

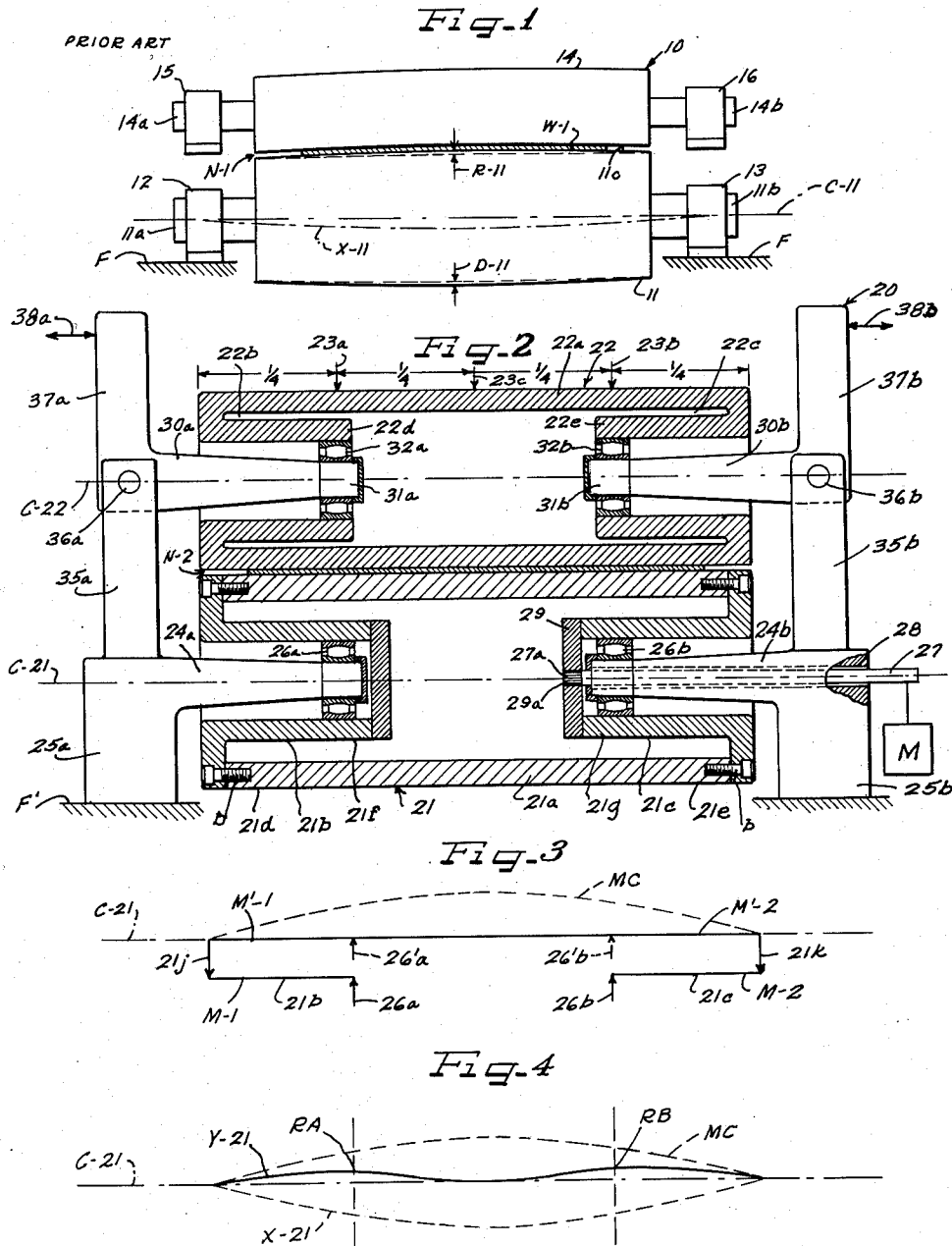
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ANTI-DEFLECTION ROLL

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ANTI-DEFLECTION ROLL

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This invention relates to apparatus for mounting a roll whose centroidal axis is subject to deflection, and more particularly, to an apparatus for mounting a roll that is subjected to a load tending to effect central deflection of the roll axis.

