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J. D. ROBERTSON
CURVED EXPANDER ROLL
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2,582,280

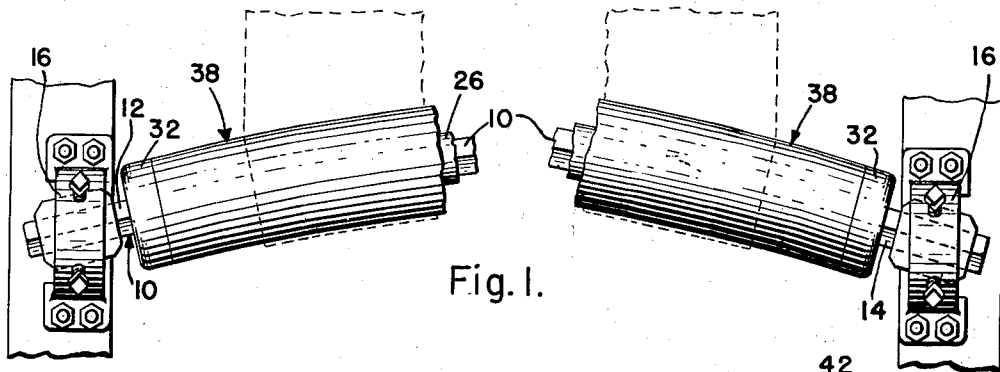


Fig. 1.

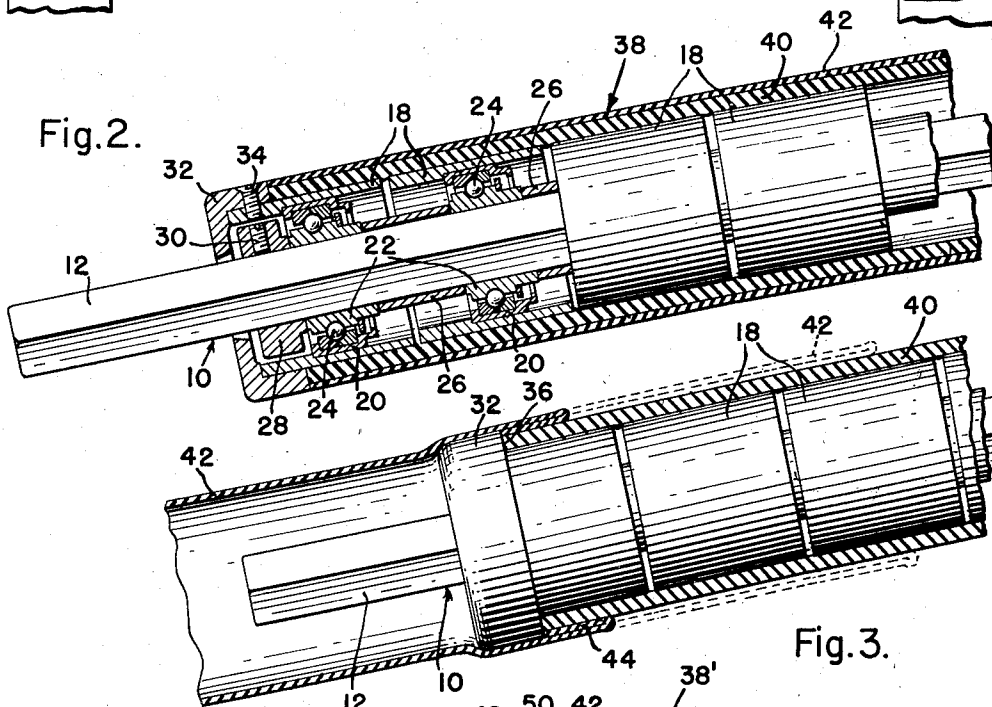


Fig. 2.

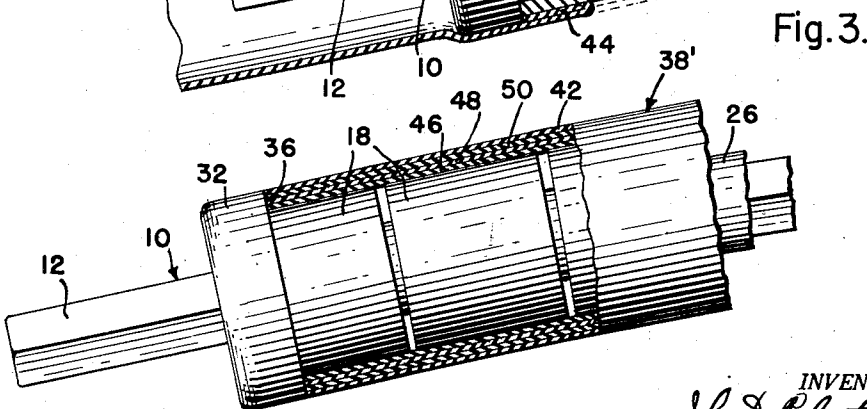


Fig. 3.

