, the threaded sleeves 67a and 67b, through which passes rod 67, are made long enough to facilitate the full intended travel of brackets 64 and 65 in the deckling system. As can be seen in Figs. 1a and 16 each of the sleeves 67a and 67b has an axial bayonet slot for engaging an associated bayonet pin on rod 67. In the position shown the pin is engaging the sleeve 67a so that it will turn as rod 67 turns, but the pin associated with sleeve 67b is disengaged. Axial movement of the rod to the left will disengage sleeve 67a and engage sleeve 67b. In this manner the deckling means at each end of the roll is separately adjustable. Rod 67 is axially adjusted by pushing and pulling hand wheel 71. Adjustment of the position of channel 56 or channel 57, as selected, is accomplished by rotation of rod 67 which may be done by hand wheel 71, or automatic drive means (not shown) which may be applied at the key stub 73. Stub 73 is at one end of shaft 75 journaled in cover 70 at the other end of which shaft is pinion 74. Pinion 74 mates with and drives main spur gear 76 which is fixed directly to shaft 67. Bearings for all sliding and rotary parts are advantageously made of bronze.

Other details and refinements of the invention include such things as the provision of a layer of resinous material such as tetrafluoroethylene, having low friction,
applied to the top surface of the top closure members 58 and 59.

As can be seen in Figs. 3 and 8, in a preferred construction, the channels 51 and 52 rest atop and are fixed to the sidewalls 35 and 34. The pre-formed channel members are made to receive the wiper members quite snugly and the wiper members are preferably made of or contain a resinous material having self-lubrication properties, such as tetrafluoroethylene. Alternatively, they may be surface coated with such material or may consist of some other solid material suitably impregnated. Springs 53 and 54 are utilized in the structure and appearance having a corrugated or S-shaped form of the same general cross section throughout their length so that they apply uniform pressure over this distance. The width dimensions of these springs is selected to be a major part of the channel width. The shape of the bearing surface of the wiper members 47 and 48 is preferably made to conform to the contour of the inside surface of the shell in order to provide a maximum of bearing surface and no rough edges.

In the tops of wipers 47 and 48 are provided a pair of axial grooves 76 and 79 (see Figs. 3 and 8) which, as can be seen in Figs. 3 and 5, are connected to the walls of parallel water supply conduit 82 extending longitudinally through the wiper. As seen in Fig. 5, a suitable coupling means including a plug 83 for connecting distributing tubing 84 (see Fig. 2) to conduit 85 at a duct 87 (see Fig. 1e) to lubricant supply tubing 86 is provided. A threaded cap 88 is provided at the other end of the duct 82 to close it and prevent leakage. It will be observed that the lubricant supply system is arranged to by-pass all movable parts. In Fig. 1e it will be seen that tubing 86 has an associated supply valve 89. The lubricant normally employed is water. While it would appear that sufficient water would be available for lubrication in these locations, in practice this proves not to be the case particularly at the rear wiper after water has been removed from the paper. In the prior art insufficient lubrication has accounted for much wear which is eliminated by this system. Also, as previously mentioned, the lubricant serves as a vacuum seal and also as a sound deadening layer.

As seen in Fig. 2, the preferred form of the suction box is not rectangular in cross section but is essentially round in cross section. In this case it is difficult to specify the bounds of the sidewalls and bottom walls, but these are large areas which may be considered to overlap one another and whose bounds are not necessary to define.

Fig. 9 shows in cross section a modified form of wiper 48' which may be molded in two pieces 91 and 92 to avoid the need for boring the channel 82. The pieces 91 and 92 may be interlocked or otherwise fitted together to afford sufficient water tightness.