Although the instant invention may be useful in a number of arts, it is particularly useful in the paper making art and will be described primarily in connection therewith. In paper machines there are a number of different types of rolls of substantial size (i.e. substantial length-to-diameter ratio) which are subjected to loads tending to deflect such rolls centrally. For example, in press couples, calender stacks, etc. the web passes through a nip between a pair of rolls whereat the web is subjected to pressures. The pressures thus applied to such nip tend to load the rolls defining the nip and to deflect the axes of these rolls in a direction generally away from the nip. If one of the rolls defining a nip is backed up by other rolls or other means, its tendency to deflect away from the nip is reduced or may be completely overcome so that it is deflected in the direction of the nip. On the other hand, certain press rolls and, for example, the king roll or bottom roll in a calender stack may not be provided with backup means and the pressures or load thus applied to the nip for a calender stack king roll (as an example) tends to deflect the same centrally in a direction away from the load (which is usually downwardly). Such deflection results in an undesirable application of forces across the nip and other undesirable operating features; and such deflection is often corrected in paper machines by "crowning" of the king roll. The crowning of the roll requires accurate and expensive finishing of the roll surface so as to obtain a slightly greater roll diameter in the central portion of the roll; but such crowning is carried out on the basis of a predetermined set of force conditions and may not be satisfactory for operation under a different set of force conditions. Accordingly, crowning of rolls often does not afford satisfactory operation for many different types of operating conditions. In addition, the surface speed of the portion of the roll having a greater diameter is actually faster than the surface speed of the portion of the roll having a relatively smaller diameter, when the roll is rotating, and this difference in surface speeds at a point of contact between the web and the roll (such as at a nip) may result in undesirable phenomena.

In arts such as the coating of paper or fabrics with plastic materials, pressure or calender rolls are also used. In addition, paint mixing systems or the like are also subject to the build up of forces in the central portion of pressure nips which tend to cause central deflection of the rolls and result in non-uniform and/or other undesirable conditions across the width of such pressure nips.

It will be appreciated that one may think of most of these various pressure rolls in terms of the outer annularly cross sectioned functional component or "shell" thereof. The instant invention affords a simple but unique mounting arrangement for a roll shell subject to a load tending to cause deflection of its centroidal axis. One important aspect of the instant invention involves the use of force couples for applying internal counter-deflection moments to the shell in response to the application of the load to the shell in such a manner as to more or less automatically resist or minimize deflection of the roll when it is sub-

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jected to varying loads. This is accomplished through the use of allochiral mounting means cantileverly secured to the ends of the shell, but extending inwardly from the ends of the shell at locations disposed inwardly of the shell ends from the points at which these mounting means are secured to the ends of the shell. The mounting means are cantileverly mounted in that they are secured at or near the ends of the shell, but extend into the shell without being directly connected to the shell at their inner ends, by radially aligned means securing the inner ends of the mounting devices to an interior portion of the shell itself. These mounting means are allochiral in that they are "right hand" and "left hand" members mounted at opposite ends of the shell (or looking in the "machine direction" at opposite sides of the roll shell). These members are referred to herein as "allochiral" for the reason that they are opposed right and left hand assemblies although not necessarily entirely symmetrical in every detail.

The use of a pair of bearings to rotatably receive a stub shaft extending outwardly from the end of the roll for the purpose of applying a force couple thereto, wherein one of the bearings is fixed and the other movable, as shown in the prior art, for example, in Goulding U.S. Patent No. 2,611,150. The Goulding mounting arrangement calls for a pair of bearings for each of the stub shafts at opposite ends of the roll. In addition, the prior art in the form of Hornbostel U.S. Patents Nos. 2,648,122 and 2,651,103 shows the mounting of a roll shell on a through shaft using mounting elements that are positioned inwardly from the ends of the shell, but which afford a direct (radially aligned force) connection between the through shaft and the shell at the mounting element positions inwardly from the ends of the shell.

In the instant invention, however, the advantages of applying a counter-deflection moment to the shell are obtained without the necessity of using a pair of bearings at each end of the roll, and without the necessity of providing means for applying a force couple to each of such pairs of bearings. The application of a counter-deflection moment to the shell in the instant invention is effected by the use of a unique and simple arrangement of allochiral mounting (and "force couple applying") means preferably in the form of annular members which are secured to the ends of the shell but which extend inwardly rather than outwardly of the ends of the shell.

The basic idea of the use of such inwardly turned mounting members is disclosed and claimed in my application Serial No. 102,571, filed April 12, 1961, which is incorporated herein by reference. This is a continuation-in-part of such application.