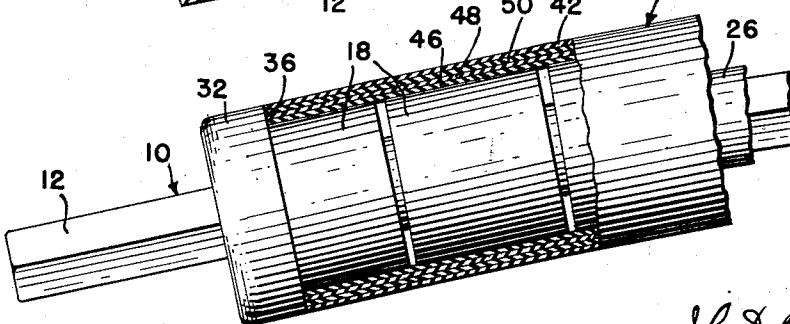


Fig. 4.

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CURVED EXPANDER ROLL

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6 Claims. (Cl. 26—63)

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This invention relates to improvements in expander rolls for flexible sheet material, and more particularly to such rolls of the general type which have curved or bowed extent for laterally spreading and removing wrinkles and slackness from travelling sheet materials as the sheet material is drawn over one or more of the expander rolls, causing the roll or rolls to rotate.

Expander rolls of the general type to which the invention relates have a principal utility for spreading or stretching textile fabrics weft-wise, with incidental removal of wrinkles, as a web of the fabric is guided along a course which may lead to or from any of various textile machines or frames during processing of the fabric. The rolls ordinarily have a relatively thick tubular surface layer of rubber mounted on a series of roll sections which are distributed along and rotatable on a curved axially extending shaft. Adjustable clamps at the opposite ends of the shaft permit adjustments of the curved roll about a straight longitudinal axis. Such a roll, and the manner in which it operates to laterally expand or spread a travelling web, are more particularly described in my United States Patent No. 2,393,191, granted January 15, 1946.

In the case of a web of textile fabric, the web is guided to the roll at the concave side of its bowed extent, and leaves the roll at the convex side of its bowed extent, the tubular rubber surface, and its supporting roll sections rotating as a unit on the relatively fixed shaft, with the rubber tube expanding and contracting during rotation in order to accommodate the roll sections as the latter rotate on the curved relatively fixed shaft.

Inasmuch as expander rolls of the mentioned general type rotate in response to the draft of the web of sheet material, it is essential that resistance to rotation offered by the roll be reduced to the lowest possible amount. Hence, the more practical and efficient curved expander rolls include anti-friction bearings for the distributed roll sections on the curved shaft, as disclosed in my said Patent No. 2,393,191, for example. But, notwithstanding the presence of anti-friction bearings for the roll sections there continues to be an inherent substantial resistance to rotation due to the constant flexings of the surface tube of rubber which latter has been required to have substantial thickness for smoothly bridging the spaces between roll sections. Also, because of the constantly changing surface contour of such rolls, and the frictional effect of the travelling web thereon, the surface is subjected to substantial wear in service, and it has been a practical

necessity to have a substantial thickness of rubber to avoid the need for too frequent renewals of the rubber surface.

Nevertheless, surface wear necessitates periodic renewals of the rubber surfaces of such rolls, and this has involved dismantling the expander and shipping the expander roll to the manufacturer for the purpose of replacing a worn surface tube with a new one. Sometimes one end portion of a surface of a roll will be worn more than other portions of the surface, suggesting that the surface tube might be reversed on the roll sections to locate the worn portion at the opposite end, and thereby get further service from the old tube. But, even such a reversal has required the shipping of the expander roll to the manufacturer to effect the change, because of the need for special skill and equipment to effect a proper mounting of a surface tube on the roll sections.

When it is considered that the expander rolls are sold and distributed in foreign countries as well as throughout the United States, it will be realized that considerable trouble and expense, and substantial loss of time, are involved to renew the surface tube of such a roll even at infrequent intervals.

