

Nov. 22, 1960

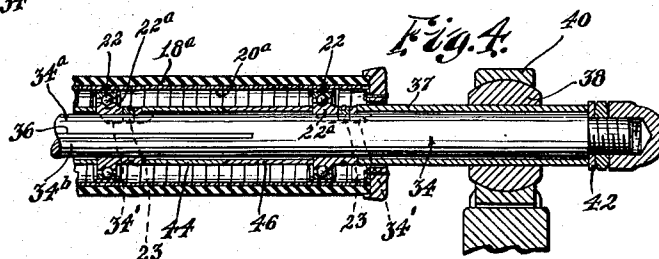
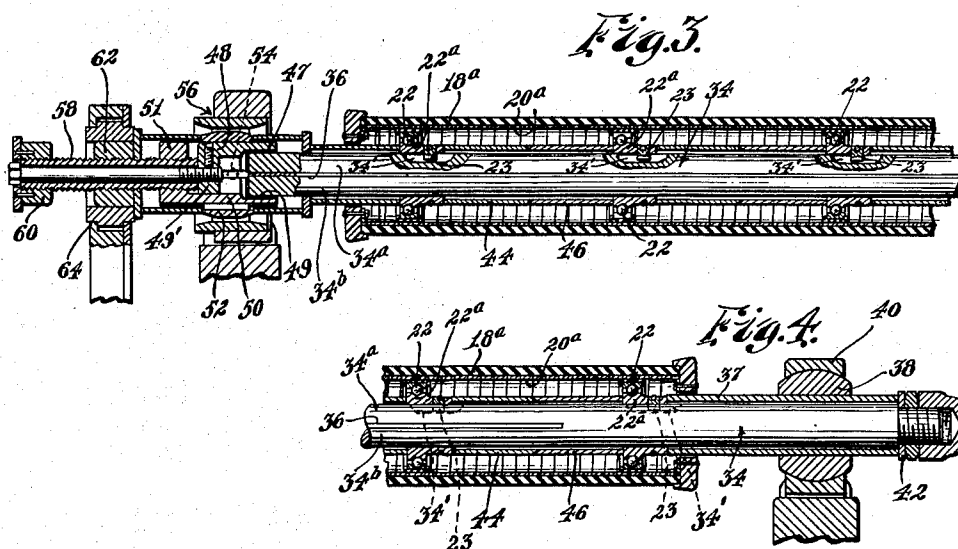
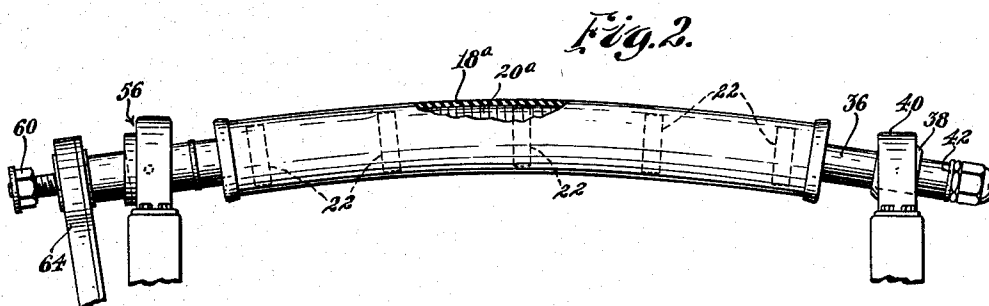
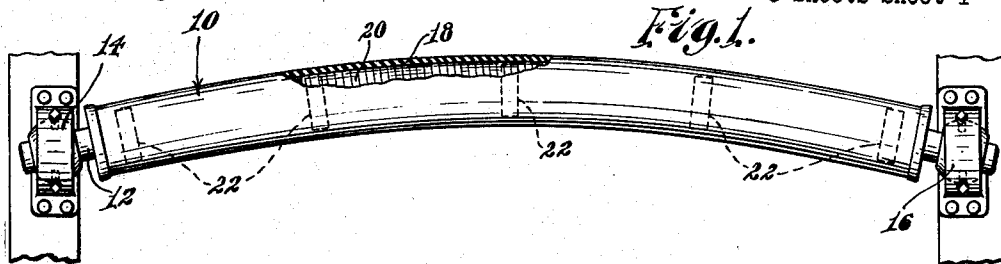
J. D. ROBERTSON ET AL