These mounting members are carried at a location inwardly from their outer extremities and the ends of the shell by means of allochiral shaft means which, in the present invention, are cantileverly mounted at opposite ends of the shell so as to extend inwardly from the shell to engage the inner ends of the hereinbefore described mounting means. Bearings are preferably provided at the inner end of the allochiral shaft means for rotatably supporting and engaging the inner ends of such mounting means; but it will be appreciated that the engagement between the inner ends of the mounting means and the inner ends of the shaft means may be rigid or resilient, connected for corotation, if the outer ends of the allochiral shaft means are each cantileverly mounted on a plurality of bearings. Still another advantage of the instant invention resides in the fact that, when the preferred arrangement of the invention is used with bearings providing for relative rotation between the inner ends of the allochiral shaft means and the inner ends of the allochiral mounting means, each allochiral shaft means may be mounted pivotally for separate and independent

movement toward and away from the load applied to the roll shell. In this latter arrangement the roll shell itself may be loaded toward or away from an exterior load applied thereto merely by the application of force through movable means associated with the allochiral shaft means.

In any event, substantially the entire weight of the shell and any load applied thereto is carried by the cantileverly mounted allochiral shaft means at the previously described locations inwardly from the shell ends. And the internal mounting means (preferably annular mounting members) which are to effect the internal counter-deflection moments in the shell are mounted on and fully supported by the allochiral shaft means at the aforesaid locations inwardly from the shell ends, but these annular members are not connected directly to the interior of the shell radially opposite to the positions at which they are mounted on the shaft means. Instead, these annular mounting members extend outwardly from the locations at which they are carried by the shaft means and they are in turn cantileverly secured to the shell at the ends thereof (although not necessarily the exact extremities of the shell) in such a manner that the internal counter-deflection moment is applied to the shell via these annular mounting members in response to the application of a load to the shell. This results in a greatly simplified, sturdy assembly which is essentially "self correcting" with respect to its tendency to resist the normal deflection to which the conventionally mounted rolls are subjected under load.

It is, therefore, an important object of the instant invention to provide an improved anti-deflection roll and/or anti-deflection assembly for the mounting of a roll shell subject to a load.

It is another object of the instant invention to provide an improved roll assembly wherein force couples are applied to effect internal counter-deflection moments via simple, sturdy and effective members positioned internally of the shell ends.

Yet another object of the instant invention is to provide a rotatable roll shell whose axis is subject to deflection in response to a load applied to said shell, allochiral mounting means each having an outer end rigidly and cantileverly secured to one end of the shell and having an inner end extending within the shell inwardly of the shell ends, and allochiral shaft means each having an outer end cantileverly mounted outside one end of the shell and extending within the shell to engage the inner end of the mounting means secured to such shell end and to thereby support the weight of said shell inwardly from the ends of the shell, thereby applying internal counter-deflection moments to said shell in response to the application of the load to said shell.

Other and further objects, features and advantages of the present invention will become apparent to those skilled in the art from the following detailed disclosure thereof and the drawings attached hereto and made a part hereof.

On the drawings:

FIGURE 1 is a diagrammatic illustration showing the two lower rolls of the stack of rolls, illustrating in exaggerated form the manner in which such rolls may be deflected during specific correlation among essential control factors in a calender stack of the prior art;

FIGURE 2 is a diagrammatic illustration similar to FIGURE 1, but showing the roll shells in sectional elevation for an assembly embodying the invention;

FIGURE 3 is an essentially diagrammatic view showing the alignment of internal counter-deflection moments of the type effected in the operation of the assembly of FIGURE 2; and

FIGURE 4 is an essentially diagrammatic illustration of deflection curves involved in a consideration of the instant invention.

As shown on the drawings:

In FIGURE 1, a bottom portion of a calender stack, indicated generally by the reference numeral 10, is shown

comprising a king roll 11 at the bottom mounted on suitable bearings 12 and 13 which are in turn firmly secured to a fixed mounting such as a floor F. Immediately above the king roll 11 is a calender roll 14 which, in turn, is mounted for rotation in bearings 15 and 16. Actually, the roll 11 is provided with a left hand stub shaft 11a or shaft element which is rotatably received by the left hand bearing 12 and a right hand stub shaft 11b which is rotatably received by the right hand bearing 13. The roll 14 is also provided with a left hand stub shaft 14a rotatably received by the left hand bearing 15 and a right hand stub shaft 14b rotatably received by the right hand bearing 16.