Heretofore, the relatively thick surface tubes of rubber have been expensive, and the available tubes usually require grinding of their surfaces to attain desired predetermined dimensions. Also, as the surface tube is required to resiliently grip the roll sections on which the tube is mounted, the getting of a tube on the roll sections has involved a difficult and time consuming procedure requiring special apparatus for stretching or expanding the tube as it was being engaged over the succession of roll sections.

It is among the objects of my present invention to provide curved expander rolls of the mentioned general type wherein the relatively thick resiliently flexible tube on the roll sections provides substantially less inherent resistance to rotation of the tube about the curved axis of the fixed shaft. I have discovered that, by forming the flexible tube of a plurality of tubes or sleeves, with one inside another on the roll sections, the composite tube more readily stretches, contracts and conforms as its multiplicity of supporting roll sections rotate respectively around, and at different locations along, the curved axis of the fixed shaft, thereby materially reducing the tensional force required to induce rotation of the curved roll.

Another object is to provide a curved expander roll of the mentioned general type wherein a plu-

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ality of individual tubes or sleeves of resiliently flexible material are associated together with one tube inside another on the distributed supporting roll sections, and wherein at least the outer surface of one of the associated tubes is of a character to be readily rolled axially to and from its operative position on the adjacent tube, whereby a worn outer surface tube or sleeve quickly may be replaced by a new one without need for any special skill or mechanism to effect the change.

Yet another and important object is to provide a curved expander roll wherein individual tubes or sleeves of resiliently flexible material may have different characteristics and be associated together with one tube inside another on the distributed supporting roll sections, whereby the inner-most tube may have the quality of being oil resistant, for example, while the outer-most tube may have the property of being abrasion-resistant, any one or more intermediate tubes being of highly resilient character without need for any particular regard for its or their oil-resisting and abrasive-resisting qualities.

It is, moreover, my purpose and object generally to improve the structure and efficiency of curved expander rolls, and especially such rolls of the general type having a resiliently flexible web-engaging surface.

In the accompanying drawing:

Fig. 1 is an elevational view of a mounted curved expander roll embodying features of the invention, the central portion of the roll being broken away;

Fig. 2 is an elevational view of one end portion of the roll of Fig. 1, on a larger scale, and showing the resiliently flexible composite tube in cross-section;

Fig. 3 is a view similar to Fig. 2 but showing the outer surface tube in the process of being applied over the adjacent tube; and

Fig. 4 is a view similar to Fig. 2 but showing a modified form of composite resiliently flexible tube.

Referring to the drawing, the curved expander roll of Fig. 1 is representative of curved expander rolls of the general type which have a resiliently flexible work-engaging surface. As shown, the roll has a curved shaft 10 of angular cross-section, and has straight end portions 12, 14 which are rigidly mounted and fixed in the similar clamps 16, 16. The clamps, preferably, will include means for adjustment of the setting of the shaft to position the crest of the curved shaft in any selected angular position around a straight axis which passes through both clamps 16, 16.

As seen in Figs. 2-4, a multiplicity of roll sections 18 are distributed along the curved shaft 10, each roll section 18 being a cylinder of metal, or other suitable material, having drive fit on, or being otherwise secured to, the outer ring member 20 of a conventional ball-bearing unit whose inner ring member 22 has an angular bore whose walls non-rotatably engage around shaft 10, with the balls 24 operatively retained between the inner and outer ring members 20, 22 of the unit.

The roll sections 18 are maintained in slightly spaced relation to each other by the cylindrical sleeves 26, each sleeve 26 being loose on shaft 10 with its ends engaging the inner ring members 22 of adjacent roll sections. The two end-most roll sections are retained against outward travel on shaft 10 by means of the collars 28, each adjustably fixed to the shaft, as by a set screw 30. Also,

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each end of the roll, around shaft 10, is closed by an end cap 32 which may be secured to the end-most cylindrical roll sections 18, as by the screws 34, each end cap providing an inward-facing annular shoulder 36 which constitutes an end-abutment against which one end of the resiliently flexible surface tube, indicated generally at 38, engages.

The invention relates more particularly to the structure of, and the manner of mounting, the surface tube 38.

