# United States Patent [19]

**Cauffiel et al.**

[11] **3,863,858**

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[54] **TENSIONING APPARATUS**


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[73] Assignee: **Ford B. Cauffiel,** Toledo, Ohio



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[52] **U.S. Cl.** ..... **242/75.2,** 226/195

[51] **Int. Cl.** ..... **B65h 23/10**

[58] **Field of Search** ..... 242/75.2; 226/39, 195



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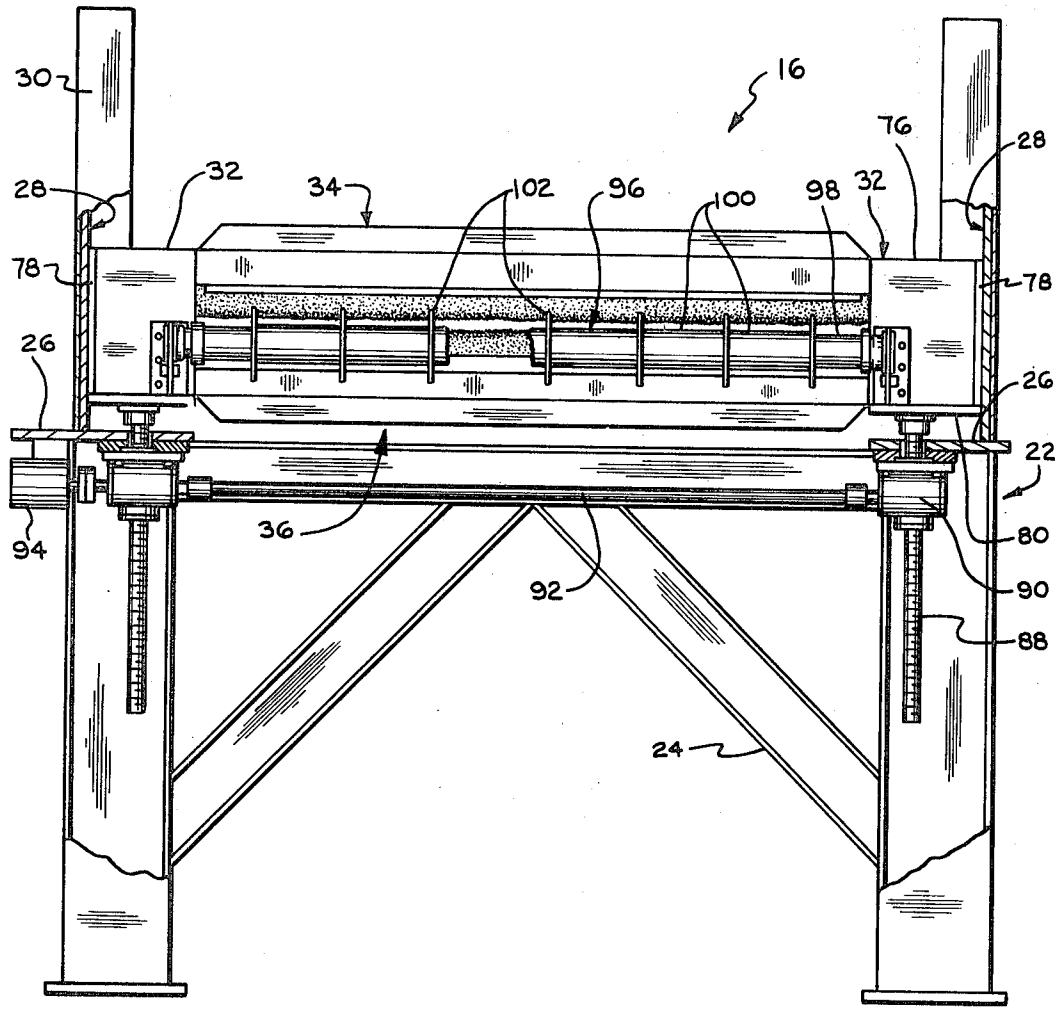
*Attorney, Agent, or Firm*—Allen D. Gutchess, Jr.



