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BOW ROLL

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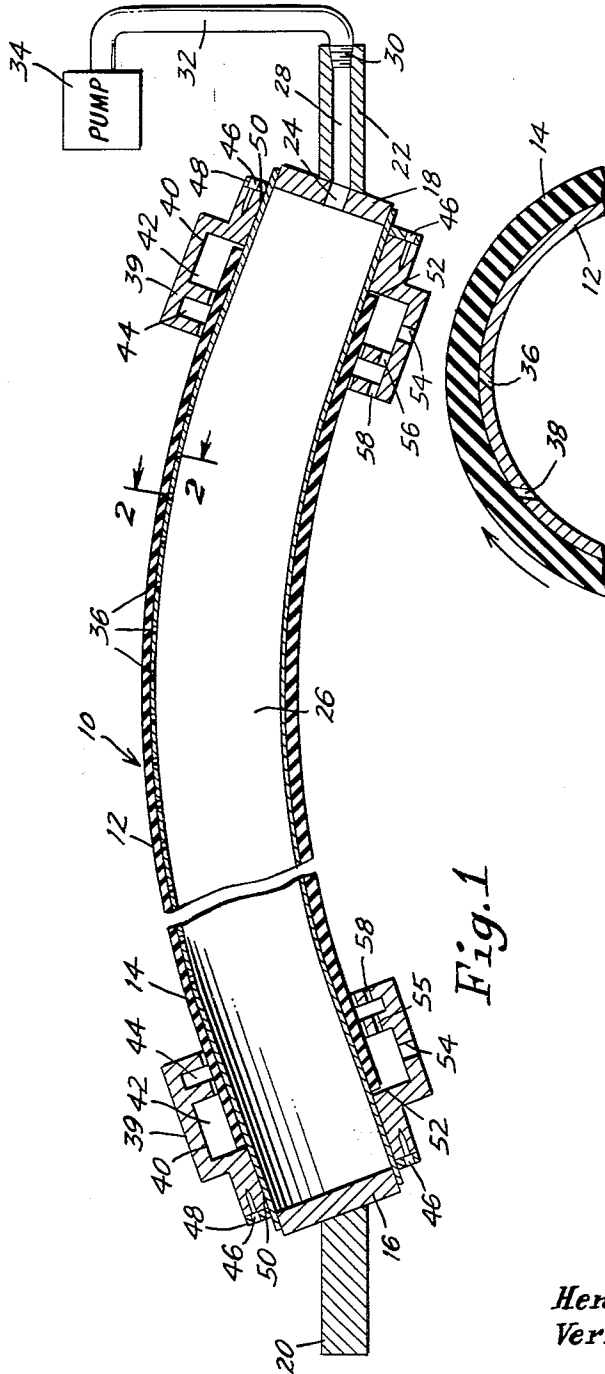


Fig. 2

Fig. 1

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BOW ROLL

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The present invention relates to apparatus for spreading or smoothing sheet material such as paper, fabrics or the like and more particularly is directed to a novel expander or bow roll having a resilient tube rotatably supported upon a thin fluid film over the outer surface of a central bow bar or axle of the expander roll.

It is well known to employ bow rolls, arched in the form of a bow, in the paper, plastic sheet or film and textile industries for spreading or smoothing materials and fabrics continuously drawn over the convex arch of the roll. Devices commonly employed for these purposes generally consist of one or more curved spindles upon which are mounted, either by friction-bearings or ball-bearings, a plurality of individual rollers in side by side relation along the bowed axis. These rollers are usually covered with a flexible sleeve of rubber or the like. Conventional bow roll assemblies have the serious disadvantage in that the individual rollers are mounted so that each lies in a plane extending perpendicular to the axis of the curved spindle. As a result, small gaps or irregularities inherently occur along the surface of the roll between adjacent rollers. Because of the independent operation of each roller, accurate product widths are difficult to maintain and very often wrinkles and distortion are incurred in the fabric during the spreading or smoothing operation.