In the Figs. 2 and 3 form, the surface tube 38 is composed of an inner tube 40, and a thinner outer tube 42 resiliently engaged over the inner tube 40, it being a feature of the invention that the outer tube 42 is adapted to be readily rolled into place on the inner tube by effecting inversion of the outer tube in the rolling process. To facilitate this rolling of outer tube 42, it preferably is made of high grade rubber, with wall-thickness of say one-eighth of an inch. The inner tube 40, in the Figs. 2 and 3 form, may have wall-thickness of say three-eighths of an inch, and it too may be of rubber, or other suitable resiliently flexible material. The inner tube will be mounted on the roll sections 18 in the customary way, using the special tube-stretching mechanism which constitutes a part of the equipment of manufacturers of such curved expander rolls.

Preliminarily to rolling the outer tube 42 over inner tube 40, one end portion of outer tube 42 may be turned within the adjacent wall portions of the tube, as at 44 in Fig. 3. This provides a short double thick end of tube which may be stretched enough to engage it over the end of the inner tube 40, as in Fig. 3. Then the outer tube may be forced along the inner tube, as suggested in dotted outline in Fig. 4, with inversion of the tube progressing until inversion is complete, at which time the outer tube 42 will be in smoothly covering relation to the inner tube throughout their extents.

By employing the described composite tube, service wear comes only on the outer tube 42, which relatively quickly and easily may be removed, and a new one substituted, without need for any special equipment or skill to effect the change, as distinguished from the prior practices which required return of the entire expander roll to the manufacturer when renewal of a worn roll surface was needed. But, in addition to the substantial savings in time and costs involved to renew a roll surface, I have discovered that my composite tube structure offers substantially less inherent resistance to rotation on the curved axis of shaft 10 as compared with the single relatively thick tubes heretofore employed. Apparently, this is due to a more or less independent stretching and contracting of the individual tubes, with slight slippage between the tubes during their rotation around the curved shaft 10. In any event, my composite tube structure imposes substantially less tension on the web whose draft must rotate the roll, as compared with the prior comparable rolls, and this promotes the general aim in such expanders of keeping the tension in the driving web at the lowest possible minimum.

Another important advantage resulting from my improved composite tube resides in the fact that the individual tubes or sleeves may have different properties. It is essential in such expander rolls that oil from interior bearings be prevented from seeping through the resilient tube to the exterior work-engaging surface. Hereto-

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fore, the prior relatively thick integral resilient tubes have been required to be made of resilient material which combined the properties of oil-resistance and abrasion-resistance and which also would have a practicable amount of resilient flexibility. The attainment of these combined requisite properties in an integral tube required concessions resulting in an ultimate structure which could have abrasion-resistance and resilience in less than desired amounts. Hence, it is a feature of my improved expander roll that only the inner tube or sleeve 40 is required to be oil-resistant, and only the outer tube or sleeve 42 is required to be abrasion-resistant. At a result, the inner tube 40 may be made to have needed oil-resistance and resilience without regard to its resistance to abrasion, and the outer tube 42 may be made to have needed abrasion-resistance and resilience without regard to its ability to resist seepage of oil therethrough. My improved ultimate expander roll, in consequence, may have a substantially greater amount of each of the mentioned required properties as compared with the prior expander rolls.

In the form of the invention illustrated in Fig. 4, the inherent resistance offered by the resilient tube to rotation of the roll is still further reduced by a multiple tube construction in which four relatively thin tubes 46, 48, 50 and 42 of rubber, or the like, are arranged one upon another to provide a composite tube 38' of the desired thickness. Each individual tube, for example, may have walls one-eighth of an inch thick, to provide a composite thickness of one-half inch. In this case, each individual tube may be incorporated in the expander roll in a manner comparable to that described in connection with mounting of the outer tube 42 in the Figs. 1-3 form, and the outer tube may be renewed relatively quickly and easily the same as in the Figs. 1-3 form. But, in the modified form of Fig. 4, there are three cleavages between the individual tubes 46, 48, 50 and 42 at which relative adjustment and slippage can occur during rotation of the roll, which materially reduces the stiffness of the composite tube, and its resistance to conformation to the roll sections 18. Yet the built-up composite thickness of the tube provides an adequate stability of tube walls for bridging the gaps between the roll sections 18, to attain a desired general smoothness of surface contour.

Also, in the Fig. 4 form, only the inner-most tube 46 needs to be oil-resistant, and only the outer-most tube 42 needs to be abrasion-resistant. The intermediate tubes 48, 50 may be made highly resilient without regard to their abilities to resist oil seepage or abrasive wear. Hence, the ultimate composite tube may have relatively high resilience and flexibility and yet have needed oil-resistance and abrasion-resistance at the critical regions thereof.