[57] **ABSTRACT**

Apparatus for applying uniform tension to a plurality of steel strips being wound into coils on a coiler is provided. The apparatus includes a pair of drag members between which the strips pass in parallel relationship. One of the drag members is in a fixed position relative to the other and the other is movable toward and away from the fixed one. Two elongate, fluid-filled members are behind the movable member and extend the length thereof. Air is supplied under pressure to the elongate members to urge the movable drag member toward the fixed one in order to place constant drag or tension on all of the strips passing therebetween. Both of the drag members can be held by supporting means which are moved vertically in a frame to move the drag members up as the strips are wound on the coils and the coils increase in diameter. This keeps the strips in constant relationship relative to the coil diameter and enables the tensioning apparatus to be placed closer to the coils than heretofore possible. The drag members can also be mounted on pivoted arms adjacent the mandrel of the coiler and move with the arms as the coil diameter increases.


**21 Claims, 8 Drawing Figures**



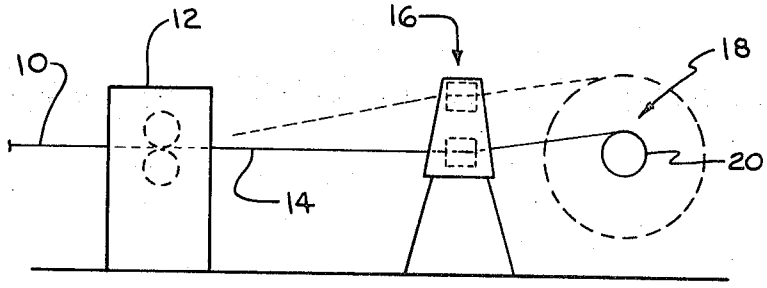

12
16
10
18
20
14

FIG. 1

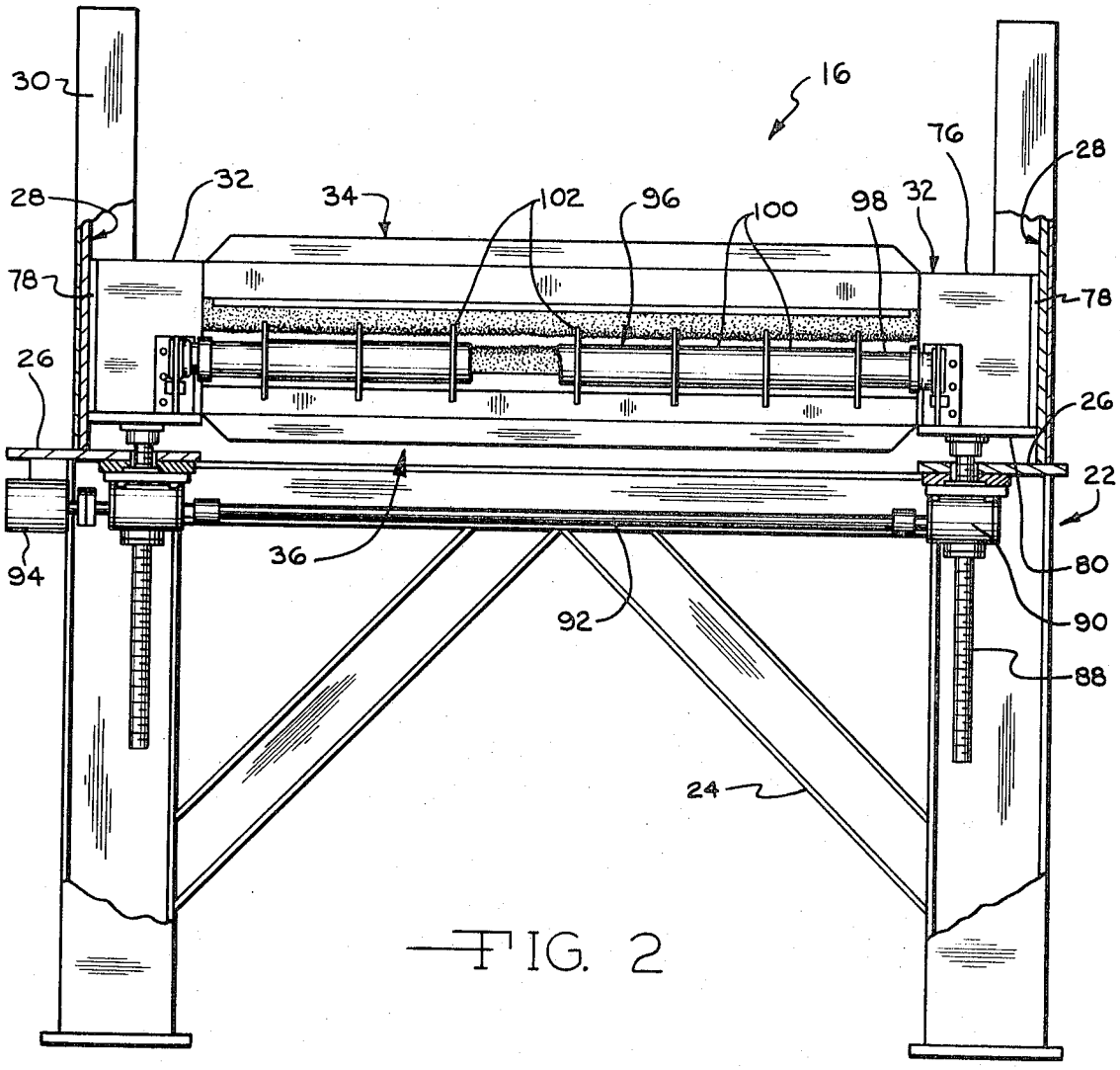

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102
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88
24

