April 13, 1954 J. D. ROBERTSON 2,674,776

APPARATUS FOR EXPANDING AND CONTRACTING TRAVELING SHEET MATERIALS

Filed Oct. 31, 1951 2 Sheets-Sheet 1

Fig. 1.

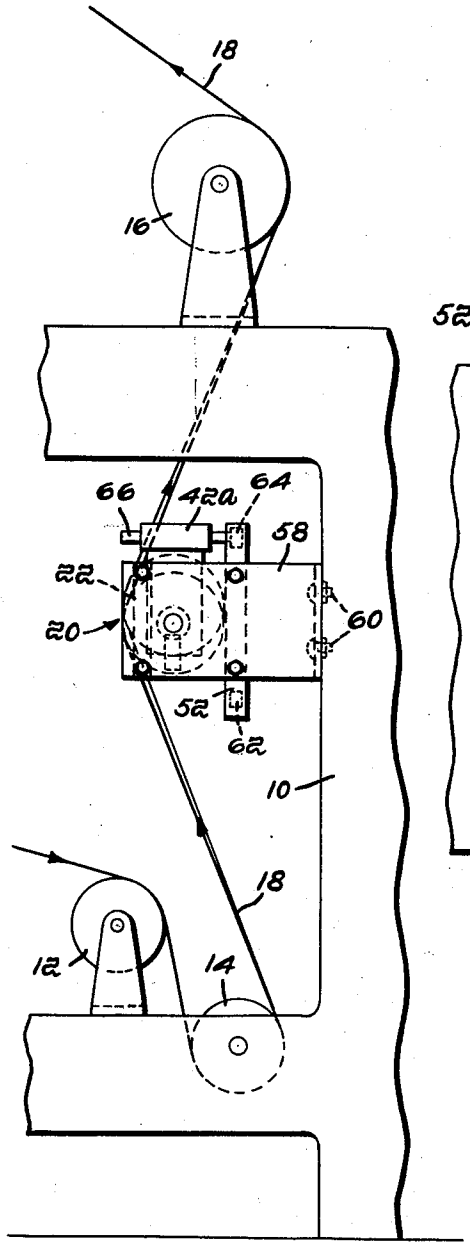
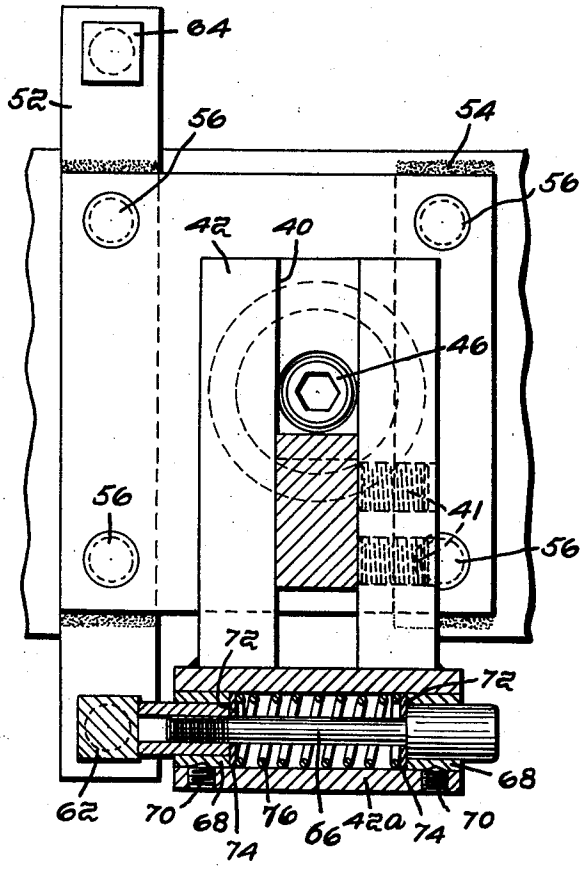


Fig. 4.