In addition the flexible sleeve does not stretch substantially where it is in contact with the rollers so that substantially all flexure is concentrated in the spaces between the rollers. This materially reduces the life of the sleeve.

The bearings for the individual rollers are for the most part inaccessible without completely disassembling the entire bow roll assembly, making it difficult to lubricate the rollers and frequently these bow rolls are constantly subject to the action of water or even more corrosive fluids such as dyes, bleaches and the like. Maintenance costs on the individual rollers are similarly high. While various attempts to overcome the above difficulties have been made, for example by the incorporation of a resilient tubular cover extending over a plurality of individual rollers, these attempts have not been completely satisfactory in that the resilient covers tend to introduce excessive friction and do not completely solve the problems mentioned above.

The novel bow roll of the present invention avoids the above-mentioned difficulties by the provision of a resilient tubular member or sleeve rotatable on a fixed axle or curved spindle and lubricated by means of a fluid film between the spindle and resilient fabric engaging sleeve. Fluid such as water under pressure is introduced into the hollow center of the spindle passing through the entire length of the spindle, and gains access to the resilient sleeve by way of a plurality of spaced holes along the geometric top of the spindle. The resilient sleeve tends to float on a fluid surface extending over substantially the entire area of the curved spindle with the fluid acting as a lubricant between the resilient sleeve and the spindle surface. In addition, the relatively large reservoir of fluid within the elongated hollow central portion of the curved spindle permits the rapid carrying away and dissipation of any heat generated by friction between the rotating surfaces. Conversely, the roll may be heated and

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maintained at any desired temperature by controlling the temperature of the fluid.

The bow roll of the present invention involves primarily a rigid pipe or spindle of stainless steel, aluminum or other suitable non-corrosive material which is curved to the extent desired for the bow. This rigid pipe is perforated and a rubber sleeve is placed over the outer surface of the pipe. Water under pressure is forced into the pipe and passes out through the perforations into the space between the pipe and the rubber sleeve, thus serving as a lubricant for the rubber sleeve.

Structures superficially similar to the present invention have been suggested in the past and at least one such structure was actually made and tried. However, the unit was a failure and made no impression upon the market. The reason why the prior unit was a failure was that the holes in the rigid pipe were placed at random and possibly for the further reason that the rubber sleeve did not meet the rather critical requirements of hardness. Such a unit is illustrated in U.S. Patent No. 2,054,214.

We have found that unless the holes in the pipe are properly located, and unless the rubber is of the proper hardness, lubrication will be inadequate and the water lubricant, following the path of least resistance, will merely flow between the pipe and the rubber sleeve at the geometric bottom of the bow roll with either no lubrication or inadequate lubrication at the top of the bow roll.

We have found that it is not enough that water pressure be introduced between the pipe or spindle and the rubber sleeve but it is essential that this water be introduced at or very near the top of the bow roll regardless of the direction in which the convex side of the bow is facing. It is also sometimes advantageous to have water introduced along the line of contact between the fabric, paper or other web and the bow roll. Further, the pipe or spindle should be imperforate elsewhere so that the water cannot flow out through the bottom of the pipe but will be forced to flow out along the top so that the water lubricant will be supplied at the point of maximum friction.

Finally it is essential that the rubber sleeve be of sufficient hardness that it grips the pipe leaving room for only a thin substantially uniform film of water lubricant, and does not sag away from the pipe at the bottom leaving a relatively free unrestricted path for the flow of the water.

It is therefore a primary object of the present invention to provide a novel expander roll for use with fabric, paper and other sheet materials.

Another object of the present invention is to provide an expander roll for stretching or smoothing sheet materials which presents a uniform resilient surface across the width of the material.

An additional object of the present invention is to provide a novel bow roll in which a rotating resilient tubular sleeve is supported throughout its length on a thin film of fluid.

Another object of the present invention is to provide a bow roll in which the friction and heat present at the roll surface are both reduced to a minimum.

Another object is to provide a bow roll in which the entire surface may be maintained at a uniform temperature.