FIG. 2

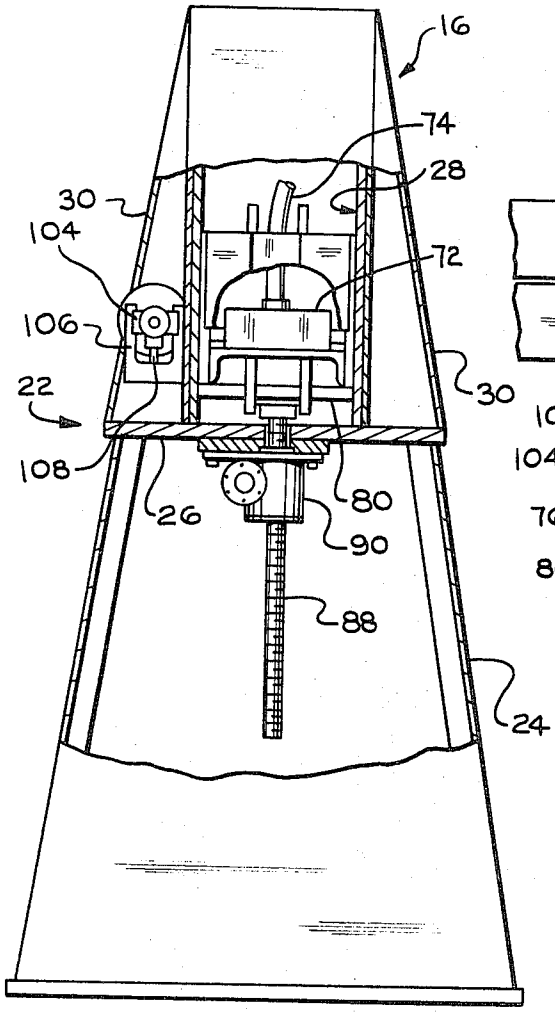



FIG. 3

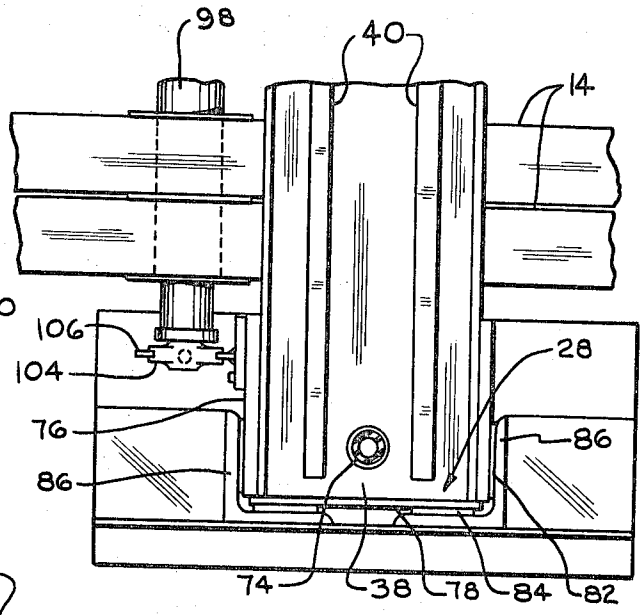



FIG. 4

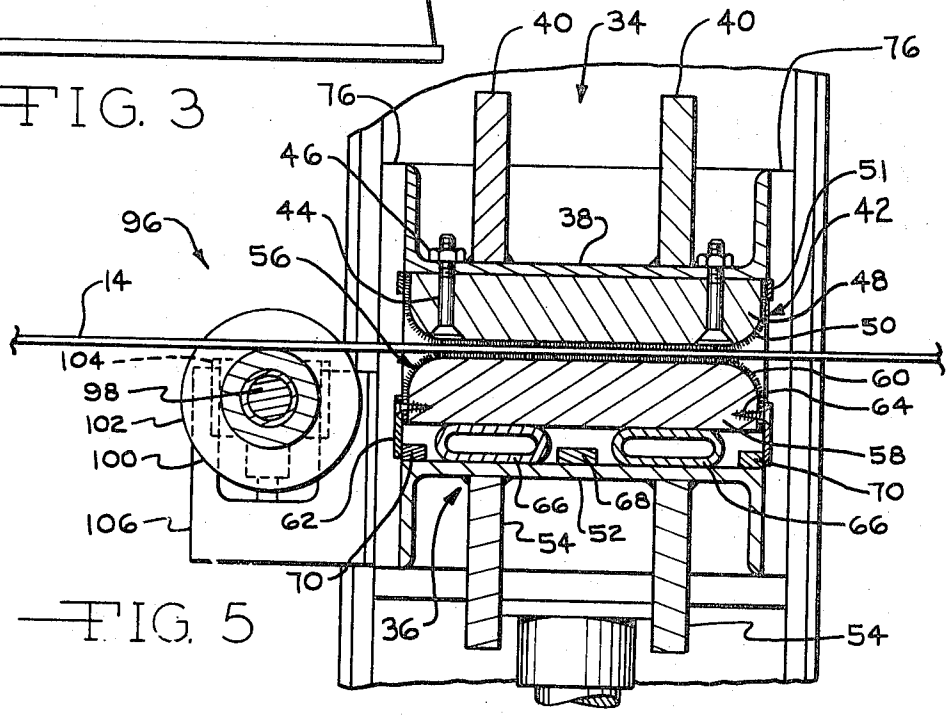



FIG. 5

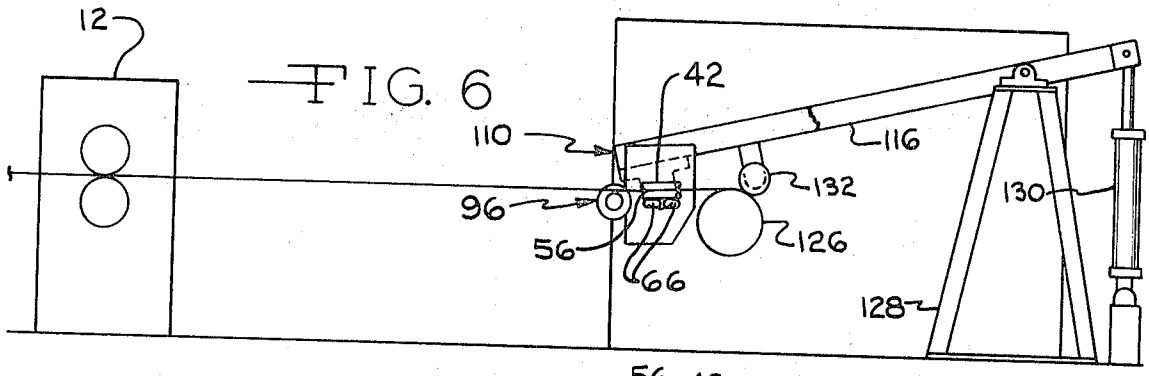



FIG. 6

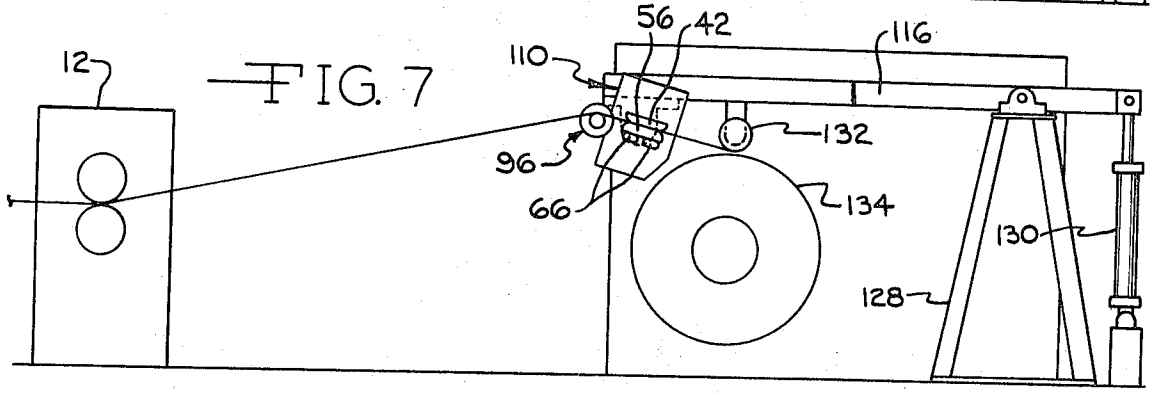



FIG. 7

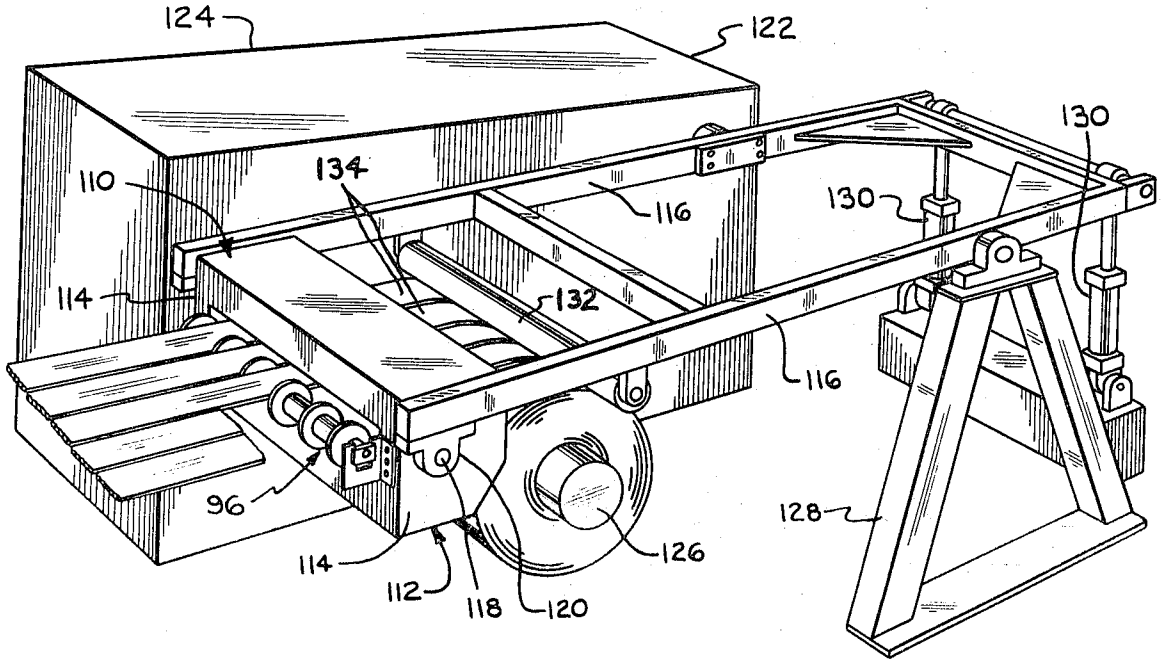



FIG. 8

# TENSIONING APPARATUS

This invention relates to apparatus for placing constant tension on a plurality of flexible, elongate members and to maintain a substantially constant relationship between the flexible members and coils on which they are wound.

The overall apparatus in accordance with the invention includes a slitter which severs a relatively wide sheet of steel into narrower ribbons or strips which are then wound on coils of a coiler or winding apparatus. During the coiling, it is important to keep constant tension on each of the flexible strips as they are wound. Heretofore, this has been difficult to achieve, with the difficulty increasing as the number of strips being wound increases.

The present invention provides a pair of drag members between which the strips pass. One of the drag members is fixed while the other is movable, being guided for movement toward and away from the fixed member. Means are provided which extend over substantially the entire length of the movable drag member to urge it toward the fixed drag member. Preferably, these means are in the form of flexible, tubular members to which air is supplied under pressure.

Heretofore, any tensioning device used had to be positioned at a substantial distance from the coiler so that the relationship between the strips being wound and the coils, as the diameters thereof increased, would not be unduly changed. In accordance with the invention, the drag members are mounted on supporting means which are raised as the strip coils increase in diameter to maintain a substantially constant relationship between the strips being wound and the coils. With this arrangement, the tensioning apparatus can be placed much closer to the coiler to save a substantial amount of floor space. Also, with the tensioning apparatus near the coiler, the strips are directed more precisely onto the coiler so that separators between the adjacent strip coils are not necessary.

