

(19)



Europäisches Patentamt

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(11)

EP 0 865 882 A2

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
23.09.1998 Bulletin 1998/39

(51) Int Cl.⁶: **B26D 3/02**, B26D 7/14,
B26D 1/04

(21) Application number: **98302030.6**

(22) Date of filing: **18.03.1998**

(84) Designated Contracting States:
**AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC
NL PT SE**
Designated Extension States:
AL LT LV MK RO SI

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(30) Priority: **20.03.1997 US 821646**

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(54) Ultrasonic skiver for unvulcanized rubber material

(57) A skiver device is comprised of an ultrasonically excited knife (50) and its holder, an upper floating roller assembly (30) with a material lead-in device which guides the material to the knife blade, a roller anvil assembly (20) with material lead-in and support rollers providing support of the underside of the material during cutting, an upper material separation device (60) and a lower material separation device (65), which cooperate to keep apart the edge of the material from a supply roll and the edge of the severed strip as the cut progresses. These elements are supported from a traversing carriage (12) which moves along a rail (14) supported transversely with respect to a path along which a web (W) of

uncured rubber material is guided as the material is fed from the supply roll. The rail (14) extends at a predetermined angle to the web path so as to make a diagonal cut across the web material, and the knife (50) is supported to cut the web material at an acute angle to the surfaces of such material, e.g. a skive type of cut. The skiver device incorporates the roller anvil assembly (20) and a floating roller assembly (30), with freely independently rotatable arrays of rollers (22, 32) supported in close association with the skiver knife, to control closely the positioning of the uncured rubber material from which the skiver knife will sever strips of predetermined width, and to provide separation devices which keep the edges of material apart as the severing action proceeds.

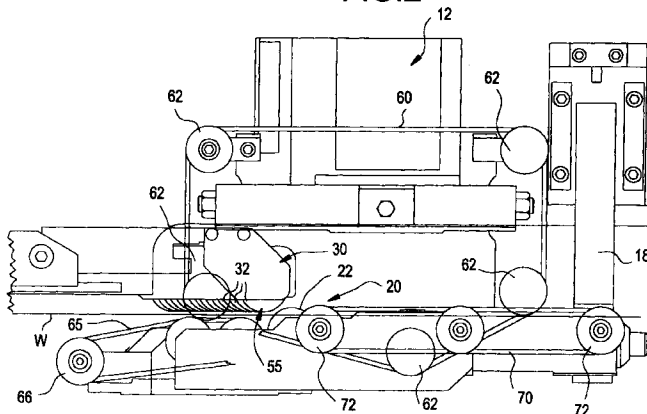
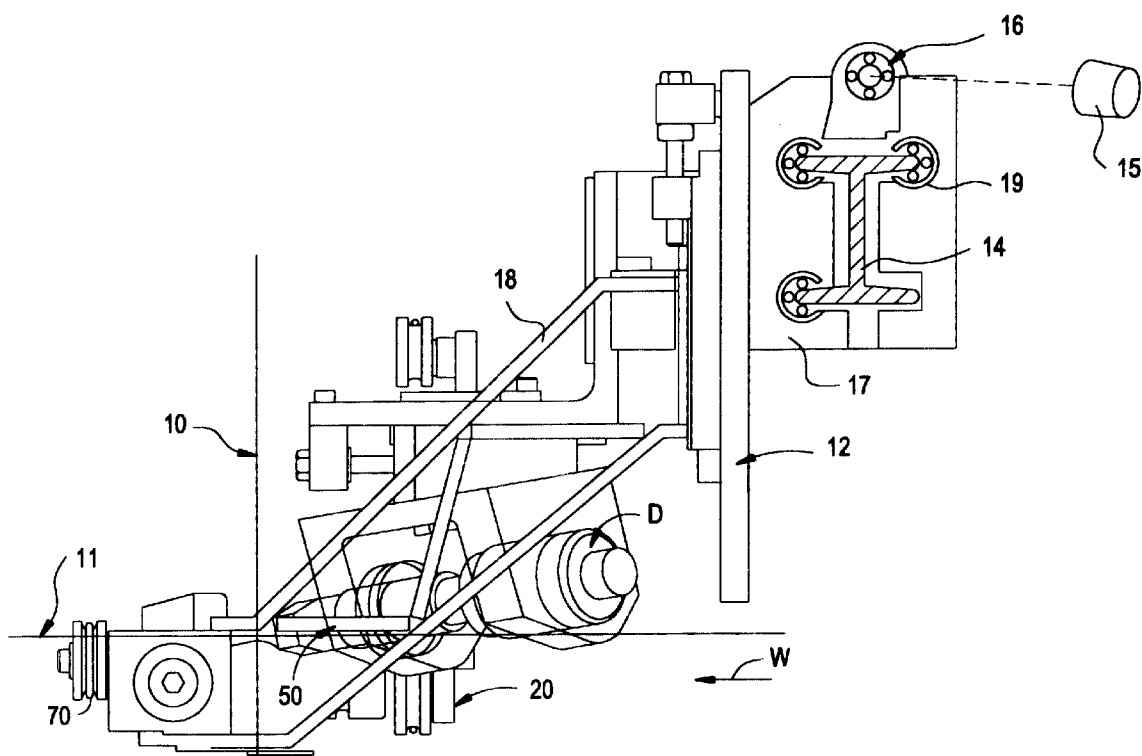
FIG.2**EP 0 865 882 A2**

