United States Patent [19]

Judelson

[11] **3,752,024**

[45] **Aug. 14, 1973**

[54] **CUTTING MECHANISM FOR ROTARY KNIFE CUTTING MACHINES**

[75] Inventor: **David N. Judelson**, New York, N.Y.

[73] Assignee: **Oscar I. Judelshon Inc.**, New York, N.Y.

[22] Filed: **Nov. 6, 1962**

[21] Appl. No.: **237,431**

[62] Continuation of Ser. No. 50,917 Aug. 22, 1960, Pat. No. 3,700,402.

[52] **U.S. Cl.** ..... **82/86 R**, 82/53 R

[51] **Int. Cl.**..... **B23b 3/04**, B23b 5/14, B23b 37/00

[58] **Field of Search**..... 82/46, 86, 101

[56] **References Cited**

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Primary Examiner—Harrison L. Hinson

Attorney—Amster and Rothstein

[57] **ABSTRACT**

The present invention relates to rotary knife cutting machines which sever a roll of material wound on a core into plural narrower rolls by utilizing two rotary knives that are opposed to each other on opposite sides of the work-piece axis and by having knife feeding means that advances one of the knives into the work-piece by a fixed merement ahead of the other knife all during the working cut.

9 Claims, 3 Drawing Figures

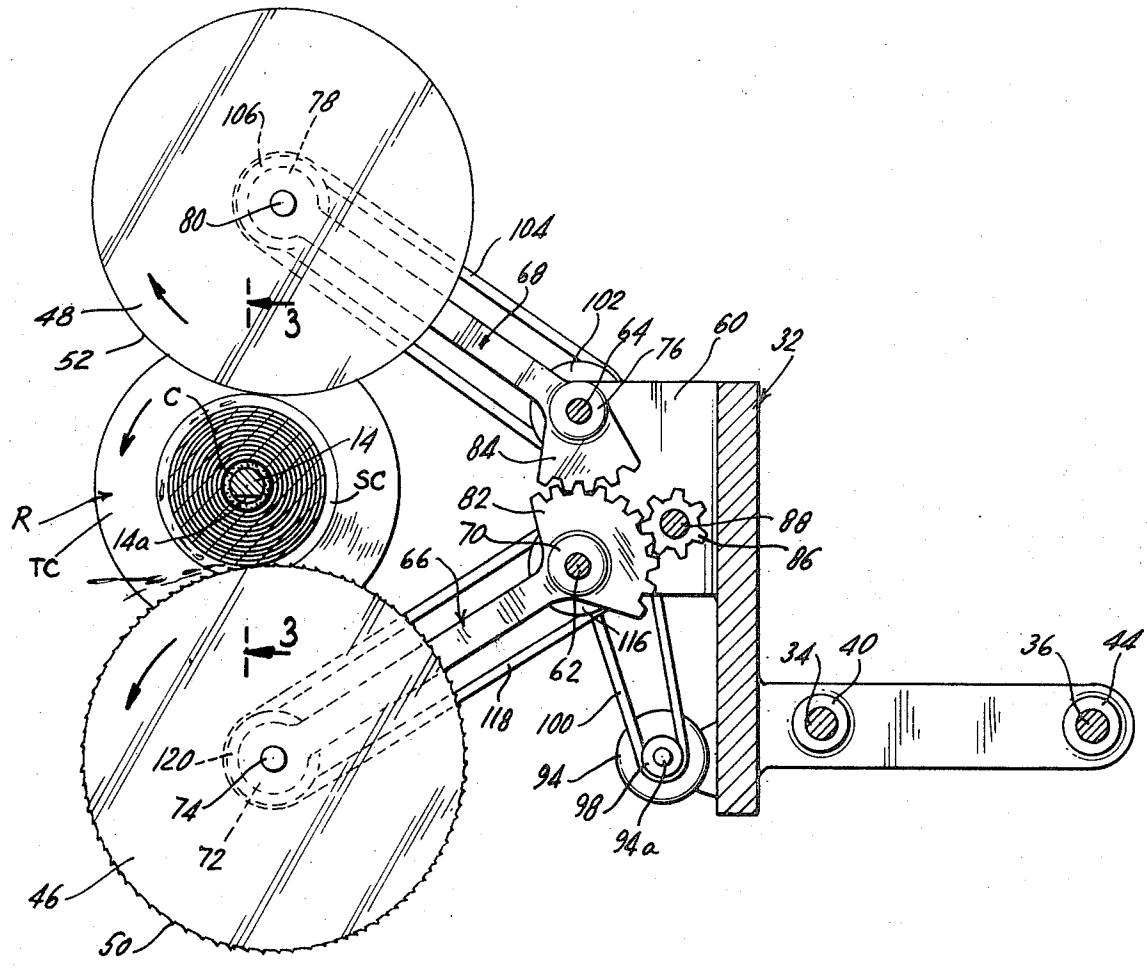


FIG. 1.

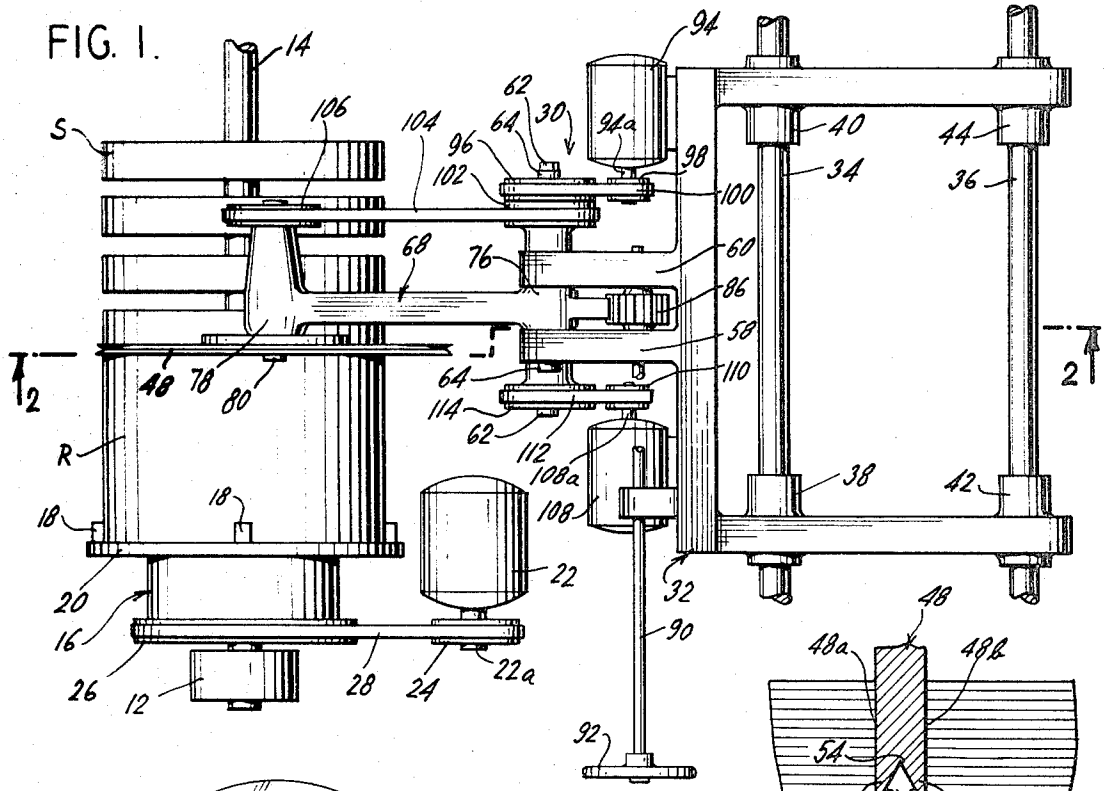


FIG. 3.