2,960,749

EXPANDING AND CONTRACTING ROLLS

Filed Aug. 20, 1958

3 Sheets-Sheet 1



Inventors
John D. Robertson
John N. Basic
By John H. McKenna Attorney

Nov. 22, 1960

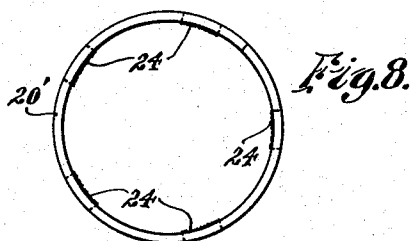
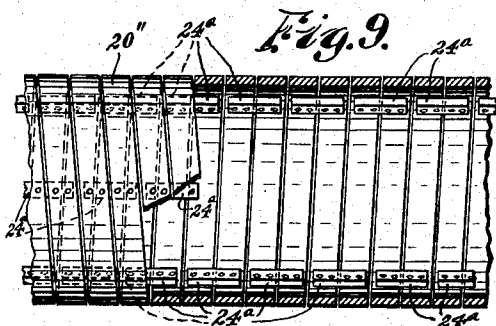
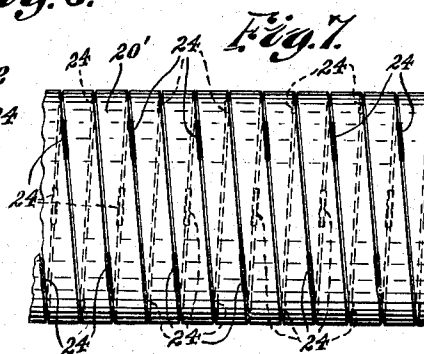
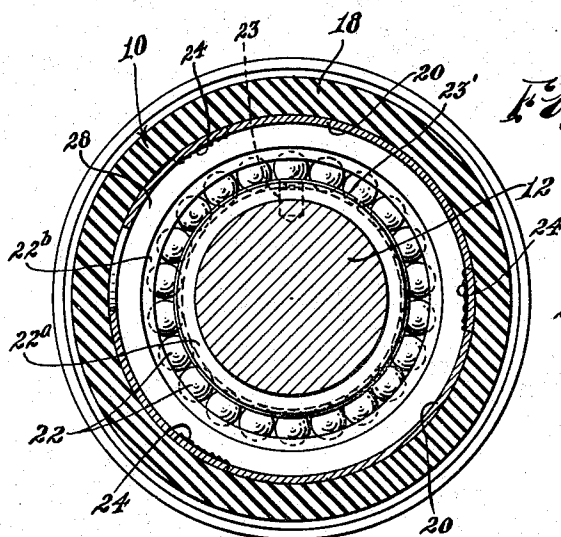
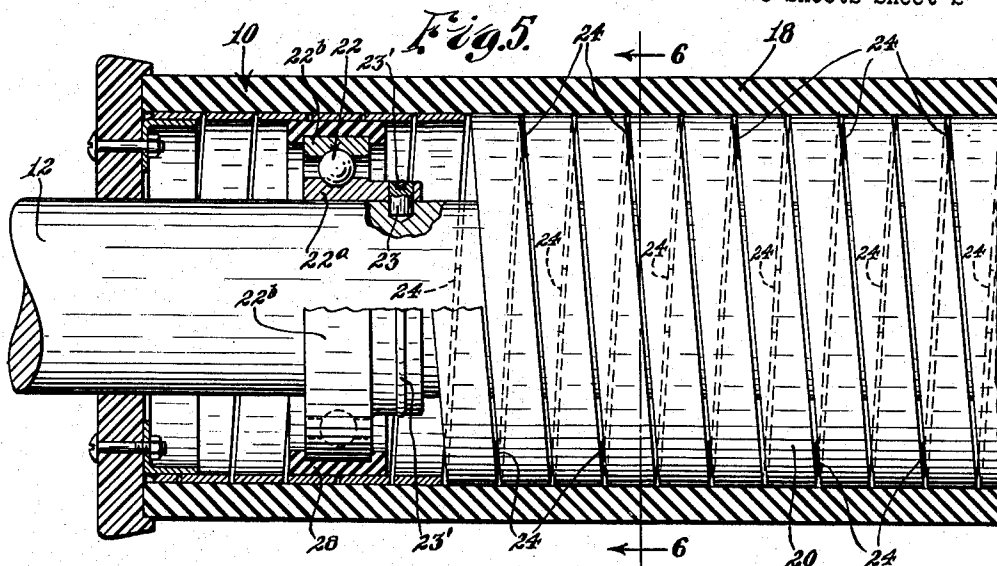
J. D. ROBERTSON ET AL