FIG.3



Description

The invention relates to a cutting device utilizing an ultrasonic knife in the separation of lengths of strips from a roll of unvulcanized rubber at a low angle from the horizontal surface plane of the strip and at some angle diagonally across the width of the strip. Such devices are commonly termed a skiver. The strip end product requirements demand that the resultant cut ends of the material be dimensionally accurate and statistically consistent.

Known devices for the cutting of this type of material with various cutting devices commonly employ stationary or rotating knives, sometimes with a stationary anvil or no anvil at all.

Some of the characteristics of these are as follows. First, with devices using some sort of stationary anvil, parallelism between the path of the knife and the anvil surface is very critical in low angle cutting, particularly because of the feather-like edges of the finished cut. In reality, it can be very difficult to produce and maintain this degree of parallel accuracy and structural integrity in a production environment within practical budget considerations.

With increasing gap between the knife and anvil to help to accommodate non-parallelism, there is a resulting loss of consistency and dimensional accuracy in the finished cut. With decreasing gap, the knife and/or anvil may become damaged if there is contact between them. In the case of the ultrasonic knife, this contact can also result in dampening of the vibration and resultant ineffectiveness of the knife.

Stationary anvils by nature are placed at or following the cutting edge. Because the knife must have some finite and increasing wedge-like thickness following the cutting edge for structural rigidity, a narrow or narrowing gap is created between the knife and the anvil, producing a pinching or perhaps even some extruding of the material. This produces a very undesirable build-up of unvulcanized material on the knife and/or anvil from the friction and resultant heat. Eventually this action can prevent passage of material through the gap and causes a jam and buckling of material ahead of the knife.

A common, but relatively ineffective, remedy for this situation has been to apply tension to the material to help to pull it through this gap. This longitudinal stretching of the material has not been observed to prevent build-up, nor has it produced a consistent quality of cut.

With no anvil employed, it is normally required that some amount of longitudinal tension be applied to the strip of material, causing undesirable stretching of unpredictable nature. Lack of control of the interface line between the material and the knife can produce scalloping, irregular angle, changes in direction and generally inconsistent cuts of unacceptable quality.

A major contribution of the skiver device provided by this invention is the use of a rolling anvil cutting system which has the ability to control the material at the

cutting edge of the ultrasonic knife, independent of ancillary devices or forces, with low friction between the system and the material to be cut.

Characteristic features of this novel skiver device are accurate positioning of the material in the area immediately preceding the cutting edge of the knife, low friction operation, separation of the sticky edges of the unvulcanized material as the cut progresses, and adaptability to a wide range of various cutting conditions and configurations of the cut edge.

