United States Patent [19]

Lucas

[11] **3,848,304**

[45] **Nov. 19, 1974**

[54] **VARIABLE CURVATURE BEAM**

[75] Inventor: **Robert F. Lucas,** Janesville, Wis.

[73] Assignee: **Beloit Corporation,** Beloit, Wis.

[22] Filed: **Feb. 7, 1973**

[21] Appl. No.: **330,212**

[52] **U.S. Cl.** ..... **29/116 AD**

[51] **Int. Cl.** **B21b 13/02**

[58] **Field of Search** ..... 29/116 AD, 116 R; 26/63

[56] **References Cited**

UNITED STATES PATENTS

2,898,662	8/1959	Robertson	29/116 AD X
2,952,889	9/1960	Hanssen	26/63
3,094,771	6/1963	Robertson	29/116 AD
3,099,072	7/1963	Robertson et al	29/116 AD
3,500,524	3/1970	Jagminas	29/116 R

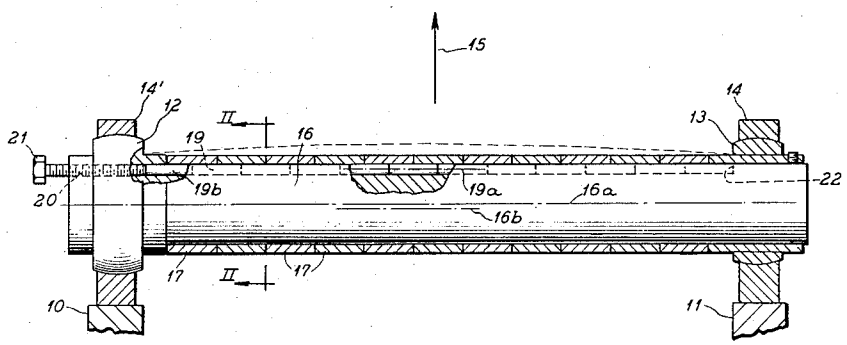
Primary Examiner—Alfred R. Guest

Attorney, Agent, or Firm—Hill, Gross, Simpson, Van Santen, Steadman, Chiara & Simpson

[57] **ABSTRACT**

A variable curvature roll having a roll body formed of a plurality of independently rotatable uniform diameter rings rotatably mounted on a resiliently flexible structural axle extending through said rings with the axle having a slot along one side and compression means such as separate pins extending axially along in the slot with pressure members on the ends of the axle pressing the end of the row of pins to transmit a force from the pins to the ends of the axle to bow the structure.