2,960,749

EXPANDING AND CONTRACTING ROLLS

Filed Aug. 20, 1958

3 Sheets-Sheet 2



Inventors
John D. Robertson
John N. Basic
By John H. Hanna Attorney.

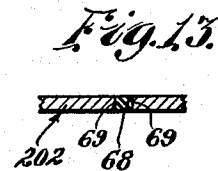
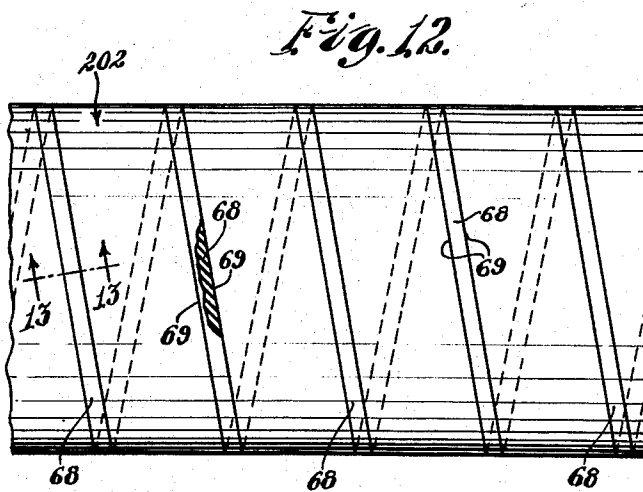
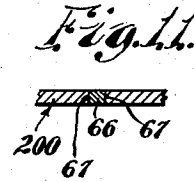
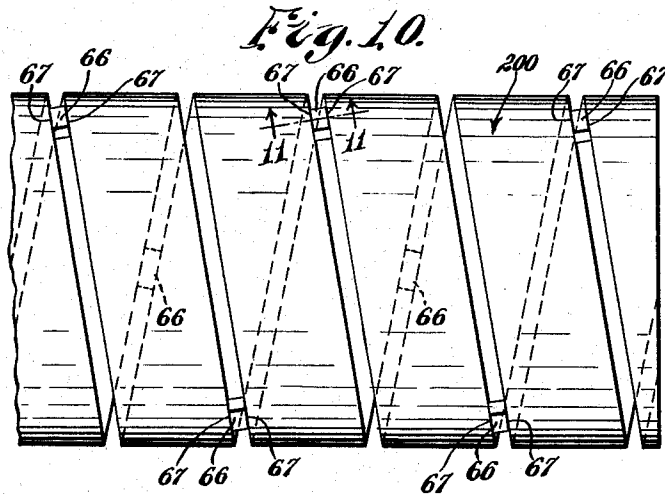
Nov. 22, 1960

J. D. ROBERTSON ET AL
EXPANDING AND CONTRACTING ROLLS

2,960,749

Filed Aug. 20, 1958

3 Sheets-Sheet 3



Inventors
John D. Robertson
John N. Basic
By John H. McNamee Attorney.

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2,960,749

EXPANDING AND CONTRACTING ROLLS

John D. Robertson, Taunton, and John N. Basic, Raynham, Mass., assignors to Mount Hope Machinery Company, Taunton, Mass., a corporation of Massachusetts

Filed Aug. 20, 1958, Ser. No. 756,240

5 Claims. (Cl. 26—63)

This invention relates to improvements in expanding and contracting rolls of the general variety having longitudinal curvature which may be a fixed predetermined curvature, or which may be an adjustable curvature whereby the expanding or contracting effect of the roll on engaged sheet material may be increased or decreased by adjustment of the roll curvature. Such rolls ordinarily have a surface sleeve of resiliently flexible material suitably supported for rotation on a longitudinally curved axle, and the present invention relates more particularly to an improved supporting structure for the resiliently flexible surface sleeves.