Still another object of the present invention is to provide a bow roll having novel sealing means at each end for preventing undesired escape of fluid.

A still further object of the present invention is to provide a bow roll having means for preventing fluid overflow when the roll is stopped.

These and further objects and advantages of the invention will be more apparent upon reference to the fol-

lowing specification, claims, and appended drawings wherein:

FIGURE 1 is a cross-section through a longitudinal portion of one form of the novel bow roll of the present invention; and

FIGURE 2 is a partial cross-section taken along line 2—2 of FIGURE 1.

Referring to the drawing, the bow roll of the present invention generally indicated at 10 includes a round hollow metal pipe or spindle 12 curved to form the arc of a bow and covered over substantially its entire length by a flexible resilient sleeve 14. The outer surface of the hollow pipe or spindle 12 presents a smooth even surface to sleeve 14 and is preferably constructed of a non-corrosive metal such as stainless steel. Each end of the spindle 12 is sealed by an end plate as indicated at 16 and 18.

Projecting from the outer surface of end plate 16 is a gudgeon 20 while a similar gudgeon 22 extends outwardly from end plate 18 in axial alignment with gudgeon 20. The bow roll 10 may be supported in suitable trunion brackets by means of gudgeons 20 and 22 and rotated to the desired position to effect optimum spreading or smoothing of a fabric which may be frictionally driven over the bow roll.

End plate 18 includes a central aperture 24 leading into a chamber 26 formed by the hollow center of spindle 12, which aperture 24 is also in communication with a central passageway 28 passing through the entire length of gudgeon 22. The extreme end of gudgeon 22 may be threaded as indicated at 30 for connection to a fluid supply-line 32 delivering fluid under pressure to bow roll 10 from a suitable fluid supply by means of pump 34. While the description will be concerned with water as the fluid medium, it is to be understood that the present invention is not restricted to this particular fluid medium but that other fluids such as oil or air may be used with equal facility.

The pipe or spindle 12 is provided with a series of small holes 36, spaced axially along the extreme upper longitudinal surface of the roll. By way of example only, holes 36 may be spaced along 9 inch centers and may be in the order of .036 to .040 inch in diameter.

These holes 36 must be at or very near the top of the bow roll regardless of the direction in which the bow faces. Unless the holes 36 are at the top, the rubber sleeve 14 will rest on the pipe or spindle 12 and rotation of the sleeve can be initiated only by excessive tension on the web or sheet. When the water or other lubricant is introduced at the top of the roll, there is lubrication at the point of greatest friction and starting difficulties are reduced or eliminated.

When the water or other lubricant is introduced at the geometric top of the roll, it lifts the sleeve 14 away from the pipe or spindle 12 thus substantially reducing the friction and insuring a film of lubricant around the entire pipe or spindle.

Operation may be improved by providing a second row of holes 38 in the pipe or spindle 12 along the line where the web or sheet of paper, fabric or the like is in contact with the sleeve 14. While this is not as important as the placing of holes 36 along the top of the pipe or spindle 12, it does provide for the introduction of lubricant at another major friction point.

It is to be noted that the lubricant is introduced only at the major points of friction and pressure and that elsewhere the pipe or spindle is imperforate. This compels introduction of lubricant on the lines of maximum pressure and friction and prevents the discharge of lubricant at points where pressure and friction are at a minimum, such as at the bottom of the roll.

It is also important that the rubber or plastic constituting the sleeve 14 be of sufficient hardness or stiffness that it grips the pipe or spindle 12 leaving only room for a thin substantially uniform film of lubricant. Otherwise, due to the weight of the sleeve and the weight of the

lubricant, the sleeve 14 would sag away from the pipe or spindle 12 at the bottom of the roll and leave a free, low pressure, escape path for the lubricant. This would preclude adequate lubrication at the high pressure, high friction areas.