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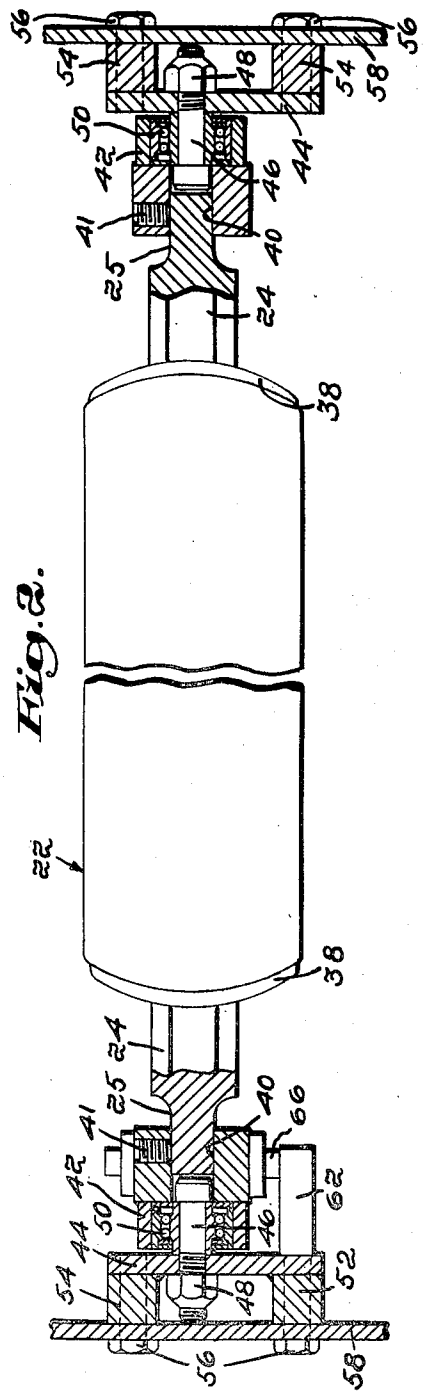


Fig. 2.