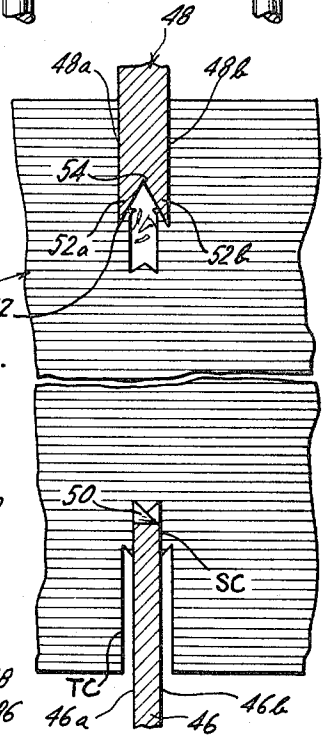


FIG. 2.

INVENTOR.
DAVID N. JUDELSON
BY
Amster & Levy
ATTORNEYS

CUTTING MECHANISM FOR ROTARY KNIFE CUTTING MACHINES

This is a continuation of U.S. Pat. application Ser. No. 50,917 filed on Aug. 22, 1960 Pat. No. 3,700,402 and entitled "Cutting Mechanism for Rotary Knife Cutting Machines."

The present invention relates generally to rotary knife cutting machines which are adapted to sever a roll of material wound on a core into plural strips, and in particular to mechanisms for cutting relatively dense rolls of material, such as relatively thin polyethylene and like thin films of plastic, which when wound into a roll exhibits a high order of hardness.

In a typical rotary knife cutting machine, such as disclosed in U.S. Pat. No. 2,457,310 of Dec. 28, 1948 and in pending application Ser. No. 722,301 filed Mar. 18, 1958, both said patent and application being assigned to the assignee of the present invention, there is disclosed a rotary knife cutting machine which enables the automatic or manual cutting of a roll of material into a number of strips of a prescribed width. A typical machine includes a frame upon which is supported a stationary shaft which receives the roll of material wound on a core and usually enclosed within a paper wrap. The roll of material is rotated about the longitudinal shaft axis by means of a chuck which engages one end of the roll and is driven from an appropriate variable high speed drive. A high speed rotary knife is mounted on a knife carrier and is movable toward and away from the stationary supporting shaft. The carrier in turn is mounted on the movable carriage which has an indexing mechanism selectively engageable with the frame of the machine such that the carriage may be moved stepwise through a prescribed and adjustable traversing stroke for moving the carrier and the rotary knife into successive indexed cutting positions along the length of the machine toward the chucked end of the roll of material. After each stepwise advance of the carriage, the knife carrier is actuated, either automatically or manually, to move the rotary knife inwardly toward the stationary supporting shaft such that the rotary knife moves in a cutting plane substantially at right angles to the longitudinal shaft axis and shears transversely through the roll of material and its core to sever the same into tapes or ribbons.

Such rotary knife cutting machines may be employed to cut relative dense rolls of material, such as of thin polyethylene film and the like, by employing a two-stage operation. After a roll is placed upon the stationary shaft and turned at the prescribed speed, the first stage involves employing a rotary sawing blade to cut through the material and through the core. Rolls cut with such sawing blade have successive end cut faces defining opposite sides of the strips or ribbons, which are rough and irregular. Often, unless caution is exercised, there is a tendency for such rough end faces of the strips or ribbons to fuse due to the heat developed incident to the action of the sawing blade as it penetrates radially inwardly through the roll towards the core in its cutting stroke. After this initial rough cutting or sawing, the second stage involves the taking of a trim cut with a trimming blade to provide relatively smooth cut end faces defining opposite sides of the strips or ribbons. Here again care must be taken to rotate the trimming knife and to penetrate at a rate such as to avoid the tendency to fuse the cut end faces of the roll. Necessarily such two-stage operation is time-consuming, comparatively expensive, and wasteful of material.