Longitudinally curved rolls of the general type to which the invention relates 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 to insure that a sheet or web leaving a curved roll will approximate a predetermined width. Also, longitudinally curved rolls may be used for contracting such sheets and webs, and for correcting bow of weft or filler elements of woven webs.

It is among the objects of the present invention to provide a longitudinally curved roll whose resiliently flexible surface sleeve is mounted on a helically wound strip-form member which is rotatably supported on a longitudinally curved axle which may be suitably mounted in a fixed position by means of supporting clamps engaging opposite end portions of the axle. A feature is that the helically wound strip-form member is suitably stabilized by means introduced between adjacent edges of adjacent convolutions of the member, or by means extending from one to the other of adjacent convolutions across the space therebetween, whereby the helix acquires a desired stability and yet has a required substantial amount of resilient flexibility which enables the helix to rotate on the longitudinally curved axle, with bearings on the axle at relatively widely spaced locations therealong.

Another object of the invention is to provide a longitudinally curved roll wherein a helix of strip-form material may have adjacent convolutions welded or otherwise secured together only at relatively widely spaced locations around the helix, whereby the helix is suitably stabilized while retaining a substantial amount of its inherent resilient flexibility, the helix being rotatably supported at relatively widely spaced locations along a longitudinally curved axle, and a resiliently flexible surface sleeve being mounted on the helix and extending from end to end thereof for rotation therewith about the said longitudinally curved axle.

Yet another object of the invention is to provide a longitudinally curved roll having a longitudinally curved axle whose curvature is adjustable, and having a flexibly resilient helix of strip-form material rotatable on the curved axle and stabilized by relatively widely spaced welds at adjacent edges of adjacent convolutions whereby the stabilized helix retains a substantial amount of its

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original resilient flexibility for rotating on the said curved axle, the said helix having a resiliently flexible surface sleeve mounted thereon and rotatable therewith.

A further object of the invention is to provide a longitudinally curved roll wherein a helix of strip-form material may be stabilized by a substantial body of elastic material, such as rubber, or the like, intervening between and secured to adjacent edges of adjacent convolutions of the helix throughout the length of the helix, or throughout substantial portions of the extent of said adjacent edges at uniformly spaced locations along the helix, there being a resiliently flexible surface sleeve mounted on the helix, and relatively widely spaced bearing means supporting the helix for rotation on a longitudinally curved axle.

It is, moreover, our purpose and object generally to improve the structure and effectiveness of longitudinally curved rolls both of the fixed curvature and adjustable curvature varieties, and more especially to provide an improved interior roll structure, rotatable on a curved axle for supporting a resiliently flexible surface sleeve which rotates about the said curved axle.

In the accompanying drawings:

Fig. 1 is an elevational view, with a portion broken away, showing a mounted longitudinally curved roll having a fixed curvature and embodying features of the invention;

Fig. 2 is a similar view of an adjustable curvature roll embodying features of the invention;

Fig. 3 is a cross-sectional view through one end portion of the roll of Fig. 2, on a larger scale;

Fig. 4 is a cross-sectional view through the other end portion of the roll of Fig. 2, on the scale of Fig. 3;

Fig. 5 is a cross-sectional view of an end portion of the roll of Fig. 1, with portions of the helical strip-form member in elevation on a scale substantially larger than that of Fig. 1;

Fig. 6 is a cross-sectional view on line 6—6 of Fig. 5;

Fig. 7 is an elevational view of a fragment of a modified form of helical strip-form member, on a scale substantially smaller than that of Figs. 5 and 6;

Fig. 8 is an end elevation of the helical strip-form member of Fig. 7;

Fig. 9 is an elevational view, with portions broken away, showing another modified form of helical strip-form member;

Fig. 10 is an elevational view of a further modified form of helical strip-form member;

Fig. 11 is a detail cross-sectional view on line 11—11 of Fig. 10;

Fig. 12 is an elevational view of still another modified form of helical strip-form member; and

Fig. 13 is a detail cross-sectional view on line 13—13 of Fig. 12.