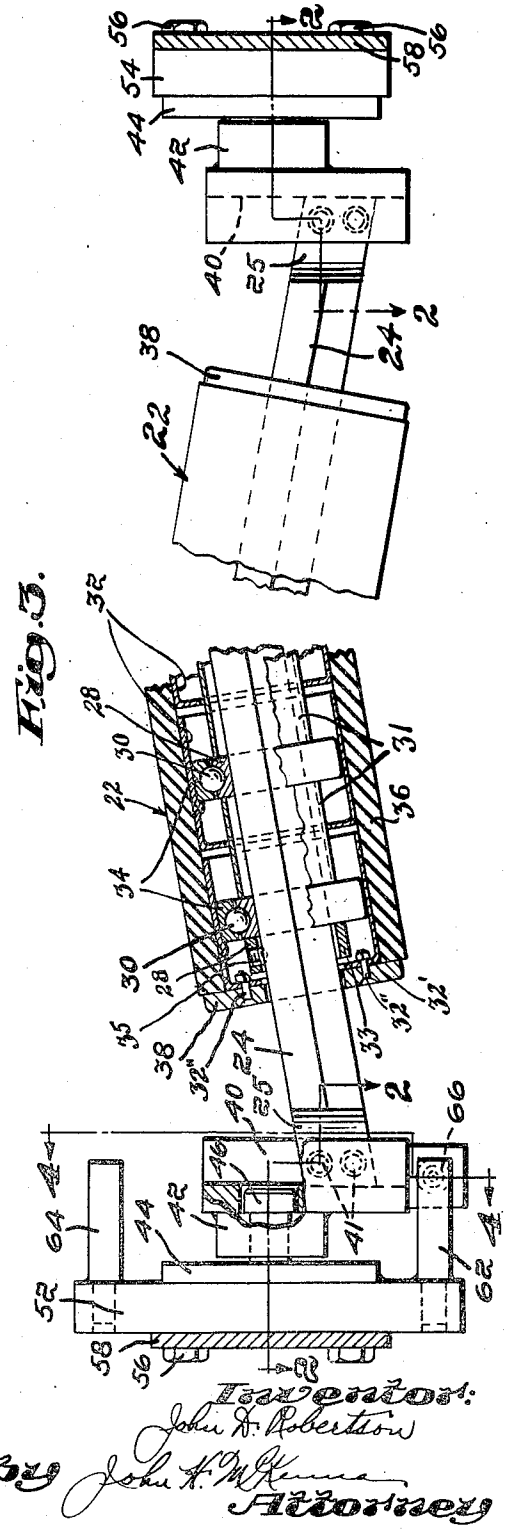


Fig. 3.

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APPARATUS FOR EXPANDING AND CONTRACTING TRAVELING SHEET MATERIALS

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Application October 31, 1951, Serial No. 254,007

5 Claims. (Cl. 26—63)

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This invention relates to improvements in apparatus for width-wise expansion or contraction of travelling sheet materials. More particularly it relates to apparatus primarily designed for acting on travelling sheets of flexible materials, such as textile fabrics, paper, plastic sheets and films, foils, and the like, in a manner to expand or stretch them width-wise as the sheets travel to or from any of various processing devices. However, my improved apparatus may be employed for reducing the width of such travelling sheets, as in the process of making crepe paper, for example. The invention provides improvements whereby a travelling sheet which periodically reverses its direction of travel may be acted upon to provide substantially the same expansion or contraction effect on the sheet during its periodic travels in opposite directions.

In processing various sheet materials, it frequently becomes necessary or desirable to expand or stretch the sheets width-wise in the course of their travels to or from any of various processing mechanisms. Woven textile sheets, for example, may become substantially reduced in width as a result of processing treatments and it is desirable to restore them to their original widths, or to expand them to some other predetermined widths, at some one or more locations along the paths of travel of the sheets. Well known types of sheet expanders have been available for acting on such travelling sheets in a manner to expand or stretch the sheets width-wise. One efficient and popular type of sheet expander employs a longitudinally curved roll, or a plurality of such rolls, disposed across the path of travel of a sheet with the sheet advancing to the roll at its concave side and leaving the roll at its convex side. The roll has an adjustably fixed longitudinally curved axle about which the sheet-engaged surface portion of the roll rotates in response to draft of the sheet. This prior curved-roll type of expander is satisfactorily effective so long as a sheet which is being expanded travels continuously in one direction past the expander. However, in certain sheet-processing procedures, the travelling sheet is required to reverse the direction of its travel periodically, and the prior curved roll sheet expanders, so far as I am aware, have not been useable under these conditions because the expanding effect of the prior curved roll sheet expanders, so far as I am aware, can be attained only when the sheet approaches the expander continuously in the same direction. Reversal of the direction of sheet travel not only would eliminate the expanding effect of the prior expanders but would introduce a reducing effect width-wise of the sheet.

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It is among the objects of my present invention to provide sheet expander and contractor apparatus wherein a curved expander roll responds to the draft of a travelling sheet to assume a position in which it will have a width-wise expanding effect on the sheet regardless of the direction of approach of the sheet to the expander roll. In a preferred embodiment, the curved axle of the expander roll has its opposite ends mounted in bearings which themselves are rotatable on suitable supporting parts of a frame, or the like, whereby the curved roll can move bodily about the axis of the bearings, with stop means for limiting the bodily movements of the roll in each direction about the axis of the bearings. At one limit of bodily movement of the roll, the concave side of the roll is in position to be engaged by a sheet approaching the roll in one direction, and the sheet leaves the roll at its convex side. If the direction of travel of the sheet is reversed, the reversed draft of the sheet acting on the roll carries the roll to the other limit of its bodily movement in which its concave side will be in position to be engaged by the sheet approaching the roll and the sheet will leave the roll at its convex side.

