The present invention relates to squeeze rolls and more particularly is concerned with a fluid pressure actuated squeeze roll for the treatment of textiles and the like materials.

As is well-known, conventional rolls for the treatment of webs of material under pressure experience a flexure or bending toward the side of the roll facing away from the nip area in contact with the material being treated. This bending or sag, which is most pronounced near the center of the roll, has a detrimental effect in that it makes it practically impossible to obtain uniform pressure over the entire length of the roll when the roll is pressed by way of supporting journals against a counter roll or support.

Various attempts have been made to avoid this difficulty without complete success. One such attempt, for example, has included the employment of a barrel-shaped roll having a concave curvature which, upon bending of the roll, assumes substantially a straight line along the contact side of the roll. Barrel-shaped rolls, however, have the serious drawback in that a given amount of camber or curvature can only take into consideration one specific application of pressure so that different amounts of pressure or different points of application each require a different barrel-shaped roll.

It is possible through the use of a plurality of supporting rollers placed along the entire length of the roll and individually exerting pressure to obtain uniform pressure distribution over the entire length of the roll so that bending is eliminated. However, such construction, in addition to being cumbersome and requiring a large amount of expensive equipment, has the added disadvantage in that when it is used for squeezing moisture out of textiles, particularly when the textiles come from a dye bath, the supporting rolls become dirty and form dirt and lint catchers necessitating that the device be cleaned at relatively short intervals. This results in a reduction in the speed and operating efficiency of the roller equipment.

The present invention provides a novel pressure roll avoiding the above-mentioned difficulties through the use of a roll floating in a trough-like container filled with fluid to obtain a uniform pressure throughout the entire length of the roll. The roll of the present invention is particularly adapted for the pressure treatment of webs of material, for the smoothing and embossing of paper, for squeezing the moisture out of textiles, mangling, stretching sheets of plastic and rubber, as well as other well-known pressing processes. In addition to the uniform pressure application the device of the present invention makes it possible to completely do away with such auxiliary devices as supporting rollers, carrying rollers and back-up rolls acting on the roll at an area remote from the nip.

It is therefore a primary object of the present invention to provide a novel press roll for treating webs of material.

Another object of the present invention is to provide a novel press roll assuring uniform pressure application over the entire length of the roll.

Another object of the present invention is to provide a fluid supported press roll requiring no auxiliary carrying or back-up rolls.

Still another object of the present invention is to provide a press roll eliminating the necessity for bearing supports.

An additional object of the present invention is to provide novel sealing means for fluid actuated press rolls.

Further objects and advantages of the invention will be more apparent upon reference to the following specification claims and appended drawings wherein:

FIGURE 1 is an elevation of a press roll constructed in accordance with the present invention with parts in section.

FIGURE 1a is an enlarged view of the seal shown in FIGURE 1.

FIGURE 2 is an elevation of apparatus for adjusting the height of the trough shown in FIGURE 1.

FIGURE 3 shows a vertical guide arrangement for a roll constructed according to the present invention including roll journals;

FIGURE 4 is a partial cross-section through a roll constructed in accordance with the present invention showing in detail the longitudinal seal and abutment lip.

FIGURE 5 is a plan view with parts in section showing end seals constructed in accordance with the present invention;

FIGURE 6 is an elevation showing one end of a roller constructed in accordance with the present invention;

FIGURE 7 is a cross-sectional view showing a modified embodiment of the abutment strip and longitudinal sealing means;

FIGURE 8 shows a modified embodiment employing liquid as the pressure exerting fluid medium including a pneumatic cushioning arrangement;

FIGURE 9 shows a further modification of the longitudinal sealing arrangement;

FIGURE 9a shows a still further modification of the longitudinal sealing strips;

FIGURE 10 shows a preferred embodiment of the seal at the end of the roll.

FIGURE 11 is a modification of the end seal of FIGURE 10 used in conjunction with a journal type roll; and

FIGURE 12 shows a still further modification of the longitudinal sealing means of the present invention.

Referring to the drawings, the pressure roll of the present invention illustrated at 1 acts against an upper roll 2 under the influence of a fluid pressure medium indicated at 3. The pressure roll may be constructed of any suitable material, for example, plastic or hard rubber. If desired roll 1 may be formed from materials having elastic properties or may be a roll of hard rigid material, surrounded by a suitable elastic sleeve or integral resilient pressure surface.