In both of the illustrated embodiments of the invention, it is essential that the dimensions and character of adjacent tubes shall be such that an inner tube will be relatively strongly frictionally gripped by the next outer tube which engages around it, so that friction between tubes at their cleavages will restrain them against any appreciable relative endwise crawling under the stress imposed on the expander roll in service. However, the end cap shoulders 36 constitute definite and fixed abutments preventing any total relative shifting of the associated tubes in longitudinal directions.

It will be apparent from the foregoing descrip-

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tion that my improved expander roll offers less inherent resistance to rotation around its curved shaft, as compared with prior comparable rolls. But perhaps of greater practical and economical importance is the feature that a worn surface of a roll may be quickly renewed, at the general location of use, by merely replacing the worn outer surface tube with a new one, without need for special equipment or skill, and without the expense and loss of time which heretofore was involved in returning a complete expander roll to the manufacturer for surface renewal. Replacement outer tubes 42, supplied by the manufacturer, may be held in reserve by the users of the expander rolls, ready to be quickly substituted for worn outer tubes 42 as the occasion may require.

I claim as my invention:

1. An expander roll for flexible sheet material, comprising a stiff longitudinally curved shaft, a series of generally cylindrical roll sections rotatably mounted on the curved shaft in slightly spaced relation, a tube of resiliently flexible material resiliently engaging around all of the said roll sections and bridging the spaces between roll sections, said tube being composed of a plurality of separable tubes arranged one within another, of which the outer tube has relatively thin walls of resiliently flexible material and is mountable on the adjacent tube by an inside-out inverting of the outer tube on the adjacent tube.

2. An expander roll for flexible sheet material, comprising a stiff longitudinally curved shaft, a series of generally cylindrical roll sections rotatably mounted on the curved shaft in slightly spaced relation, a tube having relatively thick walls of resiliently flexible material resiliently engaging around all of the said roll sections and having stability of walls for bridging the spaces between roll sections with preservation of a general smoothness of its exterior curved surface, and a relatively thin-walled surface tube of resiliently flexible material resiliently separably around the first tube approximately throughout the length of the latter, said surface tube being mountable on and removable from the first mentioned tube by inside-out inversion of the surface tube on the first mentioned tube.

3. An expander roll for flexible sheet material, comprising a stiff longitudinally curved shaft, a series of generally cylindrical roll sections rotatably mounted on the curved shaft in slightly spaced relation, a series of separable tubes of resiliently flexible material associated together to provide a composite tube of predetermined thickness of walls, said tubes being organized with one constituting an inner tube intimately resiliently engaged around all of said roll sections, and with the other tubes successively resiliently engaged around the inner tube and each other, and each said tube being mountable on and removable from the expander roll by inside-out inversion of the tube.

4. An expander roll for flexible sheet material, comprising a stiff longitudinally curved shaft; a series of generally cylindrical roll sections rotatably mounted on the curved shaft in slightly spaced relation, means on said shaft providing an inward facing annular abutment at opposite end regions of the shaft, a tube of resiliently flexible material resiliently engaging around all of the said roll sections and bridging the spaces between roll sections, said tube having a separable relatively thin tubular surface covering of resiliently flexible material which absorbs service wear on

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the roll, and said surface covering being mountable on and removable from said tube while all other elements of the expander roll continue in operative relationships.

5. An expander roll for flexible sheet material, comprising a longitudinally curved shaft, roll sections of circular cross-section rotatably mounted in slightly spaced relation along the curved shaft, a tube having walls of resiliently flexible material resiliently engaging around all of said roll sections and bridging the spaces between roll sections, said tube material having the property that it successfully resists seepage of oil there-through from its inner surface to its outer surface, and a second tube separably resiliently engaged around the first mentioned tube, said second tube being of abrasion-resisting resiliently flexible material and being substantially more resilient than the first mentioned tube.

6. An expander roll for flexible sheet material, comprising a longitudinally curved shaft, roll sections of circular cross-section rotatably mounted in slightly spaced relation along the curved shaft, a series of resiliently flexible tubes associated together to provide a composite tube having wall thickness composite of the wall thick-

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nesses of the individual tubes, the inner-most individual tube being of resiliently flexible material having the property that it successfully resists seepage of oil therethrough from its inner to its outer surface, and the outer-most tube being of resiliently flexible material having the property that it has relatively high resistance to frictional wear, there being at least one intermediate tube having substantially greater flexible resilience than either of said inner-most and outer-most tubes.

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