Another object of the invention is to provide sheet expander and contractor apparatus wherein a curved expander roll is bodily movable between two operative positions in response to draft of a travelling sheet which constantly engages the roll, the roll having a curved axle on which a flexible roll body is rotatable in response to draft of the sheet, and the opposite ends of the axle being mounted in bearings which are rotatable to effect bodily movements of the roll between its two operative positions, there being anti-friction means associated with said bearings whereby the resistance to rotation of said bearings is less than the resistance to rotation of the flexible roll body on its curved axle, which ensures that the roll will be drawn bodily to one of its operative positions by draft of the sheet prior to rotation of the flexible roll body on its curved axle by the draft of the sheet.

Yet another object of the invention is to provide a curved roll expander for travelling sheet material wherein the roll comprises a curved axle with a flexible roll body rotatable thereon, the opposite ends of the curved axle being mounted in bearings which are rotatable to effect bodily movements of the roll about the axis of

the bearings between two operative positions, and there being shock-absorbing means for cushioning any shock which might otherwise accompany a movement of the roll from one to the other of its operative positions.

It is, moreover, my purpose and object generally to improve the structure and effectiveness of curved roll expander and contractor apparatus for travelling sheet materials and especially such apparatus which is effectively operable regardless of the direction of approach of the sheet to the expander and regardless of reversals of the direction of approach of the sheet to the expander.

In the accompanying drawings:

Fig. 1 is a side elevation of a fragment of sheet-guiding apparatus having sheet expander and contractor apparatus embodying features of the invention associated therewith;

Fig. 2 is a top plan view looking down at the convex side of the expander roll of Fig. 1, on a larger scale, the opposite end mountings of the roll axle being in cross-section approximately on the lines 2—2 of Fig. 3, and the central portion of the roll being broken away;

Fig. 3 is an elevational view of the roll and axle mountings of Fig. 2, at right angles to Fig. 2, and looking upward at the roll as presented in Fig. 2; and

Fig. 4 is a cross-sectional view approximately on line 4—4 of Fig. 3.

Referring to the drawings, any suitable frame 10 may support a suitable number of guide rolls 12, 14, 16 in positions for guiding sheet material 18 through a region in which the sheet material 18 is to be acted upon by sheet-expanding apparatus, indicated generally at 20 in Fig. 1, it being assumed that the sheet material is drawn over the guide rolls, by means not shown, intermittently or periodically in opposite directions. For example, the sheet material 18 may be a woven fabric undergoing treatment or processing in a so-called semi-decating machine wherein reversals of the directions of travel of the sheet occur periodically.

The sheet-expanding apparatus 20 is illustrated in Fig. 1 mounted on the frame 10 in position to engage the sheet material 18 as it travels in generally vertical directions between the guide rolls 14, 16. However, it should be understood that the expander apparatus may engage the sheet material at any suitably spread portion of the sheet, at either side thereof, and regardless of whether the engaged portion is disposed generally vertical or generally horizontal or at any intervening general plane at angles to the vertical and horizontal.

According to the invention, a curved expander roll 22 is utilized for width-wise expansion of the sheet material, the roll 22 being of a well known variety comprising a curved axle 24 on which the sheet-engaging body of the roll is rotatable. As herein represented, the axle 24 is a non-round rigid curved shaft on which inner races 28 (Fig. 3) for ball-bearings 30 are non-rotatably mounted. Roll sections or spools 32 are fixed on the outer races 34, and a flexible surface tube or sleeve 36, of rubber, or the like, is engaged over the roll sections or spools 32 bridging the spaces between them and tieing them all together for rotation in unison with the surface tube 36, which latter expands and contracts as it and the roll sections or spools 32 rotate about the curved axle 24. Spacing sleeves 31 loosely encircle axle 24 and are clamped endwise between adjacent ones of the inner races 28. This clamping is effected by the shorter sleeves 33, one at each end of the roll, which are positively secured to axle 24 by the set screws 35. Only the short sleeves 33 and set screw 35 at one end of the roll are shown in Fig. 3. Each end-most roll section or spool 32 has its end wall 32' secured as at 32'' to an end disk 38 which latter rotates with the roll sections or spools 32 and the surface tube 36.

