

Jan. 9, 1968

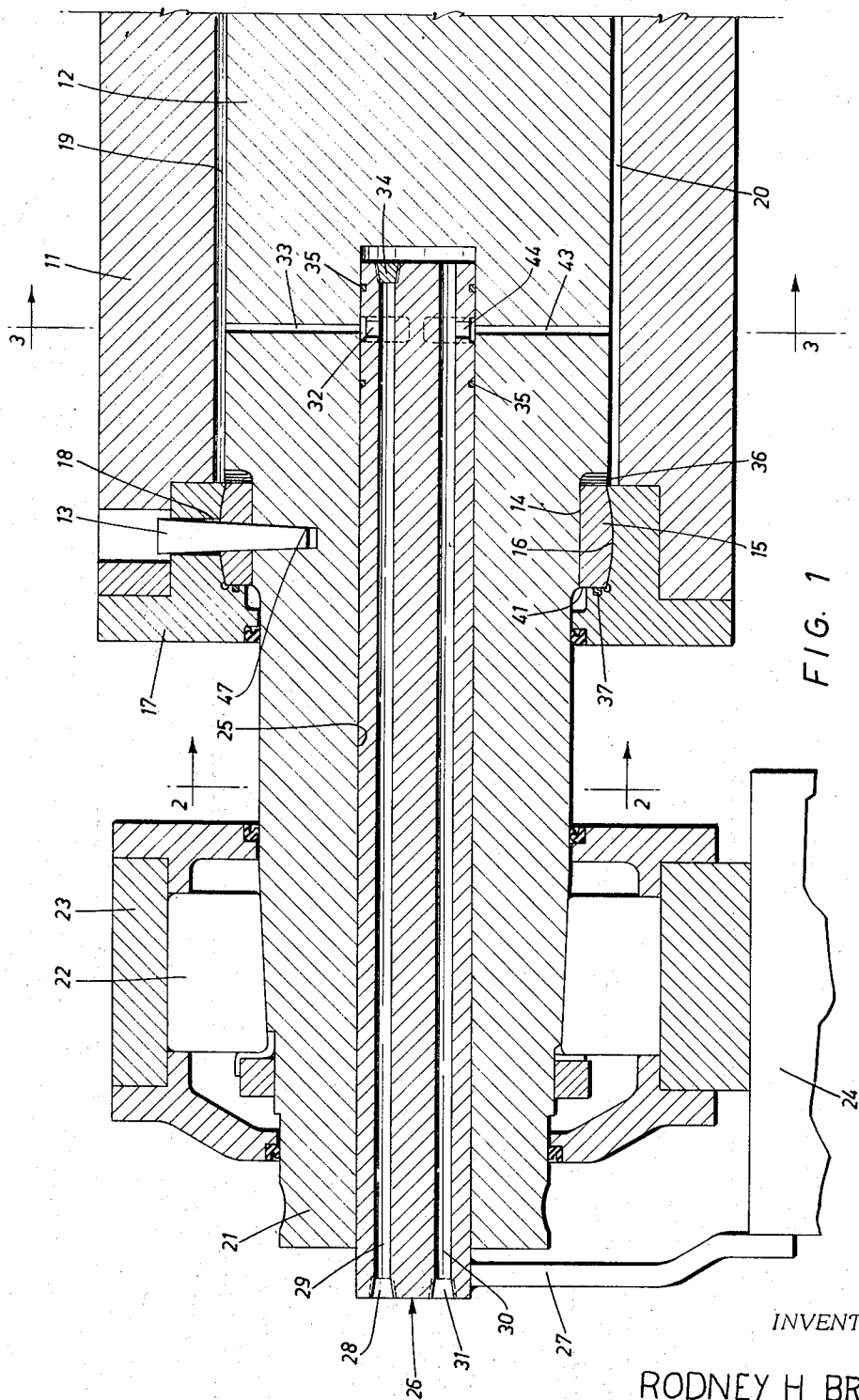
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3,362,055