Referring to the drawings, and more particularly to the embodiments of the invention shown in Figs. 1 and 5 through 9, the roll indicated generally at 10 is mounted for rotation on the longitudinally curved axle 12 whose opposite end portions project beyond the roll body and may be adjustably clamped in any suitable end clamps 14, 16. The axle may be adjusted in the end clamps 14, 16 to dispose the axle with the plane of its longitudinal curvature in any of various positions of rotation about a straight axis extending through the two end clamps.

The roll body has a surface sleeve 18 of flexible, resilient material rotatably mounted on axle 12 by means of a helically wound strip-form member 20 over which the surface sleeve 18 directly engages, and the helically wound member 20 is supported for rotation with sleeve 18 about the curved axle 12 by means of relatively widely spaced ball-bearing units 22, or the like, which are fixed with-

in the helically wound member 20 at selected locations along the roll body 10.

The helically wound member 20 of the Figs. 5 and 6 embodiment has adjacent convolutions welded together at predetermined spaced locations around the helix, the welds being indicated at 24 spaced approximately 240° apart around the helix throughout substantially the entire length of the helix. This provides a structure, as viewed in Fig. 5, wherein the welds 24 are in three generally parallel rows located 120° apart around the circle of the helix, but the welds 24 in each row secure together adjacent edges of only alternate convolutions so that adjacent edges of two convolutions which are welded together in one of said rows will not again be welded together until said edges have reached another of said rows 240° removed from the weld in said one of said rows. Hence, although the helical strip-form member 20 is substantially stabilized by the welds 24, adjacent edges of adjacent convolutions are free of welds throughout approximately 240° of their helical extent between welds, whereby the strip-form member 20 retains a substantial amount of its initial resilient flexibility, sufficient to permit rotation of the helical strip-form member about the longitudinally curved axle 12 when the member 20 is rotatably supported on axle 12 by the relatively widely spaced ball-bearing units 22.

Figs. 7 and 8 illustrate a helical strip-form member 20' in which welds 24 connect adjacent edges of adjacent convolutions at locations 144° apart around the circle of the helix, with the welds in five generally parallel rows, as shown in Fig. 7. Here again the welds 24 in each row secure together adjacent edges of only alternate convolutions so that adjacent edges of two convolutions which are welded together in one of said rows will not again be welded together until said edges have reached another of said rows 144° removed from the weld in said one of said rows. This increased number of welds naturally produces a stiffened and more stable helical member 20' as compared with the Figs. 5 and 6 embodiment, suitable for use in larger diameter rolls such, for example, as rolls having outside diameters above 7 inches. Seven or nine of the rows of welds may be provided, if desired, for still greater stabilization of the larger diameter rolls, the welds being spaced 102½° apart along adjacent edges of convolutions in a seven row helical member, and 80° apart along adjacent edges of convolutions in a nine row helical member.

Obviously the stabilizing of helical members 20, 20' may be accomplished by securing together adjacent convolutions by other means than the welds 24. For example, adjacent convolutions of a strip-form member 20'' may be rigidly connected together by short strips or bars 24^a pinned or otherwise secured to the convolutions at their inner surfaces, as shown in Fig. 9, wherein each end of the strips has two pins or rivets therein to avoid any relative pivoting movement of the strips and convolutions. Obviously, spot welds, or other means, may be employed in place of the pins or rivets. Various other means for connecting adjacent convolutions will occur readily to those skilled in the art, and it is intended that the disclosed connecting means shall be regarded as representative of securing means in general in the spaced relationships as herein disclosed, without limitation to the specific securing means shown.