As will be noted, the axis X-11 for the roll 11 is deflected downwardly (shown in exaggerated manner) below a horizontal or center line C-11 at the middle of the roll 11 and this is caused by the load applied to the roll 11 by the weight of the roll 14 (and any other rolls thereabove). This weight is transmitted through the sheet of paper (shown in exaggerated thickness at W-1) passing through the nip N-1 between the rolls 11 and 14. In the calender 10, however, the central portion of the top surface of the roll 11 is still crowned so as to extend a distance R-11 above the outer extremities of the roll 11, and the bottom surface of the roll 11 is downwardly bowed still a greater distance D-11. The amount of operating crown R-11 depends upon the amount of original crown formed on the roll 11 and the total weight of the calender stack of rolls 14, etc. mounted thereabove. As will be appreciated, if it is desired to operate a calender with substantially no operating crown (R-11) in the king roll 11, the initial crown of the king roll 11 and the total weight of the calender rolls 14, etc. are correlated so as to obtain substantially no operating crown. If, however, it then becomes desirable to make a change in the operation of the prior art calender by using less calender rolls in the stack, then a greater operating crown R-11 will be obtained. This may possibly result in an undesirable pressure distribution at the portion of the web W-1 passing through the nip N-1. The same is true with respect to variations in load which may be applied to any other crowned roll in a paper machine or other device.

In many of such prior art devices, the crown initially formed on the roll being subjected to the load is just sufficient to permit the roll to deflect in response to this predetermined load to such an extent that the roll presents a substantially flat (usually horizontal) nip defining surface. It will be appreciated that any variation from such predetermined load will, however, necessarily result in a deviation from the desired flat or level contour of the operating surface or nip defining line of the roll (herein designated 11c).

Referring now to FIGURE 2, it will be seen that the assembly 20 of the instant invention is adapted to mount a roll shell 21 whose centroidal axis in the unloaded condition of the roll (indicated at C-21 in FIGURES 2, 3 and 4) is subject to deflection. As will be appreciated, the extent of deflection and crown has been greatly exaggerated in FIGURE 1 and will also be exaggerated in the description of FIGURES 2, 3 and 4 for the purpose of simplifying the nature of the disclosure. As indicated diagrammatically in FIGURES 2, 3 and 4, the axis C-21 is a center line for the shell 21 which would be a substantially straight, horizontal line in the views shown, if the shell 21 were not subjected to any loading forces including the load of its own weight. The roll 21 is, however, subjected to a load across its entire width, including the load of its weight and the load of a first upper press roll 22 forming a press nip N-2 therewith.

As indicated in FIGURE 2, a web W-2 is trained through the nip N-2 in the manner shown for the bottom two rolls of a calender stack. It will be appreciated that the nip N-2 may also be a nip between two press rolls (such as the rolls 21 and 22) through which a felt may travel with or without a web thereon. For the instant

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purposes, however, the load is indicated diagrammatically as being applied uniformly across the entire width (or length) of the shells 21 and 22, by the use of arrows 23a and 23b at the quarter points and 23c at the mid point. It will be appreciated that the load (i.e. 23a, 23b, 23c, etc.) applied to the top of the roll 22 may result from additional rolls of a calender stack or it may result solely from the weight of the roll 22 itself; and this load (23a, 23b, etc.) is assumed for the moment to be applied uniformly across the top of the lower roll 21 (although it will be appreciated that the actual numerical figures for the load, for example, in pounds per inch of nip width, will probably be different at the top surface of the roll 21 from the load figures at the top surface of the roll 22 which are represented diagrammatically in FIGURE 2). It will also be appreciated that, as indicated diagrammatically in FIGURE 4, in the case of a conventionally mounted roll shell the load 23a, b, etc. which is here assumed to be applied uniformly across the nip N-2 at the top of the roll 21 would result in a conventional deflection curve X-21 in the shell axis.

The shell 21 is, however, mounted in accordance with the instant invention on generally co-axially spaced, separate and independent allochiral shaft means or elements 24a and 24b, which are held against rotation and fully supported by fixed mounting blocks 25a and 25b, respectively.

Each of these cantileverly mounted shaft elements 24a and 24b extends from its cantilever mounting 25a and 25b, respectively, outside the ends 21d and 21e of the shell 21a for the roll 21 appreciably axially inwardly of and radially spaced from the shell 21a to approximately the quarter points (which are generally aligned with the force arrows 23a and 23b). At the inner end of each of the shaft elements 24a and 24b are mounted co-axially spaced allochiral annular bearing elements 26a and 26b. The bearing elements 26a and 26b are shown diagrammatically since they may be of conventional structure, but it will be understood that spherical roller bearing assemblies are preferred for use in the invention, since these bearing assemblies are known to be resistant to a radially applied load, but capable of limited yielding to a pivotal or momental movement of the type described and desired herein.