HYDRAULIC ANTI-DEFLECTION ROLL

Filed Dec. 6, 1965

3 Sheets-Sheet 1



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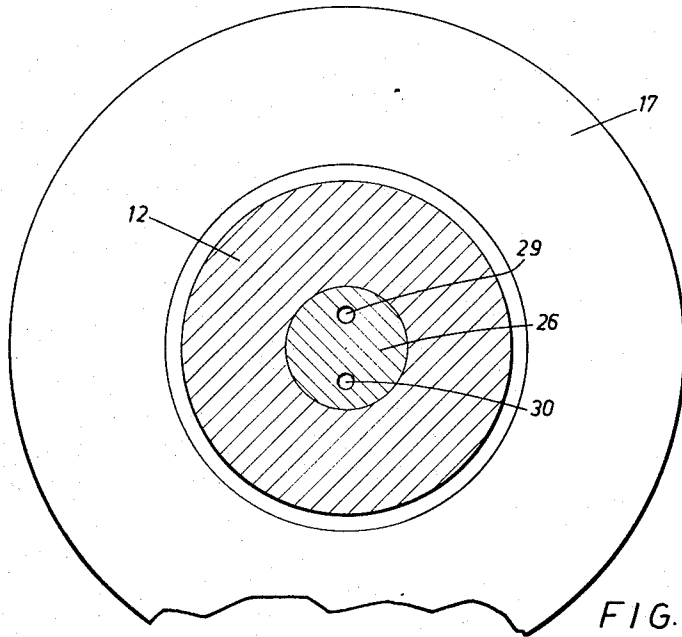
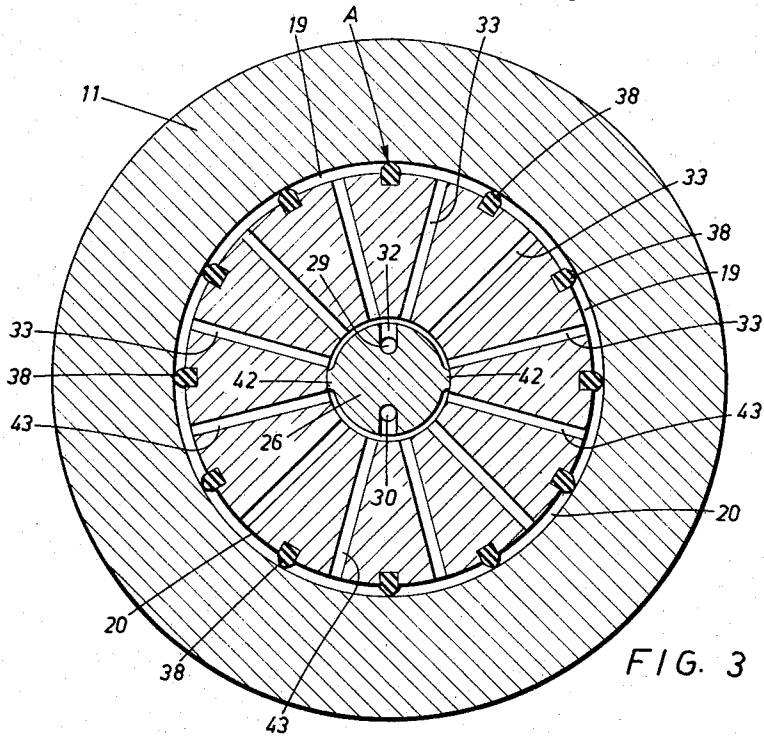
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HYDRAULIC ANTI-DEFLECTION ROLL

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3 Sheets-Sheet 2



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HYDRAULIC ANTI-DEFLECTION ROLL