It is impossible to specify exact hardness for the rubber or plastic sleeve 14 because of the variables involved. If the bow has a relatively short radius of curvature, the sleeve must be relatively soft so as to rotate freely while if the bow has a longer radius of curvature, a harder and stiffer sleeve 14 may be used. In general, it is preferable to use stiffer or harder rubber or plastic to avoid the possibility of sag at the bottom.

It has been found that if the sleeve 14 is softer than about 60 to 65 Shore A durometer, the sleeve will sag at the bottom and will be very difficult to start. Hardnesses of not substantially less than 65 to 70 Shore A durometer are essential so that the sleeve 14 will maintain close spacing with the pipe or spindle 12 and harder or stiffer sleeves may be used.

It has also been found to be advantageous to have the holes 36 and 38 inclined at an angle in the direction in which the sleeve 14 is to rotate. When this is done, the force of the water or other lubricant tends to rotate the sleeve 14 and thus eliminates or reduces drag on the web or the need of an outside drive for the bow roll.

From the foregoing it is to be noted that each bow roll of the present invention is engineered for the specific application. The position of the bow roll must be known so that the holes 36 may be located at the top and the line of web contact must be known to locate the holes 38.

A pair of novel end seals 39 are secured to each end of spindle 12 and includes a housing 40 defining a first large chamber 42 and a second smaller surge chamber 44. Each of the housings 40 may be secured to the roll by means of screws 46 passing through a suitable collar 48 on the ends of spindle 12. Each housing 40 is drawn by screws 46 into tight engagement with a flexible O-ring 50 positioned between the housing 40 and a collar 48. The flexible O-ring 50 seals the entire unit against water leakage at the ends of the roll and is compressed sufficiently against spindle 12 to prevent rotation of the housing 40.

Water escaping from between spindle 12 and resilient cover 14 at the ends of the roll is directed through the space 52 between the ends of sleeve 14 and each of the housings 40 to the large chambers 42. The water may subsequently be exhausted from chambers 42 through lower outlets 54 in the bottom of each large chamber. Communication is established between large chambers 42 and small surge chambers 44 by a passageway 56. Access hole 58 for providing entrance to passageway 56 is sealed by a plug not shown.

In operation, roll 10 is adapted to be placed in suitable trunion brackets as previously described, rotated to the desired position and locked in place by means of gudgeons 20 and 22. As the web of paper or fabric to be smoothed or spread is drawn by suitable means over the surface of the roll, water under pressure is supplied from pump 34 into chamber 26 forming the central portion of hollow pipe or spindle 12. The water under continuous pressure from pump 34 passes through holes 36 and 38 to form a thin film between the outer surface of spindle 12 and the inner surface of sleeve 14. Sleeve 14, in rotating, floats upon the thin lubricating film formed over the surface of the hollow pipe or spindle 12.

During normal operation the water or other fluid medium under pressure exhausts from the ends of sleeve 14 into the large chambers 42. This fluid is removed by way of outlet 54 and may be recirculated through the pump if so desired. When the roll is stopped there is a sudden increase in exhaust fluid due to contraction of resilient sleeve 14 against the outer surface of the spindle 12, causing overflow of the fluid into smaller

surge chambers 44. The overflow fluid in smaller surge chambers 44 drains back through passageways 56 into larger chambers 42 and is exhausted through outlets 54. Flooding of excess fluid onto the roll covering upon stopping of the roll is in this way eliminated.

As can be seen the present invention provides a novel bow roll presenting a uniform curved surface to the material to be smoothed, thus avoiding undue and unequal stresses in the material during the smoothing operation. In addition, the roll is of relatively simple construction, includes an absolute minimum of moving parts, and is adapted for easy and relatively inexpensive maintenance. Friction losses are reduced to a minimum and the operating surface of the roll may be cooled or heated to any desired temperature by controlling the lubricant temperature. The novel end seals assure that no leakage fluid will escape onto the surface of the roll covering particularly during stoppage of the roll.