Each end of the curved axle 24 is shown reduced at 25, and each reduced end extends into a groove 40 (Fig. 3) in a bearing member 42 and is secured therein as by the two set screws 41. Each bearing member 42 is rotatably mounted on a plate element 44 by means of a pivot bolt 46 and nut 48, a suitable anti-friction ball-bearing 50 intervening between each bearing member 42 and its pivot bolt 46. The plate element 44 at one end of the roll has two spaced and parallel rigid bars 52, 54 fixed thereto at its outer side, the bar 52 being longer than bar 54. They and plate element 44 are rigidly secured by screws 56 to a mounting bracket 58 which in turn is secured, as at 60 in Fig. 1, to a portion of the frame 10. The plate element 44 at the other end of the roll has two rigid bars 54 similar to bar 54 at the first mentioned end of the roll and these bars 54 are fixed to plate element 44 at its outer side, and they and plate element 44 are rigidly secured by screws 56 to a mounting bracket 58 which is secured to frame 10 the same as at the first described end of roll 22.

The longer rigid bar 52 at the left hand end of roll 22, in Figs. 2 and 3, has the projecting abutments 62, 64 extending in parallelism with the axis of pivot bolt 46, as best seen in Fig. 3. The abutment 62 projects at one end and the abutment 64 projects at the other end of bar 52 in positions to serve as stops for limiting permissible rotation of the bearing members 42 and the mounted roll 22 about the axis of the pivot bolts 46. One of the bearing members 42 has mounted thereon a double-acting plunger 66 (Fig. 4) which is slidable in the part 42*a* of the bearing member, with the opposite ends of the plunger 66 projecting from said part 42*a*. Spaced bushings 68 in the part 42*a* of the bearing member 42 are fixed therein as by the set screws 70 to provide interior annular shoulders 72 against each of which a washer 74 is urged by a coiled spring 76 acting between the washers in the part 42*a*.

The opposite ends of the plunger 66 are arranged and adapted to engage respectively the stops 62, 64 when the roll 22 and its attached bearing members 42 rotate about the axis of the pivot bolts 46, and as one end or the other of the plunger 66 engages a stop 62 or 64, the plunger resiliently yields to cushion the shock, with the spring 76 becoming compressed as one washer 74 is driven toward the other within the part 42*a* of a bearing member 42. Fig. 4 shows one end of the plunger 66 in engagement with the stop projection 62 and it will be obvious that a counter-clockwise 180° rotation of the bearing member 42, from its position of Fig. 4, will bring the other end of the plunger into engagement with the stop projection 64. Actually, however, the engagement of plunger 66 with stop projection 62 in Fig. 4 would be a relatively forceful engagement resulting in yielding of the plunger and compression of spring 76, assuming that the direction of travel of sheet material 18 engaging roll 22 has been reversed and that the draft of

the sheet in its new direction has rotated bearing member 42 clockwise in Fig. 4. Also, continued draft of the sheet in its new direction ordinarily would maintain the plunger in pressed-in condition against the resilient force of spring 76.

Each end of roll 22 may be mounted in the same manner, but the rigid bars 54 fixed to plate element 44 at one end of the roll, herein shown as the right hand end in Figs. 2 and 3, both are of the relatively shorter length of the rigid bar 54 at the other end and neither bar carries stop projections inasmuch as the stops at one end only have been found adequate. For the same reason, the bearing member 42 at the right hand end of the roll 22, in Figs. 3 and 4, does not have a part 42a or plunger 66. In other respects, the roll supports at the opposite ends of the roll may be the same.

In operation, the sheet material 18, travelling in the direction of the arrows in Fig. 1, approaches the curved roll 22 at a concave portion of the roll and leaves the roll at a convex portion thereof, whereby the roll acts on the sheet to spread it width-wise, and the draft of the sheet holds the plunger 66 against the stop projection 64, in Fig. 1. Sheet 18 may have from 20° to 120° engagement around the periphery of the roll depending upon the requirements for any particular installation.