Each ball-bearing unit 22, in the Figs. 1 and 5 embodiment, may have an inner race 22^a suitably pinned at 23, or otherwise secured, to the axle 12, a resilient ring 23' being shown seated in an annular groove in the outer end of the pin, removably retaining the pin in locking engagement with axle 12. The outer race 22^b of each ball-bearing unit is rotatable relative to the inner race, with a usual series of ball bearings between the races, and the outer race preferably is seated within an annular sleeve 28 of rubber, or the like, which latter has tight force fit within the convolutions of the mem-

ber 20. As compared with the prior comparable rolls which have required a multiplicity of bearing units distributed relatively closely throughout the length of a roll, the present helically wound interior roll structure is stabilized to a degree whereby a much smaller number of bearing units are necessary within any particular roll, as compared with prior proposals. For example, in a fifty inch roll having a 7" outside diameter, and having the convolutions of member 20 welded as described in connection with Figs. 5 and 6, as few as three of the ball-bearing units 22, in some cases, will adequately support the helical member 20 and sleeve 18 in service although, for relatively heavy duty, the helical member 20 preferably will be stabilized by from four to six or more of the bearing units 22, five of the units 22 being represented in the Fig. 1 roll, which is greatly less than the twelve and more ball-bearing units heretofore required in the prior comparable longitudinally curved rolls.

Figs. 2, 3 and 4 illustrate the invention as it may be embodied in a longitudinally curved roll whose curvature is adjustable. The particular structure which enables the curvature of the roll to be adjusted, other than the supported helical member 20^a, is no part of the present invention and should be regarded as illustrative of adjustable curvature rolls in general. As shown, the cross-sectionally round axle 34 has a groove or slit 36 extending inward from one end and terminating a substantial distance short of the other end of the axle thereby to provide two axle sections 34^a, 34^b which are relatively slidable for imparting longitudinal curvature, of selective amounts, to the roll. The roll of Figs. 2-4 has a surface sleeve 18^a mounted on a helical member 20^a, generally the same as in the roll of Figs. 1, 5 and 6, with ball-bearing units 22 at relatively widely spaced locations rotatably supporting the helical member 20^a and surface sleeve 18^a for rotation in unison on axle 34. However, in the Figs. 2-4 embodiment, the inner races 22^a of the ball-bearing units are permitted to slide a little along the axle 34 due to the provision of grooves 34' in axle section 34^a, in which grooves the pins 23 slidably engage for locking the axle sections 34^a and 34^b and the inner races 22^a against relative movement after the desired curvature has been imparted to the roll.

The unsplit solid end portion of axle 34 is shown enclosed within a loose sleeve section 37 which extends slidably through the pivoted element 38 of end bearing member 40. An abutment 42 is provided at this end portion of axle 34 and serves as a stop against which the outer end of sleeve section 37 engages. The inner end of sleeve section 37 is in engagement with the inner race 22^a of the adjacent end-most bearing unit 22.

Cylindrical sleeve sections 44, 46 are loosely arranged in pairs on axle 34, between the bearing units 22, each sleeve section 44 having an exteriorly tapered end portion for coaxing engagement within an interiorly tapered adjacent end of a sleeve section 46, whereby the sleeve sections are self-adjusting for accommodating themselves to varying curvatures of axle 34. The inner races of bearing units 22 are slidably keyed only to the axle portion 34^a, by the pins 23 in grooves 34', and permit relative slip of the portions 34^a, 34^b in the bearing races and relative slip of the inner races 22^a and axle section 34^a.

The slit axle 34, as viewed in Fig. 3, has its left-hand end portion extending appreciably beyond the left-hand end of the roll body, the extending end of axle portion 34^a being welded or otherwise rigidly secured at 47 to a member 48, and the extending end of axle portion 34^b being welded or otherwise rigidly secured at 49 to a member 50 which is slidably supported relative to member 48.

Members 48, 50 are slidably but non-rotatively mounted within a bearing member 52 which is pivotally mounted at 54 within a bearing unit indicated generally at 56. Member 50 has an upstanding part 51 thereon provided