It has been suggested that the two stages may be achieved concurrently in a rotary knife cutting machine by arranging the sawing and trimming knives or blades at approximately 180° circumferentially of the roll of material such that the sawing and trimming may occur simultaneously. One suggested system involves the mounting of the trimming knife or blade which includes two bevelled trimming edges having a pneumatic control and to similarly mount the sawing knife or blade on an independently pivoted arm with an independent pneumatic control. The sawing blade is arranged radially outwardly in relation to the trimming blade and the blades advance simultaneously through the cutting stroke toward the core such that the sawing blade lags throughout the cutting stroke. As the trimming blade moves forwardly and penetrates the roll of material, a reaction force is developed by the roll of material; and periodically the trimming blade will tend to stop in its forward motion due to such reaction force. Concurrently, the lagging sawing blade cuts away the material removed initially by the trimming blade; and once the accumulation of cut material is removed, the operation may go forwardly with the trimming blade making a further forward penetration into the roll of material. This proposed system is inherently fraught with difficulty since it requires for its operation the development of a reaction force or back pressure on the trimming blade which reaction force or back pressure causes the development of heat with the attendant risk of fusing the cut edges of the plastic material. Further, it is difficult to establish optimum cutting conditions with any degree of flexibility as is required to handle various types of plastic materials and rolls of varying density and diameter.

Broadly, it is an object of the present invention to provide an improved cutting mechanism which obviates one or more of the aforesaid difficulties. Specifically, it is within the contemplation of the present invention to provide a cutting system for relatively dense rolls of plastic and like materials in which sawing and trimming operations occur simultaneously, with the trim taken from the roll by the trimming blade being thrown into the cut made by the sawing blade such that the trimmed material is comminuted and the cut is kept relatively free of clogging.

It is a further object of the present invention to establish individual speeds of rotation for the sawing and trimming knives or blades such as to permit the establishment of optimum cutting conditions for varying types of materials, roll densities and roll diameters.

In accordance with an illustrative embodiment demonstrating objects and features of the present invention, there is provided a cutting mechanism for cutting a roll of material into a plurality of tapes which comprises a supporting frame, a rotary sawing blade or knife having a sawing edge, and a rotary trimming blade or knife having a trimming edge. The blades are disposed substantially in a common cutting plane at right angles to the longitudinal axis of the roll of material and its supporting shaft. Carrier means mount the blades on the supported frame for movement through a cutting stroke in the common cutting plane from a retracted position spaced from the longitudinal axis of the roll of material to an advanced position contiguous thereto. The sawing edge is disposed radially inwardly

of the trimming edge by a fixed increment such that the sawing edge leads the trimming edge as the roll of material is cut. Provision is made for turning the blades at desired sawing and trimming speeds which advantageously may be made independent of each other, with the sawing blade preferably being turned at a lower rate of speed to develop a relatively low order of heat incident to the initial rough cutting action. As the sawing proceeds, the trimmed material taken from the opposite rough cut faces of the saw cut are thrown into such saw cut wherein the trimmed material is comminuted thereby keeping the cut relatively free of clogging and permitting the uniform advance of the blades through the forward cutting stroke.

The above brief description, as well as other objects and features and advantages of the present invention will be more fully appreciated by reference to the following detailed description of a presently preferred, but nonetheless illustrative embodiment according to the present invention, when taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a fragmentary plan view of a typical rotary knife cutting machine embodying cutting mechanisms in accordance with the present invention;

FIG. 2 is a sectional view taken substantially along the line 2—2 of FIG. 1 in the direction of the arrows, and on a somewhat large scale, showing details of the cutting mechanism; and,

FIG. 3 is a sectional view taken substantially along the line 3—3 of FIG. 2 in the direction of the arrows, with parts broken away to show the concurrent sawing and trimming action achieved in accordance with the present invention.

Referring now specifically to the drawings, a brief description will be set forth of portions of a typical rotary knife cutting machine, generally designated by the reference numeral **10**, to illustrate the environment for a cutting mechanism in accordance with the present invention. For further details of a manual machine suitable for the practice of the present invention, reference may be made to U.S. Pat. No. 2,457,310; and for details of an automatic machine, reference may be made to said pending U.S. Pat. application, Ser. No. 722,301. The machine includes a frame or support having an upright standard **12** at one end thereof from which projects the longitudinally extending stationary supporting shaft **14** which has a flat **14***a* on one side and which receives the roll of material R wound on a core C, as of cardboard, (see FIG. 2). The roll R is adapted to be cut into plural strips or ribbons S on a manual or automatic basis. One end of the roll of material R is brought into abutment with a chuck **16** which is of the type including a number of roll-penetrating elements which may be engaged into the outer periphery of the roll R for fixing the same, with one end thereof against the adjacent end face of the chuck plate **20**. For a detailed description of an improved chuck **16** which may be employed in the present machine, reference may be made to U.S. Pat. No. 2,938,733 of May 31, 1960, assigned to the assignee herein. As seen in FIG. **1**, the chuck **16** is rotated about the stationary roll-supporting shaft **14** at the prescribed roll turning speed by a variable speed drive motor **22** which is mounted on an appropriate support provided by the machine frame. The drive shaft **22***a* of the motor **22** is coupled to the chuck **16** by a belt and pulley coupling, including the pulley **24** on the motor shaft **22***a*, the pulley **26** on the chuck **16** and the belt **28** trained over the pulleys **24**, **26**. The belt and pulley coupling is arranged to achieve the required speed reduction between the motor shaft **22***a* and the chuck **16**.

Mounted on the machine frame is the improved cutter assembly of the present invention, generally designated by the reference numeral **30**, which includes a knife carriage or mount **32** which is movable along the machine frame in a path parallel to the longitudinal axis of the roll-supporting shaft **14** and on appropriate guide rail **34**, **36** extending through the bearings **38**, **40**, **42** and **44** on the knife carriage **32**. The knife carriage **32** is moved longitudinally of the machine frame through successive longitudinal traversing incuments or strokes to bring the high speed rotary sawing and trimming knives into successive positions incutting planes at right angles to the roll-supporting shaft **14**, either manually or automatically, as described in U.S. Pat. No. 2,457,310 and said copending application Ser. No. 722,301.

Disposed within a common cutting plane and extending at right angles to the roll-supporting shaft **14**, which cutting plane may be progressively advanced along the length of the roll R, are a rotary sawing blade or knife **46** and a rotary trimming blade or knife **48**. As seen best in FIG. **2**, the sawing knife **46** is below the roll R and the trimming knife **48** is above the roll R. The respective knives are circumferentially spaced at approximately 180° relative to each other. The sawing knife **46** is provided with circumferential or peripheral sawing teeth **50** of an appropriate configuration to take a relatively rough sawing cut SC through the roll of material, as shown in FIG. **3**; while the trimming blade **48** is provided with a V-shaped circumferential or peripheral notch **52** defining bevelled trimming edges **52***a*, **52***b*, which meet at an apex **54** inwardly of the outer periphery of the knife **48**. As best seen in the enlarged showing of FIG. **3**, the trimming knife **48** is of a greater width than the sawing knife **46**, with median lines through the knives **46**, **48** being arranged symmetrically about a common plane and with the outer faces **48***a*, **48***b*, of the trimming knife **48** being respectively disposed outwardly of the adjacent outer faced **46***a*, **46***b* of the sawing knife **46** for making a wider trimming cut TC. The sawing edge **50** of the sawing knife or blade **46** is disposed radially inwardly of the bevelled trimming surfaces **52***a*, **52***b* of the trimming knife **48** such that as the knives **46**, **48**, concurrently penetrate the roll of material R with a fixed interval or increment therebetween, the leading sawing knife **46** makes the narrow sawing cut or groove SC which is followed up by the somewhat wider and symmetrical disposed trimming cut TC. With this arrangement, there is substantially no tendency for the sawing cut SC to clog up due to the accumulation of sawings from the roll R in that such accumulation is chewed up or comminuted by the action of the trimming knife **48**.

In order to mount the rotary sawing and trimming knifes **46**, **48** on the knife carriage **32**, there is provided a pair of upstanding mounting plates **58**, **60** which extend at right angles to the guide rails **34**, **36** And are welded or otherwise secured to the knife carriage **32**. Extending transversely of the upstanding mounting plates **58**, **60** are lower and upper mounting studs **62**, **64** which are journaled in the mounting plates **58**, **60** and provide respective pivotal mounts for the sawing knife carrier **66** and the trimming knife carrier **68**. Since the knife carriers **66**, **68** are disposed one above

the other in a common vertical cutting plane, the trimming knife carrier **68** is only visable when the machine is view from above as shown in FIG. **1**. The sawing knife carrier **66** includes a mounting bearing **70** on the end thereof remote from the sawing knife **46** which bearing **70** is journaled about the axis provided by the lower mounting stud **62**. At its end remote from the mounting bearing **70**, the knife carrier **66** is provided with a knife-supporting bearing **72** (see the dotted line shown in FIG. **2**) through which extends the sawing knife shaft **74** which is fixed at one end to the sawing knife **46** and is driven from its other end, as will subsequently be described. In a similar fashion the trimming knife carrier **68** is provided with a mounting bearing **76** at the end thereof remote from the trimming knife **68** which mounting bearing **76** is journaled on the upper mounting stud **64**. At its end remote from the mounting bearing **76**, the trimming knife carrier **68** is provided with a knife-supporting bearing **78** (seen in FIG. **1**) through which extends the trimming knife shaft **80** which is fixed at one end to the trimming knife **48** and is driven from its opposite end, as will subsequently be described.

The sawing and trimming knives **46, 48** are moved through their forward or cutting stroke in the cutting cycle of the machine and in the required radial relationship by the provision of a driven gear sector **82** on the sawing knife carrier **66** which is in meshing engagement with a follower gear sector **84** on the trimming knife carrier **68**. By appropriate initial positioning of the knives **46, 48** and selection of the intermeshing relationship between driven gear sector **82** and the follower gear sector **84**, it is possible to arrange the sawing knife **46** to lead the trimming knife **48** by a prescribed fixed increment over the entire operative portion or stroke in the cutting cycle. In this illustrative arrangement, the driven gear sector **82** is turned to bring about the in unison advance of the knives **46, 48** by a manual arrangement which includes a driving gear **86** which is journaled on a gear stud **88** extending between the upstanding mounting plates **56, 58**, which driving gear **86** is turned by an actuating shaft **90** through a hand wheel **92**. Although a manual arrangement is shown for moving the knives **46, 48** through the cutting stroke, it will be appreciated that it is within the contemplation of the invention to actuate the knives **46, 48** by other appropriate manual arrangements, as well as by the automatic mechanism disclosed in said copending U.S. Pat. application, Ser. No. 722,301.

Independent drives are provided for the respective sawing and trimming knives **46, 48** such that desired knife speeds may be established in accordance with the type of material being cut. The trimming knife drive includes a variable speed drive motor **94** which is mounted on the knife carriage **32**. A belt and pulley coupling is arranged between the motor shaft **94***a* and the knife shaft **80**. Specifically, the upper mounting stud **64** is projected outwardly of the mounting plate **60** to serve as a pulley shaft on which there is fixed an intermediate driven pulley **96**. The driven pulley **96** is coupled to a drive pulley **98** on the motor shaft **94***a* by a belt **100**. The driven pulley **96** in turn is fixed to a further intermediate pulley **102** which is coupled by a belt **104** to a knife pulley **106** fixed to the knife shaft **80**. In a similar fashion an independent drive is provided for the sawing knife **46** which includes a drive motor **108** having its motor shaft **108***a* coupled by driving pulley **110** and a belt **112** to an intermediate pulley **114** on the lower mounting stud **62** which serves as a pulley shaft. The intermediate pulley **114** is connected to a further intermediate pulley **116** which in turn is connected by a belt **118** to a knife pulley **120** fixed to the knife shaft **74** (see FIG. **4**).

In order to facilitate a more thorough understanding of the present invention, reference will now be made to a typical sequence of cutting in accordance with the present invention:

After the machine operator places the roll of material R on the machine and engages the same with the chuck **16**, the machine is placed in operation. The knife carriage **32** is indexed to the appropriate position longitudinally of the machine to orient the coplanar sawing and trimming knives **46, 48** to take a cut transversely through the roll R towards the core C thereof. Such indexing may be in accordance with the principles of issued patents assigned to the assignee of the present invention or in accordance with the teachings of said copending U.S. Pat. application Ser. No. 722,301. Thereupon the sawing and trimming knives **46, 48** are moved inwardly through their cutting strokes, with the sawing edge **50** of the sawing knife **46** leading the bevelled surfaces **52***a*, **52***b* of the trimming edge **52** of the trimming knife **48**. The cutting progresses until such as the sawing edge **50** penetrates through the core C and approaches the flat **14***a* on the roll-supporting shaft **14**. It will be appreciated that only one flat is required on the roll-supporting shaft **14** opposite the point of penetration of the sawing knife **46** in that the lagging relationship of the trimming knife **48** precludes the possibility of contact with the shaft. During the cutting operation, which progresses at a substantially uniform rate as established by the motion imparted to the carriers **66, 68**, the sawing knife **46** takes the rough cut SC, followed by the fine cut TC of the trimming knife **48**, with clogging being effectively precluded due to the comminuting action of the trimming knife **48**. At the end of the cut, the knives **46, 48** are retracted to a clearance position relative to the roll, the knife carriage is indexed, and the operation is repeated.

A latitude of modification, change and substitution is intended in the foregoing disclosure and in some instances some features of the invention will be employed without a corresponding use of other features. Accordingly, it is appropriate that the appended claims be construed broadly and in a manner consistent with the spirit and scope of the invention herein.

What I claim is:

1. A cutting mechanism for cutting a roll of material into plural tapes comprising a support, a rotary sawing blade having a sawing edge, a rotary trimming blade having a trimming edge, said blades being disposed substantially in a common plane at right angles to the longitudinal axis of said roll and substantially in opposed relation to each other, carrier means mounting said blades on said support for movement through a cutting stroke in said common plane from a retracted position spaced from said longitudinal axis to an advanced position contiguous thereto, said sawing edge being disposed radially inwardly of said trimming edge by a fixed increment such that said roll of material is first cut by said sawing blade and then trimmed by said trimming blade during said cutting stroke, and means operatively connected to said sawing blade and to said trimming blade for rotating said blades.

2. A cutting mechanism according to claim 1 wherein said trimming blade is of a greater width than said sawing blade.

3. A cutting mechanism for a cutting machine including a support, a shaft on said support adapted to receive a roll of material and a chuck for rotating said roll of material comprising a rotary sawing blade having a sawing edge, a rotary trimming blade having a trimming edge, said blades being disposed substantially in a common cutting plane at right angles to the longitudinal axis of said stationary shaft and substantially in opposed relation to each other, carrier means mounting said blades on said support for movement through a cutting stroke in said common cutting plane from a retracted position spaced from said stationary shaft to an advanced position contiguous to said shaft, said sawing edge being disposed radially inwardly of said trimming edge such that said roll of material is first cut by said sawing blade and then trimmed by said trimming blade during said cutting stroke, saw-rotating means operatively connected to said sawing blade, and trim-rotating means operatively connected to said trimming blade.

4. In a cutting machine, a support, a stationary shaft on said support adapted to receive a roll of material, a chuck for rotating said roll of material, and cutting mechanisms for cutting said roll of material into plural tapes, the improvement comprising said cutting mechanisms including a rotary sawing blade having a sawing edge, a rotary trimming blade having a trimming edge, said blades being disposed substantially in a common cutting plane at right angles to the axis of said stationary shaft and substantially in opposed relation to each other, carrier means mounting said blades on said support for movement through a cutting stroke in said common cutting plane from a retracted position spaced from said stationary shaft to an advanced position contiguous to said shaft, said sawing edge being disposed radially inwardly of said trimming edge by a fixed increment such that said roll of material is first cut by said sawing blade and then trimmed by said trimming blade during said cutting stroke, and means operatively connected to said sawing blade and to said trimming blade for rotating said blades.

5. In a rotary knife cutting machine, a frame including a knife mount, roll-supporting and turning means on said frame including a shaft adapted to receive and support a roll of material which is to be cut into a plurality of tapes while turning about the shaft axis, a sawing knife carrier mounted on said knife mount for movement toward and away from said shaft, a rotary sawing knife having a sawing edge mounted on said sawing knife carrier for rotation about a sawing axis parallel to said shaft axis, a trimming knife carrier mounted on said knife mount for movement toward and away from said shaft, a rotary trimming knife having a trimming edge mounted on said trimming knife carrier for rotation about a trimming axis parallel to said shaft axis, said sawing and trimming knives being disposed in opposed relation to each other and in a common cutting plane extending at right angles to said shaft axis, said sawing edge being disposed radially inwardly of said trimming edge by a fixed increment such that said roll of material is first cut by said sawing knife and then trimmed by said trimming knife during movement of said knives toward said shaft, means operatively connected to said sawing and trimming knife carriers for moving said sawing and trimming knives toward said shaft during a cutting stroke while maintaining said fixed increment between said sawing and trimming edges, and means operatively connected to said knives for rotating said knives.

6. In a rotary knife cutting machine according to claim 5, said trimming knife being of a greater width than said sawing knife such as to trim adjacent faces of said roll of material after cutting said said sawing knife.

7. In a rotary knife cutting machine, a frame, roll-supporting and turning means on said frame including a stationary shaft adapted to receive and support a roll of material which is to be cut into a plurality of tapes while turning about the shaft axis, a knife carriage, means mounting said knife carriage on said frame for longitudinal traverse along a path parallel to said shaft axis, a sawing knife carrier mounted on said knife carriage for movement toward and away from said stationary shaft, a rotary sawing knife having a sawing edge mounted on said sawing knife carrier for rotation about a sawing axis parallel to said shaft axis, a trimming knife carrier mounted on said knife carriage for movement toward and away from said stationary shaft, a rotary trimming knife having a trimming edge mounted on said trimming knife carrier for rotation about a trimming axis parallel to said shaft axis, said sawing and trimming knives being disposed in a common cutting plane extending at right angles to said shaft axis, said sawing edge being disposed radially inwardly of said trimming edge such that said roll of material is first cut by said sawing knife and then trimmed by said trimming knife during movement of said knives toward said stationary shaft, means operatively connected to said sawing and trimming knife carrier for moving said sawing and trimming knives toward and away from said stationary shaft during a cutting cycle while maintaining the radial relationship between said sawing and trimming edges, means operatively connected to said sawing knife for rotating said knife at a sawing speed, and separate means operatively connected to said trimming knife for rotating said trimming knife at a trimming speed.

8. A cutting mechanism for use in a rotary knife cutting machine including a frame, roll-supporting and turning means on said frame including a stationary shaft adapted to receive and support a roll of material which is to be cut into a plurality of tapes while turning about the shaft axis, a knife carriage and means mounting said knife carriage on said frame for longitudinal traverse along a path parallel to said shaft axis, said cutting mechanism including a sawing knife carrier adapted to be pivotally mounted on said knife carriage for movement toward and away from said stationary shaft, a rotary sawing knife having a sawing edge rotatably mounted on said sawing knife carrier for rotation about a sawing axis parallel to said shaft axis, a trimming knife carrier adapted to be pivotally mounted on said knife carriage for movement toward and away from said stationary shaft, a rotary trimming knife having a trimming edge rotatably mounted on said trimming knife carrier for rotation about a trimming axis parallel to said shaft axis, said sawing and trimming knives being disposed in opposed relation to each other in a substantially common plane extending at right angles to said shaft axis, said sawing edge being disposed radially inwardly of said trimming edge by a fixed increment and being of a lesser width then said trimming edge such that said roll of material is first cut by said

sawing knife and then trimmed by said trimming knife during movement of said knives toward said stationary shaft, and means for rotating said knives.

9. A cutting mechanism for cutting a roll of material into plural tapes comprising; a support, a rotary sawing blade having a sawing edge, a rotary trimming blade having a trimming edge, said blades being disposed substantially in a common plane at right angles to the longitudinal axis of said roll and substantially in opposed relation to each other, carrier means mounting said blades on said support for movement through a cutting stroke in said common plane from a retracted position spaced from said longitudinal axis to an advanced position contiguous thereto, said sawing edge being disposed radially inwardly of said trimming edge by a fixed increment such that said roll of material is first cut by said sawing blade and then trimmed by said trimming blade during said cutting stroke, and power means for driving one of said blades.

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