Oct. 8, 1963 C. M. WESTBROOK 3,106,153

CONTROLLABLE DEFLECTION ROLL

Filed March 9, 1961 2 Sheets-Sheet 1

Fig. 1

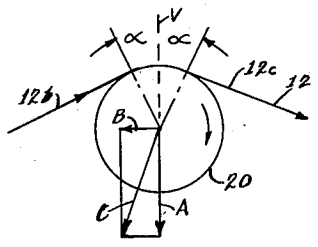


Fig. 3

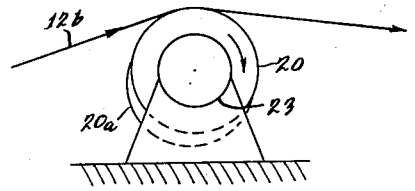


Fig. 2

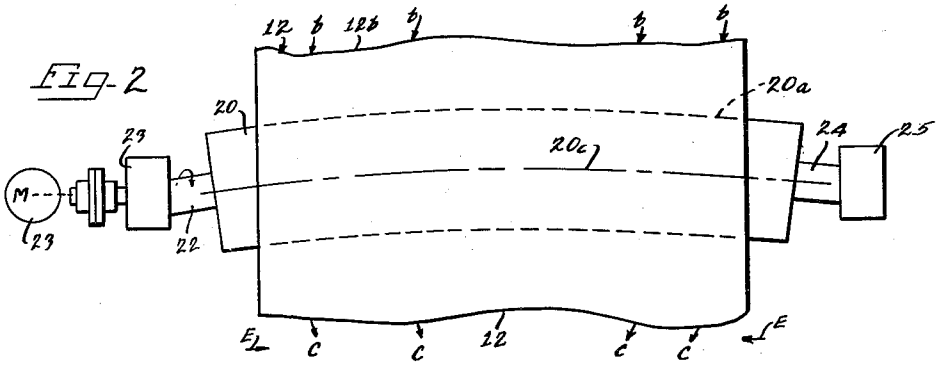
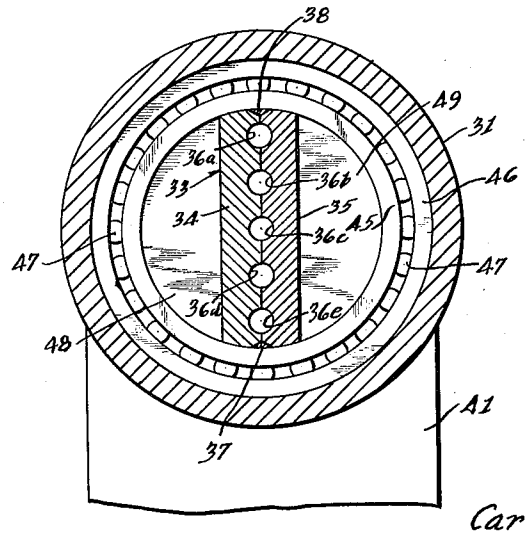


