Oct. 27, 1970 W. E. HAWKINS 3,536,273

METHOD OF AND APPARATUS FOR WINDING A WEB OF PLASTIC FILM

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FIG. 1

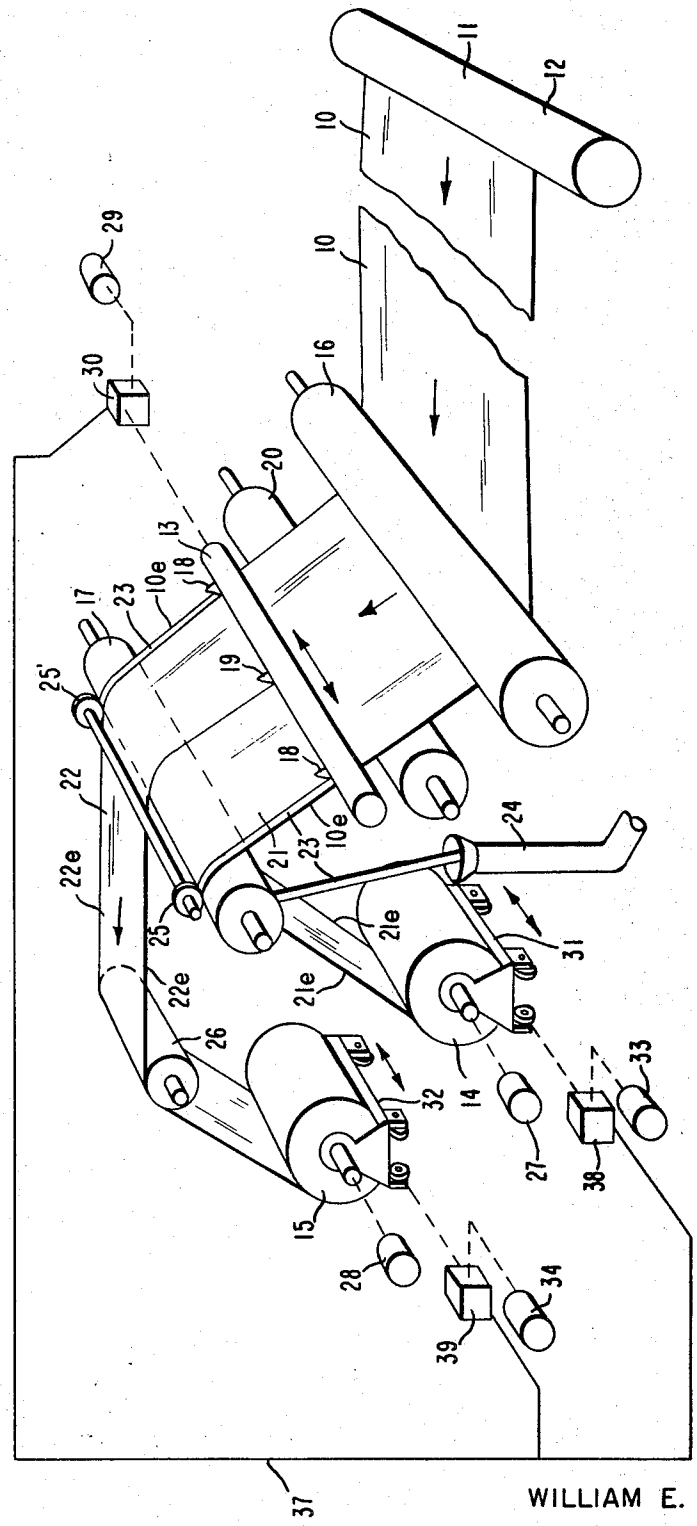

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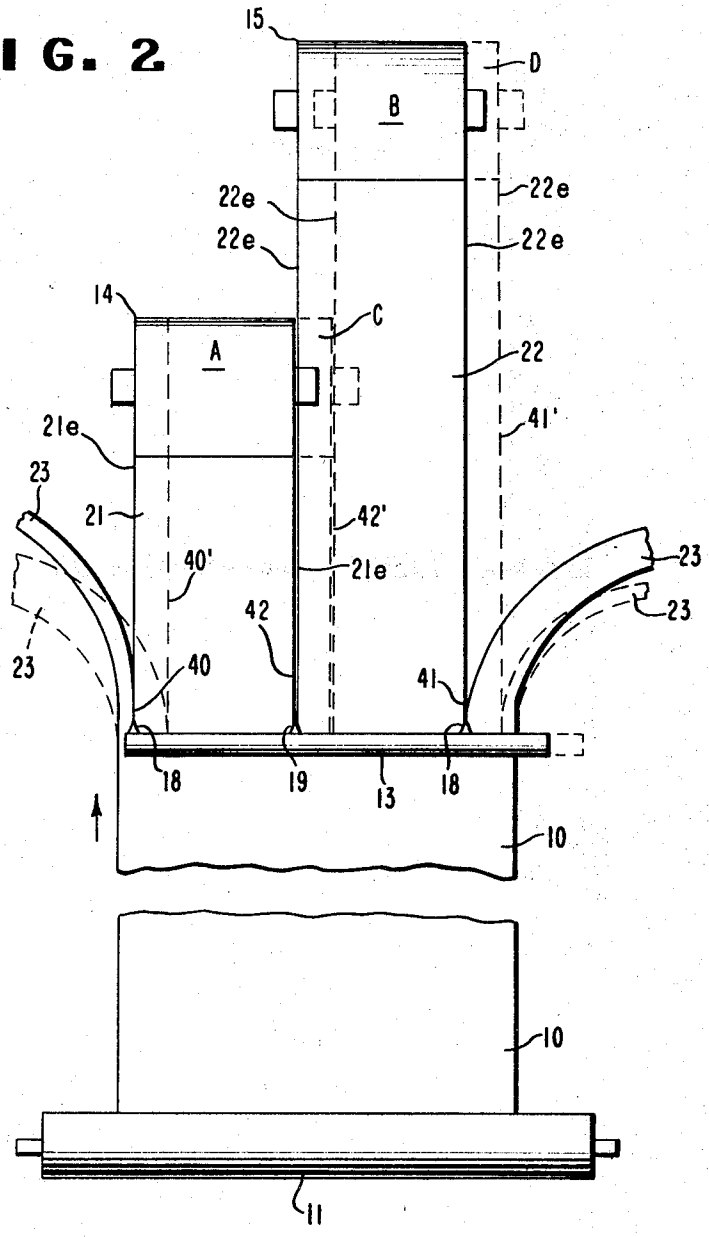
FIG. 2



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METHOD OF AND APPARATUS FOR WINDING A WEB OF PLASTIC FILM

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U.S. Cl. 242—56.7 10 Claims

ABSTRACT OF THE DISCLOSURE

Method of continuously winding a web of plastic film from a supply source onto a windup roll including the steps of moving the web continuously from the supply source to the windup roll; slitting the web continuously at least at the edges thereof with web edge slitters as it moves from the supply source to the windup roll; reciprocating the web edge slitters continuously relative to the supply source as the edges of the web are slit; and, reciprocating the windup roll continuously relative to the supply source and in timed relationship with the web edge slitters as the web is being wound onto the windup roll whereby the only relative motion of the web with respect to the supply source occurs substantially only after the web is wound onto the windup roll thereby to distribute gauge bands in the web laterally throughout the wound web, still obtaining even edges in the wound web as it is wound. Apparatus is provided for performing the above described method of winding.

BACKGROUND OF THE INVENTION

Field of the invention

This invention is a web winding method and apparatus and, more particularly, is directed to a novel method of and apparatus for continuously distributing gauge bands (i.e., bands of different thickness then general web thickness) in a web laterally throughout such web by oscillating the windup roll during winding of the web thereon and still obtaining even edges on such wound roll as it is wound by reciprocating web edgeslitters (and web center slitter or other web slitters) in timed relationship with such windup roll. The winding operation is accomplished with no lateral movement of the web with respect to its supply source except after it is wound on the windup roll.

Description of the prior art

Web winding and gauge band distributing devices of this general type are old. It is known, for example, to reciprocate only a windup roll, or an unwind roll, or a rewind roll in a second winding operation, or to reciprocate intermediate rolls between a supply source and a windup roll to impart sinusoidal motion to gauge bands to distribute them laterally throughout the web as it is wound.

