MULTI-BOW EXPANDER ROLL

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Fig-1

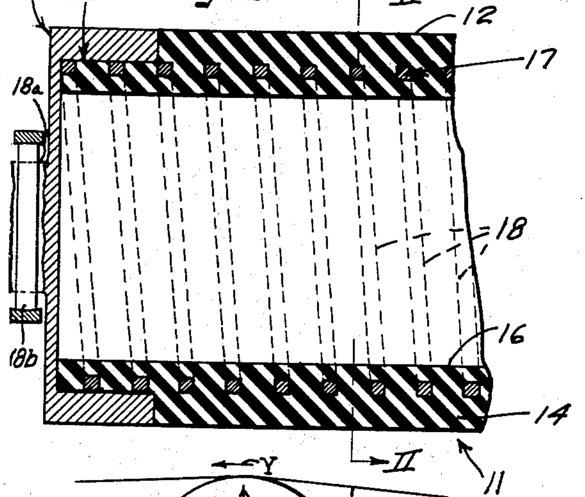


Fig-2

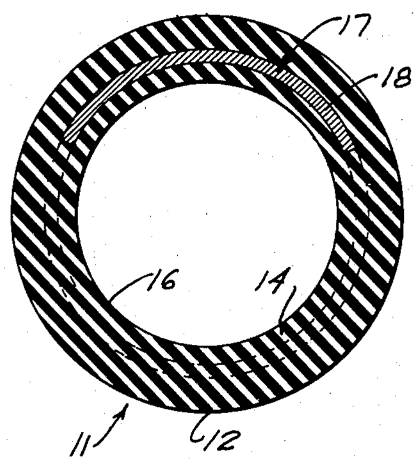


Fig-3

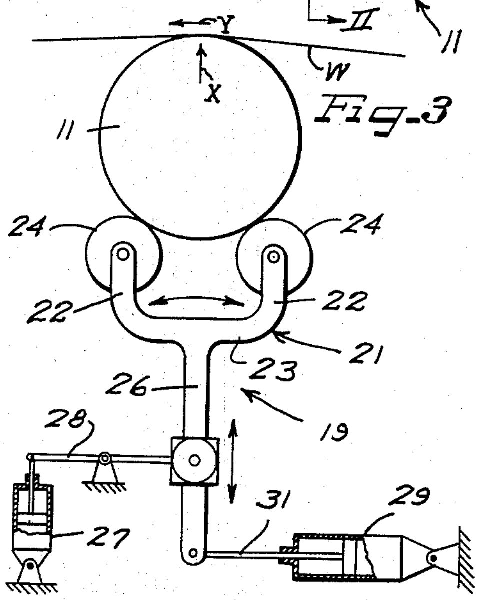


Fig-5

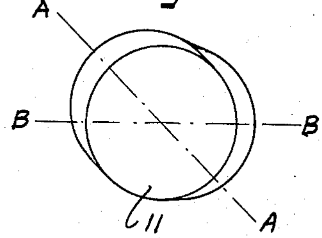
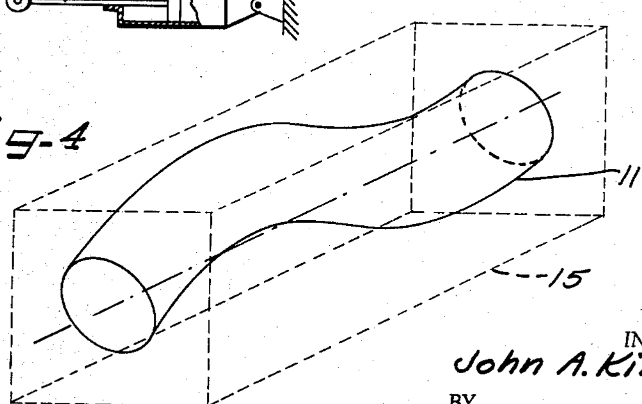


