METHOD AND APPARATUS FOR SLITTING WEB MATERIAL

10 Claims, 11 Drawing Figs.

U.S. Cl. .................................................. 83/1,
83/341, 83/444, 83/596, 83/926

Int. Cl. .................................................. B26D 1/28,
B26D 3/00

Field of Search .......................................... 83/1, 332,
341, 596, 355, 444, 438, 443, 926

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Primary Examiner—Frank T. Yost
Attorney—Hopgood and Calimafde

ABSTRACT: A method and apparatus is provided for producing transverse edge slits at an angle in a web of material in which a cutter wheel is provided mounted on a rotatable shaft and having a plurality of knife blades mounted in spaced relation on the periphery of said wheel, the knife blades having knife edges parallel with each other and disposed at an angle to the plane of the wheel. A web of material is fed in a longitudinal path across a portion of which the cutter wheel is transversely disposed in cutting relationship with the web. The cutter wheel is rotated at a rate correlated to the rate of feed of the web, such that each of the blades produces a parallel edge slit at an angle starting from within the web and extending transversely towards a side edge of the web. In a preferred embodiment, two oppositely disposed cutter wheels are employed, one for slitting the web towards one side edge of the web, and the other for slitting towards the other side edge of the web.
METHOD AND APPARATUS FOR SLITTING WEB MATERIAL

This invention relates to a method and apparatus for producing transverse slits in a web of material and, in particular, edge slits on opposite sides of such materials as strips of plastic, paper, metal foil, and the like, wherein:

It is known to produce twisted wire products with bristles or similar material interlocked between the wires. The bristles are deposited between adjacent strands of wire and a twist applied to the strands. (Note: U.S. Pat. No. 3,160,440, Nov. 3, 1919, and No. 3,254,682). Similar products are produced from materials in the form of a continuous web, such as sheet or strip material, the web being partially transversely slit at opposite side edges to provide edge fringes with the center line or spine of the web unsevered. Such web material, whether in the form of plastic, paper, metal foil and the like flexible material, has particular use in the production of twisted wire products for ornamental purposes, for example, in forming artificial Christmas trees, decorative fringe strips, and other articles of manufacture.

It would be desirable to provide a method and apparatus for continuously slitting web material. It is thus the object of this invention to provide a continuous method for producing transverse slits in web material, preferably, although not necessarily, at both side edges of the web.

Another object is to provide an apparatus for continuously producing transversely extending slits in web material.

A further object is to provide a cutter wheel characterized by a plurality of knife blades spaced around its periphery for use in continuously producing transversely extending slits on web material, such as strips of plastic, paper, metal foil and the like.

These and other objects will more clearly appear when taken in conjunction with the following disclosure and the accompanying drawings, wherein:

FIG. 1 shows in plan perspective one embodiment of an apparatus for producing transversely extending slits in web material;

FIG. 2 depicts in plan view a detailed rendition of the cutter wheels employed in producing transversely extending slits, e.g., edge slits, in web material;

FIG. 3 is a view in elevation of the cutter wheels as viewed along line 3-3 of FIG. 2;

FIG. 4 is a view in elevation of the cutter wheels taken along line 4-4 of FIG. 2;

FIG. 5 is a schematic showing the relationship of the knife blades of the cutter wheel relative to the slits being formed in the web material;

FIG. 6 is a fragmentary view of the web in perspective through which the web material is drawn in carrying out the slitting operation;

FIG. 7 is a view in elevation taken along lines 7-7 of FIG. 6;

FIG. 8 is an end view of the wheels shown along line 8-8 of FIG. 7;

FIG. 9 is a plan view of a portion of web material, e.g., plastic strip, showing edge slits extending from within the strip near the center through the side edges of the strip, the center of spine of the strip being unsevered;

FIG. 10 is a fragment of a twisted wire product formed from the slit material of FIG. 9, and

FIG. 11 is illustrative of a slit web in which the slits do not pass through the edges of the web.

Stating it broadly, the method aspects of the invention comprise, providing a cutter wheel on a rotatable shaft having a plurality of knife blades mounted in spaced relation on the periphery of the wheel, with the blades mounted so that their knife edges are parallel with each other and at an angle to the plane of the wheel, disposing a web of material in a longitudinal path relative to the cutter wheel with the plane of the cutter wheel oriented at an angle transversely to the longitudinal axis of the web, with the surface of the web supported in the cutting path of the blades, the angle of the knife edges to the longitudinal axis of the web corresponding to the desired angle of the slits to be cut, and then moving the web along its longitudinal axis to the slitting station at a rate of feed correlated to the rotation of the cutter wheel and the angle of the cutter blades, such that each of the blades produces an edge slit at the desired angle starting from within the web and extending transversely through a side edge of said web.