Figs. 10 and 11 show a modified form of spring arrangement in which "nega-tor" springs or flat spiral springs are used to keep tension uniform at spaced points throughout the length of the device. Here on wiper 48' there are affixed at periodic intervals "nega-tor" springs 94 which are fixed to the sidewalls of channel 52' and preferably in grooves on the inside surface of the sidewalls with their ends bent back over the sidewalls. The other end of the "nega-tor" is in a spiral roll either on a spindle attached to the bottom of platform 95 or arranged to bear against the bottom of the platform. These members 52' of the channel are under-cut in this embodiment so that the bottom part of the channel is wider than the top. The platform is approximately the width of the bottom part with notches cut away to accommodate springs 94. This arrangement provides shoulders 96 which act as stops to limit upward movement of platform 95 under the urging of springs 94 and hence the upward movement of wiper 91'. It is characteristic of this type of spring to provide uniform pull so that careful pre-selection and matching identical springs will provide equal lifting force throughout the length of the wipers.

The wiper members 47 and 48 or their corresponding pieces in modified structures are arranged so that they can be easily removed. It is believed that by the use of Figs. 1a, 1b, 16, as well as in Fig. 4, that openings 97 and 98 in castings 12 and 13 are provided so that by stopping the roll in one of two general positions, such as the one illustrated in Figs. 1a, 1b and 4, access may be had to the wiper members.

As can be seen in Fig. 1a and 9, one end of each wiper member terminates adjacent a spring bracket 99, which is arranged to provide a stop for the slide members as well as support for the coupling member 83 which passes through opening 99a and into the channels 82 of the wiper. The shoulder 99b in these brackets gives sufficient vertical movement that the opening 99a may follow movement of the wiper without difficulty with respect to couplings. As can be seen in Fig. 5, the plug coupling 83 is adapted to be snugly received into an enlarged socket portion of channels 82 wherein it is vertically held in place and preferably sealed by O-ring 100. The coupling is advantageously supported by the bracket 99a and 99b which thread-ably engages the outer threaded surface of a portion of the coupling member 83, clamps the bracket 99 between itself and a shoulder on the coupling member. This arrangement permits axial sliding of the wiper members away from and toward the coupling to disengage the coupling so that the wipers may be removed and replaced simply by an axial sliding movement. Fig. 6 and Fig. 4 illustrate bracket members 103 at the opposite end of the channel member, which are to be adapted to be rotated about a supporting pin 104 away from the position shown in Fig. 6 upon loosening of set screw 105 and rotation of the clock-wise direction. An integral part of this structure, including the screw 105, may be conveniently reached through access opening 98, and either or both wipers 47 and 48 may be removed and replaced by temporarily displacing brackets 103 and sliding wipers axially outwardly through the opening 98. Replacement is accomplished by sliding new wipers inwardly through opening 98 into their respective channels 51 and 52 and re-positioning the brackets 103 and tightening the set screw 105.

Access is afforded within the roll for reaching the deckling mechanics inside the suction box by access plates 107 at opposite ends of the box and the opposite sides thereof as may be seen in Figs. 1a, 1b and 2. The whole structure of the suction roll in general is such that it may be easily assembled and disassembled with a minimum of effort.

The operation of the suction roll is conventional and, therefore, need not be described. Modifications within the scope of the claims will occur to those skilled in the art, and are intended to be within the scope and spirit of the present invention.

I claim:

1. In a paper making machine having a hollow cylindrical perforated suction roll shell mounted for rotation about its major axis, an elongated suction box internal of the suction roll shell relative to which the shell rotates and which is on one side adjacent to the shell, vacuum producing means adapted to produce a suction within the suction box, and sealing means on the suction box resiliently urged into contact with the internal surface of the shell, said sealing means including longitudinal wiper members, holders for said wiper members wherein the longitudinal wiper members are loosely held, and resilient means independent of the pressure of the lubricant employed acting upon the wiper members to urge them into contact with the internal surface of the shell, the improvement of providing said wiper members with lengthwise conduits entirely within the wiper mem-
7. The suction roll of claim 1 in which there are two longitudinal wipers, other than the wipers on the deckling means, and the lubricant is water.

8. The structure of claim 4 in which at least one trough in each of the wiper members runs longitudinally of the wiper member.

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