Fig. 6



INVENTOR.
Carl M. Westbrook
BY

Hill, Sherman, Meroni, Gross & Simpson ATTORNEYS

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FIG. 4

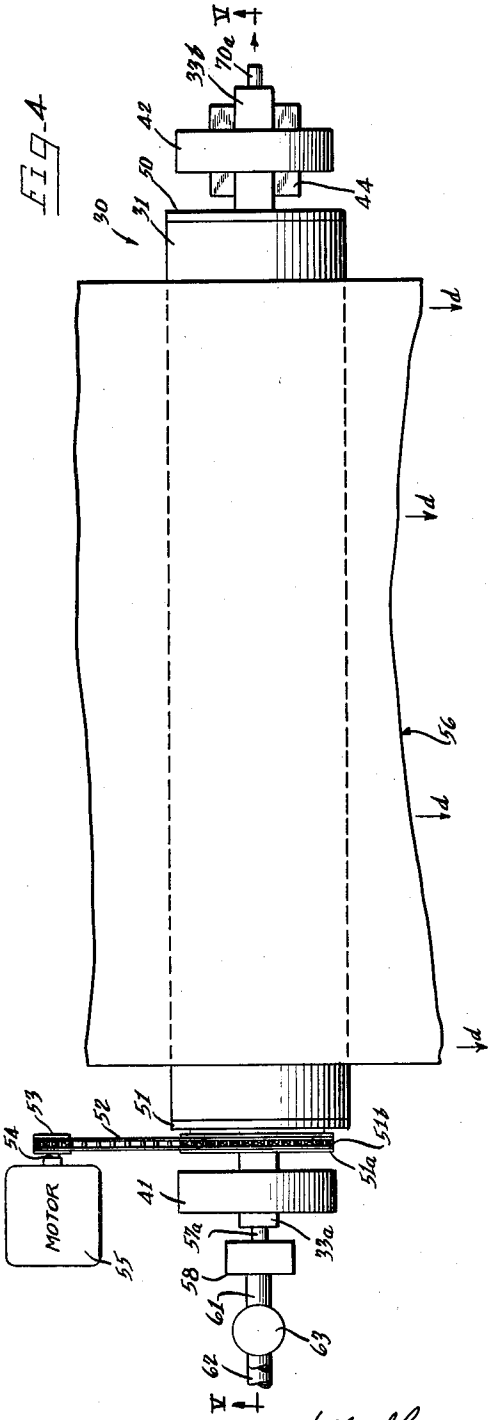
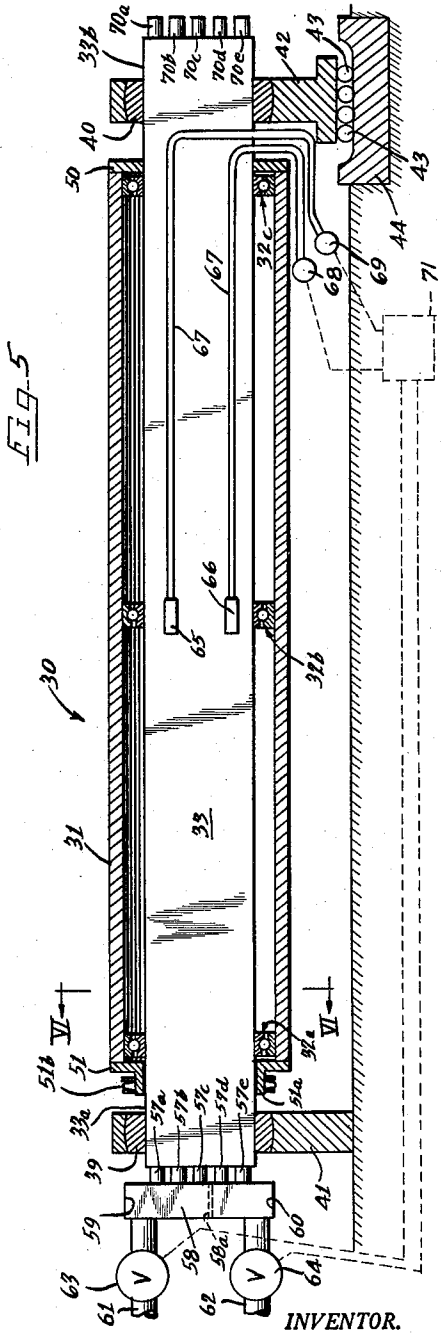


FIG. 5



INVENTOR.
Carl M. Westbrook

BY

Hill, Sherman, Meroni, Gross & Simpson ATTORNEYS

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CONTROLLABLE DEFLECTION ROLL

Carl M. Westbrook, Beloit, Wis., assignor to Beloit Iron Works, Beloit, Wis., a corporation of Wisconsin

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The present invention relates broadly to the paper making and related arts, and is more particularly concerned with a roll structure and deflection means for use therewith featuring a thermally expansible support member mounting a roll shell and applying forces to the shell to accurately counteract the forces tending to deflect the same.

At different stages during the course of paper manufacture it is of course known to employ roll structures of various types for performance of diverse functions. Illustrative of such rolls are wire drive rolls, plain press rolls, smoothing press rolls, pressure rolls, breaker stack rolls, size press rolls, pull rolls, calender rolls and the like. Each of the stated types of rolls has in common, for the purposes of the instant description, the use therewith of means normally contacting the roll and tending to deflect the centroidal axis thereof.