The roll 21 comprises a generally annularly cross sectioned functioning body portion or shell 21a plus generally co-axially spaced, allochiral turned-in mounting means or end portions 21b and 21c, respectively (which may be referred to as "sleeves" or "inner shells"). Although the shell 21a may be integrally formed with the turned-in portions 21b and 21c, in the embodiment here shown the end portions 21b and 21c are separate elements which are secured to the ends 21d and 21e of the shell 21a by means of bolts or similar means b. The turned-in ends 21b and 21c are cantileverly secured to and rigid with the respective ends 21d and 21e of the shell 21 and extend appreciably axially inwardly of the end portions of the shell 21 surrounding but without engaging the shell 21 directly opposite their inner extremities 21f and 21g, respectively (i.e. so as to be radially spaced from the shell axially inwardly from such ends). Instead, the inner extremities 21f and 21g engage the bearing assemblies 26a and 26b, respectively, and the entire weight of the roll 21, plus the load (23a, 23b, 23c, etc.) applied thereto is carried by the bearing assemblies 26a and 26b positioned interiorly from the ends of the shell 21a at approximately the quarter points. The turned-in ends 21b and 21c are thus radially spaced from the shaft elements 26a and 26b axially outwardly from their inner ends 21f and 21g mounted on the shaft elements 24a and 24b via the bearing assemblies 26a and 26b, and the shell 21 is thus supported interiorly or from within solely on the shaft elements 24a and 24b, via the turned-in ends 21b and 21c (and the bearing assemblies 26a and 26b).

It will be seen that the total weight of the roll 21 plus the additional load applied thereto being supported at the

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inner ends of the cantileverly mounted turned-in ends 21b and 21c by the bearings 26a and 26b results in the creation of generally allochiral moments M-1 and M-2 indicated diagrammatically in FIGURE 3; with the moment arm in each case being one of the turned-in ends 21b and 21c, respectively; the forces at the inner end of the moment arm being applied via the bearing assemblies 26a and 26b, respectively; and the opposite forces for the moment arms 21b and 21c being applied at the outer ends, here shown as the arrows designated 21j and 21k, respectively. Although the forces resisting the load applied to the roll 21 via the bearing assemblies 26a and 26b are not applied directly to the interior of the shell 21a opposite the bearings 21a and 21b, it will be appreciated that within the shell 21a there is created a secondary moment M'-1, shown at one side of FIGURE 3 and a secondary moment M'-2 at the opposite end of the roll, and this secondary moment is represented diagrammatically at the left hand side of FIGURE 3 by the oppositely directed arrows designated 21j and 26'a; and at the right hand side of FIGURE 3 by the oppositely directed arrows designated 26'b and 21k. These secondary moments M'-1 and M'-2 are actually applied to the annular body of the shell 21a so as to tend to bow the centroidal axis thereof upwardly in the middle, as indicated diagrammatically in FIGURE 3 by the dotted line MC. The dotted line MC which is also indicated in FIGURE 4 represents in exaggerated manner the shape of the centroidal axis of the roll which might result if the only forces applied to the shell were those of the moments M'-1 and M'-2. It will be appreciated, however, that a load (including the weight of the roll 21) is simultaneously being applied to the roll 21 tending to deflect the centroidal axis of the same downwardly along the line X-21 shown in FIGURE 4. The net result is a general cancellation between the two curves X-21 and MC, which results in a configuration Y-21 shown in solid lines in FIGURE 4 that is actually a substantially straight line conforming generally with the true center line C-21, with very slight peaks RA and RB at the quarter points.

As described in detail with mathematical calculations in my copending application Serial No. 102,571, filed April 12, 1961, an increase in the overall load 23 applied to the top of the roll 21 results not only in a "tendency" to increase the deflection of the load curve X-21, but also results in a "tendency" to increase the upward deflection curve MC resulting from the application of the counter-deflection moments, so the net result is little or no change in the final configuration Y-21 of the roll axis. As shown in FIGURE 4 the configuration Y-21 has greatly exaggerated peaks RA and RB, although in actual practice it will be appreciated that such peaks are only a negligible distance, if any, away from the true center line C-21 of the shell.

As here shown, in the case of the roll 21, the roll 21 may represent a king or bottom roll in a calender stack and this is the roll which will ordinarily be driven and is ordinarily not mounted for movement toward and away from the other rolls of the stack. For this reason the roll 21 is shown on fixed mountings 25a and 25b, although it will be appreciated that under appropriate circumstances the roll 21 could be suitably mounted on bearings 26a and 26b which could be moved or urged to a limited extent in one direction or another, in accordance with the mounting arrangement which will be described for the upper roll 22 hereinafter.