This new skiver device is comprised of the following major elements: 1) an ultrasonic knife and its holder; 2) an upper floating roller assembly with a material lead-in device which guides the material to the knife blade; 3) a roller anvil assembly with material lead-in and support rollers, which provides support of the underside of the material during cutting; 4) an upper material separation device, and 5) a lower material separation device, which cooperate to keep apart the edge of the material supply roll and the edge of the severed strip as the cut progresses.

All of these elements are supported from a traversing carriage which moves along a rail. The rail in turn is supported transversely with respect to a path along which a web of uncured rubber material is guided as the material is fed from a supply roll. Preferably, the rail extends at a predetermined angle to the web path so as to make a diagonal cut across the web material, but the cut could be perpendicular to the edges of the web. The knife is supported to cut the web material at an acute angle to the surfaces of such material, e.g. a skive type of cut.

The principal object of the invention is to provide a skiver device which incorporates a roller anvil assembly and an upper floating roller assembly, supported in close association with a skiver knife (preferably an ultrasonically excited knife) to control closely the positioning of a web of uncured rubber material from which the skiver knife will sever strips of predetermined length; to provide material separation devices which keep the edges of material apart as the severing action proceeds; and thus to provide accurate and consistent separation of the strips from the web.

One embodiment of the invention will now be described with reference to the accompanying drawings, in which:-

Fig. 1 is a partial plan view of the skiver device with the knife and its ultrasonic driver shown in outline; Fig. 2 is a front view of the skiver device and portions of the supporting structure omitting the knife; Fig. 3 is an end view of the skiver device mounted to traverse a supply web of unvulcanized rubber sheet-like material which is to be cut into strips of predetermined length, and with angled cut edges at the opposite ends of the strip; Fig. 4 is a top partial view of the lower roller anvil assembly;

Fig. 5 is view of one of the holders and associated rollers which are embodied in the lower roller anvil assembly;

Fig. 6 is a partial top view of the upper floating roller assembly, with a portion of the ultrasonic knife edge shown in phantom lines;

Fig. 7 is a partial side view of the upper floating roller assembly; and

Fig. 8 is a detail showing a holder and roller embodied in the upper guide assembly; and

Fig. 9 is an enlarged fragmental view showing the skive style of cut.

In Figs. 1, 2 and 3 web W of uncured rubber material is shown with the skiver device 10 of the invention located to the outside of one edge of the web, preparatory to moving across the web so as to sever strip 11 from the free or leading edge of the web. Typically, the severed strip will become a component in a tire assembling and manufacturing operation, as by wrapping the strip around a tire carcass such that the skived ends of the strip are joined together. The skiver device is suspended from a traversing carriage 12 which is moved (e.g. driven) along a rail 14 (Fig. 3) by a reversible motor 15 which powers a rotary to linear actuation mechanism, e.g. a ball screw mechanism 16. Arm 18 extends forward and downward from carriage 12 to provide a rigid depending support for the skiver device 10 and its various parts. Thus, for purposes of description the motion of carriage is considered to be from side to side, e.g. from right to left as seen in Figs. 1 and 2. The parts of the skiver device nearest to the carriage are considered as at the back, to the right in Fig. 3, and the parts farthest from the carriage are considered as at the front, to the left in Fig. 3.

Rail 14 may be an I-beam, so as to define a rigid support and a precise path of motion for the skiver device. Brackets 17 extend from carriage 12, and include linear bearings 19 which engage the flanges of rail 14, and also include the follower of a rotary to linear actuation mechanism 15. Any equivalent linear drive device can be used in place of the ball screw mechanism.

The web W is advanced intermittently in increments which determined the length of the severed strips. This feeding movement of the web is generally from top to bottom in Fig. 1 and 4, from right to left in Fig. 3, and from the back to the front in Fig. 2. The web W is fed or advanced the predetermined increment with the skiver device to one side (the right side in Figs. 1 and 2), the web is halted, and the skiver device is driven across the web, along rail 14. The knife, as the skive progresses, severs the strip from the web with an acutely angled cut, as shown in Fig. 9.