In the embodiments shown in FIGURES 1 and 4 roll 1 is arranged without journals in a trough-like container 8 to lie in fluid pressure medium 3 up to the height of its central axis. A pressure inlet 9 supplies fluid under pressure from a suitable source to the vessel 3. While it is apparent that any fluid pressure medium such as a liquid dye or other liquid-treating composition as well as water or even air may be employed as the fluid pressure medium, the remaining description will be primarily concerned with the operation of the device in conjunction with water as the pressure-applying fluid.

Container 8 includes a pair of elongated sealing strips 4 extending along both sides of the top edges of the container parallel with the roll 1 and adjacent the rotating surface of the roll. Each of the strips 4 includes an extended lip 5 which rests against the periphery of the roll. Lips 5 preferably consist of suitable elastic material such as rubber and may if desired be reinforced at the surface of contact with the periphery of the roll with some of the well-known wear resistant, low friction plastic materials such as polytetrafluoroethylene as indi-
Sealing lips 5 are pressed against the circumference of roll 1 by the pressure liquid. Perforated webs 12 having apertures such as that indicated at 12a in FIGURE 1 press against the side of the lips facing the interior of the container and serve as supporting members for the lips. Alternatively, webs 12 could, if desired, be secured to the inner wall of container 8.

Sealing members 4 may be secured to the top edges of container 8 by means of any suitable fastening means, for example, screws passing through a surrounding frame 10. The configuration of the seal at each end of the roll is indicated by dotted lines at 6. Also shown in dotted lines at 13 is an inflatable bag which may be provided along the entire bottom surface of container 8 and when filled with air acts as an air cushion for the press roll.

Air may be supplied to the bag 13 through any suitable compressed air inlet passing through one of the walls of container 8.

FIGURE 2 shows an arrangement providing for the coarse adjustment of press roll 1 with respect to counter roll 2. Trough 8 can be raised and lowered along vertical guides 24 by means of a handle 23 driving an eccentrically mounted supporting roller or disc 22.

Movement of handle 23 rotates shaft 22c journaled in a frame which in turn carries disc or roller 22 having a pin 22a. Movement of pin 22a effects a camming action on the edge of a slot 22d formed in the trough resulting in a raising or lowering of the trough in vertical guide 24. The trough 8 is suspended by pin 22a extending into slot 22b of the trough.

In the modification shown in FIGURE 3, roll 1 is provided with a journal 25 supported in a slide block 26. Slide block 26 is in turn moveable in a vertical guide 27.

FIGURE 4 shows a modification in which the surrounding frame 14 acts as an abutment strip for the pressure loaded roll 1 during its rotation. In addition to securing the sealing strip 4 frame 14 provides a longitudinal abutment for roll 1 preventing displacement of the roll in a horizontal plane when pressure is applied to the roll. As shown frame 14 abuts only the side of the roll at which the treating material leaves the nip but it will be understood that frame 14 may abut both sides of the roll if desired. If the frame 14 is constructed of suitable flexible material webs 12 may be completely eliminated.

FIGURES 5 and 6 show in detail the arrangement for sealing each end of roll 1. End gasket 6 is disposable in the container 8 with respect to the end surfaces of the roll. Sealing strip 4 is enclosed by a bellows 20 which gasket 6 against the ends of the roll and the sealing strips. Bellows 20 may be connected to a gasket 6 and the inner surface of trough 8 by suitable means to establish a seal tight about the spring 19. Gasket 6 is additionally provided with a vertical flange 28 pressing against an elastic sealing jack 29 secured between the end of the flange and the inner wall of trough 8.

Pressure liquid enters the gap between gasket 6 and the inner surface of the trough mostly through space 21 between the gasket and the bottom of the trough. This pressure liquid presses gasket 6 with greater force so as to additionally insure a tight seal between the gasket and the ends of roll 1.

FIGURE 7 shows a modification in which the crown of the pressure roll 1 facing away from the counter roll is removed provided with a pressure load roll preventing movement of the roll in a horizontal plane. Abutment strip 17 is supported upon an auxiliary arm 18 formed integrally with the trough 15.

FIGURE 8 shows a modification in which the fluid containing trough includes a lower section 30 only partially filled with pressure liquid as indicated at 31. As shown one or more tubular conduits 32 establish communication between the lower section 30 of the trough for the transfer of liquid between the two sections. An air or gas cushion is provided above the level of liquid 31 as indicated at 33 and may be supplied gas under pressure through a charging connection 34 passing through a wall of the trough.