If and when the direction of travel of the sheet material 18 in Fig. 1 is reversed, the roll 22 and its bearing members 42 immediately swing counter-clockwise in Fig. 1 about the axis of the pivot bolts 46, in response to the changed direction of draft of the sheet material 18. This counter-clockwise swinging of the roll and bearing members carries the plunger 66 out of contact with stop projection 64 and through approximately 180° into engagement with stop projection 62, with the plunger yielding resiliently to cushion the shock. The roll 22, as a result, assumes a position in which its concave side is generally toward the advancing sheet material, and the sheet material again approaches the roll at a concave portion thereof and leaves the roll at a convex portion thereof. In other words, the sheet material is subjected to substantially the same expanding effect before and after a reversal of the direction of its travel, with the roll 22 shifting automatically in response to each reversal of direction of sheet travel.

Inasmuch as the draft of the sheet material is relied upon to rotate roll 22 about its curved axle 24 and also is relied upon to swing the roll about the axis of the pivot bolts 46, it is desirable that there shall be less resistance to swinging of the roll from one of its limit positions to the other than there is to rotation of roll 22 about its axle 24. This result ordinarily will occur, or may be attained easily, due to the nature of the curved expander roll whose flexible surface tube or sleeve 36 must expand and contract as it and the roll sections or spools 32 rotate about the curved axle 24, with the tube or sleeve 36 offering substantial resistance to distortion as it is forced to expand at constantly changing locations along the roll so that it can be rotated about the curved axle. This resistance is additional to frictional resistance at the bearings 30. On the other hand, swinging of the roll between its two limit positions is about a straight axis with only friction and gravity resisting the swinging movement of the roll in either direction. Both the amount of friction and the influence of gravity may be readily controlled to provide an aggregate resistance

to swinging of the roll which will be appreciably less than the said substantial resistance to rotation of the roll. The ball-bearings 50 at the opposite ends of the roll axle 24 ensure a minimum of frictional resistance to swinging movements of the roll about the pivot bolts 46. Preferably, the axis of the pivot bolts coincides with the center of gravity of the expander roll 22, so that the resistance to swinging of the roll is substantially the same in each direction of its swinging movements, assuming that the abutments 62, 64 are disposed in a common horizontal plane, as distinguished from their illustrated disposition in Fig. 1.

It will be obvious that the specific embodiment of the invention as herein shown and described in detail is illustrative rather than limiting, and it is intended that the patent shall cover, by suitable expression in the appended claims, whatever features of patentable novelty exist in the invention disclosed.

I claim as my invention:

1. Apparatus for width-wise expansion of travelling sheet material whose direction of travel may be in either of two opposite directions, comprising a curved roll disposed across the path of travel of the sheet material and in engagement with said travelling sheet material, a curved axle for said roll about which the roll rotates in response to draft of the travelling sheet material, said curved roll having means therein creating substantial resistance to rotation of the roll, a pair of members mounted for rotation on a common straight axis, each of said members having a different end of said curved axle secured thereto whereby said draft of the travelling sheet material tends to swing the curved roll about said common straight axis of said members in the direction of travel of the sheet material and the resistance offered by friction and gravity to a said swinging movement of the roll in either direction being less than the said substantial resistance to rotation of the roll, and stop means angularly spaced apart around said common straight axis limiting the permissible swinging movement of said roll in either direction to a predetermined fraction of a complete swinging rotation of said roll about said common straight axis, whereby said roll is stopped at one limit of its swinging movement when the draft of the travelling sheet material is in one direction and is stopped at the other limit of its swinging movement when the draft of the travelling sheet material is in the opposite direction, the resistance to rotation of said roll about said curved axle being greater than the resistance to swinging movements of said roll between said angularly spaced stop means.