Also, it will be noted that the mounting arrangement shown for the roll 21 does permit suitable drive means therefor. Such drive means are here shown as comprising a suitable drive motor or other means, indicated diagrammatically at the box M, connected to a drive shaft 27 which extends through a bore 28 axially aligned through the mounting 25b and the cantileverly mounted shaft 24b. The drive shaft 27 is splined at its inner end 27a and is received in a splined socket 29a in an internal head member 29 that is secured to the inner end 21g of the turned-in mounting member 21c. The head 29 is spaced from the

bearings 26b and the inner end of the cantileverly mounted shaft 24b, so that the only mounting for the turned-in end 21c on the shaft element 21b is via the bearing assembly 26b.

Referring now to the top roll 22 shown in FIGURE 2, it will be seen that this roll under no load at all has the theoretical centroidal axis or center line C-22, although it will be appreciated that the roll 22 is subjected to a load across its entire width, which may consist solely of the weight of the roll itself or, as indicated diagrammatically herein, consists of the weight of the roll itself plus the load 23 (i.e. 23a, 23b, 23c, etc.) which is assumed to be uniformly applied across the top of the roll 22.

The shell 22 comprises a generally annularly cross sectioned functioning body portion 22a plus integral, allochiral turned-in end portions 22b and 22c, respectively. The shell 22 is here formed integrally with turned-in end portions 22b and 22c, for example, by conventional casting techniques for metal which result in the formation of such annularly cross sectioned "turned-in" (i.e. cantilevered) members 22b and 22c each encircling one of a pair of allochiral cantileverly mounted shaft elements 30a and 30b, which have mounted at their inner ends 31a and 31b suitable bearing assemblies 32a and 32b respectively which engage the inner extremities 22d and 22e of the cantileverly mounted turned-in ends 22b and 22c of the roll 22.

As will be appreciated, the effect of the load 23 applied to the roll 22 (assumed for the moment to be mounted in the total absence of any counteracting forces from the roll 21) is to tend to cause an overall downward deflection in the centroidal axis comparable to the line X-21 indicated diagrammatically in FIGURE 4. In like manner, the cantileverly mounted turned-in ends 22b and 22c will tend to create counter-deflection moments in the manner already described in connection with FIGURES 3 and 4 as they relate to the roll 21. The net result is thus a centroidal axis for the roll 22 which will have the general configuration Y-21 shown in FIGURE 4.

An additional feature here shown in connection with the roll 22 (which will be described in detail immediately hereafter) permits limited movement or at least urging of the bearing assemblies 32a and 32b toward and away from the nip N-2. It will thus be appreciated that if forces are applied to the bearings 32a and 32b tending to urge the same upwardly and away from the nip N-2, this may create what amounts to an increase in the load 23 applied to the top of the roll 22. It will be appreciated, of course, that if the load 23 is free to "ride" upwardly slightly as in the case of calender stack rolls, there may not be an overall increase in the "effect" of the load 23 against the top of the roll 22, and there would thus only be a slight decrease in the pressure applied by the roll 22 at the nip N-2 and against the bottom roll 21. If, however, the load 23 is effectively increased by the tendency to urge the bearings 32a and 32b upwardly, then the "self correcting" effect of the mounting for the roll 22 will become apparent, for the reason that the moment curve in the roll will increase to counteract the tendency for the increase in the deflection curve, as already described in connection with FIGURE 4.

On the other hand, if it is desired to increase the pressure on the nip N-2, the net result will be what is comparable to a substantial reversal in the curves indicated in FIGURE 4, for the reason that the immovable bottom roll 21 may then function as the means for applying a substantially uniform load upwardly against the bottom of the roll shell 22. This will result in a substantially more uniform pressure across the width of the nip N-2, even though the total pressure across the width of the nip N-2 is increased. It will be appreciated that if the bearings for the roll 22 were mounted exteriorly of the ends of the shell 22a and the increase in load just proposed were applied to these bearings in this exterior location, the net result would be a tendency to bend the outer ends of the axis of the roll downwardly and perhaps crush a paper web along the edges of the nip N-2

without being able to apply adequate additional nip pressure in the middle of the nip N-2.

As indicated in FIGURE 2, the preferred method of applying the "urging" force to the bearings 32a and 32b against the roll 22 in either direction comprises a pivotal mounting for each of the cantileverly mounted shafts 30a and 30b. As here shown, allochiral uprights 35a and 35b are mounted to fixed supports such as the blocks 25a and 25b and carry at their upper ends pivots 36a and 36b, which in turn receive the exterior ends of the cantileverly mounted shafts 30a and 30b for pivotal or swinging motion.