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with a threaded hole through which the exteriorly threaded relatively long tubular element 58 is screwed. Member 48 has a depending part 49' thereon in position to be engaged by the inner end of element 58, the outer end of element 58 having a nut 60 rigid thereon. Another nut 62 is in threaded engagement with element 58 and adjustable therealong by means of a wrench 64 which may be shifted from engagement with nut 62 to engagement with nut 60. Suitable strut means intervene between the pivoted bearing member 52 and the adjacent end-most bearing unit inner race 22^a, and between the said pivoted bearing member 52 and the nut 62, whereby inward tightening of nut 62 effects longitudinal clamping together within the roll of the interior elements 22^a, 44, 46, 37, for locking the elements of the roll and axle with any predetermined curvature therein. The inner races 22^a can slip on axle 34 due to the previously described pin-in-groove connection between the inner races and axle section 34^a. Introduction of curvature, or varying of curvature, is accomplished by inward screwing of threaded element 58 by means of wrench 64 engaging nut 60, it being assumed that nut 62 first will be loosened. This inward screwing of element 58 forces parts 49', 51 of members 48, 50 relatively apart thereby to move axle portion 34^a relatively inwardly and axle portion 34^b relatively outwardly for introducing desired curvature in the roll, following which a tightening of nut 62 maintains the curvature. The herein disclosed mechanism for effecting relative movement of the axle portions 34^a, 34^b is more fully disclosed in U.S. Patent 2,898,662 issued on August 11, 1959 to John D. Robertson, to which reference is made for a more detailed disclosure. However, it should be understood that the present invention is applicable to fixed curvature and adjustable curvature rolls generally, and that the herein disclosed structures, other than the interior supporting structure for the roll bodies, is intended to be illustrative of fixed curvature and adjustable curvature rolls generally.

The helical strip-form member 20^a in the adjustable-curvature type of roll, of which Figs. 2-4 are representative, may be generally the same as described in connection with fixed curvature rolls of which Fig. 1 is representative.

It may be desirable, in some cases, to effect rigid securing of edge portions of adjacent convolutions by means of relatively small inserts 66 between and suitably secured to the edges of adjacent convolutions of the helical member 200, as shown in Figs. 10 and 11. The inserts 66 may be employed when the spacing of convolutions is of the order of $\frac{1}{8}$ " or more, and the inserts may be welded in place but are shown secured to the adjacent convolutions by an adhesive 67 which may be one of the available synthetic resin adhesives which effect an extremely strong bond between metal parts or between metal and any of various other materials. Any of numerous well known thermoplastic and thermosetting adhesives may be employed to adhere inserts 66 of metal in place. Or adhesives having elastomeric materials modifying thermoplastic and thermosetting resin base adhesives may be used. For example, Epon 828, produced by Shell Chemical Co., is an epoxy resin base adhesive which can be cured with only contact pressure, to provide an adequately strong bond between the metal inserts 66 and the metal convolutions of the helical member 200. Polyurethane adhesives, and rubber-base adhesives modified with polyurethanes will adequately serve, as will many other commercially available adhesives prepared for adhesion of metal parts to metal.

Yet another modified form of stabilized helical member 202 is represented in Figs. 12 and 13, wherein a continuous strip 68 of rubber, or other comparable elastic material, is inserted and suitably secured within the space between convolutions of the helix throughout the extent of the helix. The strip 68 may be secured to the adjacent edges of convolutions by adhesive 69 which may

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be one of the available rubber base adhesives applied directly to the metal and/or strip 68 or applied in accordance with the well known brass plating process. The helical member 202 of Fig. 12 usually will be of the heavier and more rigid variety, as compared with the helical members 20, 20' and 20'', and the strip 68 is of a nature to resiliently yield and stretch as the helical member is flexed to conform to any particular curvature of an axle 12 or 34, and to permit rotation of the mounted helical member upon the longitudinally curved axle.

In some cases, the strip 68 of the Figs. 12 and 13 disclosure, instead of being adhered to edges of adjacent convolutions of helical member 202, may be integral on or secured to the inner surface of the flexible surface sleeve 18 or 18^a which engages over the helical member 202, in which case the strip 68 may engage between the edges of adjacent convolutions without being adhered thereto. The sleeve and its associated strip may be properly engaged in operative position upon the helical member by suitably tightening the wind of said member to reduce its diameter and subsequently pulling said member within the sleeve until the strip 68, or rib, has been worked into place between its convolutions.

When the helically wound member of either a fixed curvature or adjustable roll has dimensions such that it is inherently stiff, the bearing units 22 may coact to provide needed stabilization thereof without need for means between the units 22 for further stiffening and stabilizing the helically wound member.

The axles 12 and 34 may be cross-sectionally round as represented or may be non-round, such as hexagonal, in which latter case the inner races 22^a may have axial holes therein of non-round shape complementing and receiving the non-round axle.