FIGURE 9 shows another modification of the longitudinal seal including sealing strips 35 having upwardly facing lips 36 in engagement with the periphery of the roll. Sealing strips 35 are secured to the trough by means of fastening strips 37 of suitable material such as bronze. Strips 37 are provided with an upwardly extending flange 38 which engages lips 36. FIGURE 9e represents a variation of the seal of FIGURE 9 in which sealing member 35 is secured to the container by means of a bronze bar 42 having a recess for the reception of an inflatable member 43. Inflation member 43 presses against sealing lip 36 bringing it into positive engagement with the periphery of the roll so that the lip 36 takes up any possible roll wear. It will be apparent that the sealing element 35 can simultaneously form the abutment surface for the roll and may if desired be itself inflatable in lieu of the separate inflatable member indicated at 43.

In the modification shown in FIGURE 10 the edges 39 of roll 1 are rounded to provide a more effective seal at the ends of the roll. Sealing strip 40 rests against the ends of the roll about the rounded edges and is fastened to the trough by a suitable fastening strip 41. If the roll is made of high friction plastic material or of rubber, the end of the roll extending beyond dotted lines 44 may preferably be constructed of hard steel. In such a case the portion of seal 40 cooperating with the hard steel end of roll 1 will be formed from a highly elastic material having high abrasion resistance such as rubber or flexible plastic. The remaining portion of seal 40 extending longitudinally along the major portion of roll 1 may then be formed of spring bronze or bronze sintered with polytetrafluoroethylene or super polymide to act both as a seal and as a horizontal stop or abutment surface.

If the roll 1 is provided with journals as shown at 25 in FIGURE 11, sealing strip 40 and covering strip 41 include central depressions indicated at 45 providing clearance for the journal 25.

FIGURE 12 shows a still further embodiment of the longitudinal seal of 4 seal 46 having adjacent portions which the fluid pressure medium is utilized to insure proper contact between the roll and seal. A housing 46 which may form a portion of the fluid pressure medium containing trough or container has secured to its top edge a cover plate 48 by suitable means such as screws 47. A portion of cover plate 48 is undercut at 49 to define channels for the reception of rubber pistons 50 spaced along the length of roll 1 adjacent a horizontal plane passing through the roll axis. Each piston 50 in turn engages an angled sealing foil 51 in driving relationship to assure a proper seal along the longitudinal length of the roll. Housing 46 also includes a plurality of upwardly extending channels 52 through which the pressure medium passes into engagement with the right hand abutment of piston 50. It is important in effecting the seal along the length of the roll that the contact pressure exerted by the seal on the roll be between the range too high a value. In order to maintain the desired pressure on the journal pressure differential is established across piston 50. If piston 50 is constructed as shown in the drawing with an indentation as indicated at 53 a slightly larger pressure force will be exerted upon the right hand side of the piston than will be exerted upon the left, urging the rubber piston 50 in contact with sealing foil 51. This pressure differential is automatically controlled in conjunction with variations in pressure application to the
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roll through the fact that the pressure liquid acts upon each side of piston 50 in substantially opposite directions. Different pressure ratios may be obtained by varying the surface areas in contact with the fluid on each side of rubber piston 50.

Sealing foil 51 is preferably constructed of relatively thin foil made of synthetic material, bronze or the like, of suitable flexibility to compensate for inevitable uneven wear of the roll surface occasioned by weaving edges of the goods and other factors which cannot be completely eliminated.

It is apparent that the present invention provides a novel floating roll supported in a trough-like container to apply uniform pressure over the entire surface of the roll. A novel sealing means is provided along both sides of the roll and about each end. In addition, abutment strips are provided for preventing the pressure loaded roll from traveling in a horizontal plane during its rotation.

The roll of the present invention exerts uniform pressure over its entire length on a counter roll or other base since the liquid pressure is propagated uniformly in all directions. No additional special seal is required to ensure uniform application of pressure. Liquid which leaks out at the periphery of the roll or at the roll ends, when liquid is used as a pressure medium, may if desired be recirculated. When the roll is used for the pressure treatment of webs of material which are either previously or subsequently subjected to treatment with a special liquid, such as the squeezing of moisture from textiles coming from a dye bath, the treatment liquid itself may be used as a pressure medium. This has the additional advantage that the roll cannot leave any traces which might impair the material in the event of leakage of the pressure medium through the sealing means.

A modification of the device of the present invention includes the employment of a pneumatic pressure cushion in order to obtain a resilient cushioning of the roll. It will be understood that a gas pressure medium may be used exclusively if so desired. An inflatable bag or bladder may also be employed which tends to set as a seal for the walls of the container.

The roll of the present invention may be solely supported by the trough-like container which acts upon it through the pressure medium. The roll can be constructed without or without journals depending upon whether or not it is desirable to drive the roll through a driving gear, as may be done when using the roll for the pressure treatment of paper webs.