To illustrate, drive drolls mounted to engage the loop of the forming wire in a Fourdrinier type paper making machine engage the surface of the wire, and the weight of the roll coupled with an applied load arising from the resistance of the wire to being driven produce a force component which tends to deflect the drive roll in a direction downwardly and toward the oncoming forming wire. As well, in press roll couples and in other roll arrangements wherein at least a pair of rolls are in nip-defining relationship, the algebraic summation of the weight, the nip forces, the bending moments produced by the journal loading, and torque (if any) tends to produce in each of such rolls a curvature of its centroidal axis, in accordance with well known laws of flexure of materials. It is common to attempt to counter this effect by "crowning," i.e., by grinding the roll slightly barrel shape in an amount and curvature calculated to offset the curvature under operating conditions.

The normal deflection, when concave toward the wire wrap, on a wire drive roll, if not relieved, tends to cause the off-running portion of the forming wire to be compacted or squeezed laterally, which increases substantially the wear on the wire. The initial investment in a forming wire is very substantial, but even more important, the production loss during wire replacement is frequenty enormous.

Specifically as to press rolls, a different problem exists. Production schedules for many paper machines require relatively frequent changes in the type and grade of product. Certain grades of paper demand that the pressing and other treatment not reduce significantly the thickness or caliper of the web, and this in turn requires that the nip loads in a press couple be relatively light. On the other hand, certain other paper products required from the same paper machine permit or even demand more severe pressing, and in order to achieve some measure of versatility with the same paper machine, one practice followed by the art to accomplish the noted changes is the removal of the press rolls for regrinding to a different amount of crowning. Obviously, this practice is also both expensive and time consuming. And as will be later noted, crowning of the roll causes differences in the surface speed of the roll between the central and end portions of the roll, which is often harmful to the function of the press.

It is accordingly an important aim of the instant invention to provide a roll assembly embodying therein

novel means to counteract the forces tending to deflect the roll.

Another object of this invention lies in the provision of an improved paper machine arrangement comprising a roll, means normally contacting the roll and tending to deflect the centroidal axis thereof, and support means in bearing relation with the roll generally centrally of the interior thereof and extending outwardly from its opposite ends and susceptible of deflection upon the application of a controlled heat thereto for applying forces to the roll to counteract the forces tending to deflect the same.

Still another object of this invention is to provide apparatus for controlling deflection in a roll member and which comprises a thermally expansible support member coextensive with and mounting the roll member, and means for applying heat to a portion of the support member to deflect the same and impart a deflecting force to the roll member.

A further object of the instant invention lies in the provision of a roll assembly, and which includes a shell having normally a central deflection, a thermally expansible support member received by and extending outwardly from opposite ends of the shell for mounting said shell, bearing means between said support member and the shell generally centrally thereof, and means for applying heat to the support member to deflect the same and impart a deflecting force to the shell generally centrally thereof in opposition to the normally central deflection.

An even further object of the present invention is to provide apparatus of the foregoing character, and which further features sensing means responsive to the thermal expansion of the support member and indicating the change in length therein, whereby deflection of the shell may be measured.

Other objects and advantages of the invention will become more apparent during the course of the following description, particularly when taken in connection with the accompanying drawings.

In the drawings, wherein like numerals designate like parts throughout the same:

FIGURE 1 is a more or less diagrammatic view showing forces applied to a drive roll in a Fourdrinier type paper making machine;

FIGURE 2 is an exaggerated essentially diagrammatic top plan view of a drive roll mounting of the prior art;

FIGURE 3 is an essentially diagrammatic side elevational view of the device of FIGURE 2;

FIGURE 4 is a diagrammatic top plan view drawn along the lines of FIGURE 2, but showing deflection means constructed in accordance with the principles of this invention.

FIGURE 5 is a longitudinal vertical sectional view taken substantially along the line V—V of FIGURE 4; and

FIGURE 6 is a transverse vertical sectional view taken substantially along the line VI—VI of FIGURE 5.

The controllable deflection roll of this invention will be now specifically described in connection with certain problems presented in the paper making arts, however, it will be immediately apparent that the present concepts also produce substantial improvements on rolls used in steel mills and other industries. As well, the invention is of important application in combination with conventional loading applied at the journals of a mating roll and/or with a straight roll or a roll having conventional crown. By regulating the forces produced by the thermally expansible support member of this invention, in cooperation with journal loading, there is thus obtained a novel manner of altering the shape of the nip pressure profile.