The absolute vertical location of the web material relative to the skiver device is not critical, since as the skiver approaches the uncut material, it directs the material to the opening or gap between the roller anvil assembly 20 and the upper floating roller assembly 30, in

a low friction manner with the web captured for close control of the material at the cut edge as the skiver progresses across web W. The knife 50, excited by an ultrasonic driver D, has its cutting edge 52 located in the gap where the upper floating roller and lower roller anvil assemblies 20, 30 face the line of severance of strip 11 from web W.

Narrow individual rollers 22 in the roller anvil assembly 20, and similar rollers 32 in the upper floating roller assembly 30, not only reduce friction, but also allow for the optimization of the shear angle to knife relationship required by a given cutting situation. In this instance, a solid roller of the approximate width of the knife would produce unacceptable friction.

Referring to Figs. 2, 3 and 5, rollers 22 are relatively thin disc-like members preferably made of a plastic material (such as Teflon), supported for free rotation in holders 24 which are arranged in a stack within a support frame 25, the stack being disposed in an angular array with respect to carriage 12 and its path of motion along rail 14. Arms 24 are retained in frame 25, so as to allow each roller 22 independent rotating motion against the underside of the material just ahead of the location of the angled cut, i.e. the cutting edge 52 of the ultrasonically excited knife 50, as the action proceeds, right to left as viewed in Figs. 1 and 2. The tops of rollers 22 are tangent to the underside of web W, and displaced along a line which is parallel to knife edge 52, thus providing the free rolling array moving along the web underside as the knife approaches and moves across (through) the web material.

Placement of the rolling anvil assembly 20 immediately forward of the knife edge 52 introduces the material at the proper location relative to the knife cutting edge and does not require other devices at, or following, the cutting edge which (as mentioned) might tend to hinder the operation.

The narrow individual rollers 32 in the upper floating guide assembly are captured in C-shaped cavities 33 at the ends of arm-like holders 34, which are angularly stacked and individually pivotally supported within a frame 35 which is mounted to carriage 12 by arm 36. Upper rollers 32 are thus arranged in an array complementary to the anvil rollers and will rest upon, and roll along, the upper surface (or top side) of web W. The entire frame and roller/holder assembly is pivoted to arm 36 through a bushing support 37, so the entire assembly can be raised for access purposes. When it is in the lowered operative position the upper floating rollers 32 rest on the upper surface of web W, and each roller 32 is independently rotatable and also movable in a rocking type floating motion against the web. This provides control of the material by holding it down against the roller anvil 20 and toward the cutting edge 52 of knife 50. The skiver device thus enters the web W of material at an angle which is determined by the desired skive type of cut without loss of control; the control is maintained on stepped or tapered edges.

The skiver device also accomplishes separation of the cut ends of the web material, without tensioning or stretching, past the cut made at the knife edge. This is accomplished by dislocation (vertical dislocation or separation in the illustrated embodiment) of the material immediately following the cut. Four sets of endless friction driven belts are supported about-freely rotatable rollers, and engage the top and underside of the strip being cut and of the web, tending to separate those edges so they do not rejoin as they pass beyond knife 50.

Thus, upper belt 60 is supported on and around rollers 62 and moves along the cut edge of the web preceding the anvil assembly, and depressing that portion of web W due to the lower path of belt 60 extending below the level of web W (see Fig. 2) in the region of the anvil immediately following the knife cutting edge 52. Lead-in belts 65 are mounted on and supported by or around rollers 66 front and back of the roller anvil assembly, and will guide the underside of web W as the knife edge approaches. A following belt 70 supported on and around rollers 72, engages the underside of the severed strip 11, and helps to guide that edge of the strip upward onto the tapered roller 75 which is freely rotatably mounted on the rolling anvil, following the knife edge.

These belts engage the surface of the web and the strip being severed, on either side of the skive cut, as the skiver device proceeds across the web. The forces for moving the belts are derived from the forward (right to left in Figs. 1 & 2) motion of the skiver device, and portions of the belts in contact with surfaces of web W simply travel along the web and strip 11 without relative movement between the respective web and strip surfaces and the contacting belt portions.