7 Claims, 3 Drawing Figures



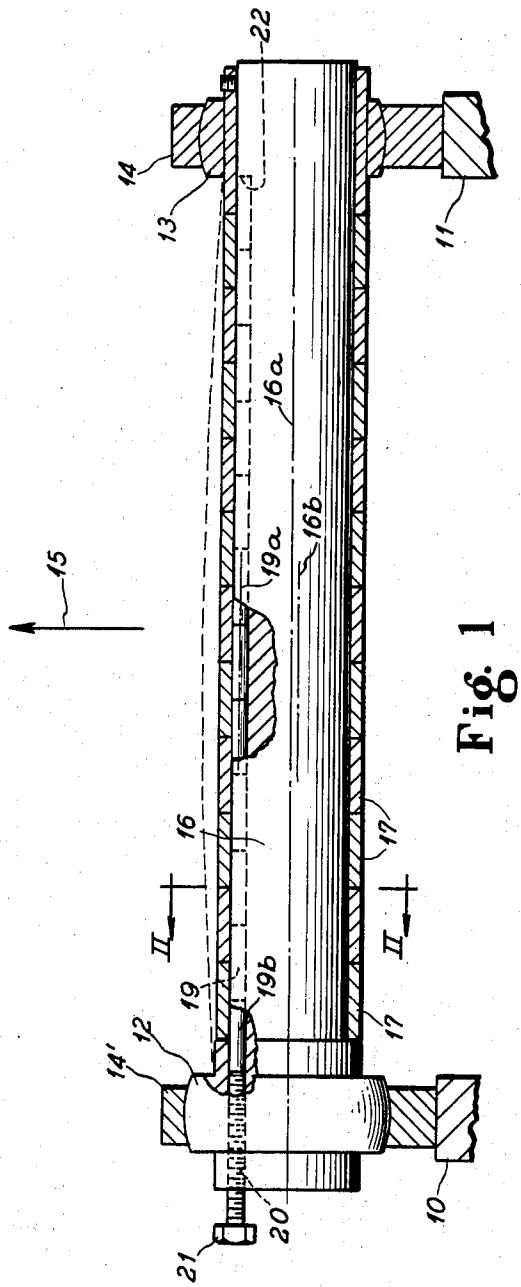


Fig. 1

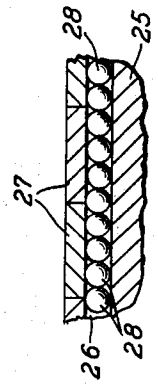


Fig. 3

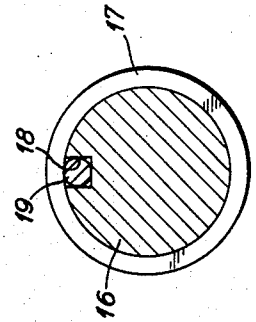


Fig. 2

VARIABLE CURVATURE BEAM

BACKGROUND OF THE INVENTION

The present invention relates to improvements in rolls having longitudinal curvature which can be controllably varied in accordance with requirements of the mechanism in which the roll is used.

More particularly, the invention relates to a variable curvature roll of the type that may be used in a paper making machine or paper handling machine wherein the roll supports a continuously travelling web of sheet material or wire or felt or a similar web. While the features of the invention are particularly useful in the environment of a paper making or paper handling machine, it will be appreciated that they may be used in other environments. Longitudinally curved rolls of this general type are employed in various arts for laterally expanding flexible sheet materials or webs of cloth, paper, plastic films, foils, wire screening and the like to remove wrinkles and insure that a sheet or web leaving the curved roll will approximate a predetermined width and be void of wrinkles. Also, longitudinally curved rolls may be used for contracting such sheets or webs or for correcting the bow or weft or filler elements of woven webs. For this type of roll it is important that the curvature be adjustable to attain the desired effect on the web. It is also important that with the change in curvature the radius remain constant along the length of the roll and not varied so that different effects occur at different locations across the web width.

It is accordingly an object of the present invention to provide a longitudinally curved roll wherein the curvature can be varied by a compression element which extends axially along the length of the roll and where the compression element does not contribute to the section modulus of the roll.

Another object of the invention is to provide an improved variable curvature roll which has an axle or beam extending through the center that can be bent along its length to a uniform radius of curvature by the application of a compression force thereto and the means which applies the compression force extends parallel to the axle and is located a constant distance from the axle center at all axial locations.

Other objects, advantages and features will become more apparent, as will equivalent structures which are intended to be covered hereby, with the teaching of the principles of the invention in connection with the disclosure of the preferred embodiments in the specification, claims, and drawings in which:

DESCRIPTION OF THE DRAWINGS

FIG. **1** is an elevational view of a variable curvature roll constructed and operating in accordance with the principles of the present invention with portions shown in section;

FIG. **2** is a vertical sectional view taken substantially along line II—II of FIG. **1**; and

FIG. **3** is a fragmentary sectional view of a portion of the roll of FIG. **1** showing a modified form.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As illustrated in FIG. **1**, a variable curvature roll is provided capable of supporting a load such as a travelling web on its upper surface. The roll will be bowed upwardly in the direction of the arrow **15** a controlled amount. As an example of curvature used in a paper machine, the roll may be bowed to have a radius in the range of 10,000 to 40,000 inch radius of curvature.

At the ends of the roll it is mounted on frame pieces **10** and **11.** On the frame pieces are mounted spherical journals **14** to carry the roll ends and permit bending without introducing a restraining force. The roll is free to change in curvature and the journals are so mounted so that as the length of the roll changes slightly with change in curvature, the journals permit free axial movement of the ends.

Extending through the center of the roll is a flexible non-rotatable beam or axle **16.** The axle has spherical bearings **12** and **13** at its ends supported in the journals **14.**

Along the upper or working side of the axle an elongated continuous axially extending slot **18** is milled. Positioned in this slot is a compression means shown in FIGS. **1** and **2** in the form of a plurality of free pusher pins. The pins are positioned in end-to-end engagement and are short in length so that as the axle bends their effective center line **19***a* remains a constant distance at all locations from the center line **16***a* of the axle.

Because of the slot **18** being cut in the axle, its center of gravity is shifted as shown at **16***b*.

Surrounding the axle is a roll body shown in the form of a plurality of separate axially adjacent rings freely rotatable on the axle which has a cylindrical outer surface. The rings are of uniform diameter and present a continuous smooth surface to the web carried thereon. The rings are suitably lubricated and will rotate due to surface contact of the web which normally would be partially wrapped over an arc of the rings.