It has earlier been the accepted practice in a Fourdrinier type paper making machine to drive the forming wire through the suction couch roll, however, recently it has been found advantageous to use the return rolls as drive rolls and to drive the wire with drive rolls mounted outside the loop of the wire and engaging the outer surface of the wire. In the case of such rolls the wire passes over the top of the drive rolls.

While these changes in the wire drive arrangement have resulted in a much longer wire life, it is apparent that many further improvements can be made. Specifically, it is known that the drive roll has a tendency to deflect from its own weight and forces applied thereto, and such deflection curvature causes at least a compacting together of the woven elements of the wire, and in some cases an overlapping or ridging of small portions of the wire. These conditions markedly increase wear on the wire and may destroy its usefulness.

This may be more fully understood when reference is made to FIGURE 1, which is a diagram showing some of the forces applied to a drive roll 20. The wire 12 (traveling in the direction indicated by the arrow) passes over the top of the roll 20 and wraps the roll 20 by a total angle of wrap of 2 alpha. As here shown the oncoming side 12*b* of the wire 12 wraps the roll 20 over the angle alpha and the off-running side 12*c* of the wire also wraps the roll over the angle alpha with the dividing line *v* therebetween being a substantially vertical line passing through the center of the roll 20. The tension on the wire 12 thus applies a force in an essentially downward vertical direction indicated by the arrow A.

The weight of the roll 20 also applies a force in the direction of the arrow A. It will be appreciated that loading forces such as the weight of the roll and the tension on the wire 12 load the roll 20 as a beam. And the roll 20 has a substantial length compared to its diameter. For example, in a typical paper machine the roll 20 will be approximately 20 feet long and approximately 1½ feet in diameter.

It will further be appreciated that when the roll 20 is rotated in the direction indicated by the arrow (on the roll 20) there is a load applied across the top of the roll in a direction generally tangential to the roll portion wrapped by the wire 12. The wire 12 resists being driven to this extent so as to apply this load to the roll 20 and this load applies generally in the direction of the line of force B. The resulting sum of all of the loads applied to the roll 20 may be indicated by the force line C and this generally is the direction in which the roll 20 tends to deflect the centroidal axis thereof. It will be noted that the roll tends to deflect in a direction downwardly and toward the oncoming wire (12*b*).

Referring now to FIGURES 2 and 3, it will be seen that the deflection is shown in exaggerated form. In FIGURE 2 the roll 20 is shown rotatably driven by drive means 23 (indicated diagrammatically) and both journals 23 and 24 rotatably mounted in bearing means 25. The wire 12 passes over the top of the roll 20; and it will be seen that the roll 20 is deflected in its central portion 20*a* backwardly or in the direction of the oncoming side 12*b* of the wire 12. Or as may be otherwise stated, the indicated centroidal axis 20*c* is deflected. As shown in FIGURE 3, the central portion 20*a* of the roll 20 is deflected off-center from the drive means 23 and the extreme edge of the roll, which is full line marked 20. The central portion 20*a* is deflected toward the oncoming side 12*b* of the wire and also downwardly. The curvature of the roll surface, although not visible, reorients the driving effort forces so that their lines of action tend to converge, resulting in the application to the wire of transverse forces in the directions indicated by the arrows E of FIGURE 2. Thus, although the oncoming side 12*b* of the wire 12 may have no transverse forces applied thereto and the wire 12 may be traveling in substantially a "straight line" in a plane generally tangential to the roll 20 (as indicated by

the arrows *b*), as the wire 12 passes over the bowed or deflected roll 20, there is a tendency to narrow the wire at the off-running side 12*c* (as indicated by the arrows *c*). This transverse compression of the off-running wire side 12*c* tends to offer an opportunity for the wire to ridge, particularly if any slight forces may be applied normal to the plane of the wire (for example, by fibers or some dirt or impurity adhering to the roll 20 and passing between the roll 20 and the wire 12).