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3 Sheets-Sheet 3

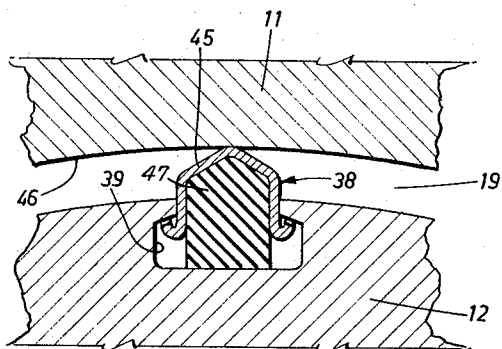


FIG. 4

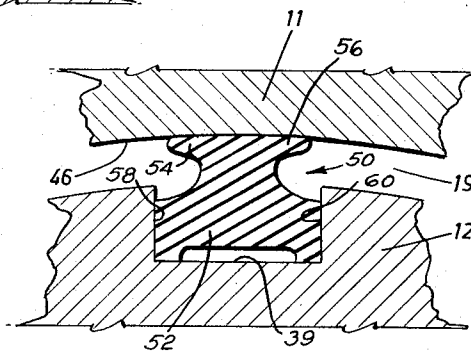


FIG. 5

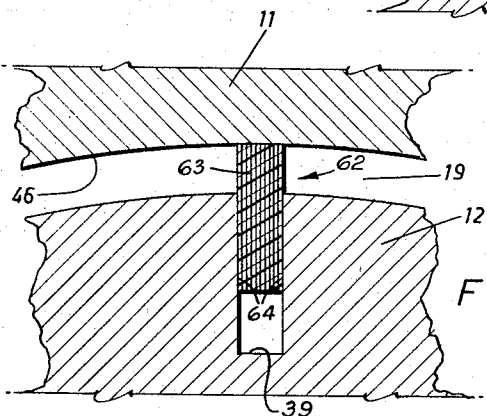


FIG. 6

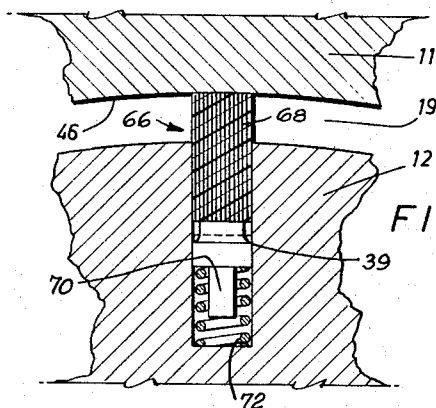


FIG. 7

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HYDRAULIC ANTI-DEFLECTION ROLL

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4 Claims. (Cl. 29—113)

ABSTRACT OF THE DISCLOSURE

An anti-deflection roll is provided with a rotary load carrying inner shaft and a number of peripheral fluid pressure chambers arranged between the shaft and the roll shell. The shaft is of improved structure to provide optimum bending strength and improved sealing of the individual pressure chambers, by maintaining minimum radial clearance between the shaft and the shell inner surface, substantially one-half of the chambers being pressurized to withstand nip loading, the other half of the chambers being depressurized.

This invention relates to improvements in the rolls of calenders, press sections and breaker stacks of paper making machines.

In rolls used for calenders, press sections, breaker stacks or other heavily loaded machines, considerable problems have arisen due to the tendency for the roll to bow or deflect when in the loaded condition. The result of such roll deflection produces a variation in nip width and pressure across the face of the roll, it being impossible to maintain the axes of opposing rolls parallel one to the other.

One solution which has been adopted in the past in order to counteract the effects of deflection of rolls was to "crown" the rolls, that is, to increase their diameter progressively towards the mid-span, so that on application of load the adjacent surfaces which constitute the nip deflect to a substantially parallel configuration.

However, when rolls are crowned to compensate for deflection, the crown that is applied is suitable for one nip load only and should be changed if the load is changed. A disadvantage of the crowning method is that it causes a differential speed between the center of the roll and the ends of the roll, thus distorting of scuffing the web passing between the two rolls. Furthermore, with two rolls operating together it is difficult to maintain the same relative crown between the centre and the ends of the rolls. Thus a differential speed often results between mating portions of the two rolls.

The differential speeds thus produced cause undue wear to the roll surfaces and, in the case of felted presses, produces undue wear and distortion of the felt blanket.

A further proposed remedy to overcome this problem is disclosed in Canadian Patent No. 594,589 issued Mar. 15, 1960, to Edward Kusters. This patent teaches the use of a cylindrical shell supported by bearings mounted on a stationary central shaft and wherein seals are attached along the sides of the central shaft to provide a separate compartment on the loaded side of the shaft which can be pressurized, using an hydraulic medium, to bear against the inner rotating surface of the shell to resist the deflection of the shell. However, this device has the disadvantage that the roll cannot be readily driven, be-

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cause the central shaft is stationary, so that driving effort must therefore be applied directly to the shell by means of a ring gear, belt, or chain. Because of the proximity of the paper web, and felts, if used, such direct drive is not generally suitable. This type of roll construction, thus leads to applying a drive to the mating roll, which in turn drives the first roll by friction. Alteration of existing installations for this purpose is both costly and time consuming.