Between the inner edge of the trough and the sealing member resting against the periphery of the roll there are preferably provided supporting members 12 in the form of a perforated web in order to prevent the roll from striking the edge of the trough or the sealing members from being pressed against the trough.

While in the preferred embodiment the roll is submerged in the fluid pressure medium to a depth reaching up to the horizontal diameter of the roll it is possible to employ the invention described wherein the fluid surrounds less than the lower half of the roll. It should be noted, however, that in all instances fluid pressure is applied over the entire longitudinal surface of the roll and over a portion of the end surfaces of the roll.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics of the invention. The present embodiments are 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. A pressure roll mechanism for use in treating webs of material comprising a container, a roll supported in a fluid tight relation in said container and having end faces extending transversely to the roll axis, said roll closing off said container against the escape of pressure fluid, a fluid pressure medium in direct contact with and partially surrounding said roll over its entire length acting on said roll, and sealing means along the length and against each end face of said roll sealing said fluid pressure medium within said container.

2. A pressure roll mechanism for use in treating webs of material comprising a trough-like container, a roll supported in a fluid tight relation in said container and having end faces extending transversely to the roll axis, said roll closing off said container against the escape of pressure fluid, a fluid pressure medium partially surrounding said roll over its entire length acting on said roll, sealing means along the length and against each end face of said roll sealing said fluid pressure medium within said container, and an abutment strip extending along at least one side of said roll for preventing roll travel under pressure.

3. A roll mechanism according to claim 2 in which the sole support for said roll is said pressure medium.

4. A roll mechanism according to claim 2 including supporting members between the edge of said container and the periphery of said roll.

5. A roll press for use in treating webs of material in which at least one of the rolls is enclosed in fluid pressure means at the side of said roll which is turned away from the working surface, characterized by the fact that said roll as a swimming roll dips into a pressure medium enclosed in said fluid pressure means, said fluid pressure means comprising a trough-like container closed off by said roll, and sealing elements slided with the roll circumference provided at the borders of the container walls and bearing on both roll face surfaces and on both ends of said roll.

6. A roll press according to claim 5 including an abutment strip supported by said container over said sealing means.

7. A roll press as defined in claim 5 in which said fluid pressure medium is liquid, including an additional fluid pressure medium container having a gaseous cushion in a portion thereof, and at least one tubular connection establishing communication for the flow of liquid between said containers.

8. A roll press according to claim 5 in which said fluid pressure medium surrounds less than half of said roll, said sealing means being positioned at the height of the upper surface of said fluid medium, and an abutment strip lying in a transverse plane passing through the axis of said roll.

9. A roll press according to claim 5 in which said roll includes roll journals, and vertical guide means receivably engaging said journals.

10. A roll press according to claim 5 in which the ends of said roll are rounded, said sealing elements resting against the rounded ends of said roll.

11. A roll press according to claim 5 in which said sealing elements include sealing lips, and inflatable means pressing said lips against the periphery of said roll.

12. A roll press according to claim 11 in which said lips extend away from said fluid pressure medium.

13. A roll press according to claim 12 including a frame for securing said sealing elements to said container, said frame having a recessed portion adjacent said roll, and said inflatable means comprising an inflation member received in said recessed portion for pressing said lips against said roll.

14. A roll press according to claim 5 in which said sealing elements include sealing lips extending away from said fluid pressure medium, a housing secured to said container defining at least one transverse channel, piston means slideable in said channel, and means establishing
A roll press according to claim 14 in which said lips comprise a thin flexible foil.

A pressure roll mechanism for use in treating liquid-treated webs of material comprising a trough-like container, a roll supported in a substantially fluid tight relation in said container, said roll acting to substantially close off said container against the escape of pressure fluid, a fluid pressure medium partially surrounding said roll over its entire length acting on said roll, sealing means along the length and about each end of said roll sealing said fluid pressure medium within said container, and an abutment strip extending along at least one side of said roll for preventing roll travel under pressure, said pressure medium being the same as the liquid for treating the webs of material, whereby spotting of the material is avoided in the event of leakage of said fluid pressure medium through said sealing means.

A pressure roll mechanism for use in treating webs of material comprising a trough-like container, a roll supported in a fluid tight relation in said container, said roll closing off said container against the escape of pressure fluid, a fluid pressure medium partially surrounding said roll over its entire length acting on said roll, sealing means along the length and about each end of said roll sealing said pressure medium within said container, an abutment strip extending along at least one side of said roll for preventing roll travel under pressure, and an air cushion in the bottom of said container.

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