In FIGURES 4, 5 and 6, there is shown an exemplary embodiment of the instant invention for relieving deflection in a roll member. The roll assembly illustrated therein is designated generally by the numeral 30, and comprises a cylindrical shell 31 mounted for rotation by bearing means 32*a–c* upon a stationary thermally expansible support member generally identified as 33, which is received by the shell 31 and centrally positioned within the shell 31. The central bearing element 32*b* may and often preferably is replaced by a pair of centrally disposed allochiral bearing elements (not shown) which are positioned on both sides of the 32*b* position at approximately the ⅓ or ¼ points. The member 33 may take various forms, and may be a bi-metallic element or may have the specific construction of FIGURE 6.

As appears therein, the thermally expansible support member may be formed of a pair of generally flat steel plates 34 and 35 one face of which is milled or otherwise formed with transversely spaced and longitudinally extending slots or grooves, which form fluid flow passages 36*a–e* when the plates 34 and 35 are assembled in face-to-face relation. Welding techniques may be employed to effect the securement between the plate members 34 and 35, and to assure a fluid-tight seal therebetween gasket means (not shown) may be used. In any event, the plate member 34 and 35, if welded rather than bolted one to the other, are formed into a unitary structure along seam lines 37 and 38 at the top and bottom thereof. Each plate member has a length greater than the axial length of the shell member 31, as appears in FIGURES 4 and 5, to provide end portions 33*a* and 33*b* on the thermally expansible support member which extend outwardly from opposite ends of the shell 31.

The opposed end portions 33*a* and 33*b* of the support member 33 are received in self-aligning bearing means 39 and 40, respectively, and it may be noted from FIGURE 5 that the bearing means 39 is mounted in a fixed support 41, while the bearing means 40 at the opposite end thereof is mounted in a movable support 42. The latter support is provided in order to compensate for thermal expansion of the support member 33, and for this purpose the support 42 rides upon a plurality of rod or ball members 43 slidable or movable upon a fixed contoured base plate 44. Of course, in substitution for the elements 43 and 44 shown, there could be utilized a suitable slide arrangement.

As was stated, the cylindrical shell 31 rotates about the stationary non-rotatable support member 33 upon bearing means 32*a–c* spaced along the axis of the shell 31. Each bearing means may include a pair of radially spaced annular races 45 and 46 (FIGURE 6) housing therebetween a plurality of rolling elements 47. To preclude the possibility of collapse of one or more of the bearing rings 45 and 46 during rotation of the shell 31 about the support member 33, there may be positioned between the flat faces of the plate members 34 and 35 and the inner race ring 45 a pair of semi cylindrical spacer members 48 and 49.

The end of the cylindrical shell 31 adjacent the movable support 42 mounts thereon a plate or cap member 50 receiving therethrough the end portion 33*b* of the support member 33 with sufficient spacing therebetween to avoid any interference during shell rotation. The opposite end of the shell 31 rigidly mounts a cap or plate member 51 shaped to provide a collar portion 51*a* having formed thereon sprocket teeth 51*b* over which is trained a sprocket

52 which wraps a sprocket wheel 53 mounted upon shaft means 54 driven in rotation by motor means 55. While motive means 55 are illustrated to impart rotation to the shell member 31, this may not at all times be required since movement of the forming wire 55 (FIGURE 4) may be sufficient to rotatably drive the shell 31.

The support beam 33 is desirably constituted of a steel or any other metallic bar material having a coefficient of thermal expansion such that when a portion of the metal beam is selectively heated or heated and cooled, that portion of the beam member deflects an amount sufficient to exert forces on the shell member 31 of a magnitude to oppose the forces causing the normal central deflection in the shell 31. The normal central deflection in the shell member 31 may be caused by the weight of the roll coupled with an applied load arising from resistance of the forming wire to be driven, as was discussed in connection with FIGURES 1 to 3, or if the shell 31 forms a part of a press roll couple or other roll arrangements wherein at least a pair of rolls are in nip-defining relation, the central deflection forces may be constituted from the algebraic summation of the weight, the nip forces, the bending moment produced by the journal loading and any torque which might be present. In any event, selective expansion of the upper portion of the support beam 33, with or without selective contraction of the lower beam portion, causes a bowing of the beam 33 in an upward direction, and through the bearing connection at 32*b*, a deflection or bowing of the shell 31 is effected. The expansion and bowing of the support beam 33 are of course almost imperceptible to the human eye, and the upward forces are generally only of a magnitude sufficient to counterbalance the forces causing the original central deflection.