Various changes may be made in the details of the present disclosures within the scope of the appended claims, and it is intended that the patent shall cover, by suitable expression in the appended claims whatever features of patentable novelty that exist in the invention disclosed.

We claim as our invention:

1. In a longitudinally curved roll having a curved axle and a roll body including a surface sleeve of flexible material mounted for rotation on said curved axle, that improvement comprising a helical strip-form member within and supporting said sleeve, and bearing units spaced substantially apart within said helical member and supporting said helical member and sleeve for rotation in unison on said axle, said helical member being stiffened and stabilized by means securing together adjacent convolutions thereof at locations spaced substantially apart around the curved axis of said axle whereby substantial portions of mutually extending adjacent convolutions are free for relative movement when said helical member and said sleeve are rotating about said longitudinally curved axle.

2. A longitudinally curved roll comprising a longitudinally curved axle, a resiliently flexible helically wound strip-form member rotatably supported on said axle, a sleeve of flexible material snugly engaged over said helical member for rotation therewith, and stabilizing means engaging portions of successive convolutions of said member, at least at a plurality of locations spaced substantially apart along said member, for modifying the natural flexibility thereof and positioned entirely inward of said sleeve, said stabilizing means comprising a series of connections substantially rigidly securing together adjacent portions of adjacent convolutions of said member at locations spaced substantially apart around the helix of said member, said connections being located in an odd number of rows equally spaced apart around the said helix and having extent generally in parallelism with said axle, and said adjacent convolutions being secured to-

gether by said connections only at locations in alternate ones of said rows.

3. A longitudinally curved roll comprising a longitudinally curved axle, a resiliently flexible helically wound strip-form member rotatably supported on said axle, a sleeve of flexible material snugly engaged over said helical member for rotation therewith, and stabilizing means engaging portions of successive convolutions of said member, at least at a plurality of locations spaced substantially apart along said member, for modifying the natural flexibility thereof and positioned entirely inward of said sleeve, said stabilizing means comprising a series of connections substantially rigidly securing together adjacent portions of adjacent convolutions of said member at locations spaced substantially apart around the helix of said member, said connections being located in an odd number of rows equally spaced apart around the said helix and having extent generally in parallelism with said axle, and said adjacent convolutions being secured together by said connections only at locations in alternate ones of said rows, there being three of the said rows of connections spaced approximately 120° apart around the curved axis of said axle whereby adjacent convolutions of said member are secured together at locations approximately 240° apart around the said curved axis of the axle.

4. A longitudinally curved roll comprising a longitudinally curved axle, a resiliently flexible helically wound strip-form member rotatably supported on said axle, a sleeve of flexible material snugly engaged over said helical member for rotation therewith, and stabilizing means engaging portions of successive convolutions of said member, at least at a plurality of locations spaced substantially apart along said member, for modifying the natural flexibility thereof and positioned entirely inward of said sleeve, said stabilizing means comprising a series of connections substantially rigidly securing together adjacent portions of adjacent convolutions of said member at locations spaced substantially apart around the helix

of said member, said connections being located in an odd number of rows equally spaced apart around the said helix and having extent generally in parallelism with said axle, and said adjacent convolutions being secured together by said connections only at locations in alternate ones of said rows, there being five of the said rows of connections spaced approximately 72° apart around the curved axis of said axle whereby adjacent convolutions of said member are secured together at locations approximately 144° apart around the said curved axis of the axle.

5. A longitudinally curved roll comprising a longitudinally curved axle, a resiliently flexible helically wound strip-form member rotatably supported on said axle, a sleeve of flexible material snugly engaged over said helical member for rotation therewith, and stabilizing means engaging portions of successive convolutions of said member, at least at a plurality of locations spaced substantially apart along said member, for modifying the natural flexibility thereof and positioned entirely inward of said sleeve, said stabilizing means comprising a series of connections substantially rigidly securing together adjacent portions of adjacent convolutions of said member at locations spaced substantially apart around the helix of said member, said connections being located in an odd number of rows equally spaced apart around the said helix and having extent generally in parallelism with said axle, and said adjacent convolutions being secured together by said connections only at locations in alternate ones of said rows, each said connection being a weld securing together adjacent edges of adjacent convolutions of said helically wound strip-form member.

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