

Feb. 28, 1967

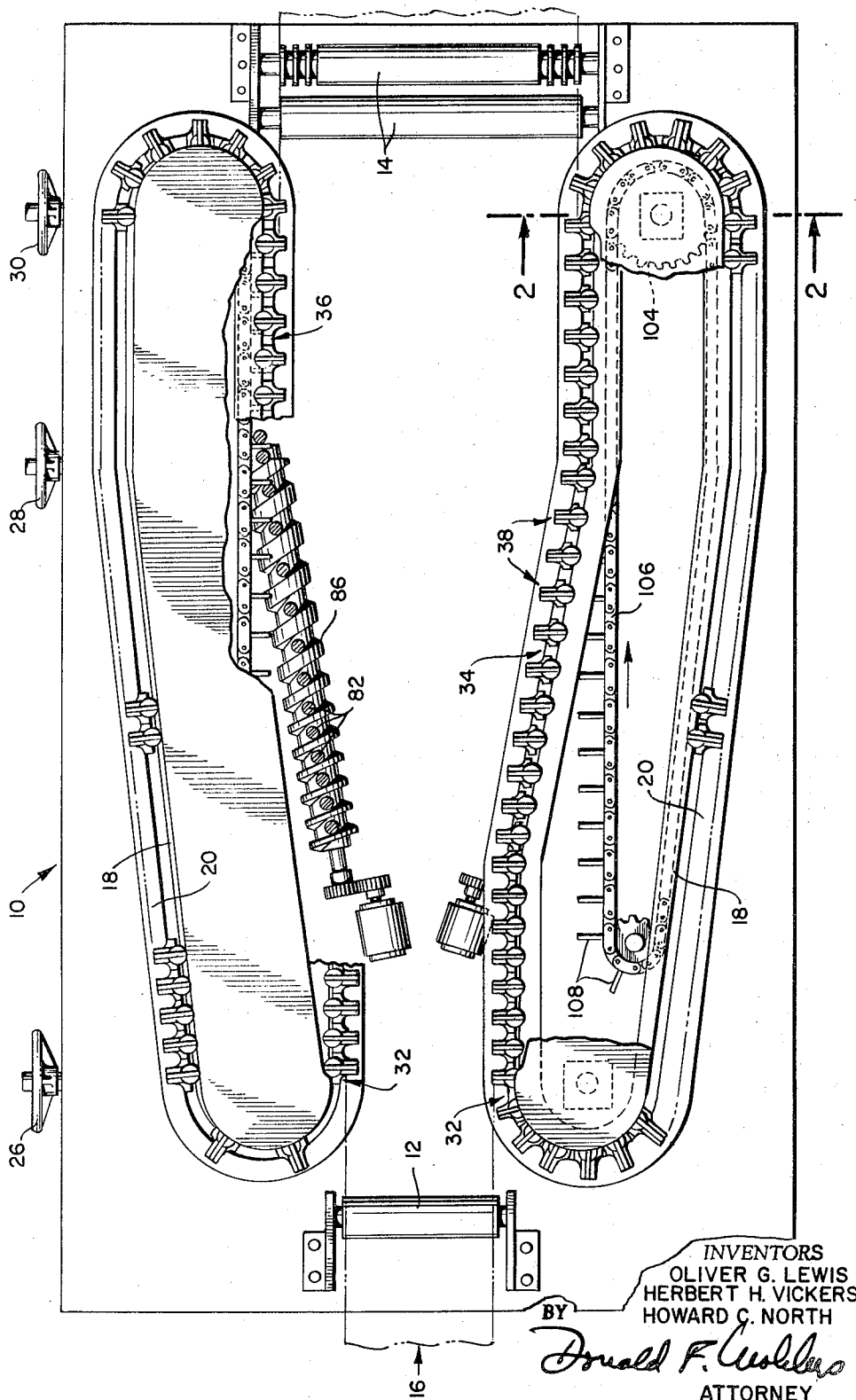
O. G. LEWIS ET AL

3,305,889

BI-AXIAL STRETCHING MACHINE

Filed May 3, 1965

3 Sheets-Sheet 1



INVENTORS
OLIVER G. LEWIS
HERBERT H. VICKERS
HOWARD C. NORTH

BY

Donald F. Wheeler
ATTORNEY