While the invention has been described with respect to an axial gudgeon-type support, it is apparent that this merely represents one manner of supporting the roll and that various modifications, for example, ball and socket holders, may be employed. The resilient sleeve 14 may be constructed of rubber or any of the well-known rubber-like resilient synthetic materials. Similarly housings 40 may be formed from any of a wide variety of metals or from suitable plastics.

Furthermore, it will be apparent that spindle 12 may take any of a wide variety of forms. The invention is not limited to the specific bow shape shown in the drawing and is applicable to rolls in which the central spindle is straight, such as a straight idler roll. Troughed conveyer rolls in which the high point of the bow is inverted are likewise deemed to be within the scope of the present invention.

This application is a continuation in part of application Serial No. 769,454, filed October 24, 1958.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

1. An expander roll comprising a spindle having a central bore extending throughout substantially its entire length, a resilient sleeve rotatably mounted on said spindle, said spindle having a row of longitudinally spaced apertures along the gravitational top of said spindle communicating with the interior of said sleeve, the remainder of said spindle being imperforate, and means for introducing fluid under pressure into said central bore whereby said pressure fluid passes through said apertures and acts against the inner surface of said sleeve to overcome the friction between said sleeve and spindle caused by the weight of said sleeve.

2. An expander roll for smoothing a web passing around and in contact with a portion thereof comprising a spindle having a central bore extending throughout substantially its entire length, a resilient sleeve rotatably mounted on said spindle, said spindle having a row of longitudinally spaced apertures along the gravitational top of said spindle communicating with the interior of said sleeve, means for introducing fluid under pressure

into said central bore whereby said pressure fluid passes through said top row of apertures and acts against the inner surface of said sleeve to overcome the friction between said sleeve and spindle caused by the weight of said sleeve, and a second row of apertures in said spindle along a line at which a web is in contact with the roll, the remainder of said spindle being imperforate.

3. An expander roll for smoothing a web passing around and in contact with a portion thereof comprising a spindle having a central bore extending throughout substantially its entire length, a resilient sleeve having a hardness not less than about 65 Shore A durometer rotatably mounted on said spindle, said spindle having a row of longitudinally spaced apertures along the gravitational top of said spindle communicating with the interior of said sleeve, and means for introducing fluid under pressure into said central bore whereby said pressure fluid passes through said top apertures and acts against the inner surface of said sleeve to overcome the friction between said sleeve and said spindle caused by the weight of said sleeve, and a second row of apertures along a line at which a web is in contact with the roll, the remainder of said spindle being imperforate.

4. An expander roll for smoothing a web passing around and in contact with a portion thereof comprising a spindle having a central opening extending throughout substantially its entire length, a resilient sleeve having a hardness not less than about 65 Shore A durometer rotatably mounted on said spindle, said spindle including a set of longitudinally spaced apertures along the gravitational top of said spindle communicating with the interior of said sleeve, means for introducing fluid under pressure into said central opening, whereby said pressure fluid passes through said top row of apertures and acts against the inner surface of said sleeve to overcome the friction between said sleeve and spindle caused by the weight of said sleeve, said spindle having a second row of apertures along a line at which a web is in contact with the roll, the remainder of said spindle being imperforate, and fluid sealing means including a housing non-rotatably mounted on each end of said spindle, said housing defining first chambers in communication with each end of said sleeve for receiving escaping fluid from between each end of said sleeve and said spindle and a surge chamber in communication with each first chamber.

5. An expander roll as defined in claim 3 in which the apertures are inclined in the direction of rotation of the sleeve.

6. An expander roll as defined in claim 3 in which the axis of the spindle is arcuate.

7. An expander roll as defined in claim 4 in which said surge chambers includes means for permitting overflow fluid to pass back into said first chamber.

8. An expander roll as defined in claim 7 in which said fluid is water.

9. An expander roll as defined in claim 8 in which said spindle terminates in end plates and said water is introduced into said central opening through one of said end plates.

10. An expander roll as defined in claim 1 wherein said resilient sleeve has a hardness not less than about 65 Shore A durometer.

References Cited in the file of this patent

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