The apparatus employed in carrying out the foregoing method comprises as one embodiment, a slitting station, means for feeding a web of material to the slitting station and a cutter wheel rotatably disposed transversely across a portion of the path at the slitting station with the plane of the wheel oriented at an angle to the path, the wheel having a plurality of knife blades mounted in spaced relation around the periphery thereof with the knife edges of the blades substantially parallel to each other and at an angle to the plane of the wheel, such that the knife edges make an angle transverse to the longitudinal axis of the web corresponding to a desired angle of slit so that when the cutter wheel is rotated at a rate correlated to the rate of feed of said web, each of the blades produces a parallel slit at the desired angle to the longitudinal axis of the web starting from within the web near the center or spine and extending transversely towards or through a side edge of the web. In a more preferred embodiment of the apparatus, two or a pair of cutter wheels are employed, one above the web in overlapping relation to one side edge thereof, and one below the web in overlapping relation to the other side thereof.

Referring to FIG. 1 of the drawing, the essential elements making up the apparatus are shown comprising a supporting surface 10 having mounted thereon a pair of pinch feed rollers designated generally by numeral 11 mounted between end frames 12A and 12B, the pinch feed rollers being in driving relationship with each other via meshing end gears 13 and 14, gear 14 being driven by a belted pulley 15 coupled to conventional driving means not shown.

The apparatus also includes forward of the feed rollers a pair of pedestals 16 and 17 mounted on supporting surface 10 each of which is coupled via stub shafts to lugs 18 and 19, respectively, of shoe assembly designated generally by numeral 20, said shoe assembly having an extending shoe 21 disposed above web 22 and a corresponding extending shoe portion 21A disposed below web 22 not shown in FIG. 1 but more clearly shown in FIGS. 3, 6 and 8. The purpose of the two shoes is to provide a cradle in the shape of a concave surface along which the web is supported during the slitting operation, the contour of the concave surface of one shoe as viewed in cross section coextending into the contour of the concave surface of the other shoe whereby to provide an S-curve contour (note FIG. 8). Web or strip 22 is drawn from a spool, not shown, along a longitudinal path between pinch feed rollers 11, through shoe assembly 20 where the web is slit and the slitted web then wound up on Capstan 23.

Disposed transversely to the longitudinal path relative to shoes 21 and 21A is a pair of cutter wheels 24 and 25 which wheels are mounted on shafts 26 and 27, respectively, which shafts, in turn, pass through journal bearings 28 and 29, respectively, supported by posts 28A and 29A, the shafts having pulleys 30 and 31 coaxially mounted thereon which are driven by belts 32 and 33, respectively, by a common drive means, not shown. The shoes 21, 21A, together with the cutter wheels, constitute a slitting station. As will be noted, the plane of each of the cutter wheels is oriented at an angle to the longitudinal axis of web 22, the plane, for purposes of reference, being that plane which passes through substantially the centers of knife blades 34 and 34A which are mounted in spaced relation about the periphery of each of the wheels. This is shown more clearly by dot and dash lines S-S and T-T shown in FIG. 2. The knife edges of the blades are disposed at an angle to the plane of each wheel, such that the knife edges make an angle with the longitudinal axis of the web corresponding to the desired angle of slit. The rate of feed of the web, as determined by pinch feed rollers 11 to the slitting sta-
tion, is correlated to the rate of rotation of the cutter wheels and the angle of the cutter blades such that each of the blades, on each of the wheels produces an edge slit at the desired angle starting from within the web and extending outwardly from the center of the web through the side edges thereof as shown by side slits 35 and 36 in FIGS. 1 and 2, the center or spine 37 of the web being lift unscrewed.

In passing between the shoes, the cross section of the web takes on the configuration of an S-curve as shown in FIG. 3, which is an end view taken along line 3-3 of FIG. 2. Shoe foot blocks 38, having convex surfaces, are provided in cooperation with the concave surface of each of the shoes at the web entering side 40A as shown in FIGS. 7 and 8, each of the shoe foot blocks being mounted so that the convex surface of each, i.e. 38A and 39A, is brought into spaced relation with the corresponding concave surface of the shoe so as to provide an S-curve opening through which web 22 is drawn so that the web conforms to the contour of the concave faces of the shoes. The midportion 40 between the two shoes shown in FIGS. 6 and 8 is a neutral region insofar as the web is concerned and is the region through which the spine of the web travels while the side edges are being transversely slit. However, the slits need not pass through the side edges but may stop just short thereof as shown in FIG. 11.

In passing the web through the shoes, the shoe cradle is separated from the foot blocks and the shoe and foot blocks then brought together in preparation for the slitting. Each of the concave surfaces of the shoes has a narrow groove, such as groove 41, shown in shoe 21A of FIGS. 4, 6 and 7. FIG. 4 being a view against face 24A of cutter wheel 24 taken along line 4-4 of FIG. 2. The purpose of the groove in each of the shoes is to enable each of the knife edges to cut into and get below the surface of the web in order to achieve the slitting as the web travels through the shoe assembly.

The manner in which the slitting is achieved is shown schematically in FIG. 5 of the drawing. There, web 22 is shown moving in the direction of arrow 42 with the cutter wheel 25 phantomly shown in dotted line as being disposed below the web. The knife edges 35 are shown disposed at an angle of 15 degrees to the plane of the cutter wheel T-T, the plane of the cutter wheel itself being disposed at an angle of 30' to the longitudinal axis X-X of the web. Thus, as will be noted, each of the knife edges of the blades on the cutter wheel makes a total angle of 45' with longitudinal axis X-X which is the resulting angle of 35 and 36 of the web. As will be appreciated, the slits may be cut at various angles. Blades 34 of wheel 24 (not shown) are schematically indicated as producing similar slits 35. As will be noted, blades 35 (as is also true for blades 34) continually ride through the groove in the concave surface of the corresponding shoe (for example, groove 41 shown in FIG. 6), the groove in each shoe lying in a plane which is substantially in the plane of the blades of the corresponding cutter wheel.

Referring to FIG. 6, which is a fragment in perspective of the shoe assembly, upper and lower shoes 21, 21A are shown connected to shoe housing 43 shown phantomly in dot-dash lines, the shoes being connected by screws 44, or similar fasteners. The entering side 40A of each shoe is tapered slightly, for example at 45 of shoe 21A, to allow freedom of play of the entering web as it is being gradually contoured in cross section to the shape of the concave faces of each of the shoes. Thus, as the web passes the terminating portion of the shoe tape at 46, one side portion of the web has by this time conformed to the concave face and extending against it above groove 41 into which the blades of cutter wheel 24 ride during the slitting of this portion of the web, the slitting starting from near the center of the strip and proceeding to the outside edge of the web (note the direction of blades 34 shown schematically in FIG. 5). The slitting of the other side of the web is meanwhile carried out by cutter wheel 25 shown dotted in FIG. 6.

FIG. 7, which is a partial cross section of FIG. 6 taken along line 7-7, shows a portion of the web passing through the slitting station over groove 41 where the slitting is achieved. The web, complete with slits, is shown in FIG. 9 comprising a major portion 37 with slits 35, 36 extending transversely from the spine through the side edges thereof. A twisted wire product produced from the slit web is illustrated in FIG. 10.

However, the slit product need not be limited to such use, but can be used for any ornamental purpose where inside or edge fringe effects are desirable. Only one side of the strip or web may be slit by using one blades substantially parallel to such a product is desirable. Thus, while the preferred embodiment of the apparatus is shown with two cutter wheels, it will be obvious to one skilled in the art that one cutter wheel can be employed to form slits only along one side edge of the web.

FIG. 11 is illustrative of a slit web in which the slits are in side the web, that is, the slits stop short of the edge. Thus, when it is stated that the slits extend transversely towards a side edge, it is meant to cover the situation where the slit stops short of the edge or passes through the edge. While the slits are shown in FIGS. 2, 5 and 9 as being substantially straight, they may, depending on the feed rate, have a slight S-curve configuration. In fact, it may be preferred to provide a slight S-curve slit as it gives a pleasing design effect to the resulting product, particularly in the manufacture of Christmas trees.

Although the present invention has been described in conjunction with preferred embodiments, it is to be understood that modifications and variations may be resorted to without departing from the spirit and scope of the invention as those skilled in the art will readily understand. Such modifications and variations are considered to be within the purview and scope of the invention and the appended claims.

I claim:

1. As apparatus for producing transverse slits at an angle in a web of material which comprises, a slitting station, means for feeding a web of material in a longitudinal path to and past said slitting station, and a cutter wheel rotatably disposed transversely across a portion of said path at said slitting station, with the plane of said wheel oriented at an angle to said path, said wheel having a plurality of knife blades mounted in spaced relation around the periphery thereof, with the knife edges of said blades substantially parallel to each other and at an angle to the plane of said wheel, such that the knife edges make an angle with the longitudinal axis of said web at said slitting station corresponding to a desired angle of slit, so that when the cutter wheel is rotated at a rate correlated to the rate of feed of said web, each of said blades produces a parallel edge slit at said desired angle starting from within the web and extending transversely towards a side edge of said web.

2. The apparatus of claim 1, including web support means at said slitting station, said web support means being adapted to maintain said web in the cutting path of said cutter wheel.

3. The apparatus of claim 2, wherein said web support means has a concave face conforming substantially in curvature to the periphery of the cutter wheel.

4. The apparatus of claim 3, wherein the concave face of the web support means has a groove therein through which the knife blades of the cutter wheel travel during the cutting operation.

5. An apparatus for producing transverse slits at an angle on each side of a web of material which comprises, a slitting station, means for feeding a web of material in a longitudinal path to and past said slitting station, and a pair of cutter wheels each being rotatably disposed transversely across a portion of said path at said slitting station, one of said cutter wheels being disposed on one side of said path above the web and the other being disposed on the opposite side of said path below said web, with the plane of each wheel oriented at an angle to said path, each of said wheels having a plurality of knife blades mounted in spaced relation around the periphery thereof, with the knife edges of said blades substantially parallel to each other and at an angle to the plane of each wheel, such that the knife edges of each wheel make an angle with the longitudinal axis of said web at said slitting station corresponding to a desired angle of slit, so that when the cutter wheels are rotated
at a rate correlated to the rate of feed of said web, each of the blades of each cutter wheel produces a parallel edge slit at said desired angle starting from within the web and extending transversely towards the side edges of said web, leaving the center portion of said web unsevered.

6. The apparatus of claim 1, including web support means at said slitting station, said web support means being adapted to maintain said web in the cutting path of said cutter wheels.

7. The apparatus of claim 6, wherein said web support means has a pair of oppositely disposed concave faces conforming substantially in curvature to the periphery of the cutter wheels.

8. The apparatus of claim 7, wherein each of the concave faces of the web support means has a groove therein through which the knife blades of the corresponding cutter wheel travel during the cutting operation.

9. A method of cutting transverse edge slits at an angle in a web of material which comprises, providing at a slitting station a cutter wheel on a rotatable shaft having a plurality of knife blades mounted in a spaced relation on the periphery of said wheel, with the blades mounted so that their knife edges are substantially parallel to each other and at an angle to the plane of said wheel, disposing a web of material in a longitudinal path relative to said cutter wheel with the plane of the cutter wheel oriented at an angle transversely to the longitudinal axis of said web and with the surface of said web supported at said slitting station in the cutting path of said blades, the angle of the knife edges of said blades to the longitudinal axis of said web corresponding to the desired angle of the slits to be cut, and moving said web along its longitudinal axis through said slitting station at a rate of feed correlated to the rotation of said cutter wheel and the angle of the cutter blades, such that each of said blades produces a transverse slit at said desired angle starting from within said web and extending towards a side edge of said web.

10. A method of cutting transverse slits at an angle on each side of a web of material which comprises, providing at a slitting station a pair of rotatably mounted cutter wheels having a plurality of knife blades mounted in spaced relation on the periphery of said wheel, with the blades of each wheel mounted so that their knife edges are substantially parallel to each other and at an angle to the plane of said wheel, one of said cutter wheels being disposed on one side of said slitting station above the web, the other cutter wheel being disposed on the opposite side of said slitting station below said web, disposing a web of material in a longitudinal path relative to said slitting station with the plane of each of the cutter wheels being oriented at an angle transversely to the longitudinal axis of said web and with the surface of said web supported at said slitting station in the cutting path of the blades of said wheels, the angle of the knife edges of said blades to the longitudinal axis of said web corresponding to the desired angle of the slits to be cut, and moving said web along its longitudinal axis through said slitting station at a rate of feed correlated to the rotation of said cutter wheels and the angle of the cutter blades, such that each of said blades produces a transverse slit at said desired angle starting from within said web and extending towards each of the side edges of said web, leaving the center portion of said web unsevered.