2. Apparatus for width-wise expansion of travelling sheet material whose direction of travel may be in either of two opposite directions, comprising a curved roll disposed across the path of travel of the sheet material and in engagement with said travelling sheet material, a curved axle for said roll about which the roll rotates in response to draft of the travelling sheet material, said curved roll having means therein creating substantial resistance to rotation of the roll, means supporting the opposite ends of said axle for swinging movements of the roll about a common straight axis, a pair of stops angularly spaced apart around said common straight axis, one of said stops limiting the swinging movement of the roll in response to draft of the

sheet material in one direction and the other of said stops limiting the swinging movement of the roll in response to draft of the sheet material in the opposite direction, the weight of said roll and the friction at said axle-supporting means being such that their resistance to said swinging movements of the roll is appreciably less than said substantial resistance to rotation of the roll, and the expanding effect of said roll on said travelling sheet material being substantially the same when the roll is at either limit of its swinging movement.

3. Apparatus for width-wise expansion of travelling sheet material whose direction of travel may be in either of two opposite directions, comprising a curved roll disposed across the path of travel of the sheet material and in engagement with said travelling sheet material, a curved axle for said roll about which the roll rotates in response to draft of the travelling sheet material, said curved roll having means therein creating substantial resistance to rotation of the roll, means supporting the opposite ends of said axle for swinging movements of the roll about a common straight axis, stop means for limiting the permissible swinging movement of said roll to approximately a 180° swinging movement about said common straight axis in response to draft of said sheet material in either of two opposite directions, the weight of said roll and the friction at said axle-supporting means being such that their resistance to said swinging movements of the roll is appreciably less than said substantial resistance to rotation of the roll, and means for cushioning any shock incident to stopping of the swinging movement of the roll at either of its said limits of swinging movements.

4. Apparatus for width-wise expansion of travelling sheet material whose direction of travel may be in either of two opposite directions, comprising a curved roll disposed across the path of travel of the sheet material and in engagement with said travelling sheet material, said curved roll having means therein creating substantial resistance to rotation of the roll, a curved axle for said roll about which the roll rotates in response to draft of the travelling sheet material, a rotatable support for each end of said axle, the said supports being rotatable on a common straight axis, whereby the roll may be swung in either direction about said common straight axis in response to draft of the sheet material travelling in either of two opposite directions, the weight of said roll and the friction at said rotatable supports being such that the resistance to swinging of the roll about said common straight axis is appreciably less than said substantial resistance to rotation of the roll, and abutment means for stopping a swinging movement of the roll, in response to draft of the sheet material in one direction, with the roll in position to have a predetermined expanding effect on the sheet material, and for stopping a swinging movement of the roll, in response to draft of the sheet material in the opposite direction, with the roll in position to have substantially the same expanding effect on the sheet material.

5. Apparatus for width-wise expansion of travelling sheet material whose direction of travel may be in either of two opposite directions, comprising a curved roll disposed across the path of travel of the sheet material and in engagement with said travelling sheet material, said curved roll having means therein creating substantial resistance to rotation of the roll, a curved axle for said roll about which the roll rotates in response to draft of the travelling sheet material, a rotatable support for each end of said axle, the said supports being rotatable on a common straight axis, whereby the roll may be swung in either direction about said common straight axis in response to draft of the sheet material travelling in either of two opposite directions, the weight of said roll and the friction at said rotatable supports being such that the resistance to swinging of the roll about said common straight axis is less than the said substantial resistance to rotation of the roll about said curved axle, spaced abutments carried on one of said rotatable supports and movable therewith about said common straight axis, abutment means at a fixed location around said common straight axis for coaction with one of said spaced and movable abutments to limit a swinging movement of the roll in response to draft of the sheet material in one direction, and for coaction with the other of said spaced and movable abutments to limit a swinging movement of the roll in response to draft of the sheet material in the opposite direction, and means for cushioning the shock when a said abutment and abutment means coact to limit a swinging movement of the roll.

No references cited.