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O. G. LEWIS ET AL

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3 Sheets-Sheet 2

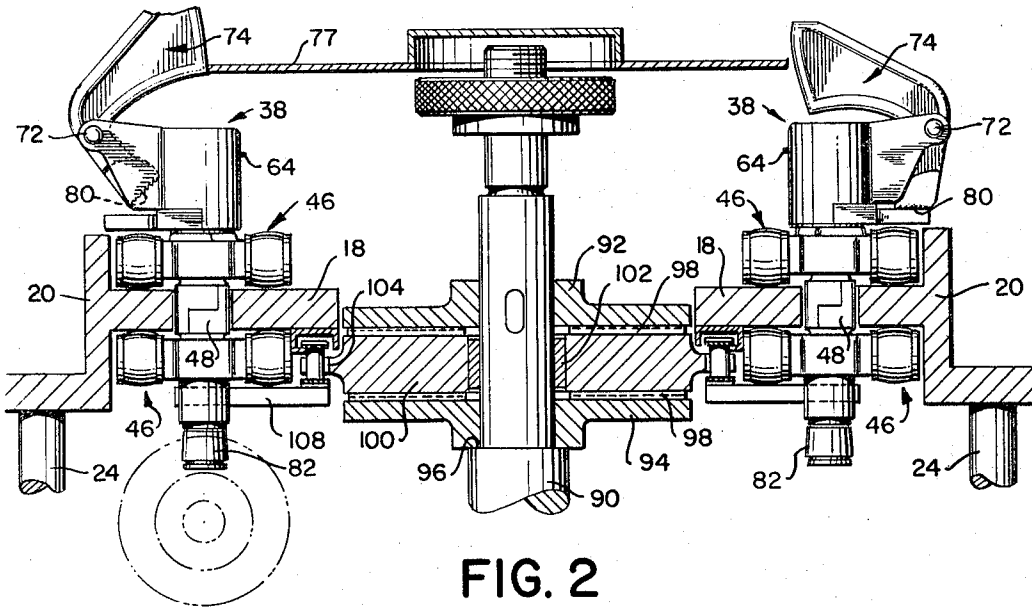


FIG. 2

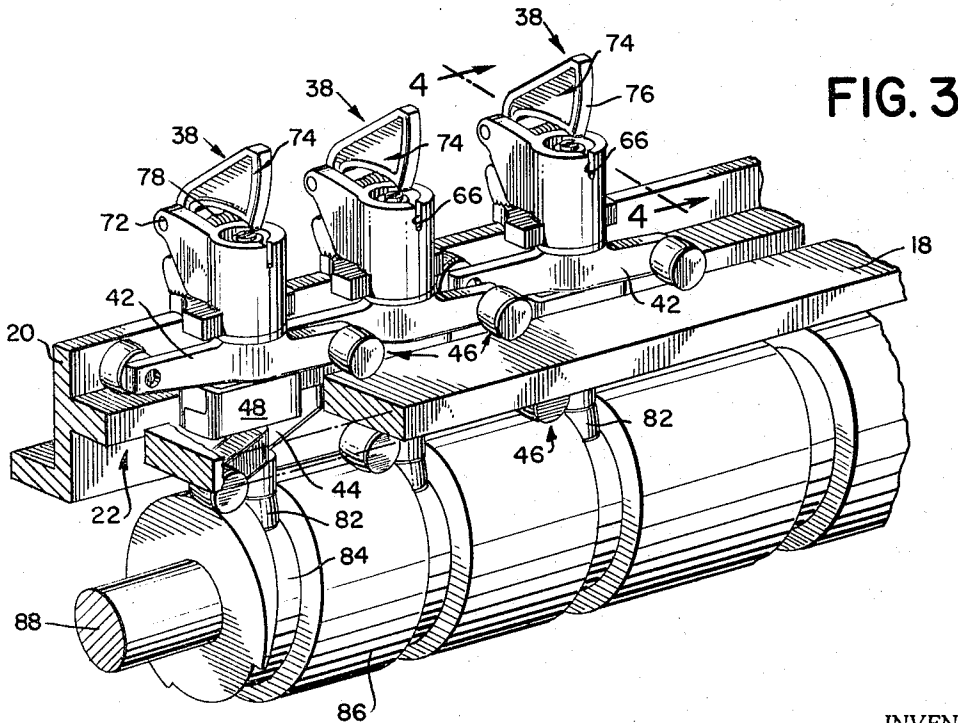


FIG. 3

INVENTORS
OLIVER G. LEWIS
HERBERT H. VICKERS
HOWARD C. NORTH

BY

Donald F. Wheeler