Although the element or arm (here indicated at 37a and 37b, respectively) for effecting the necessary limited movement or force application to the pivotally mounted shaft means 30a and 30b may extend in alignment or at an angle to the axis of the shaft elements 30a and 30b, the arms 37a and 37b, respectively, are here shown as integral with the shaft means 30a and 30b, respectively, and extending upwardly. Force applying means 38a and 38b are indicated diagrammatically in FIGURE 2 acting upon the arms 37a and 37b, respectively. It will be appreciated that the force applying means may comprise diaphragms or suitable fluid actuated motors for limited movement and/or force application to the arms 37a and 37b, all of which fluid motor devices are well known in the art and need not be described in further detail herein.

It will be appreciated also that the overall assembly for the cantilever mounting and the force application or limited movement of the shaft element 30a is separate and independent for corresponding mounting for the shaft element 30b. This permits an additional selective variation in the operation of the assembly.

As here shown, the bearing assemblies 26a, 26b and 32a, 32b are mounted at substantially the quarter points for the shells 21 and 22 which they carry. These bearing assemblies need not be mounted precisely at the quarter point in each case, although it has been found preferable that they be mounted approximately at the quarter point. In any event, it will be appreciated that the bearing assemblies should be mounted inwardly from the ends of the shell substantially 20 to 30% of the shell length in order to obtain the desired application of internal counter-deflection moments to the shell in response to the actual application of load to the shell and/or the "effective" application of load to the shell as a result of limited movement of and/or the application of forces to these bearing assemblies via the actuation of movable force applying means (e.g. 38a and 38b) to the cantileverly mounted shafts (e.g. 30a and 30b).

It will be understood that modifications and variations may be effected without departing from the spirit and scope of the novel concepts of the present invention.

As used herein, the terms "cantilevered" and "cantileverly" refer to a supporting arrangement for a member mounted on a given base element wherein one portion of such member is secured to and supported by such base element and another portion of such member extends away from such one portion and is not otherwise secured to or supported by such base element, i.e., as in the mounting of a conventional cantilever beam.

I claim as my invention.

1. In combination, a roll shell whose centroidal axis is subject to deflection in response to a load applied to said shell, separate and independent allochiral co-axially spaced shaft means in each end of the shell and rotatably mounting the shell, and allochiral co-axially spaced mounting means surrounding the shaft means and extending appreciably axially inwardly of each of the shell ends intermediate the shell and the shaft means, each such mounting means being secured rigidly to the shell solely at its outer end and mounted on the shaft means solely at its inner end appreciably axially inwardly of the shell ends, each said mounting means being radially spaced from the shaft means axially outwardly from its

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inner end mounted on the shaft means and being radially spaced from the shell axially inwardly from its outer end secured to the shell, thereby applying internal counter-deflection moments to said shell in response to the application of a load to said shell.

2. In combination, a roll shell whose centroidal axis is subject to deflection in response to a load applied to said shell, said shell having a substantial length-to-diameter ratio, separate and independent allochiral co-axially spaced shaft means in each end of the shell and radially spaced from the shell for rotatably mounting the shell, and allochiral co-axially spaced mounting means surrounding the shaft means and extending appreciably axially inwardly of each of the shell ends intermediate the shell and the shaft means, each such mounting means being secured rigidly to the shell solely at its outer end and mounted on the shaft means solely at its inner end appreciably axially inwardly of the shell ends, each said mounting means being radially spaced from the shaft means axially outwardly from its inner end mounted on the shaft means and being radially spaced from the shell axially inwardly from its outer end secured to the shell, thereby applying internal counter-deflection moments to said shell in response to the application of a load to said shell, said shell being supported from within solely on said shaft means via said mounting means.

3. In combination, a roll shell whose centroidal axis is subject to deflection in response to a load applied to said shell, separate and independent allochiral co-axially spaced shaft means in each end of the shell and radially spaced from the shell, co-axially spaced allochiral bearing means mounted on said shaft means appreciably axially inwardly of the shell ends for rotatably mounting the shell, separate and independent allochiral support means connected to each said shaft means outside the ends of the shell, and allochiral co-axially spaced mounting means surrounding the shaft means and extending appreciably axially inwardly of each of the shell ends intermediate the shell and the shaft means, each such mounting means being secured rigidly to the shell solely at its outer end and mounted on the shaft means via said bearing means solely at its inner end appreciably axially inwardly of the shell ends, each said mounting means being radially spaced from the shaft means axially outwardly from its inner end mounted on the shaft means and being radially spaced from the shell axially inwardly from its outer end secured to the shell, thereby applying internal counter-deflection moments to said shell in response to the application of a load to said shell.