An object of the present invention is the provision of an improved roll for calenders, press sections and the like of paper making machines in which the exterior surface of the roll will not deflect away from a load applied along the line of contact with a second rotating roll. This is accomplished by means of a plurality of segmental fluid chambers located between a solid inner shaft, the ends of which form the roll journals, and a hollow cylindrical roll shell, the segmental fluid chambers being sequentially pressurized by a fluid under pressure to correspond with roll rotation to produce a force which effectively balances the applied force, whereby the deflection of the roll along the line of contact with a second rotating roll is substantially eliminated. The invention provides an apparatus specially adapted to carry out the invention comprising: a substantially cylindrical roll shell adapted for rotation about its longitudinal axis, a shaft extending through said cylindrical shell having journals at each end, partition means mounted within the roll for rotation therewith, having axially extending fluid impermeable walls defining a plurality of adjacent sequential fluid chambers between the inner periphery of the shell and the outer periphery of the inner shaft and means for admitting pressurizing fluid to the fluid chambers, whereby, in operation, by admission of pressurizing fluid to the chambers adjacent the nip surface of the shell, when under load, such as a contacting pressure roll, the tendency of the shell to deflect in response to working load applied thereagainst may be substantially controlled.

A further object of the present invention is to provide an improved roll for calenders, press sections and the like, which has substantially non-deflecting characteristics and which will provide a substantially uniform nip pressure along the face of the roll for any applied nip load.

A further object is to provide an improved roll for calenders, press sections and the like, wherein the roll is constructed in such a manner that the surface of the roll can be adjusted relative to the surface of the mating roll while in operation, whereby a deliberate variation in nip pressure can be obtained across the width of the rolls depending upon the condition of the paper web being fed through the rolls.

A further object of the present invention is to provide an improved roll for calenders, press sections and the like, wherein the roll can be readily driven through the end of the roll journal and can therefore be substituted for a conventional solid roll without the necessity of substantially altering the drive already existing on the machine to which the replacement it fitted.

A further object of the invention is to provide an improved roll for calenders, press sections or the like, wherein the roll is so constructed that the surface of the said roll can be adjusted relative to the surface of the mating roll, by use of adjusting means such as hydraulic fluid means.

The following is a description by way of example of certain embodiments of the present invention, reference being had to the accompanying drawings, in which:

FIGURE 1 is a diametrical section view of the end portion of a roll according to the present invention, including the bearing and fluid supply arrangements;

FIGURE 2 is a view at the plane 2—2 of FIGURE 1, looking in the direction of the arrows;

FIGURE 3 is a view at the plane 3—3 of FIGURE 1 looking in the direction of the arrows;

FIGURE 4 is an enlarged view of the area shown at A in FIGURE 3;

FIGS. 5, 6, and 7 illustrate alternative forms of seals contained in the area A of FIG. 3.

With reference to FIG. 1, the cylindrical shell 11 of the roll is mounted coaxially on a shaft 12, the shell 11 and shaft 12 being locked together for rotation by means of one or more tapered locking pins 13 inserted into suitable holes 47. Rigidly attached to the step 14 of central shaft 12 is a spherical bearing 15. A matching spherical surface 16 is incorporated into a split carrier cap 17 and thus locates cylindrical shell 11 in radial relationship with the central shaft 12. A series of clearance holes 18 permit insertion of locking pins 13 through the split carrier caps 17. The holes 18 permit relative movement between the shell 11 and shaft 12 on spherical bearing 15 such that no binding on the pins 13 can occur.

The inner surface of the main portion of shell 11 defines an annular space with the shaft 12, this space being divided into a series of longitudinal pressure chambers such as 19 and 20 which are shown in FIG. 1.

It will be seen that shell 11, shaft 12, locking pins 13, spherical bearing 15 and split carrier cap 17 constitute a rotatable assembly. The journal ends 21 of central shaft 12, of which one is shown, are rotatably mounted in anti-friction bearings 22, the bearing being retained in bearing housing 23 attached to the frame of the press section 24.

Mounted coaxially in opening 25 of central shaft 12 is a stationary valve plug 26. A torque arm 27 rigidly attached to the valve plug 26 retains the plug in a non-rotating position. The end of the torque arm 27 remote from the plug 26 is attached to the frame of the calender or press section 24 by bolts or other suitable means.

The stationary valve plug 26 has an inlet 28 and an outlet 31 at the outer end communicating by way of axially extending passages 29 and 30 with transverse fluid supply ports 32 and 44. These ports terminate at the surface of the plug 26 in a pair of circumferentially extending fluid galleries separated one from the other by sealing lands 42. Each of the longitudinally extending pressure chambers 19, 20 is connected with the fluid source by a radially extending bore, the upper bores 33 in FIGURE 3 being connected to the high pressure source of pressurizing fluid, while the lower bores 43 are connected by way of the outlet 31 to a low pressure drain.

The longitudinally extending pressure chambers 19, 20 are defined by seals 38, shown mounted on the outer periphery of the shaft 12, the ends of the pressure chamber being isolated by end seals 36.