U.S. patent to Davis 2,130,332 discloses a method of winding a web of paper in a manner to prevent the building up of ridges due to superimposed minute irregularities in the thickness of the paper, such as arise from its manufacture on the paper making machine, which irregularities run longitudinally of the web, consisting of continuously oscillating the web laterally in its own plane during the winding or rewinding operation by oscillating the web unwind roll or windup roll in an amount exceedingly minute in comparison with the width of the web, thereby distributing substantially uniformly such longitudinal irregularities over a lateral distance equal to the amplitude of the oscillation. The uneven edges of the wound roll obtained by oscillating the windup roll may be removed by rewinding and trimming.

U.S. Patent 2,672,299 to Jones discloses a web registering apparatus having a continuously traversing windup roll which will automatically shift as the film shifts and which prevents the web "bead" (i.e., the thick edges of the weg of plastic film) from winding on itself.

U.S. Patent 2,946,532 to Carter discloses an oscillator for web winding devices in which the windup roll is oscillated with respect to the web source in a predetermined manner related to the web speed to prevent irregularities, such as thick or thin places from building up.

These known winding methods either form wound rolls having uneven edges, or damage the web due to shifting it transversely (dragging it over a roll) during its movement from the supply source to the windup roll, or require subsequent and additional rewinding or edge trimming operations, all of which impose severe limitations of use in such devices or methods.

SUMMARY OF THE INVENTION

The web winding apparatus of this invention is continuous in operation.

Briefly described, the apparatus continuously winds a plastic web from a supply source onto a windup roll and includes means for moving the web continuously from the supply source to the windup roll; for slitting the web continuously at least at the edges thereof with web edge slitters as it moves from the supply source to the windup roll; for reciprocaitng the edge slitters continuously relative to the supply source as the edges of the web are slit; and, means for reciprocating the windup roll continuously relative to the supply source and in timed relationship with the slitters as the web is being wound onto the windup roll whereby the only relative motion of the web with respect to the supply source (and to the parts of the apparatus between the supply source and the windup roll) occurs substantially only after the web is wound onto the windup roll thereby to distribute gauge bands in the web laterally throughout the wound web, still obtaining even edges in the wound web as it is wound.

Due to nature of the casting process and the web dimensions, a web of plastic film usually has one or more zones of greater or lesser thickness than the rest of the web (i.e., gauge variations) that exist lengthwise or in the machine direction of the web and when the web is wound directly onto a windup roll these continuing zones lie one atop the other as the successive layers are wound thereon so that in cumulative effect a gauge band, either thicker or thinner as compared to normal web thickness, is built up.

Gauge bands (i.e., lanes or zones in a web of plastic film which are slightly thicker or thinner than adjacent web areas, usually by more than 10%) usually remain in the same transverse location for relatively long periods of time during production of the web, thus they are continuously wound along the same path on the windup roll. This causes the buildup of hard bands on the wound roll and results in stresses which, in time, distort the roll, thereby impairing its utility and causing waste.

Several methods involving oscillation of a windup roll only (or an unwind roll or intermediate rolls) have been practised to cause continuing web defects, such as gauge bands, to be moved laterally and prevent formation of hard gauge bands on finished film rolls.

Various patents also describe benefits to be derived from oscillation to distribute gauge bands, but the methods disclosed are incapable of fully coping with gauge band problems, or result in rolls which are undesirable for one reason or another.

For example, when the windup roll is oscillated relative to fixed edge slitters, these known winding methods form wound rolls having uneven edges, which require subsequent and additional rewinding or edge trimming opera-

tions, hence rendering such methods less than fully acceptable.

Further, it is of particular importance during its entire movement from the supply source to the windup roll that the web, particularly a web of plastic film, should follow an unerring path of movement relative to the supply source so that there will be no relative movement between the web and the various rolls that support and pull and carry it from the supply source to the windup roll. This is so because such movement, however slight, can easily create wrinkles in the plastic web or jam machine web feed or rub the web surface to scar or rip or deface the thin plastic film and render it virtually useless.

In many known winding devices, the oscillating movement of the windup roll or other rolls (such as web clamping rolls which fixedly position the web travel path with respect to web slitters) relative to the supply source moves the web relative to various other rolls that carry it or support it, for example, and hence brings about the very problem just described.

The present invention solves these problems and other problems existent in the prior art by oscillating or reciprocating a windup roll and edge (and center) slitters simultaneously to overcome these deficiencies and to form wound film rolls free of built up gauge bands and having smooth ends or edges.

It is seen, therefore, that there are particular aspects of winding webs to which this invention is particularly directed. If the edges of the web are slit by stationary knives during oscillation of a windup roll, for example, then the wound roll edges will be uneven and cause distortion of the film thereby producing baggy edges with excessive losses in conversion. This invention gives smooth web edges even during oscillatory winding.

Additionally, the oscillation of gauge bands during web winding should occur without sliding contact of the web with any roll surface in order to avoid marring the film surface. The present invention achieves this latter goal by oscillating a windup roll or rolls and slitters in synchronism; thus, while the path of the center line of the slit web and the edges of the slit web will movefrom side to side along a given path due to oscillation of the slitters relative to the web and the web supply source, there is no relative movement of the web with respect to the web supply source or to other rolls, including the windup roll. Uniform winding is achieved by oscillating the windup roll so as to follow the path of the edges of the web.

Slitting in a free span of film in which the slitters are free to move transversely relative to the web is still another advantage of this invention. In order to achieve free-span slitting, a tension idler roll is positioned adjacent the slitters to provide necessary tension and prevent billowing of the web during slitting, as will be further explained.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective diagrammatic view of the web winding apparatus of this invention, with parts omitted for clarity, showing a web as it moves from a supply source past web edge slitters and center slitter and onto windup rolls, the slitters and windup rolls being operable to reciprocate in timed relationship to each other and to the supply source, and

FIG. 2 is a plan view showing, in exaggerated form and with parts omitted for clarity, the supply source, the web, the web edge slitters and center slitters and the windup rolls of the winding apparatus of FIG. 1 and further showing the slitters and windup rolls in their extreme positions of reciprocation relative the supply source and the relative positions of the web with other parts of the apparatus during the web slitting and web winding operations.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawing, a web **10** of plastic film to be wound by the web winding apparatus of this invention is supplied from a supply source **11**, such as supply roll **12**, and moved past and into operative association with a web slitter means **13** and, after slitting, is wound onto web windup rolls **14** and **15**, in a manner to be described. The supply source **11** may be any appropriate source other than a supply roll; the web **10**, for example, may be a web of plastic film as it emerges from the tenter frame of a polyethylene terephthalate film production line.

In the embodiment shown, from the supply source **11**, the web **10** passes under an idler roll **16** and over a transfer roll **17** positioned between the supply source **11** and the windup rolls **14** and **15**. The web slitter means **13**, consisting of web edge slitters **18** and a web center slitter **19**, is positioned above and in the free span of the web **10** between the roll **16** and the roll **17** and an idler roll **20** is positioned below the web **10** and adjacent the slitter means **13**. This idler roll **20** provides tension for the web **10** in the free span and prevents billowing of the web upon contact with the slitters.

The web **10** is slit by the center slitter **19** into two webs, **21** and **22**, and the edges **10***e* of the web **10** are trimmed by the edge slitters **18** of the slitter means **13**. The edge trim **23** cut from the web **10** by the slitters **18** is conveyed around the support roll **17** to trim removal chutes **24** (only one chute is shown) from which it may be fed to a chopper. If the chopper is employed to shred trim waste, it is desirable to isolate "chopper jerk" from the web handling apparatus; therefore, narrow layon rolls **25** and **26** are employed to engage the edge trim **23** on the roll **17**.

After edge trimming and center slitting, the webs **21** and **22** are moved separately to the windup rolls **14** and **15**. For convenience, these windup rolls are positioned apart so that web **21** goes directly from the transfer roll **17** to the windup roll **14** and web **22** goes over a second transfer roll **26** to the windup roll **15**. Preferably, the windup rolls **14** and **15** are center driven; windup roll **14** being driven by a drive motor **27** and windup roll **15** being driven by a drive motor **28**. Auxiliary means, as are known to the art, may be employed to control torque and winding tension. Similarly, layon rolls of a suitable type may be employed on each windup roll to assist in producing rolls of desired characteristics. The motors **27** and **28** and various other known mechanisms employed in the practice of this invention are shown diagrammatically in the drawing for convenience.

The touchstone of the present invention is the improvement of final roll formation on windup rolls **14** and **15** and distribution of gauge bands in the web **10** (and in webs **21** and **22**) by transversely oscillating or reciprocating the web slitter means **13** and the web windup rolls **14** and **15** relative to the supply source **11** and in timed relationship to each other.

To accommodate the transverse oscillation of the apparatus, including the edge slitters **18**, the average width of the edge trim **23** will be slightly greater than that normally removed for bead trim on film produced with edge beads for gripping by transverse stretching apparatus. The total additional width of trim **23** is equal to the amplitude of the oscillation, which can be as high as 12 inches for severe gauge band problems, but generally is about 6 inches. Oscillation is usually at a rate of about 3 inches per minute or less.

Preferably, the web slitter means **13** is reciprocated by means of a reversible ¼ H.P. DC electric motor **29** through a rack and pinion in a slitter means oscillator or drive **30**. Windup rolls **14** and **15** are mounted on turrets **31** and **32**, respectively (these are usually each adapted for three rolls for rapid starting of new windup rolls, but are shown as single rolls here for simplicity). The turrets are equipped to move on rollers in a direction transverse to the direction of web travel. Turrets **31** and **32** are reciprocated relative to the supply source **11** by reversing synchronous motors **33** and **34**, respec-

tively, which are reversed by actuation of limit switches in the slitter means drive **30**, through circuit means **37**. These synchronous motors are reversible and are coupled to mechanical traversing systems **38** and **39**, such as a margin control on a Cline winder (made by Eagan Company), as is known in the art. Again, the motors, the traversing systems, and various other known parts of the apparatus are shown diagrammatically in the drawing for convenience.

The operation of the apparatus of this invention is further illustrated in FIG. 2, which shows in exaggerated dimensions, the two extreme positions of reciprocation of the web slitter means **13** and the windup rolls **14** and **15** relative to the supply source **11** and the relationship of these parts with respect to the web **10** at such positions. Various parts, such as the transfer roll **17**, have been omitted from this showing for clarity and for a better understanding of the invention.

Referring to FIG. 2, it will be seen that when the slitter means **13** and the windup rolls **14** and **15** are in their extreme lefthand positions, the lefthand edge **10***e* of the web **10** is slit along line **40** by one edge slitter **18**, and the righthand edge **10***e* of the web **10** is slitalong line **41** by the other edge slitter **18**, while the center of the web **10** is slit along line **42** by the center slitter **19**. In such positions (designated A and B, respectively, in FIG. 2), the windup rolls **14** and **15** are adapted to receive the webs **21** and **22** in a straight line from the slitter means **13** to form or obtain smooth ends or edges in the rolls wound onto the windup rolls **14** and **15**.

The web slitter means **13** and the windup rolls **14** and **15** are then reciprocated to their extreme righthand positions, as shown in FIG. 2, and, thus positioned, they slit the web **10** along lines **40'**, **41'** and **42'** (shown as dotted lines). In these positions, (designated C and D and shown as dotted lines) the windup rolls **14** and **15** again are adapted to receive the webs **21** and **22** in a straight line from the slitting means **13** thereby to obtain smooth edges on the wound rolls in these positions during winding and in all positions between the extreme lefthand and righthand positions.

Although the positions of the slitters **18** and **19** and the windup rolls **14** and **15** appear to be fixed in the drawing, it is to be understood that there is a substantially continuous cyclic motion, with brief dwell periods at the extreme lefthand and righthand positions of travel, so that the locus of the slitters **18** and **19** and of the edges **21***e* and **22***e* of the webs **21** and **22** formed by the slitting operation would be a long wavelength, low amplitude truncated sawtooth wave.

The speed of the web **10** and the speed of the traversing motion of the slitter means **13** is such that the maximum angle made by the slit with respect to an edge **10***e* of the web **10** is substantially less than a degree of arc, generally a matter of a few seconds; for example, at typical web speeds at hundreds of feet per minute and normal traversing speeds of less than three inches per minute the angle is negligible.

The timed oscillation of the windup rolls **14** and **15** and web slitter means **13** with respect to the supply source **11** prevents any continuing gauge bands that may exist in the web **10** from being repeatedly wound directly one atop the other as the webs **21** and **22** formed from web **10** are wound onto such windup rolls **14** and **15** and still produces even edges in the wound webs as they are wound. The oscillatory movement of the windup rolls **14** and **15** distributes the gauge bands or moves them laterally and prevents the cumulative formation of gauge bands in one area or line or zone of the webs **21** and **22** as the webs are wound onto the windup rolls **14** and **15** and the timed oscillation of the slitter means **13** with such windup rolls obtains in the webs wound onto the windup rolls **14** and **15** the even edges desired and required.

It would be possible, of course, to solve gauge band problems of the type described by oscillating only the windup rolls **14** and **15** and without oscillating the slitter means **13** but this would create uneven edges in the wound webs. The oscillatory movement, continuous in nature, of the windup rolls **14** and **15** changes the relationship of the edges of the webs being wound thereon during all positions of the movement of the rolls **14** and **15**. In other words, the edges **21***e* and **22***e* of the webs **21** and **22** are fed onto the windup rolls **14** and **15** at varying angles to them depending on the positions of the windup rolls at that particular time and if the web **10** were not slit by oscillating slitters this would produce uneven edges on the wound rolls which would have to be removed through additional trimming or rewinding operations. Thus, uneven feeding of webs onto windup rolls is to be avoided.

Further, the shifting of various components of known winding devices, such as slitters or transfer rolls or pull rolls, with respect to the web being wound tends to pull the web or move it laterally and such movement between the web and a carrying roll, such as **17**, could severely scar or wrinkle the web. This relative movement, then, is also to be avoided.

It is important, therefore, that the web being wound onto a windup roll feed or enter onto such roll in a straight line and that the web not be moved relative to its supply source or to other rolls or parts of the total apparatus during its movement from the supply source to the windup roll.

In the apparatus of this invention both of these goals are obtained by oscillating the slitter means **13** simultaneously with the windup rolls **14** and **15** relative to the supply source **11** and to the web **10**.

As will be seen in FIGS. 1 and 2, the reciprocation of the web slitter means **13** in a direction at right angles to the movement of the web **10** defines the edges **21***e* along web **21** and the edges **22***e* along web **22**. Due to the constant oscillation of the slitters **18** and **19** defining these edges, such edges assume or define a truncated sawtooth path which would wind in a crooked or uneven fashion if wound onto a stationary windup roll. Applicant avoids this uneven winding by oscillating the windup rolls **14** and **15** in timed relationship with the oscillation of the slitter means **13** and thereby assures that the edges **21***e* and **22***e* of the webs **21** and **22** will always wind in a straight line or fashion onto the windup rolls **14** and **15**. Further, since the web slitter means **13** is oscillated relative to the web **10**, there is no movement of the web **10** or the webs **21** and **22** with respect to the supply source **11** during slitting or during the entire movement of the web or webs from the supply source **11** to the windup rolls **14** and **15**. Hence, damage to the web or webs during travel is minimized.

While the disclosure has been directed to electrical traversing means with appropriate synchronizing means, a reversible fluid cylinder can effectively be used, as well as oscillation of the rolls with a margin adjustment device, such as a Fife or an Askania edger, on the windup roll. The use of these edgers eliminates the need for interconnection between the slitter means and the windup oscillator since edgers inherently shift rolls by following the motion of the edges of the film. Most of the advantages of this latter method of oscillation of rolls are offset to some extent by fluctuations caused by "hunting" in the edger and by malfunctions with a greater need for maintenance.

Further, while two windup rolls are shown for winding two flat webs thereon, a single web may be wound onto a single windup roll or more than two rolls may be wound onto windup rolls, still following the teachings of this invention.

The foregoing description relates primarily to a web winding apparatus for use with a web of plastic film coming from a production line, such as from a tenter frame employed in biaxial orientation of a film, such as polyethylene terephthalate. Such fim is conventionally slit

substantially near its center line and at the web edges, including the "beads" at such edges for gripping by tenter clips, are trimmed at the same time. The edge and center slitters, as described, oscillate or reciprocate in unison and take a variable trim from each edge, causing the center slit to move in a wavelike locus in conformity to the slit edges of the web to yield two sheets of substantially equal width having substantially parallel edges.

The elimination or distribution of persistent gauge bands in a web and the formation of smooth end faces or edges on the wound rolls formed from this method not only frees the rolls from distortion, by avoiding stretched lanes and baggy portions of the film, but also greatly facilitates and speeds charting for subsequent slitting into narrow widths. It should be understood, however, that the basic improvement is not limited to winding plastic film, as in the foregoing description, but webs from any source may effectively be subjected to the method of timed oscillation of doing winding of windup rolls and slitters, and slitting along each edge or center as long as no lateral motion of the web with respect to any parts of the particular mechanism involved occurs until after such web is wound onto the windup roll or rolls.

While this invention has been described in conjunction with a web of plastic film, it is further to be understood that a web of paper or web of any other slittable and windable material may be slit and wound using the novel apparatus and method of this invention.

What is claimed is:

1. A method of continuously winding a web from a supply source onto a windup roll including the steps of:

moving the web continuously from the supply source to the windup roll;

slitting the web continuously with web slitters as it moves from the supply source to the windup roll;

reciprocating the web slitters continuously relative to the supply source as the web is slit; and,

reciprocating the windup roll continuously relative to the supply source as the web is being wound onto the windup roll wherein the only relative motion of the web with respect to the supply source occurs substantially only after the web is wound onto the windup roll.

2. The method of claim **1** wherein the web slitters and windup roll are reciprocated in timed relationship to each other whereby to form on the windup roll a wound roll having even edges.

3. The method of claim **1** wherein the web is a thin plastic material.

4. The method of claim **1** wherein the web slitters include edge slitters and the edge slitters and windup roll are reciprocated in timed relationship to each other whereby the web edges continuously formed by the edge slitters are substantially constantly straight in line as the web is wound onto the windup roll.

5. A method of continuously winding a web from a supply source onto a windup roll including the steps of:

moving the web continuously from the supply source to the windup roll;

slitting the web continuously at least at the edges thereof with edge slitters as it moves from the supply source to the windup roll;

reciprocating the edge slitters continuously relative to the edges of the web as it is slit;

reciprocating the windup roll and web wound thereon continuously relative to the supply source as the web is wound onto the windup roll; and,

wherein the edge slitters and windup roll are reciprocated in timed relationship to each other whereby to form on the windup a wound roll having even edges.

6. An apparatus for continuously winding a web from a supply source onto a windup roll wherein said web is slit at least at its edges thereof prior to winding, said apparatus comprising:

means to move said web from said supply source to said windup roll;

slitter means to continuously slit at least the edges of said web as it moves from said supply source to said windup roll;

means to move said web from said supply source to said slitter means along a given path of movement;

means to continuously reciprocate said slitter means in a direction at right angles to said given path of movement and relative to said web to selectively slit the edges of said web as it moves along said given path of movement;

means to continuously reciprocate said windup roll in a direction at right angles to said given path of movement thereby to move said web being wound thereon from said given path of movement substantially only after said web is wound on said windup roll whereby to distribute gauge variations in said web therethroughout.

7. The apparatus of claim **6** including means to reciprocate said slitter means and said windup roll in timed relationship to each other whereby to form on the windup roll a wound roll having even edges.

8. The apparatus of claim **6** wherein said web is a thin plastic material.

9. The apparatus of claim **6** including rolls positioned transverse of said given path of movement and on opposed sides of said slitter means, said web being trained around said rolls and defining a free span therebetween whereby said slitter means is free to reciprocate transversely.

10. A method of continuously winding a web from a supply source onto a windup roll including the steps of:

moving the web continuously from the supply source to the windup roll;

slitting the web continuously at least at the edges thereof with edge slitters as it moves from the supply source to the windup roll;

reciprocating the edge slitters continuously relative to the supply source as the edges of the web are slit; and

reciprocating the windup roll continuously relative to the supply source as the web is being wound onto the windup roll wherein the only relative motion of the web with respect to the supply source and intermediate transfer rolls occurs substantially only after the web is wound onto the windup roll.

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