4. In combination, a roll shell whose centroidal axis is subject to deflection in response to a load applied to said shell, separate and independent allochiral co-axially spaced shaft means in each end of the shell and radially spaced from the shell, allochiral movable means connected to said shaft means beyond the shell ends and accommodating limited relative movement between the allochiral shaft means, co-axially spaced allochiral bearing means each carried by one of said allochiral shaft means appreciably axially inwardly of the shell ends for rotatably mounting the shell, and allochiral co-axially spaced mounting means surrounding the shaft means and extending appreciably axially inwardly of each of the shell ends intermediate the shell and the shaft means, each such mounting means being secured rigidly to the shell solely at its outer end and mounted on the shaft means via said bearing means solely at its inner end appreciably axially inwardly of the shell ends, each said mounting means being radially spaced from the shaft means axially outwardly from its inner end mounted on the shaft means and being radially spaced from the shell axially inwardly from its outer end secured to the shell, thereby applying internal counter-deflection moments to said shell in response to the application of a load to said shell, said shell

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being supported from within solely on said shaft means via said mounting means and said bearing means.

5. In combination, a roll shell whose centroidal axis is subject to deflection in response to a load applied to said shell, separate and independent allochiral co-axially spaced shaft means in each end of the shell and radially spaced from the shell, allochiral support means swingably mounting said shaft means beyond the shell ends and accommodating limited relative movement between the allochiral shaft means, co-axially spaced allochiral bearing means each carried by one of said allochiral shaft means appreciably axially inwardly of the shell ends for rotatably mounting the shell, and allochiral co-axially spaced mounting means surrounding the shaft means and extending appreciably axially inwardly of each of the shell ends intermediate the shell and the shaft means, each such mounting means being secured rigidly to the shell solely at its outer end and mounted on the shaft means via said bearing means solely at its inner end appreciably axially inwardly of the shell ends, each said mounting means being radially spaced from the shaft means axially outwardly from its inner end mounted on the shaft means and being radially spaced from the shell axially inwardly from its outer end secured to the shell, thereby applying internal counter-deflection moments to said shell in response to the application of a load to said shell, said shell being supported from within solely on said shaft means via said mounting means and said bearing means.

6. In combination, a roll shell whose centroidal axis is subject to deflection in response to a load applied to said shell, a second roll in nip-defining relationship with said shell and applying a load to said shell tending to effect such deflection, separate and independent allochiral co-axially spaced shaft means in each end of the shell and radially spaced from the shell for rotatably mounting the shell, and allochiral co-axially spaced mounting means surrounding the shaft means and extending appreciably axially inwardly of each of the shell ends intermediate the shell and the shaft means, each such mounting means being secured rigidly to the shell solely at its outer end and mounted on the shaft means solely at its inner end appreciably axially inwardly of the shell ends, each said mounting means being radially spaced from the shaft means axially outwardly from its inner end mounted on the shaft means and being radially spaced from the shell axially inwardly from its outer end secured to the shell, thereby applying internal counter-deflection moments to said shell in response to the application of a load to said shell.

7. The combination of two rolls claimed in claim 6 wherein each such rolls is separately and independently mounted on separate and independent allochiral co-axially spaced shaft means in each end of the shell and radially spaced from the shell, co-axially spaced allochiral bearing means mounted on said shaft means appreciably axially inwardly of the shell ends for rotatably mounting the shell, separate and independent allochiral support means connected to each said shaft means outside the ends of the shell, and allochiral co-axially spaced mounting means surrounding the shaft means and extending appreciably axially inwardly of each of the shell ends intermediate the shell and the shaft means, each such mounting means being secured rigidly to the shell solely at its outer end and mounted on the shaft means via said bearing means solely at its inner end appreciably axially inwardly of the shell ends, each said mounting means being radially spaced from the shaft means axially outwardly from its inner end mounted on the shaft means and being radially spaced from the shell axially inwardly from its outer end secured to the shell, thereby applying internal counter-deflection moments to said shell in response to the application of a load to said shell.

8. The combination of two rolls claimed in claim 7 wherein means are provided on said support means for

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effecting limited relative movement between the allo-
chiral shaft means for at least one of said rolls.

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