Referring to FIGURE 4, the longitudinal seal 38 is shown mounted in a recessed slot of the shaft 12, and comprises a steel contact strip 45 adapted to sealingly engage the inner surface 46 of the shell 11, the resilient body portion 47 acting both as a spring member to maintain the contact strip 45 in sealing contact with the surface 46 and also as a seal along the bottom of the slot 39.

Alternative embodiments of the longitudinal seal 38 are shown in FIGURES 5, 6, and 7. Due to the fact that the shaft 12 revolves with the shell 11, centrifugal force acts upon the seals 38, thereby assisting the maintenance of the sealing contact with the shell 11.

In FIGURE 5, the longitudinal seal 50 comprises a central body portion 52 and a pair of curved lobe portions 54, 56 extending radially outwardly and circum-

ferentially in relation to the roll shell 11, the sides 58, 60 of the seal 50 being in sealing relation with the sides of slot 39. The seal 62 illustrated in FIGURE 6 comprises a rectangular body portion 63, the sides 64 of which sealingly engage the sides of slot 39. In the embodiment shown in FIGURE 7, the seal member 66 slidably mounted in the slot 39 has a series of presser springs 72 mounted in the slot 39 and acting on the lower side of the seal member 68 by way of caps 70.

Additional sealing provisions such as the O-ring seal 35 at the inner end of the valve plug 26, the O-ring seal 37 between the carrier cap 17 and the spherical bearing 15 are also provided. The conduit 29 in valve plug 26 is plugged at its inner end by a line plug 34.

The means for driving the roll is not illustrated, being of the usual type.

In operation the internal chambers 19 of the roll are filled with any hydraulic operating fluid supplied through the high pressure inlet 28. The longitudinally extending chambers 19 on the upper portion of the roll are pressurized to the desired extent by the high pressure source, while the lower chambers 20 on the inner surface of the roll are at drain pressure. This pressure difference between the upper and lower portions of the roll tends to produce a resisting force in the roll which is directly opposed to the deforming force applied to the roll by the contacting roller. As the roll shell 11 rotates, together with the shaft 12, the chamber 20 moving upwardly to the line of working contact with the adjacent pressure roll moves from the zone of low fluid pressure past the sealing land 42 to the zone of high fluid pressure, while a down-moving chamber 19 moves from the high fluid pressure zone to the low fluid pressure zone. It will be seen that in this fashion the resisting force exerted across the width of the roll is maintained substantially constant, despite the rotation of the roll.

It will be seen from the foregoing description that by applying a resisting force to shell 11 by means of the differential oil pressure, an equal and opposite force is transmitted to the central shaft 12 which is supported at both journal ends 21 by bearings 22. In other words, the resisting force is effected by a deflection of the central shaft 12.

In addition to the foregoing benefits, the present invention tends to reduce the rate of wear upon the roll surfaces, and in the case of machines employing a felt, the life of the felt is benefited.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A fluid pressurized nip-compensating roll having an outer shell portion, a load supporting cylindrical inner shaft providing a close radial clearance with the inner surface of said shell, a plurality of peripherally spaced axially extending seal slots extending inwardly of said shaft outer periphery, a sealing member slidably mounted in each said slot in sealing engagement with the slot and extending outwardly in sealing engagement with the shell inner surface to form a plurality of adjacent fluid pressure chambers, bearing journal means attached in supporting relation to said roll, and pressure fluid distributing means extending through said journal means in pressure transmitting connection with said pressure chambers to provide a high pressure zone subtending approximately half of the shell inner periphery located in facing relation to the nip load, and a corresponding low pressure zone located oppositely thereto, on the side of the roll axis opposite to the nip.

2. The roll as claimed in claim 1 wherein said seal members are of substantially rectangular cross-section having the main section axis extending outwardly from said shaft.

3. The roll as claimed in claim 1 wherein said seal members are of convoluted section, having a pair of circumferential lobe portions of the section in sealing relation with the shell inner surface and providing respec-

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tive radially inwardly facing pressure responsive surfaces each bounding one side of a said fluid chamber, to provide peripheral chamber sealing in response to the applied fluid pressure.

4. The roll as claimed in claim 3 wherein said seal member has a reduced nose portion for contacting the inner surface of said roll, and a pair of transverse shoulder portions providing limited outward movement of the seal member relative to the shaft slot, to maintain sealing connection with the said shell inner surface when said shaft is in a loaded and bowed condition.

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BILLY J. WILHITE, *Primary Examiner.*