For bending the axle and roll over a uniform curvature, a bending force is applied to the ends of the axle by placing the compression pins **19** under compression and transmitting this compression to the axle. For this purpose the pins at one end engage a shoulder **22** on the axle and at the other end an actuating bolt **21** is threaded into an opening **20** in the axle with the bolt engaging the endmost pin **19***b*. The rotational adjustment of the bolt **21** will vary the compression on the pins **19** and hence the curvature of the axle **16.** The effective moment arm against which the force of the bolt **21** acts is the radial distance between the center of gravity **16***b* of the axle and the center **19***a* of the pins **19.** The pins will be held freely in the slot **18** by the rings and are fitted in the slots sufficiently loosely so that they do not introduce any bending stress as the axle is bent and therefore do not change the section modulus of the axle. Similarly, the rings **17** are sufficiently loose so that they do not bind or affect the section modulus of the axle. The pins, as the axle is bent, remain a constant distance from the center line of the axle at all positions along the length thereof so that the effective change in axial compression along the pins is the same at any curvature of the beam and does not change with the amount of curvature. In devices heretofore used, such as constructions embodying tension rods and other arrangements, the distance between the rod and the center of the roll was changed and/or the rod introduced a radial force by engagement with the surface of the roll or central axle.

The pins of the arrangement of FIGS. **1** and **2** may have radially square ends but preferably are rounded at their ends so that the tips of the rounded ends are in en-

gagement with each other and with this arrangement either spherical pins or pins of rectangular or other shape of cross section may be used.

FIG. 3 illustrates an alternate form of compression means in the form of a plurality of spherical balls. These may be provided by filling the slot with a commercially available ball bearings of uniform size. In the arrangement of FIG. 3 the balls are relatively freely positioned in the slot so as not to introduce radial or axial restrictive forces for various amounts of bowing in the axlw.

As above stated, with the arrangements illustrated the compression means does not contribute to the section modulus of the beam and the compression force is parallel to the beam axis at all points along the curve. In other words, the compression member is within the silhouette of the beam section modulus.

The roll rings serve dual functions of providing the continuous cylindrical outer surface of the roll and their inner surfaces provide a bearing surface for mounting the rings and retainers for holding the compression members in the slot. The rings do not contribute to the section modulus of the beam and are not needed to attain the beam curvature effects. Their design can be optimized for the purposes required and it is not necessary to compromise their design to obtain the bending effect necessary.

I claim as my invention:

1. An adjustable curvature roll structure comprising in combination:

a roll body having sufficient flexibility over its length to be bowed about its axis;

a resiliently flexible structural axle upon which said body is rotatably mounted with said axle adapted to be supportably mounted at its end; and

a compression means extending axially along the axle offset from the axis thereof connected to the axle at each end,

said compression means having sufficient flexibility so that it provides no increase in section modulus to the axle and being in the form of a plurality of short separated units in axial compression contact with each other.

2. An adjustable curvature roll structure constructed in accordance with claim **1**:

in which said body is in the form of separate independently rotatable rings rotatably supported on the axle.

3. An adjustable curvature roll structure constructed in accordance with claim **1**:

in which said axle has a continuous axially extending slot along one side with said compression means located in the slot.

4. An adjustable curvature roll structure constructed in accordance with claim **3**:

in which said compression means is in the form of a plurality of spherical balls positioned in said slot and in compression engagement with adjacent balls.

5. An adjustable curvature roll structure constructed in accordance with claim **3**:

wherein said compression means is in the form of a series of axially aligned pins positioned in said slot and in end-to-end compression relationship with adjacent ends.

6. An adjustable curvature roll structure constructed in accordance with claim **1**:

in which said compression means is engaged by a threaded members mounted on the end of the axle for transmitting the force of the compression means to the axle.

7. An adjustable curvature roll structure constructed in accordance with claim **1**:

in which said roll body is in the form of a plurality of uniform diameter axially adjacent independently rotatable rings and wherein said axle has a slot along one side with the compression means located within the slot and said rings retain the compression means within said slot.

* * * * *

PO-1050
(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,848,304 Dated November 19, 1974

Inventor(s) Robert G. Lucas

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Please correct the heading of the above-identified patent by changing the middle initial of the inventor from "F." to --G.-- so that line 75 reads as follows:

--[75] Inventor: Robert G. Lucas, Janesville, Wis.--

Signed and sealed this 17th day of June 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks