Dec. 1, 1970 T. A. HELMINEN 3,543,365

WEB STRETCHING AND SHRINKING DEVICE

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Fig. 1

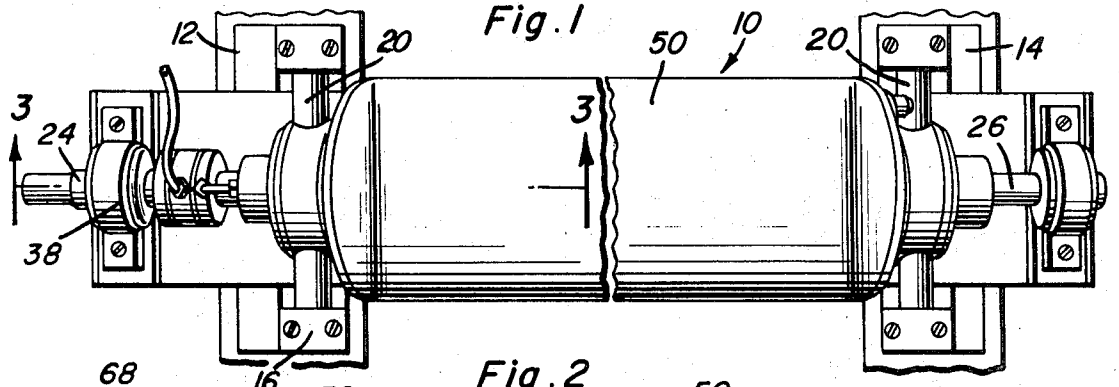


Fig. 2

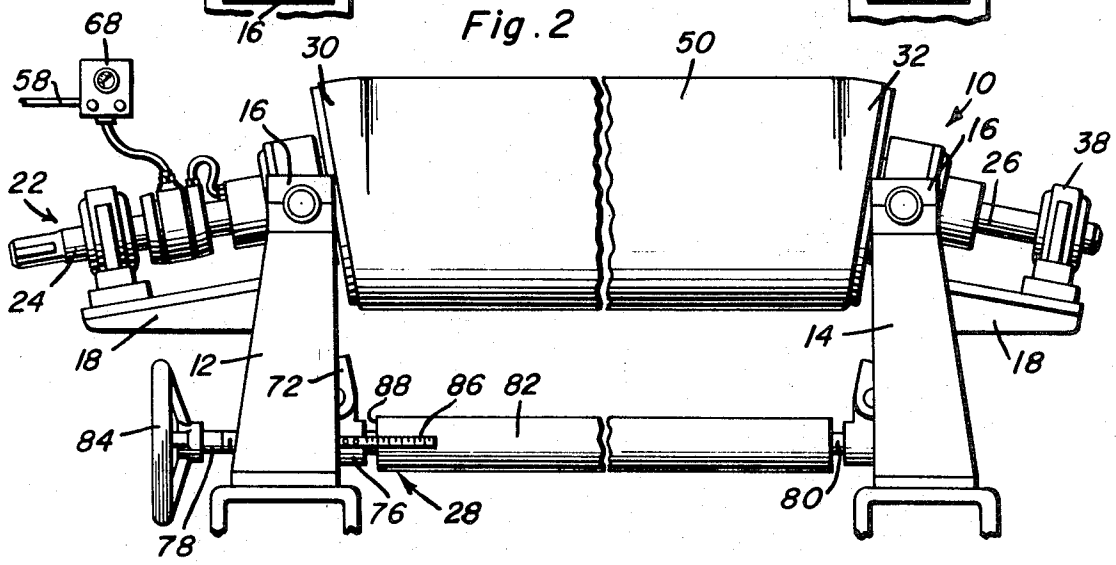


Fig. 4

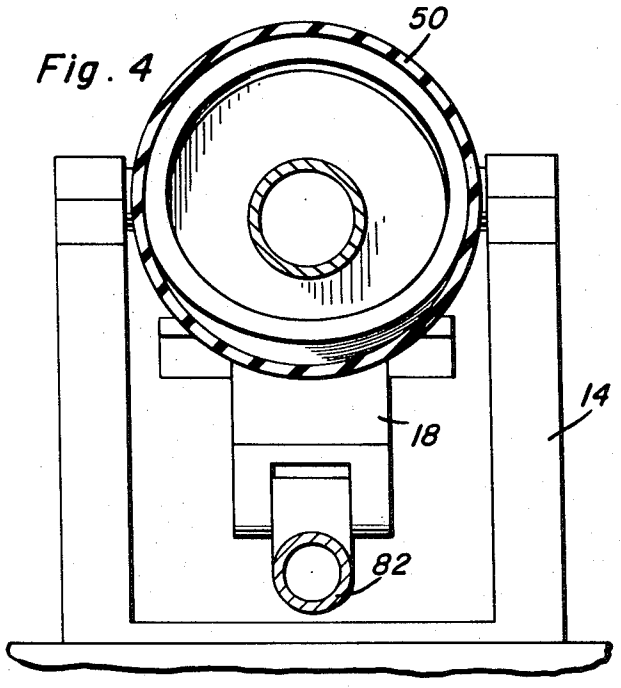
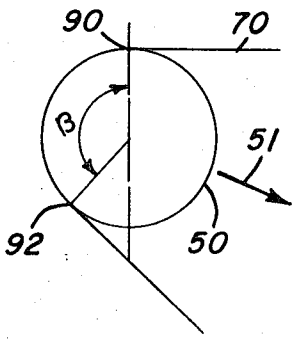


Fig. 6



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Fig. 7

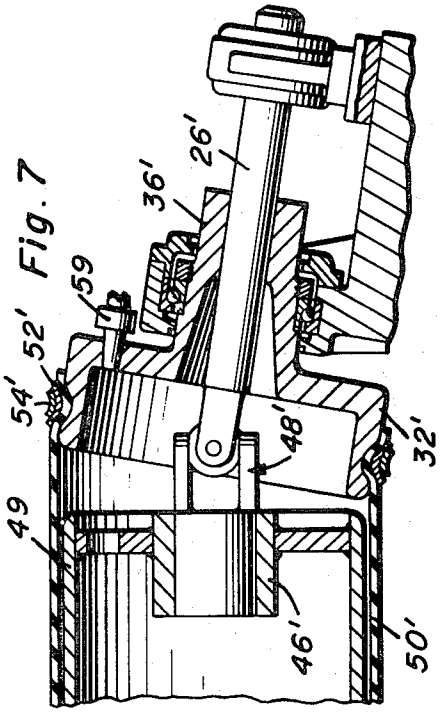


Fig. 5

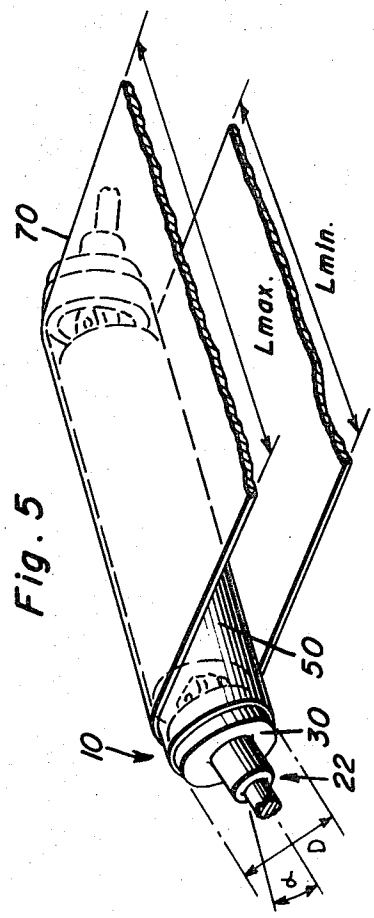
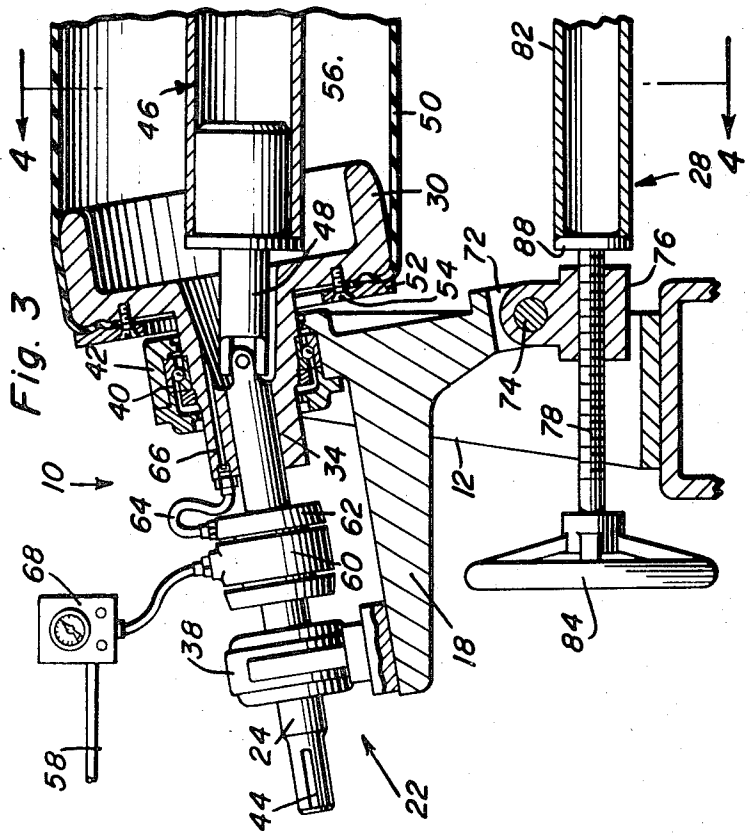


Fig. 3



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WEB STRETCHING AND SHRINKING DEVICE

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U.S. Cl. 29—113 10 Claims

ABSTRACT OF THE DISCLOSURE

Adjustable roller device for shrinking or stretching a continuously moving web in width during the manufacture of paper. A web of paper while in a semiplastic state is passed in contact with a circumferential portion of the roller undergoing a change in axial length on its peripheral contact surfaces to correspondingly change the width of the web.

BACKGROUND OF THE INVENTION

This invention relates to the expansion or contraction of a continuously moving web to a desired width during the manufacture of paper.

It is common practice to either shrink or stretch a paper web while in a semiplastic state by passing the web in contact with one or more roller devices in order to effect the desired dimensional change in the web while in contact with the roller devices.

In some roller devices, the web contacting surface has been formed with a curvature in order to effect either shrinking or stretching of the web. Aside from the severe limiation imposed upon the dimensional change possible with such roller devices, the use of the curved surface technique has resulted in non-uniform elongation or shrinkage of the web. Further because of the curvature involved, the use of a plurality of rollers in order to progressively shrink or expand the web was not possible.

Another technique utilized in effecting shrinkage or stretching of a web, has been to progressively pass the web in contact with rollers of axially increasing or decreasing length. This method however, involves lateral surface friction and requires shut-down in order to affect any adjustment.

The present invention avoids the drawbacks and disadvantages associated with prior art techniques aforementioned and is therefore capable of effecting shrinkage or stretching of a web without use of any curved contact surface so that one or more roller devices may be utilized. Also, adjustment in the amount of dimensional change may be effected during operation without requiring any shut-down of the paper manufacturing equipment.

SUMMARY OF THE INVENTION

In accordance with the present invention, a roller device is utilized to effect shrinkage or laterial elongation of a continuously moving web by contact with a circumferential portion of the roller device undergoing a variation in axial length so as to correspondingly vary the lateral dimension or width of the web in contact therewith.

The roller device of the present invention is made up of relatively rigid axial end portions which are interconnected by a tubular portion made of an elastically flexible material enclosing a chamber that is pressurized by a suitable fluid such as air in order to maintain the web substantially flat as it approaches or departs from the roller surface.

The roller device also features facilities for adjusting the angular position of the rigid end portions aforementioned in order to change the amount of web elongation while the web is moving at high speed. The amount of

shrinkage or lateral elongation of the web may also be controlled in accordance with the degree of wrap of the web about the tubular portion of the roller and the number of roller devices about which the web is wrapped.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

FIG. 1 is a top plan view of a web stretching or shrinking roller device constructed in accordance with the present invention.

FIG. 2 is a side elevational view of the roller device shown in FIG. 1.

FIG. 3 is an enlarged partial sectional view through the roller device taken substantially through a plane indicated by section line 3—3 of FIG. 1.

FIG. 4 is a transverse sectional view taken substantially through a plane indicated by section line 4—4 in FIG. 3.

FIG. 5 is a perspective view of a portion of the roller device with a web wrapped around a portion thereof.

FIG. 6 is a diagrammmatic transverse sectional view through the roller device showing the angle of wrap.

FIG. 7 is a partial longitudinal sectional view through a modified form of roller device.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings in detail, FIGS. 1 and 2 illustrate a roller device generally denoted by reference numeral **10** adapted to be mounted in proper position in a paper manufacturing process line so as to receive the web of paper in a semiplastic state. A stationary support frame is therefore provided for the roller device including a pair of spaced frame supports **12** and **14**, each of which mounts spaced bearing assemblies **16** between which a pivotal support member **18** is positioned in an adjusted angular position about an axis extending through pivot shafts **20** that extend laterally from the support member **18** for journalling by the bearing assemblies **16**. The support members **18** rotatably mount a roller shaft assembly generally referred to by reference numeral **22** including end shaft sections **24** and **26** on opposite axial sides of a spacer shaft section **46**. Thus, separate axes extend through the shaft sections **24** and **26** which intersect the general rotational axis of the roller device at intersections spaced from the pivotal axes extending through the pivot shafts **20**. The angular position of the support members **18** about the pivotal axes are adjusted in one form of the invention by means of an adjustment assembly generally referred to by reference numeral **28** that interconnects the support members **18** as will be hereafter explained.

Referring now to FIG. 3 in particular, it will be observed that the roller device includes a pair of relatively rigid end portions **30** and **32** respectively provided with tubular extensions **34** and **36** to which the shaft sections **24** and **26** are keyed. Each support member **18** rotatably mounts a roller end portion and associated shaft section between a bearing assembly **38** through which the shaft extension extends and a bearing assembly **40** mounted on the tubular extension of the roller end portion within the tubular housing portion **42** of the support member **18**. One of the shaft sections **24** may be provided with a splined end section **44** to which a suitable prime mover (not shown) may be drivingly connected if the roller device is to be independently powered. Where a rela-

tively strong web is involved, drive may be imparted to the roller device from the web itself.

The rotational axis for the roller device extends through the spacer shaft section **46** that includes universal joint assemblies **48** at opposite axial ends interconnected with the shaft sections **24** and **26** as aforementioned. The axes of the shaft sections and spacer shaft intersect at the axes of the pivot shafts **20** for rotation of the tubular portion **50** about the rotational axis of the roller device perpendicular to the direction in which the web is travelling. The tubular portion **50** is made of an elastically flexible material such as rubber, the axial ends of which are anchored to the roller end portions **30** and **32** by anchor plates **52** and fasteners **54**.

In the modified form shown in FIG. 7, the tubular portion **50'** is secured to the end portions by tie bands **52'** aligned with annular grooves **54'** formed in the end portions very close to end planes between which the tubular portion freely extends. The tubular portion **50'** is prevented from collapsing radially inwardly by means of a lubricant bearing film slidably spacing the tubular portion from the radially outer cylindrical surface of a rigid tubular portion **49** associated with the spacer shaft assembly **46'**. Also, in this form of the invention, the angular relationship between the shaft sections and the spacer shaft assembly is fixed.

The tubular portion **50** of the roller device encloses a pressure sealed chamber **56** to which fluid under pressure is supplied from any suitable source (not shown). A conduit **58** connects the source to the chamber **56** through a stationary manifold device **60** mounted in sealed relation on the shaft section on either axial side of the manifold device **60**. A flexible conduit **64** interconnects one of the glands **62** with the tubular extension **34** of the roller end portion **30** so that fluid may flow through a bore **66** formed therein into the fluid chamber **56** provided with a pressure relief valve **59** on the end portion **32**. The pressure within the chamber **56** may be monitored by a fluid pressure gauge **68** which interconnects the conduit **58** with the manifold device **60**. The level of pressure maintained within the chamber **56** may be set to support a web **70**, diagrammatically shown in FIG. 5, in a substantial flat condition as it approaches or departs from the roller device about which it is grapped. Thus, the major intermediate portion of the roller **50** is maintained substantially cylindrical as shown in FIGS. 5 and 6 while in contact with the web **70**. Bending of the tubular portion by the web tension, producing a resultant bending force **51** as shown, would be prevented by the supporting action of the bearing film on the rigid portion **49** of the spacer shaft assembly in FIG. 7 form of the invention. The diameter of portion **49** is therefore selected to accommodate the smallest diameter assumed by the tubular portion when the end portions **30'** and **32'** are angularly adjusted to extreme positions.

In the installation shown in FIGS. 1–3, each of the support members **18** is provided with a lower leg portion **72** pivotally connected by a pin **74** to an internally threaded nut member **76**. The nut members **76** receive externally threaded screw members **78** and **80** which are interconnected by a connector shaft **82**. The screw members **78** and **80** are threaded in opposite directions so that when the adjustment assembly **28** is rotated by means of the adjustment hand wheel **84** connected to the end of screw member **78**, the nut members **76** will be axially displaced in opposite directions to angularly displace the support members **18** by equal amounts in opposite directions about the pivotal axes extending through the pivot shafts **20**. The support members **18** and the roller end portions **30** and **32** may thereby be adjusted to positions indicated on a calibrated scale element **86** secured to and extending axially from one of the nut members **76** as shown in FIG. 2 in overlapping relation to the connector shaft **82**. The spacing between the index edge **88** of the connector shaft and the nut members **76** therefore gauges the amount of dimensional change to be effected by the roller device.

From the foregoing description, it will be appreciated that the amount of shrinkage or elongation will depend upon the angular position of the roller end portions **30** and **32** or the support members **18** on which they are rotatably mounted about the separate rotational axes extending through the shaft section **24** and **26** of the drive assembly, this angular position being reflected by the angle α as shown in FIG. 5 between the separate axes of the roller end portions and the rotational axis of the roller extending through the connecting shaft assembly **46**. It will be apparent therefore, that the axial length of the tubular portion **50** will vary from a minimum value to a maximum value between diametrically opposite locations by an amount depending on the angle α. Since the web **70** is in contact with the peripheral outer surface of the tubular portion **50** of the roller device, it will undergo a dimensional change corresponding to this change in axial length of the tubular portion **50** along its circumference as the roller device is rotated. The amount of dimensional change imparted to the web **70** will also depend upon the angle of wrap β as diagrammed in FIG. 6 between the lines of tangency **90** and **92** that extend along the axial length of the tubular portion **50**. The web **70** approaches or departs from these lines of tangency **90** and **92** which are substantially straight by accordingly regulating the internal pressure of the chamber **56**. Thus, the web will undergo a change in width ϵ equal to the difference between L_{max} and L_{min} as diagrammed in FIG. 5 in accordance with the equation, $e=D$, sin α $(1-\cos \beta)$, which may be readily derived from the geometry involved. Thus, the scale element **86** shown in FIG. 2 may be appropriately calibrated so that the operator may effect a change in the desired elongation or shrinkage of the web during operation. Further, since the web approaches and departs from the roller device in a flat condition in the described installation, a plurality of such variable roller devices may be similarly utilized with fixed roller devices in order to progressively elongate or shrink the web. It is also possible to control the variable roller device so as to angularly adjust the position of one of the end shaft sections relative to the other in response to lateral shift of the web in order to compensate for such lateral shift. In such case the roller device acts as a web guide. Several roller devices as described may also be positioned between fixed guide rollers for holding the web in a flat condition as it is being progressively changed in width. The change in web width could of course also be varied by increasing the internal pressure of the chamber **56** to produce a surface curvature along the roller portion **50**.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

1. Apparatus for dimensionally changing a continuously moving web of material in a direction transverse to the direction of travel of said web comprising a roller having relatively rigid end portions interconnected by a relatively flexible tubular portion, means rotatably mounting said end portions about separate axes for circumferential variation in axial length of the tubular portion in response to rotation of the roller, spacer means interconnecting said end portions in axially fixed relation to each other establishing a rotational axis for the roller perpendicular to said direction of travel, and fluid pressure means connected to the roller for supporting the web in contact with the tubular portion.

2. The combination of claim **1** including adjustment means operatively connected to the rotational mounting

means for varying the angle between said separate axes of the end portions and the rotational axis of the roller during rotation thereof.

3. The combination of claim 2 wherein said spacer means includes a shaft extending through the tubular portion having opposite ends pivotally connected to shaft sections rotatably mounted by the rotational mounting means about the separate axes of the end portions.

4. The combination of claim 3 wherein said rotational mounting means comprises a support frame, a pair of support members pivotally mounted by the support frame, and bearing means carried by the support members rotatably mounting the end portions about said separate axes, said support members being interconnected by the adjustment means in predetermined angular positions relative to the rotational axis.

5. The combination of claim 1 wherein said rotational mounting means comprises a support frame, a pair of support members pivotally mounted by the support frame and bearing means carried by the support members rotatably mounting the end portions about said separate axes.

6. The combination of claim 5 wherein said spacer means includes a pair of shaft sections rotatably mounted by the rotational mounting means for the end portions of the roller, and a spacer shaft extending through the tubular portion having opposite ends pivotally connected to the shaft sections.

7. The combination of claim 1 wherein said spacer means includes a pair of shaft sections rotatably mounted by the rotational mounting means for the end portions of the roller, and a spacer section extending through the tubular portion having opposite ends pivotally connected to the shaft sections and an intermediate rigid surface supporting a bearing film preventing collapse of the tubular portion.

8. Apparatus for dimensionally changing a continuously moving web of material in a direction transverse to the direction of travel of said web comprising a roller having relatively rigid end portions interconnected by a relatively flexible portion, means rotatably mounting the end portions in response to rotation of the roller, means for passing the web in contact with a contact surface of the flexible portion while undergoing said variation in axial length, and support means for maintaining the contact surface of the flexible portion substantially cylindrical while in contact with the web.

9. The combination of claim 8 wherein said flexible portion of the roller is made of an imperforate, elastic material.

10. The combination of claim 8 including spacer means interconnecting the end portions of the roller for rotation about a rotational axis parallel to the axis of said cylindrical contact surface.

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U.S. Cl. X.R.

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