Fig-4



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MULTI-BOW EXPANDER ROLL

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Fig-6

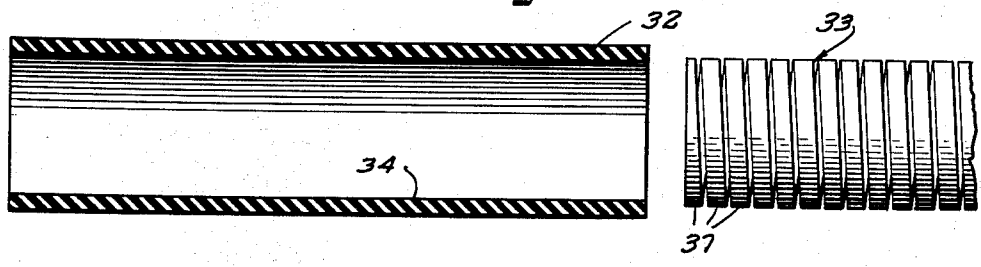


Fig-7

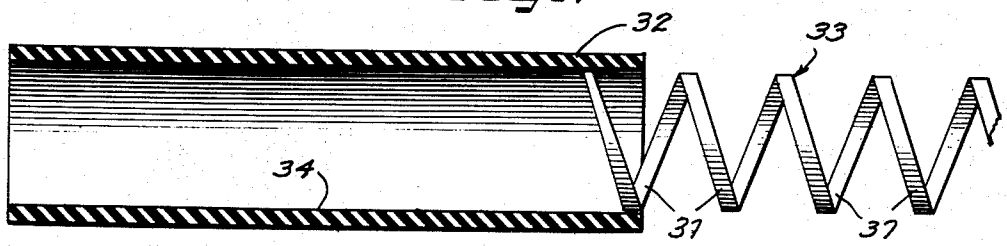
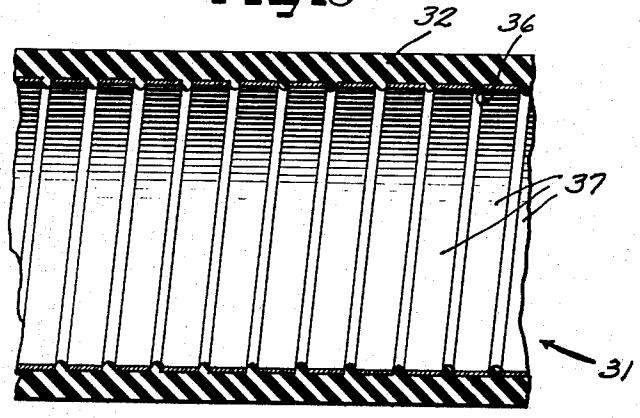


Fig-8



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3,248,031

MULTI-BOW EXPANDER ROLL

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12 Claims. (Cl. 226—194)

This invention generally relates to improved deformable rolls and more particularly relates to improved deformable rolls that will retain deformation, while rotating, in one plane or in a plurality of planes, a method of manufacturing the deformable rolls, and means for deforming said improved deformable rolls.

Deformable rolls to which this invention relates are useful as spreader rolls for web winding machines in the paper and textile industry or as a spreader roll for any portion of the paper machine. Known deformable rolls, such as described in U.S. Patent No. 2,960,749, lacked the versatility of the rolls of the present invention. These known rolls only could be deformed or bowed, while rotating, in a single plane with a fixed radius of curvature. Also, the means to bow these rolls was incapable of simultaneously bowing the rolls in more than one plane while said roll was rotating. Further, the spreader bars that could be bent in more than one plane were fixed and not rotatable. Thus, their friction surfaces would mark the sheets of paper contacted.

Therefore, it is an object of the present invention to provide an improved deformable roll and an improved means to deform said deformable roll.

It is another object of the present invention to provide an improved deformable roll that, while rotating, may simultaneously retain deformations in more than one plane.

It is still another object of the present invention to provide an improved roll bowing means that will simultaneously bow a deformable roll in more than one plane while the deformable roll is rotating.

It is further another object of the present invention to provide an improved deformable roll wherein said roll has a helically wound spring member extending the length of the roll and being embedded in a resilient roll cover to allow the roll to be deformed selectively throughout its length.

It is still further another object of the present invention to provide an improved roll deformer adapted to contact the surface of the roll to be deformed during rotation of said roll.

It is another object of the present invention to provide an improved roll deformer having two interconnected freely rotatable supporting rolls contacting the surface of a deformable roll and means connecting said supporting rolls to pivot the supportnig rolls, and raise and lower the supporting rolls.

It is still another object of the present invention to provide a web winding apparatus having a spreader roll which is freely rotatable and simultaneously deformable in more than one plane during rotation of said roll, a plurality of roll deformers contacting said deformable roll and each roll deformer having two freely rotatable interconnected supporting rolls that contact the surface of the deformable roll, and means to separately or simultaneously raise and lower, and/or pivot the two rolls simultaneously to selectively deform areas along the length of the deformable roll.

Other features, objects, and advantages of the present invention will become apparent after careful consideration of the following detailed description when considered in conjunction with the accompanying drawings wherein like reference numerals and characters refer to like and corresponding parts throughout the several views.

On the drawings:

FIGURE 1 is a partial longitudinal cross-sectional view of a web spreader roll constructed in accordance to the principles of the present invention;

FIGURE 2 is a transverse cross-sectional view of the spreader roll of the present invention taken along lines II—II of FIGURE 1;

FIGURE 3 is a plan view of a spreader means, constructed in accordance to the principles of the present invention being in contact with the web spreader roll of the present invention;

FIGURE 4 is an elevational view of the spreader roll of the present invention after it is bowed in more than one plane by the spreading means of the present invention;

FIGURE 5 is a plan view of the spreader roll illustrated in FIGURE 4;

FIGURE 6 is a partial longitudinal cross-sectional view, with parts in elevation, of the first step in manufacturing a web spreader roll constructed in accordance to another embodiment of the present invention;

FIGURE 7 is a partial longitudinal cross-sectional view, with parts in elevation, of the second step in manufacturing the web spreader roll constructed in accordance to the other embodiment of the present invention; and

FIGURE 8 is a partial longitudinal cross-sectional view of the web spreader roll constructed in accordance to the other embodiment of the present invention.

As shown on the drawings:

The spreader roll of the present invention is capable of having a plurality of bows in a single plane and/or a plurality of bows in different planes; that is, the roll may have a plurality of curvatures with the curvatures facing in the same direction or in different directions. The spreader roll of the present invention allows the roll to be bowed across its length in accordance with the desired adjustments of the web passing over the roll. The spreader roll may be driven by a drive belt suitably connected to either or both ends thereof. The spreader roll has a suitable flexible outer surface such as rubber. The rubber covering has embedded therein a helically wound spring member that extends the length of the roll. The helical spring is embedded in the rubber roll cover such that it gives strength and flexibility to the roll. The rubber is between and separates the adjacent windings of the spring.

The roll supporting or deforming means to bow the web spreader roll has a plurality of roll supporters spaced along the length of the web spreader roll. Each roll supporter has two spaced parallel contact rolls that simultaneously contact the surface of the spreader roll. The distance between the contact rolls on the surface of the web spreader roll is less than 180° apart. The contact rolls of each supporter are connected on the ends of the bifurcated fingers of a fork type mounting. The fork mounting may be moved up and down or pivoted to move both contact rolls of each supporter simultaneously. By selectively actuating the supporter along the length of the spreader roll, the spreader roll may be bowed with the accuracy desired while still allowing the spreader roll to rotate.

Referring to FIGURES 1 and 2 there is illustrated a deformable spreader roll **11**. The spreader roll **11** has a central cylindrical roll surface **12** and a pair of reduced cylindrical journal ends **13** (only one being shown). The spreader roll **11** is adapted to be a freely rotating roll with well known self-aligning free rotating bearing members connected to the journal ends **13**, or a driven roll being rotated by a belt means at either or at both ends of the spreader roll **11**.

The spreader roll **11** is a flexible resilient tubular body **14**, of a predetermined thickness, defining with its inner surface **16** a cylindrical passage therethrough. The body

is preferably manufactured from rubber having the desired flexible and resilient qualities needed for a web spreader roll. A flat helical wound spring member **17** is embedded in the body **14**. The helical wound member is concentric with and extends the length of the tubular body **14**. The diameter of the wound member **17** is less than the diameter of the outer roll surface **12** and greater than the diameter of the roll inner surface **16**. Therefore, the helical member is radially spaced a predetermined distance inwardly from the outer roll surface **12** and outwardly from the inner roll surface **16**. However, the outer surface diameter of the helical wound member is preferably equal to the outer diameter of the roll journal ends **13**.

The adjacent windings **18** of the helical wound member are not in contact with each other and are separated with the tubular body rubber being therebetween. The embedded helical separated winding spring member gives strength and flexibility to the roll **11** and enables the roll **11** to act as a spreader roll without the need of additional bearing support means located along the length of the inner diameter passage surface **16**. Further, the embedded member makes it possible for the spreader roll **11** to have a single bow in one plane or a compound bow in more than one plane maintaining a smooth curvature of the roll outer surface.

For obtaining a spreading action between the roll **11**, and a supported traveling web W, the roll **11** is bowed in a first plane as indicated by the direction X, which is normal to the plane of the traveling web W and in a second plane, as indicated by the direction Y, which is parallel to the plane of the traveling web W. This double bowing enhances the spreading effect of the roll **11** and provides laterally outwardly directed forces in the plane of the web either for smoothing wrinkles from the web or for separating separate strips when the web is formed of a plurality of strips such as when the web passes through a slitter before reaching the roll **11**. The end of the roll **10** has a suitable support journal **18***a* carried in a self aligning free rotating bearing **18***b*.

Referring to FIGURES 4 and 5, the spreader roll **11** has a compound bow in two separated planes such as may be used to obtain unique spreading effects of unequal or controlled force along the length of the roll. The roll is bowed simultaneously along the plane defined by the axis A—A and along the plane defined by the axis B—B. The dotted box **15** in FIGURE 4 is to illustrate this two plane compound bow or deformation of the spreader roll. It is of course understood that the spreader roll may be deformed in more than two planes.

The spreader roll **11** is rotated while it has its compound deformation and thereby eliminates the detrimental frictional drag contact between its surface and the web that contacts its surface; this detrimental frictional drag being associated with non-rotating fixed spreader bars. The spreader roll may have a plurality of deformations along its length and area to accurately control the desired travel of a web across the width of the web.

Spreader rolls of the present invention are particularly applicable to paper winding machines wherein it is desired to accurately control the paper web being fed to the winding drums. A typical paper winding machine spreader roll of the present invention is a roll 50 inches long and having a 6 inch outer diameter. A ¼ inch square helical wire with a ¾ inch pitch is embedded in a one inch thick rubber body of the spreader roll so as to be radially spaced approximately a half inch from the outer surface of the spreader roll.

Referring to FIGURES 6–8, there is illustrated an alternate type deformable spreader roll **31**. The spreader roll **31** is formed by having a suitable tubular rubber sleeve **32** having a predetermined thickness, diameter, and length, and a helical spring **33** of suitable length, cross-section and wound diameter. The length of the unbiased spring **33** is preferably equal to the length of the rubber sleeve **32** and the outer diameter of the unbiased spring is greater than the inner diameter of the sleeve. The unbiased spring is stretched, FIGURE 7, until the outer diameter thereof is less than the inner diameter of the sleeve **32**. The stretched spring is then inserted into the rubber sleeve **32**. When the stretched spring is within the sleeve, it is re-expanded within the rubber sleeve and returned to its unbiased position with the spring entirely contained within the rubber sleeve. The re-expansion of the helical spring to its unbiased condition causes the inner surface **34** of the tubular casing **32** to form protrusions **36** therewith between the adjacent windings **37** of the helical spring **33** (FIGURE 8) and thereby provide a tight fit between the outer diameter of the spring and the inner diameter of the tubular sleeve. This tight fit may be augmented with suitable adhesives, if desired.

The alternate spreader roll **31** is properly journalled for rotation and can have a single bow in one plane or a compound bow in more than one plane, similar to the spreader roll **11** illustrated in FIGURES 4 and 5. The typical spreader roll **31** is 50 inches long, a half inch thick, a 6 inch outer diameter and has a suitable helical spring **32** mounted therein.

Referring to FIGURE 3, a plurality of fork supports **19** are spaced along the longitudinal length of the spreader roll **11** to give it the desired curvature along its axial length, and deform it in directions X and Y. The curvature in each of the X and Y planes can be independently controlled. Also the bending curve can be varied along its length such as being flatter at the center and sharper at the ends. The distance between the adjacent support and the number of spreaders for any particular spreader roll depends on the amount of support necessary, the amount of deformations and the type of deformations desired for the particular spreader roll **11**. Usually supports at 1 to 1½ foot intervals will be suitable for a spreader roll deformed against the sheet and in the direction of sheet travel, as indicated in FIGURE 3.

Each spreader has a U-shape support member **21** with two parallel bifurcated legs **22** extending upwardly from a base **23**. The upper ends of the legs **22** have connected thereto support rollers **24** which have their longitudinal axis extending parallel to the longitudinal axis of the undeformed spreader roll **11**. The support rollers **24** are freely rotatable and preferably have a four inch outer diameter with a six inch length when used with a six inch spreader roll **11**. The support rollers are spaced apart a predetermined distance and are adapted to simultaneously maintain contact with the under surface of the rotating spreader roll **11** while a web is passing over the top surface of the spreader roll. The contact distance between the two spreader rolls **22** on the under surface of the spreader roll **11** is preferably less than 180°.

Extending away from the legs **22** and approximately centrally from the support base **23** is a support arm **26**. The support arm is fixed to or integral with the support base **23**. Attached to the support arm **26** is a lift means to raise and lower the spreader. The lift means may comprise a hydraulic piston member **27** suitably connected to the support arm by a lever arm **28**. It is of course understood that any of the well known lift means may be utilized to raise and lower the spreader.

A pivot means is also connected to the support arm to pivot the spreader about an axis substantially perpendicular to the longitudinal axis of the support rolls and transverse to the longitudinal axis of the spreader roll. The pivot means has a hydraulic piston member **29** suitably connected to the support arm **26** by a pivot arm **31** to pivot the spreader. It is of course understood that other well known pivot means may be utilized to pivot the spreader.

The spreader lift and pivot means may be operated sequentially or simultaneously.

The spreaders of the present invention are operated in

pairs with their respective support rolls effectively supporting and deforming the rotatable spreader roll. Both of the support rolls of each spreader are maintained in contact with the sperader roll during its rotation and while it is deformed.

It is seen where I have provided an improved rotatable spreader roll that may be deformed in one or more than one plane and an improved spreader for deforming a spreader roll.

The present arrangement permits deforming the axis of the spreader roll without requiring means extending through the center of the roll and by supports which are externally of the roll.

It will be understood that the above embodiments of my invention have been used for illustrative purposes only and that other modifications and variations in the present invention may be effected without departing from the spirit and scope of the invention as set forth in the hereunto appended claims.

I claim as my invention:

1. A spreader roll mechanism for paper winding machines comprising:
- a rotatable deformable spreader roll capable of being deformed in more than one plane,
- a plurality of spreaders disposed along the length of the deformable roll,
- said spreaders each having a pair of spaced support rolls freely rotatably connected to one end thereof, said support rolls having their longitudinal axis extending in the same direction as the longitudinal axis of the spreader roll,
- means maintaining the pair of support rolls of each spreader in contact with the under surface of the spreader roll,
- each pair of said support rolls being spaced to have therebetween a contact distance on the under surface of the spreader roll of less than 180°,
- means connected to the spreaders to selectively actuate each spreader to deform the spreader roll in one plane as well as in a plurality of planes when desired.

2. A spreader roll mechanism for paper winding machines comprising:
- a rotatable deformable spreader roll capable of being deformed in more than one plane,
- a plurality of fork shaped spreaders disposed along the length of the deformable roll,
- said spreaders each having a pair of spaced parallel support rolls freely rotatably connected to one end thereof, said support rolls having their longitudinal axis extending in the same direction as the longitudinal axis of the spreader roll,
- means maintaining the pair of support rolls of each spreader in contact with the under surface of the spreader roll,
- each pair of said support rolls having a contact distance on the under surface of the spreader roll of less than 180°,
- means connected to the spreaders to selectively pivot each spreader transverse to the longitudinal axis of the spreader roll, and
- lift means connected to the spreaders to selectively raise and lower each spreader

whereby selective pivoting and vertical movement of selective spreaders deforms the spreader roll in one plane as well as in a plurality of planes.

3. A spreader roll mechanism for paper winding machines comprising:
- a rotatable deformable spreader roll capable of being deformed in more than one plane,
- said spreader roll having a resilient flexible tubular body with reduced diameter journal ends,
- a helical spring member said helical spring extending the length of the tubular body and being embedded therein,
- said helical spring having adjacent windings separated by the rubber of the tubular body,
- a plurality of fork shaped spreaders disposed along the length of the deformable roll,
- said spreaders each having a pair of parallel support rolls freely rotatably connected to the upper end thereof,
- means maintaining the pair of support rolls of each spreader in contact with the under surface of the spreader roll,
- means connected to the spreaders to selectively pivot each spreader transverse to the longitudinal axis of the spreader roll, and
- lift means connected to the spreaders to selectively raise and lower each spreader

whereby selective pivoting and vertical movement of selective spreaders deforms the spreader roll in one plane as well as in a plurality of planes.

4. A spreader roll mechanism for paper winding machines comprising:
- a rotatable deformable spreader roll capable of being deformed in more than one plane, said spreader roll having a resilient flexible tubular rubber body with reduced diameter journal ends,
- a helical spring member having an outer diameter equal to the diameter of the journal ends, said helical spring extending the length of the tubular body and being embedded therein, said helical spring having adjacent windings separated by the rubber of the tubular body, a plurality of fork shaped spreaders disposed along the length of the deformable roll,
- said spreaders each having an upper U-shaped support member with a pair of parallel support rolls freely rotatably connected to the end thereof,
- said support rolls being parallel to the longitudinal axis of the spreader roll when it is not deformed,
- means maintaining the pair of support rolls of each spreader in contact with the undersurface of the spreader roll,
- each pair of said support rolls having a contact distance on the undersurface of the spreader roll less than 180°,
- a support arm fixed to the U-shaped support and extending downwardly therefrom,
- means connected to the support arm to pivot each spreader transverse to the longitudinal axis of the spreader roll, and
- lift means connected to the support arm to raise and lower each spreader

whereby selective pivoting and vertical movement of selective spreaders deforms the spreader roll in one plane as well as in a plurality of planes.

5. A roll structure having a deformable axis comprising,
- a flexible cylindrical roll,
- a helical spring member in supporting engaging relationship with the material of said roll spaced inwardly from the outer surface thereof for providing a firm curvature along the roll length,
- and supporting means for supporting said roll and deforming said roll axis in a compound deformation in more than one plane while rotating.

6. A roll structure having a deformable axis comprising,
- a flexible cylindrical roll,
- a helical spring member in supporting engaging relationship with the material of said roll spaced inwardly from the outer surface thereof for providing a firm curvature along the roll length,
- and supporting means engaging the outer surface of said roll for deforming the roll axis and obtaining a predetermined shape of the outer surface of the roll.

7. A roll structure having a deformable axis comprising,

a flexible hollow cylindrical tube,

a helical spring member within said tube having an expanded free diameter larger than the inner diameter of said tube and supportingly engaging material of said tube against the outer surface of said spring member, and means for simultaneously supporting and deforming the axis of said tube.

8. A roll structure having a deformable axis comprising,

an elongated flexible cylindrical roll,

a helical spring member embedded within the material of the roll and having sufficient strength for maintaining a firm curvature along the roll length with deflection thereof,

and bearing means engaging the outer surface of said roll for supporting the roll in rotation and for deforming the axis of the roll.

9. A spreader roll mechanism for web winding machines comprising:

a rotatable deformable spreader roll,

an upper U-shaped support member with a pair of parallel support rolls freely rotatably connected to one end thereof,

said support rolls being parallel to each other and in contact with said spreader roll,

each pair of said support rolls having a contact distance therebetween less than 180°,

a support arm extending downwardly from the U-shaped support,

means connected to the support arm to pivot the upper support member transverse to the longitudinal axis of the support rolls, and

lift means connected to the support arm to raise and lower the support member to selectively deform the spreader roll.

10. A spreader roll mechanism for web winding machines comprising:

a rotatable deformable spreader roll,

a fork shaped support having an upper U-shaped support member and a lower central extending support arm,

a pair of spaced parallel support rolls freely rotatably connected to one end of the U-shaped member and in contact with said spreader roll, each pair of said support rolls having a contact distance therebetween of less than 180°,

means connected to the support arm to pivot the fork shaped support, and

lift means connected to the support arm to raise and lower said fork shaped support to selectively deform the spreader roll.

11. A spreader roll mechanism for web winding machines comprising:

a rotatable deformable spreader roll,

a fork shaped support having an upper U-shaped support member and a lower central arm member,

a pair of spaced parallel support rolls freely rotatably connected to one end of the upper U-shaped support,

means to maintain the pair of support rolls in contact with the under surface of said spreader roll,

each pair of said support rolls having a contact distance therebetween of less than 180°,

means connected to the arm to pivot the upper U-shaped support member transverse to the longitudinal axis of the support rolls, and

lift means connected to the arm to raise and lower the fork shaped support to selectively deform the spreader roll.

12. A spreader roll mechanism for web winding machines comprising:

a rotatable deformable spreader roll,

a spreader support,

a pair of spaced parallel support rolls freely rotatably connected to one end of said spreader support,

means to maintain the pair of support rolls in contact with the under surface of said spreader roll,

each pair of said support rolls having a contact distance therebetween of less than 180°,

means connected to the support to pivot the spreader support, and

lift means connected to the support to raise and lower the spreader support to selectively deform the spreader roll.

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