It was stated herein above that the thermally expansible support member could take the form of a bi-metallic element, although conveniently the support beam is constituted in the manner specifically described in connection with FIGURE 6. The milled passages 36*a–e* may be five in number as illustrated, although it is of course appreciated that this number may be varied. In an illustrative arrangement, the upper three passages 36*a–c* may receive a fluid such as water heated to the desired temperature level, while the lower two passages 36*d* and 36*e* receive cold water.

The hot water passages 36*a–c* have connected thereto conduit means 57*a–c*, while the lower two passages have fluid communicated thereto by conduit means 57*d* and 57*e*. All conduits 57 are connected to manifold means 58 provided with a separator or divider member 58*a*. In this manner the interior of the manifold 58 is divided into a hot water compartment 59 and cold water compartment 60, and connected to the named compartments are conduit means 61 and 62, each having therein valve means 63 and 64, which may be thermally responsive and control the admission of fluid to the compartments 59 and 60 and ultimately to the passages 36*a–e* in the support beam 33.

In order to accurately control the amount of heat applied to the support beam 33 and to thereby not only regulate but measure the extent of the beam distortion, means are herein provided for measuring the changes in upper and lower portions of the beam length occasioned by either heat application or loading by external forces. Such means also may be used to measure the resultant roll deflection. Such means, as appears in FIGURE 5, comprises a pair of strain gauges 65 and 66 suitably attached generally centrally of the axial length of the beam 33 and inwardly of the marginal side portions thereof in order to sense length changes of the beam along the longitudinal portions affected by the hot or cold fluids. In other words, the strain gauge 65 detects length changes in the upper portion of the beam 33 by externally applied forces and/or the heated passages 36*a–c*, while the strain gauge 66 senses length changes in the beam

in the lower portion thereof and which arise from external loading and/or the flow of coolant through the passages 36*d* and 36*e*. Thus, both strain gauges 65 and 66 under conditions of actual loading by external means, as by wire weight and drag plug roll weight, would normally sense approximately equal beam length changes, whereas when hot fluid is flowed into the upper passages 36*a–c* and cold fluid into the lower passages 36*d* and 36*e*, the strain gauge 65 detects the increase in beam length in the upper portion caused by expansion and the gauge 66 the contraction resulting from the input of cold fluid.

The strain gauges 65 and 66 are connected by wires 67 suitably attached to the support beam 33 and extending outwardly through the cap means 50 to suitable indicating means 68 and 69. Such indicating means may be galvanometers, although other instruments may be employed for this purpose. Advantageously, conventional control means (indicated in dotted lines at 71) responsive to the strain gauge signals means 68, 69 may be employed to maintain a predetermined total shell deflection by temperature control via such valves 63, 64.

As applied to a single roll exemplified by a wire drive roll or felt in a drier section, the deflection sensing means of this invention would normally be utilized by loading the roll shell 31 and support beam 33 externally, as by the roll weight coupled with the load arising from resistance of the wire to be driven. The change in length of the respective portions of the beam by the external loading would then be measured by the strain gauge 65 and by the gauge 66. Hot fluid would then be circulated through the passages 36*a–c*, and coolant caused to flow through the lower passages 36*d* and 36*e*. The temperature of the hot fluid and cold fluid would then be controlled to provide a zero strain gauge reading. Of course, and as required, the fluids are continuously circulated through the passages 36, and for this purpose the passages communicate at one end with discharge conduits 70*a–e*. Pump means (not shown) would of course be provided to produce the desired continuous circulation.

The instant inventive concept also is productive of numerous advantages in roll couples. As applied to a press roll couple, wherein the algebraic summation of the weight, nip forces, bending moments produced by journal loading, and torque (if any) tend to produce a curvature along the centroidal axis, the deflection control means herein described would be utilized as follows. In such an application, the support beam 33 would be distorted or upwardly bowed by the application of heat, coolant also being used in the lower passages 36*d* and 36*e*. The length change of the relative portions of the beam resulting from the distortion would then be measured by the strain gauge 65 and by the gauge 66. The roll shell 31 and support beam 33 would then be loaded to a zero strain gauge galvanometer reading by the application of the forces tending to cause normal central deflection, such as the roll weights and journal loadings. Of course, a similar technique could be utilized in a calender stack, or in any other application wherein at least a pair of rolls are in nip-defining relationship.

The structural association described could be modified to incorporate a pair of strain gauges in a bridge circuit, one of the gauges being temperature sensitive and providing a zero reading at maximum heat input, and the other gauge being load sensitive and providing a zero reading at no external load. The bridge circuit could embody a temperature compensator, and actual loadings in this environment would be charted on a computer circuit.

It may now be seen that by the support beam and associated structure described forces may be applied which precisely correspond to the weight of the roll body, the wire tension, nip loading, and the like, without significant force couples which would introduce changes of shape in the flexure curve of the roll. As applied to a wire drive roll, illustrated in FIGURES 4 and 5, there is

completely eliminated any tendency of the off-running portion of the forming wire to be compacted laterally. This appears in FIGURE 4, and is shown by the arrows *d*, clearly indicating the wire leaves the roll shell 31 in full width with the driving forces oriented non-convergently.

In addition to effectively counteracting the normal roll deflection, the roll assembly 30 is characterized by an absence of undesirable bending moments and the provision of an essentially true or straight roll. Additionally, there is eliminated the earlier problem of grinding to achieve a particular crown. To illustrate, different grades of paper require different nip loads, and it is also necessary that different grades of paper be produced on the same paper machine. Furthermore, it is often desirable to alter the nip loading for other reasons. However, to accomplish this it has previously been required to remove the press rolls for regrinding to a different amount of crowning, crowning of course being practiced in an endeavor to obtain uniform nip loads across the contacting roll faces, or to accept a degree of non-uniformity as the expedient. To remove the press rolls and effect regrinding is obviously a time-consuming and expensive procedure. However, by utilization of the roll assembly 30 as the lower or even as both the top and bottom rolls in a press couple, deflection is effectively counteracted or relieved to provide uniform nip pressures entirely along the roll contact line.

The concept of this invention is productive of highly advantageous results as applied to either a single roll or to a plurality of rolls in nip-defining relationship. It is accordingly believed quite apparent that this invention is susceptible of numerous modifications without departing from the novel concepts thereof, as for example, means may be provided for shifting the support beam to compensate for non-vertical loading.

I claim as my invention:

1. Apparatus for controlling deflection in a roll member, comprising a thermally expansible support member coextensive with and mounting said roll member, and first conduit means for applying heat to an axially extending portion of said support member and second conduit means for withdrawing heat from another radially spaced axially extending portion of said support member, thereby to deflect the support member and impart a deflecting force to said roll member.

2. A roll assembly, comprising a shell subject to forces tending to cause deflection, a support beam received by and mounting said shell and extending outwardly from the opposite ends thereof for reception by support members for the assembly, means between said beam and said shell for transmitting forces from the beam to the shell, means for applying heat to an axially extending portion of said beam to distort the same and thereby impart to said shell forces in opposition to the forces tending to cause deflection, and control means connected to said beam and sensing changes of length therein resulting from heating said beam.

3. A roll assembly, comprising a shell subject to forces tending to cause deflection, a support beam received by and mounting said shell and extending outwardly from the opposite ends thereof for reception by support members for the assembly, means between said beam and said shell for transmitting forces from the beam to the shell, means for creating a temperature differential between axially extending portions of the beam for distorting said beam to impart to said shell forces in opposition to the forces tending to cause deflection, and means connected to said beam and sensing changes of length therein resulting from said distortion, whereby the deflection of the shell may be controlled.

4. A roll assembly, comprising a shell having normally a central deflection, a thermally expansible support member received by and mounting said shell and extending outwardly from the opposite ends thereof to support elements, bearing means between said support member and said shell generally centrally thereof, and first conduit means for applying heat to an axially extending portion of said support member and second conduit means for withdrawing heat from another radially spaced axially extending portion of said support member, thereby to distort the support member and deflect said shell generally centrally thereof in opposition to the normally central deflection.

5. A roll assembly, comprising a shell having normally a central deflection, a thermally expansible support member received by and mounting said shell and extending outwardly from the opposite ends thereof to support elements, bearing means between said support member and said shell generally centrally thereof, means for applying heat to an axially extending portion of said support member to distort the support member and deflect said shell generally centrally thereof in opposition to the normally central deflection, and means connected to said support member and sensing changes of length therein resulting from heating said member, whereby deflection of the shell may be measured.