It is, therefore, a principal object of the invention to provide improved tensioning apparatus for use in coiling strips of flexible material.

Another object of the invention is to provide tensioning apparatus for supplying uniform tension to a plurality of elongate, flexible members moving therethrough.

A further object of the invention is to provide tensioning apparatus which can be located closer to a coiler.

Yet another object of the invention is to provide tensioning apparatus for use with a coiler and means for maintaining a constant relationship between elongate, flexible members being coiled and the coils on which they are wound, as the coil diameters increase.

Many other objects and advantages of the invention will be apparent from the following detailed description of a preferred embodiment thereof, reference being made to the accompanying drawings, in which:

FIG. 1 is a schematic side view in elevation of a slitter, tensioning apparatus, and coiler;

FIG. 2 is a front view in elevation, with parts broken away and with parts in cross section, of the tensioning apparatus of FIG. 1;

FIG. 3 is a right end view, with parts broken away and with parts in section, of the tensioning apparatus of FIG. 2;

FIG. 4 is a fragmentary plan view of a portion of the apparatus of FIGS. 2 and 3;



FIG. 5 is an enlarged view in transverse cross section of tensioning members of the tensioning apparatus;

FIG. 6 is a schematic side view in elevation of a slitter, coiler, and modified tensioning apparatus, with the coiler empty;

FIG. 7 is a view similar to FIG. 6 but with a coil substantially fully wound; and

FIG. 8 is an enlarged view in perspective of part of the coiler and the tensioning devices of FIGS. 6 and 7.

Referring to the drawings and particularly to FIG. 1, a sheet of steel 10 from a suitable coil is fed through a slitter 12 which slits it longitudinally into a plurality of elongate, flexible members, specifically in the form of ribbons or strips 14. These strips are directed through a tensioning apparatus or device 16 which applies uniform tension to each of the strips, after which they are wound on a suitable coiler or, more accurately, recoiler indicated at 18, having a mandrel 20 on which the strips are coiled. The tensioning apparatus 16 can also be used with wire or the like as well as strips.

Referring more particularly to FIGS. 2–4, the tensioning apparatus 16 includes a frame 22 having a base 24, horizontal base plates 26, and upright channels or guide means 28 which are braced by diagonal supports 30.

End supports 32 project into the channels 28 and support two main back up members 34 and 36 extending therebetween. The upper back up member 34 comprises a channel beam 38 (FIG. 5) having stiffening plates or ribs 40 extending therealong to positions near the ends thereof. An upper, fixed drag member 42 is affixed to the web of the channel beam 38 by bolts 44 and nuts 46. The drag member itself comprises a long wooden block 48 having a suitable covering 50 thereon which can be affixed at the edges by suitable strips 51. The cover 50 can be a section of carpeting, by way of example.

The lower back up member 36 includes a channel beam 52 which faces the channel beam 38 and is affixed at its ends to the end supports 32 along with the upper channel beam 38. The lower channel beam 52 also has stiffening plates or ribs 54 affixed to the web thereof similarly to the plates 40. A movable drag member 56 is located above the channel beam 52 and includes a long wooden block 58 and a cover 60. The covering 60 is attached to the block 58 in this instance by depending side retaining plates 62 and screws 64. The retaining plates 62 extend moost of the distance between the end supports 32 but stop short of same. In addition to holding the cover 60, they restrict the movement of the movable drag member 56 to directions toward and away from the fixed drag member 42.

In accordance with the invention, two elongate, hollow, flexible members 66, shown in the form of hoses, are located on the upper surface of the channel beam 52, extending generally parallel thereto and parallel to each other with the aid of positioning blocks 68 and 70. When filled with fluid under pressure, the hollow members 66 tend to expand to a circular configuration and urge the movable drag member 56 upwardly toward the fixed drag member 42. Since pressure is applied on the member 56 along substantially the entire length thereof by the hollow members 66, the upward force exerted by the movable drag member 56 is exerted uniformly so as to place all of the strips 14 under constant tension. This assures uniformity in the resulting strip coils. The fluid, which can be air under a pressure of 60 psi, by

way of illustration, can be supplied to the members **66** by a manifold **72** (FIG. 3) connected to a flexible supply line **74** which communicates with a suitable source of air under pressure. The manifold **72** is located on the beam **52** beyond the ends of the blocks **48** and **58.** The degree of tension on the strips **14** can be controlled, for any given set of the drag members **42** and **56,** by the pressure of the air supplied to the hollow members **66.**

Each of the end supports **32** for the drag members includes upright side walls **76** to which the flanges of the channel beams **38** and **52** are affixed, an end wall **78** (FIG. 2), and a horizontally-extending wall or plate **80** therebelow. The end supports **32** are guided for vertical movement in the channels **28** by means of side and end brass ways **82** and **84** (FIG. 4) and vertical angle irons **86** which form the channel **28.**

To move the drag members **34** and **36** vertically, jack-screws **88** (FIGS. 2 and 3) are connected to the lower surfaces of the horizontal plates **80** of the end supports **32.** The jack-screws extend through the base plates **26** and through suitable drives **90** which are connected by a common connecting shaft **92** (FIG. 2) with a hydraulic drive motor **94** at one end. The motor **94** can be operated automatically by means of a timer, for example, or can be operated manually by a push button on the control panel for the overall equipment.

During the operation of the tensioning apparatus and the coiler, as the diameters of the strip coils on the mandrel **20** increase, the end supports **32** are raised through the drives **90** and the jackscrews **88** to accordingly raise the drag members **42** and **56.** This enables the strips **14** being wound on the coils to assume a constant relationship with respect thereto as the coil diameters increase, as shown in dotted lines in FIG. **1.** With this arrangement, the tensioning apparatus **16** can be placed much closer to the coils than otherwise, without any undue bend occurring in the strips. By being closer to the coiler, the strips can be directed more precisely thereon so that separators are not needed between the strip coils on the mandrel **20.**

To aid in maintaining the strips **14** in parallel relationship and with proper spacing, strip guide means **96** can be located at the upstream side of the drag members **42** and **56.** The guide means includes a spindle **98** on which are rotatably mounted spacers **100** and guide discs **102.** The spindle **98** is rotatably mounted in bearing blocks **104** which are mounted for vertical adjustable movement in brackets **106** by adjusting screws **108** to adjust the position of the guide relative to the drag members. The brackets **106** are mounted on the front or upstream side walls **76** of the supports **32** so as to maintain a constant relationship with the drag members **42** and **56** as they are moved vertically.

Referring to FIGS. **6–8,** a modified tensioning apparatus or device **110** preferably is essentially similar to that of FIGS. **1–5** but with the elimination of the frame **22** having the base **24,** the base plates **26,** the channels **28,** and the diagonal supports **30.** In this instance, the tensioning device is mounted in a frame schematically indicated at **112** which includes end frame plates **114** which can directly support the back up members **34** and **36.** Like the tensioning device **16,** the tensioning device **110** includes the drag members **42** and **56** preferably with the flexible pressure members **66** below the movable drag member **56.**

The tensioning device **110** in this instance is pivotally carried on ends of over-head arms **116,** having stub shafts **118** carried in bearing blocks **120,** by way of example. One of the arms **116** is pivotally mounted on a drive unit **122** of a coiler or recoiler **124** having a mandrel **126.** The other of the arms **116** is pivotally mounted on an outboard support or stand **128.** The weight of the tensioning device **110** can be partly offset by suitable counterbalancing means, shown as pneumatic cylinders **130** in this instance.

A straight, positioning roll **132** is rotatably carried by the arms **116** near the tensioning device **110** and in a position to contact coils **134** as they build up and increase in diameter on the mandrel **126.** As the coils increase in diameter, the roll **132** rides upwardly therewith and moves the arms **116** in a clockwise direction. The tensioning device **110** is similarly moved in an upper or clockwise direction, thereby maintaining a substantially constant relationship between the tensioning device and the coils. Thus, this relationship is achieved relatively simply without the necessity of employing the frame **22** and the related components, along with the jackscrews **88,** the drive **90,** the connecting shaft **92,** and the hydraulic drive motor **94.**

The pivotal arrangement for the tensioning device **110** enables it to change its position relative to the arms **116,** if necessary, as the coils **134** increase in diameter. The pivot points for the tensioning device, specifically the stub shafts **118,** preferably are on a line extending between the adjacent faces of the drag members **42** and **56** and somewhat forwardly, toward the slitter **12,** of a center line through the drag members.

The tensioning device **110** preferably is placed as close as possible to the mandrel **126** without interfering with the mandrel or the coils. This enables the spacing means **96** to be placed close to the points where the strips are received tangentially on the coils **134,** thereby maintaining the coils in spaced relationship. If desired or necessary, however, spacing means can be provided similar to the spacing means **96** near the straight roll **132,** somewhat forwardly thereof, or the straight roll **132** can be replaced by spacing means similar to the spacing means **96** but positioned forwardly of the present roll. Such spacing means can be similar to the spacing means of FIGS. **1–5,** including the spindle **98,** the spacers **100,** and the discs **102.**

Various modifications of the above described embodiment of the invention will be apparent to those skilled in the art and it is to be understood that such modifications can be made without departing from the scope of the invention, if they are within the spirit and the tenor of the accompanying claims.

I claim:

**1.** A tensioning device for maintaining substantially equal tension on a plurality of elongate, flexible members, said tensioning device comprising a first drag member, means for holding said drag member in a predetermined position, a second drag member, means for holding said second drag member facing said first drag member, said flexible, elongate members being passed in a common direction between said drag members, means for establishing uniform pressure over a substantial portion of the length of said second drag member to urge said second drag member toward said first drag member, supporting means for supporting both of said drag members, and at least two jackscrews engageable with said supporting means for raising and lowering said supporting means.

2. A tensioning device according to claim 1 characterized by said pressure means comprises elongate resilient means.

3. A tensioning device according to claim 1 characterized by said pressure means being tubular, and means for supplying fluid to said tubular means.

4. A tensioning device according to claim 3 characterized by said fluid being a gas.

5. A tensionning device according to claim 1 characterized by means associated with said second drag member for limiting the movement thereof to directions toward and away from said first drag member.

6. A tensioning device according to claim 1 characterized by said raising and lowering means comprises guide means for directing said supporting means along generally vertical paths.

7. A tensioning device according to claim 1 characterized by drive means engageable with each of said screws, and means for driving said drive means to turn said screws.

8. A tensioning device for maintaining tension on an elongate, flexible member, said device comprising a first drag member, means for holding and backing up said first drag member in a fixed position, a second drag member, means for holding and backing up said second drag member in a fixed position facing said first drag member, said flexible member being passed between said drag members, means for urging one of said drag members toward the other, support means for supporting both of said holding means, rotatable guide means for guiding the flexible member between said drag members, brackets supported by said support means and rotatably supporting said guide means, and means for moving said support means to move both of said drag members and said guide means equally in a given direction.

9. A tensioning device according to claim 8 characterized by adjustable means between said rotatable guide means and said brackets for adjusting said guide means relative to said supporting means and said drag members.

10. A tensioning device according to claim 8 wherein said moving means comprises at least two jackscrews engaging said supporting means for raising and lowering said supporting means.

11. A tensioning device according to claim 10 characterized by drive means engageable with each of said jackscrews, and means for driving said drive means to turn said jackscrews.

12. A tensioning device according to claim 8 characterized by said urging means acts substantially uniformly on said one drag member over substantially the entire length thereof.

13. A tensioning device according to claim 8 characterized by said urging means comprises a flexible, hollow member, and means for supplying fluid under pressure to said flexible, hollow member.

14. A tensioning device according to claim 13 characterized by said fluid being air.

15. In combination, a coiler including a mandrel, arm means extending over said mandrel, means pivotally supporting said arm means near said mandrel, a tensioning device carried by said arm means to receive elongate, flexible material to be coiled on said mandrel, and means associated with said arm means for moving said tensioning device away from said mandrel as a coil on said mandrel increases in diameter.

16. The combination according to claim 15 characterized by said moving means comprises roll means carried by said arm means and positioned to engage the coil on the mandrel.

17. The combination according to claim 15 characterized by said ellongate, flexible means comprises a plurality of strips and said tensioning device includes spacing means for spacing apart the adjacent strips to be wound on the mandrel, said spacing means being carried by said tensioning device and movable therewith.

18. The combination according to claim 17 characterized by said spacing means being on the side of said tensioning device opposite the mandrel.

19. The combination according to claim 15 characterized by said tensioning device comprises a pair of drag members between which the material to be coiled passes.

20. The combination according to claim 19 characterized by means for yieldably urging one of said drag members toward the other.

21. The combination according to claim 15 characterized by counterbalancing means connected to said arm means for at least partly offsetting the weight of the tensioning device.

* * * * *