ATTORNEY

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O. G. LEWIS ETAL

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FIG. 4

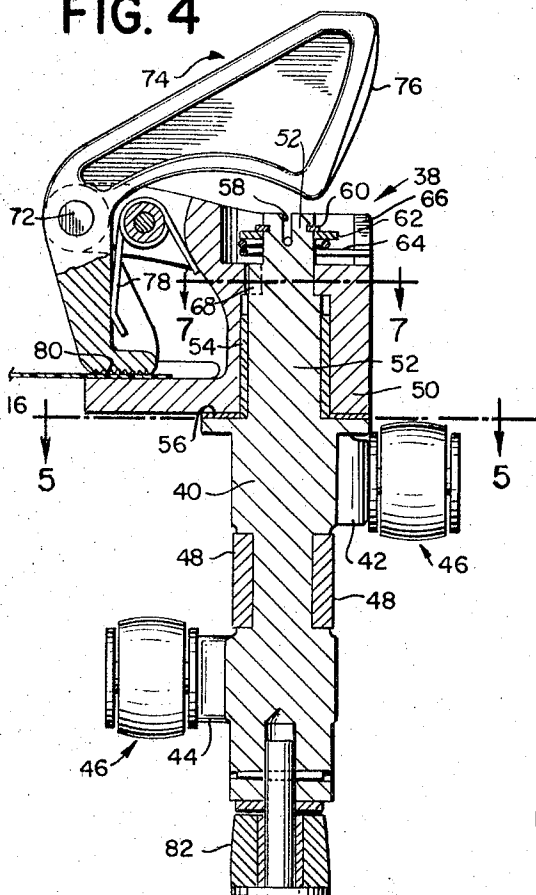


FIG. 5

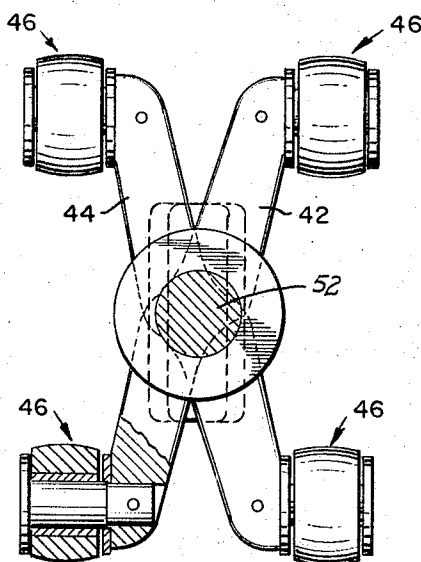
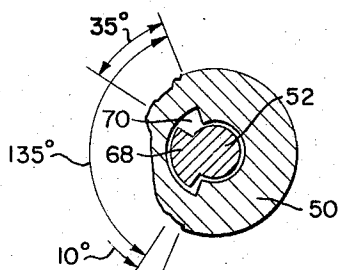


FIG. 7

C DIRECTION OF WEB TRAVEL →

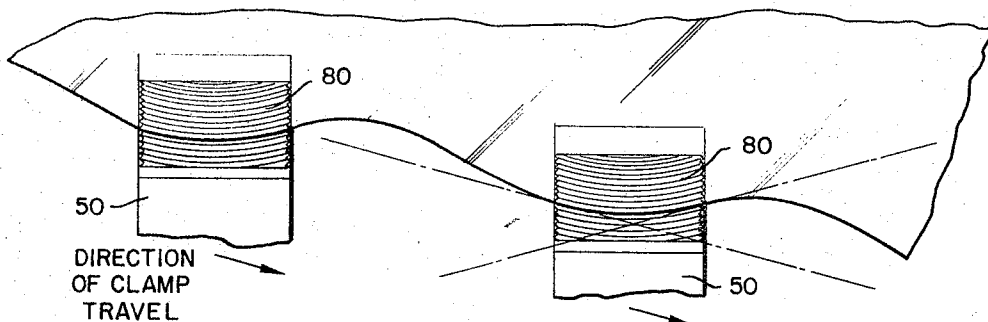


FIG. 6

INVENTORS
OLIVER G. LEWIS
HERBERT H. VICKERS
HOWARD C. NORTH
BY *Donald F. Wheeler*
ATTORNEY

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3,305,889

BI-AXIAL STRETCHING MACHINE

Oliver G. Lewis, Westfield, Herbert H. Vickers, Union, and Howard C. North, Westfield, N.J., assignors to Esso Research and Engineering Company, a corporation of Delaware

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10 Claims. (Cl. 18—1)

This invention relates to bi-axial web-stretching machines in general and in particular to improved means for gripping the longitudinal edges of the web as it passes through the stretching zone of the machine.

In machines of this type, as for example, a machine as described in U.S. Letters Patent No. 3,150,433 issued September 29, 1964 over which applicants' invention is an improvement, a plurality of individual web clamping means engage the longitudinal edges of the web as the web is fed into the stretching zone. Each of the individual clamping means is fed along diverging guide means to impart a transverse stretch to the web while it is being pulled longitudinally by the forward motion imparted to the clamping means. At the same time, the longitudinal spacing between adjacent clamping means as they enter the divergent stretching zone is increased so that a longitudinal stretching of the web will occur at the same time and along with the transverse stretching period. The changing path of travel of the web gripping clamps from an original path parallel to the longitudinal axis of the web when engagement occurs, into the divergent path in the stretching zone, in combination with the increased spacing between adjacent clamps as the clamps progress through the stretching zone imparts a changing set of stress conditions to the web in the clamped area. In machines of the type described in the aforementioned patent, unduly large stress concentrations are experienced in the web adjacent to clamps to such a degree that failure and breakage of the web in the clamp area is frequently experienced. Even in the instances where failure does not occur with clamps not incorporating applicants' invention the inability of these prior art clamps to adjust and equalize the stress concentrations along the edge of the web contributed to non-uniform stretching parameters upon the web during its passage through the stretching zone.

In accordance with the present invention, the improved clamps described herein are provided with a pivot to allow them to be in effect self-aligning in the direction of the composite forces acting upon the edge of the web. In this way, even though when they initially engage the edge of the web they are aligned parallel to the lengthwise axis of the web they are able to continue to be oriented in a similar relationship even after they have assumed their divergent path of travel in the stretching zone. Furthermore, this ability to pivot about a vertical axis permits the clamp to assume an orientation imparting the least amount of stress concentration to the web edge. Each clamp's ability to pivot also prevents binding of the clamp in the guideways thereby greatly reducing the friction between these elements. Another feature of applicants' improved clamp is the provision of novel curved serrations on the gripping jaw. The serrations formed in the jaw face are oriented so that their curvature conforms substantially to the direction of stress along the edge of the web and thereby permits the equalization of stress in the web edge between adjacent clamps as the distance between adjacent clamps varies as they progress through the stretching zone. A further novel feature of the invention is the provision of improved mounting means for the body portion of the clamp relative to the divergent guide means so that the body portion of the clamp does not rotate in a horizontal and/or vertical plane relative to the guide means thereby reducing

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the overall wear of the clamp means and reducing their tendency to bind.

Accordingly, it is a principal object of this invention to provide an improved clamp means which reduces the stress concentrations along the edge of the web as it traverses through a stretching zone.

Another object of the invention is to provide an improved clamp means for use in apparatus of the type described wherein the clamping means is capable of pivotable movement relative to its path of travel to permit it to be self-aligning with the stress vectors in the web edge.

Another object of the invention is to provide a novel clamp mechanism for use in a machine of the type described wherein a plurality of curved serrations are provided on the clamp jaw for engaging the web which serrations run generally tangent to the edge of the web between adjacent clamps and permit the stretch being imparted to the web to continue under the face of the clamp allowing for more even stretch throughout the machine direction and still not relax the grip in the transverse direction.

Another object of the invention is to provide an improved clamp which is reliable in operation, easy to service, and low in wear.

These and other objects and advantages of the invention will become apparent and the invention will be fully understood from the following description and drawings in which:

FIGURE 1 is a somewhat schematic top-plane view of a bi-axial stretching machine with which the invention may be used, certain parts being omitted for clarity of illustration and other parts being partly broken away;

FIGURE 2 is an enlarged fragmentary sectional view taken along lines 2—2 of FIGURE 1;

FIGURE 3 is an enlarged fragmentary perspective view showing several of the novel clamping means in accordance with the invention as they are advanced through the stretching zone;

FIGURE 4 is a vertical cross-section of an individual clamping means in accordance with the invention taken generally along lines 4—4 of FIGURE 3;

FIGURE 5 is a fragmentary sectional view taken substantially along lines 5—5 of FIGURE 4;

FIGURE 6 is a fragmentary plane view of an edge portion of the web showing the curved stretched portions thereof adjacent each clamp; and

FIGURE 7 is a cross-sectional view taken along line 7—7 of FIGURE 4.

Referring to the drawings, and in particular to FIGURE 1, the machine comprises a main frame structure designated generally at 10. The frame 10 supports infeed guide rolls 12 and a discharge conveyor roll system 14 for respectively receiving and guiding a web 16 to be stretched into and from the machine. The frame 10 supports two pair of parallel closed loop guide tracks 18 and 20. Both pairs of tracks are identical except that one is a mirror image of the other, as will be obvious to those skilled in the art. The outside track 20 and the inner track 18 are shown in greater detail in FIGURES 2 and 3, which will be referred to hereafter. However, the tracks 18 and 20 are parallel to each other but spaced apart to define a guideway 22 for the web clamping means. (See FIGURE 3.) The tracks 18 and 20 are supported on any suitable support structure such as for example posts 24 indicated in FIGURE 2. Similar posts not shown are provided for the inner track 18.

The posts 24 which support the track means 18 and 20 are carried by movable base members not shown which may be laterally adjusted by any one of three handwheels designated 26, 28 and 30. (See FIGURE 1.) Those familiar in the art, and particularly by reference to the aforementioned patent, will readily appreciate how adjust-

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ment of the handwheels 26, 28 and 30 affect the lateral spacing of the opposed paths of their respectively controlled portions of the tracks 18 and 20. In this way, the amount of lateral stretch imparted to the web 16 may be readily adjusted.

As shown, the tracks 18 and 20 and the guideway 22 defined therebetween form a pair of closed loop channels having initial or entrance portions 32 substantially straight and parallel to each other, divergent portions 34 diverging outwardly from each other in the direction toward the discharge end of the machine and defining therebetween a stretching zone, and straight parallel portions 36 defining the discharge ends of the guide means. (See FIGURE 1.)

As will be seen most clearly in FIGURE 3 as well as by reference to FIGURE 1, a plurality of clamp assemblies generally designated 38 are adapted to be moved about the guideways 22 in a circular endless path. Each of the clamping means 38 is advanced through its recirculating path by the combined action of an endless conveyor 106, a pair of sprocket wheels at opposite ends of the guide path, as well as by a feed screw 86 which advance the individual clamp assemblies 38 in the desired fashion through the divergent stretching zone portion of the machine. Referring to FIGURES 3 and 4, each clamp assembly 38 includes a body portion or clamp carrier 40. Each body portion 40 includes a downwardly projecting portion mounting a roller 82 adapted to engage a spiral slot 84 in the feed screw 86. The feed screw 86 is mounted upon a pivot shaft 88 and rotated in conventional fashion to advance each of the individual clamp assemblies 38 along the length of the screw. It should be noted that the spiral slot 84 has a varying pitch so that the clamps advanced along the length thereof gradually become more and more separated to thereby advance and stretch the film or web in the lengthwise direction at the same time that it is being stretched in the transverse direction. Each of the clamp carrier portions 40 includes a pair of projecting upper and lower arm or leg portions respectively 42 and 44. The upper leg 42 includes at its outermost ends a pair of guide roller assemblies 46 which engage the upper surface of the guide tracks 18 and 20. Similarly the lower arm or leg portion 44 include like roller assemblies 46 which engage the lower surface of the guide tracks 18 and 20. A pair of U-shaped interlocking slipper bearings 48, are disposed about a mid-portion of the clamp carrier 40 to provide a longitudinally elongated wearing surface in the guideway 22. The lengthwise extension of the slipper bearing surface against the guideway 22 prevents twisting of the clamp carrier 40 and binding therein. Mounted on top of the clamp body portion 40 is a clamp swivel generally designated 50 which is pivotally positioned on the upper stud portion 52. A bushing 54 and a bearing washer 56 are provided between the clamp swivel 50 and the pivot 52 to reduce friction and to make the swivel rotatable within predetermined angular limits relative to the carrier 40. In one form of the invention, the desired predetermined angular freedom of the clamp swivel 50 relative to the stud portion 52 is selected to be through a total arc of 45°, with 10° freedom forward of the perpendicular to the tracks 18 and 20, and 35° rearward of the track perpendicular. Reference should be made to FIGURE 7 in this respect wherein the pivot stud 52 includes a projecting dove-tail stop lug 68 which engages a similarly shaped but larger arc recess 70 formed in the swivel 50. As shown, the recess 70 extends through an arc of 135° while the stop lug 68 has a 90° segment to produce the total of 45° angular freedom between these respective pieces.

The upper portion of the pivot 52 includes a slot 58 arranged to receive one end of a centering torsion spring 64 which is held about the upper end of the pivot by a washer 62 and a C-clip 60. The other end of the torsion spring 64 extends through a slot 66 formed in the clamp swivel 50. In this way the normal position of the clamp assembly under the influence of the spring 64 will be in

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a position perpendicular to the path of the guide tracks 18 and 20.

Each of the clamp assembly swivels 50 carries a clamp arm 74 pivotally mounted thereto by a pin 72. One end of the clamp arm includes a curved camming surface 76 arranged to be mechanically contacted by a camming plate 77 (see FIGURES 1 and 2) during predetermined portions of their travel about the guideways. Each of the clamping arms 74 is normally held in a gripping relationship by a pigtail spring means 78 so that the jaw serrations 80 will engage the upper surface of the web 16 at all times unless they are otherwise cammed to the open position by the plate 77.

Referring to FIGURE 2 the operation and camming of the clamp arms 74 may be readily understood. In FIGURE 2, a vertical end shaft 90 will be understood to be driven by suitable means not shown. It will be obvious to those skilled in the art how any suitable driving motor may be connected to the shaft 90 to effect rotation thereof while still permitting lateral adjustment. Keyed to but slidable on the shaft 90 is a clutch plate 92 which cooperates with a back-up plate 94 mounted in abutment with a protruding shoulder 96. The clutch plates 92 and 94 are spaced apart and provided with friction driving faces 98 engageable with opposed faces of a sprocket or transfer wheel 100. The sprocket wheel 100 is journaled on a sleeve bearing 102 and provided with outer projecting teeth 104 so spaced that the recesses therebetween engage links of a feed chain 106. The feed chain 106 includes a plurality of projecting fingers 108 which continue the advance of the individual clamp assemblies 38 after they leave the spiral grooves 84.

In operation of the bi-axial orientation machine of the invention, the web 16 usually of a suitable stretchable plastic material is fed through the feed rollers 12 into the parallel entrance portion 32 of the machine. At this stage, the clamp assemblies are cammed to the open position by plate 77 and shortly thereafter as they advance are released so that serrations 80 tightly grip the edges of the web in a relationship initially perpendicular to the machine center line. As the clamp assemblies continue their travel through the entrance portion 32 in a parallel path, they operate to pull the web through the machine and at the same time are free to pivot rearwardly to the axis of the web travel in any angular amount up to 35° (the amount of rearward freedom between the stop lug 68 and the recess 70).

As the clamp assemblies 38 enter the stretching or diverging zone 34, they start their travel in an approximate angle of 20° relative to the lengthwise axis of the web. This 20° change in direction of each clamp assembly as it enters the stretching zone is readily compensated for by the ability of the clamp to pivot relative to its body portion 40. Therefore, as the clamp enters the divergent zone, no twisting of the edge of the web under the serration of the jaw is introduced. Furthermore, the pivoted relationship of the clamp swivel 50 relative to the body portion 40 permits the clamp to lag or rotate as required a further 15° to optimize and reduce stress concentrations along the edge of the film web. Referring to FIGURE 6 wherein a small section of the web edge is shown, it may readily be seen how the clamp swivels 50 have assumed a lagging angle relative to their direction of travel along the divergent guideways 18 and 20. Furthermore, in FIGURE 6 the optimized stress reduction accomplished by the curved serrations 80 on the jaws of the clamps may readily be appreciated. In this view, the scalloped edge of the web will be seen to approach the serrations in a generally tangential direction at the edges of the jaw face. In prior art clamps, such as employed in the aforementioned patent, the straight direction of the serrations along with the inability of the clamp to pivot relative to its body portion created unduly large stress concentrations in the areas adjacent the clamps which usually created ripping of the web unless

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highly optimized and controlled conditions were maintained. Applicants' invention has substantially reduced the criticality of these operating factors and has produced a machine wherein commercial operation becomes practical.

A further feature of the ability of each of the clamps to pivot relative to its body portion is that as the clamps travel along a curved path either in the stretching zone or outside thereof they tend to have uneven speeds and angles of tension relative to the edge of the web and relative to the speed at which the roller 82 is being advanced by the feed screw 86. Since all forces about each clamp jaw are in balance and its pivotal freedom allows it to temporarily assume a speed different from the forward speed of its associated drive roller 82, there is less chance of stress concentration and the possibility of the tearing of the film sheet is greatly reduced.

While a specific embodiment of the invention has been shown and described in detail to illustrate the application of the inventive principles, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. In a bi-axial web stretching machine the combination comprising, means for feeding a web of material to and through a stretching zone, said stretching zone being defined by guide means arranged in a diverging relationship relative to the longitudinal axis and direction of travel of said web, and a plurality of clamping means movable along said guide means for gripping the edge of said web and advancing said web through the stretching zone; each of said clamping means including a body portion having a lower projecting extension for engaging said feeding means for advancing said body portion along said guide means in fixed relation thereto, elongated slipper bearing means cooperative with said guide means for preventing rotation of said body portion relative to said guide means, and clamping arm means pivotally mounted upon said body portion for engaging the edge of said web, whereby said clamping arm means may rotate relative to said body portion while passing through said stretching zone to thereby equalize any uneven speed of feed and angle of tension in said web and reduce stress concentrations in said stretching zone.

2. The combination in accordance with claim 1 wherein said clamping arm means includes a movable jaw portion, said jaw portion having a plurality of serrations in the plane of said web for engagement therewith, said serrations being curved toward the central axis of said web and having end portions substantially tangent to the direction of stress in the edge of said web adjacent said jaw portion whereby the longitudinal stress in said web along the edge is substantially equalized between adjacent clamping means and continued under the face of said jaw portion.

3. In a bi-axial web stretching machine the combination comprising, means for feeding an elongated web of material to and through a stretching zone, said stretching zone being defined by guide means arranged in a diverging relationship relative to the longitudinal axis and direction of travel of said web, and a plurality of clamping means movable along said guide means for gripping the edge of said web and advancing said web through the stretching zone; each of said clamping means including, clamping arm means having a movable jaw portion, said jaw portion having a plurality of serrations in the plane of said web for engagement therewith, said serrations being curved toward the lengthwise axis of said web and having end portions substantially tangent to the direction of stress in the edge of said web adjacent said jaw portion whereby the longitudinal stress in said web along the edge is substantially equalized between adjacent clamping means and continued under the face of said jaw portion.

4. The combination in accordance with claim 1 wherein each said slipper bearing means includes a pair of in-

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terlocking U-shaped elements surrounding a portion of said clamping means body portion.

5. The combination of claim 4 further including first and second leg means extending outwardly from the body portion of each clamping means, said first leg means including a roller at each end in contact with an upper surface of said guide means, said second leg means including a roller at each end in contact with a lower surface of said guide means whereby rotation of said clamping means relative to said guide means in an axis perpendicular to the pivot axis of said clamping arm means is prevented.

6. Web securing means for use in a bi-axial stretching machine having a stretching zone comprising, clamping arm means having a movable jaw portion, said jaw portion including a plurality of serrations in the plane of said web for engagement therewith, said serrations being curved toward the central axis of said web and having end portions substantially tangent to the direction of stress in the edge of said web adjacent said jaw portion whereby the longitudinal stress in said web along the edge may be equalized between adjacent clamping means and continued under the face of said jaw portion.

7. Web securing means for use in a bi-axial stretching machine having a stretching zone comprising, securing means including clamping means movable along a guide means for gripping the edge of said web and advancing said web through the stretching zone; each of said clamping means including, clamping arm means having a movable jaw portion, said jaw portion having a plurality of serrations in the plane of said web for engagement therewith, said serrations being curved toward the longitudinal axis of the web and having end portions substantially tangent to the direction of stress in the edge of the web adjacent said jaw portion whereby the longitudinal stress in said web along the edge is substantially equalized between adjacent clamping means and continued under the face of said jaw portion.

8. Web securing means for use in a bi-axial stretching machine having a divergent stretching zone defined by spaced parallel guide means and feeding means therebelow comprising, each of said securing means including depending clamping means having a body portion including means engaging said feeding means for advancing said body portion along said guide means in fixed relation thereto, each of said clamping means including elongated slipper bearing means cooperative with said guide means for preventing rotation of said body portion relative to said guide means, and clamping arm means pivotally mounted upon said body portion for engaging the edge of the web, whereby said clamping arm means may rotate relative to said body portion while passing through the stretching zone to thereby equalize any uneven speed of feed and angle of tension in said web and reduced stress concentrations in said stretching zone.

9. The combination in accordance with claim 8 wherein each said slipper bearing means includes a pair of interlocking U-shaped elements surrounding a portion of said clamping means body portion.

10. Web securing means for use in a bi-axial stretching machine having a divergent stretching zone defined by spaced parallel guide means comprising, clamping means for gripping the edge of said web and advancing said web through the stretching zone of said machine, said clamping means including a body portion enclosed by elongated slipper bearing means slidably movable between said spaced parallel guide means for preventing rotation of said body portion relative to said guide means, and clamping arm means carried by said body portion for engaging the edge of said web, and means for mounting said clamping arm means upon said body portion to prevent transmission of twisting movement of said clamping arm means to said body portion whereby friction of said body portion along said guide means is reduced.

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WILLIAM J. STEPHENSON, *Primary Examiner.*