6. A roll assembly, comprising a shell having normally a central deflection, a thermally expansible support member received by and mounting said shell, said support member having a plurality of superimposed spaced axially extending passages formed therethrough, bearing means between said support member and said shell generally centrally thereof, means for flowing a heated fluid through the uppermost passages in said support member and cooling fluid through the lower passages to distort the support member and deflect said shell generally centrally thereof in opposition to the normally central deflection, and means connected to said support member and sensing changes of length therein resulting from heating said member.

7. A roll assembly, comprising a shell having normally a central deflection, a thermally expansible support member received by and mounting said shell and extending outwardly from the opposite ends thereof, said support member having a plurality of spaced axially extending passages formed therethrough, bearing means between said support member and said shell generally centrally thereof, means for flowing a heated fluid through the passages in one portion of said support member, means for supplying a coolant to the passages in another portion of said support member, said heated fluid and said coolant when flowing in said passages distorting the support member and deflecting said shell generally centrally thereof in opposition to the normally central deflection, and means connected to said support member and sensing changes of length in said portion resulting from heating and cooling said member.

8. A roll assembly, comprising a shell having normally a central deflection, a coaxially extending beam member protruding outwardly from opposite ends of said shell, said beam member having a bank of axially extending fluid flow passages extending completely therethrough, bearing means receiving opposite ends of said beam member, support means for said bearing means, means between said beam and said shell for transmitting forces from the beam to the shell, conduit means communicating with the passages in the upper portion of said beam member for supplying heated fluid thereto for distorting said beam and deflecting said shell generally centrally thereof in opposition to the normally central deflection, and strain gauge means attached to said beam member for detecting changes of length in said portion resulting from heating said member.

9. A roll assembly, comprising a shell having normally a central deflection, a coaxially extending beam member protruding outwardly from opposite ends of said shell, said beam member having a bank of axially extending fluid flow passages extending completely therethrough, bearing means receiving opposite ends of said beam member, support means for said bearing means, means be-

tween said beam and said shell for transmitting forces from the beam to the shell, first conduit means communicating with the passages in the upper portion of said beam member for supplying heated fluid thereto, second conduit means connected to the passages in the lower portion of said beam member for flowing coolant therethrough, said heated fluid and said coolant when flowing in said passages distorting the support member and deflecting said shell generally centrally thereof in opposition to the normally central deflection, strain gauge means attached to said beam member along the upper and lower portions thereof for detecting changes of length in said portion resulting from heating and cooling said member, and instrument means indicating the length changes detected by said strain gauge means.

10. A roll assembly comprising a shell subject to forces tending to cause deflection, a support beam received by and mounting said shell and extending outwardly from the opposite ends thereof for reception by support members for the assembly, means between said beam and said shell for transmitting force from the beam to the shell, first conduit means for applying heat to an axially extending portion of said beam, and second conduit means radially spaced from said first conduit means for withdrawing heat from said beam, whereby the first and second conduit means may distort the beam and impart to the shell forces in opposition to forces tending to cause deflection.

11. A roll assembly, comprising a shell that is subject to deflection in response to a load applied thereto, a support member having separate axial passages therein

and received by and mounting said shell, bearing means between said support member and said shell generally centrally thereof, and separate and independent conduit means for flowing a heated fluid through one of such axial passages in the support member and for flowing cooling fluid through another separate and distinct axial passage in said support member radially spaced from the axial passage receiving the heated fluid, thereby to distort the support member and deflect said shell in opposition to said deflection.

12. A roll assembly, comprising a shell tending to deflect in response to a load applied thereto, a beam member generally aligned with the centroidal axis of the roll and extending outwardly from opposite ends of shell, bearing means receiving opposite ends of said beam member, means between said beam and said shell for transmitting forces from the beam to the shell, first conduit means connected to a source of hot fluid for applying heat to an axially extending portion of said beam, and second conduit means connected to a source of cooling fluid for withdrawing heat from an axially extending portion of the beam that is radially spaced from the axially extending portion of the beam that is heated, thereby to distort the beam and deflect the shell in opposition to such deflection.

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