Such dislocation moves the material away from the knife surfaces, preventing friction, heating, and build-up of material on these surfaces. This action also reduces dampening of the ultrasonic vibration induced in the blade by driver D. The material above the knife (the cut edge of strip 11) is raised and supported as the skiver travels forward across the web material. The material below the knife (the cut edge of web W) is dislocated or deflected downward.

This arrangement also provides a compact, low friction means to facilitate clearance between the material and the knife assembly with its holder.

The entire skiver device, unlike the stationary anvil types, is removed from the area of material flow at both ends of its travel, since rail 14 extends beyond the sides of web W, thereby facilitating and not hindering conveying or transfer devices for the web and/or the severed strips.

While the method herein described, and the form of apparatus for carrying this method into effect, constitute preferred embodiments of this invention, it is to be understood that the invention is not limited to this precise method and form of apparatus, and that changes may be made in either without departing from the scope of

the invention, which is defined in the appended claims.

Claims

1. A skiver for cutting strips of unvulcanized rubber material from a web providing a supply thereof, comprising
 - a carriage supported for movement across the supply web along a predetermined path,
 - a knife mounted on said carriage and having a cutting blade positioned to sever a strip from the web,
 - a roller anvil assembly including an array of support rollers providing support for the underside of the material during cutting,
 - upper and lower separation means for cooperating action as said carriage moves across the web to keep apart the edge of the web material and the edge of the severed strip.
2. A skiver as defined in claim 1, wherein
 - said roller anvil assembly includes a plurality of freely rotatable rollers supported to contact the underside of the web along as said carriage moves along the predetermined path,
 - said rollers having their edges arrayed along a line parallel to and immediately ahead of said cutting edge of said knife in the direction of travel of said carriage.
3. A skiver as defined in claim 2, wherein
 - said rollers of said roller anvil assembly are individually rotatable.
4. A skiver device as defined in claim 2 or 3, further comprising
 - an upper floating roller assembly including an array of independently pivotally mounted arms each having an upper roller captured in a free end of the arm,
 - said upper rollers being arrayed along a line parallel to and immediately above and forward of said cutting edge of said knife in the direction of travel of said carriage.
5. A skiver as defined in any preceding claim, wherein
 - said separation means includes a plurality of pulleys mounted on said carriage about opposite sides of said roller anvil assembly to define loop paths parallel to the predetermined path of said carriage, and
 - endless belts supported on said pulleys to contact portions of the web and the severed strip

as said carriage moves across the web and to exert forces against the facing edges of the web and the strip to separate them at the region of severance.

6. A skiver as defined in claim 5, wherein

said loop paths of said endless belts extending along surfaces of the web and the strip being severed from the web to move apart the opposite cut edges of the web and the strip as said knife proceeds in making its cut.

7. A skiver device incorporating

a carriage supported for movement across a supply web of uncured rubber material movable along a predetermined path, a skiver knife mounted on said carriage and having a cutting blade positioned to sever a strip from the web, said cutting blade having an edge positioned to pass into the web at an angle with respect to its cutting path and at an angle with respect to the plane of the web of material,

a roller anvil assembly and a floating upper roller assembly, said assemblies each having a plurality of freely rotatable rollers being supported in arrays located on parallel lines respectively forward and above and forward and below in close association with said skiver knife to control closely the positioning of the web of uncured rubber material from which said cutting edge of said skiver knife will sever strips of predetermined length.

8. A skiver device as defined in claim 7, further including

a plurality of endless belts supported on said carriage for free movement along their respective lengths in loop paths, portions of said loop paths extending along surfaces of the web and the strip being severed from the web so as to move the cut edges of the web and strip apart as they pass around said knife blade and thus to provide material separation devices which keep the edges of material apart as the severing action proceeds.

9. The method of separating a length of uncured tire building material from a web thereof, comprising the steps of

a) feeding a web of uncured rubber material past a cutting position where the material is severed to produced strips of predetermined length,

b) severing the strips from the web with a skive type of cut made at an angle with respect to the thickness of the web using a knife blade having

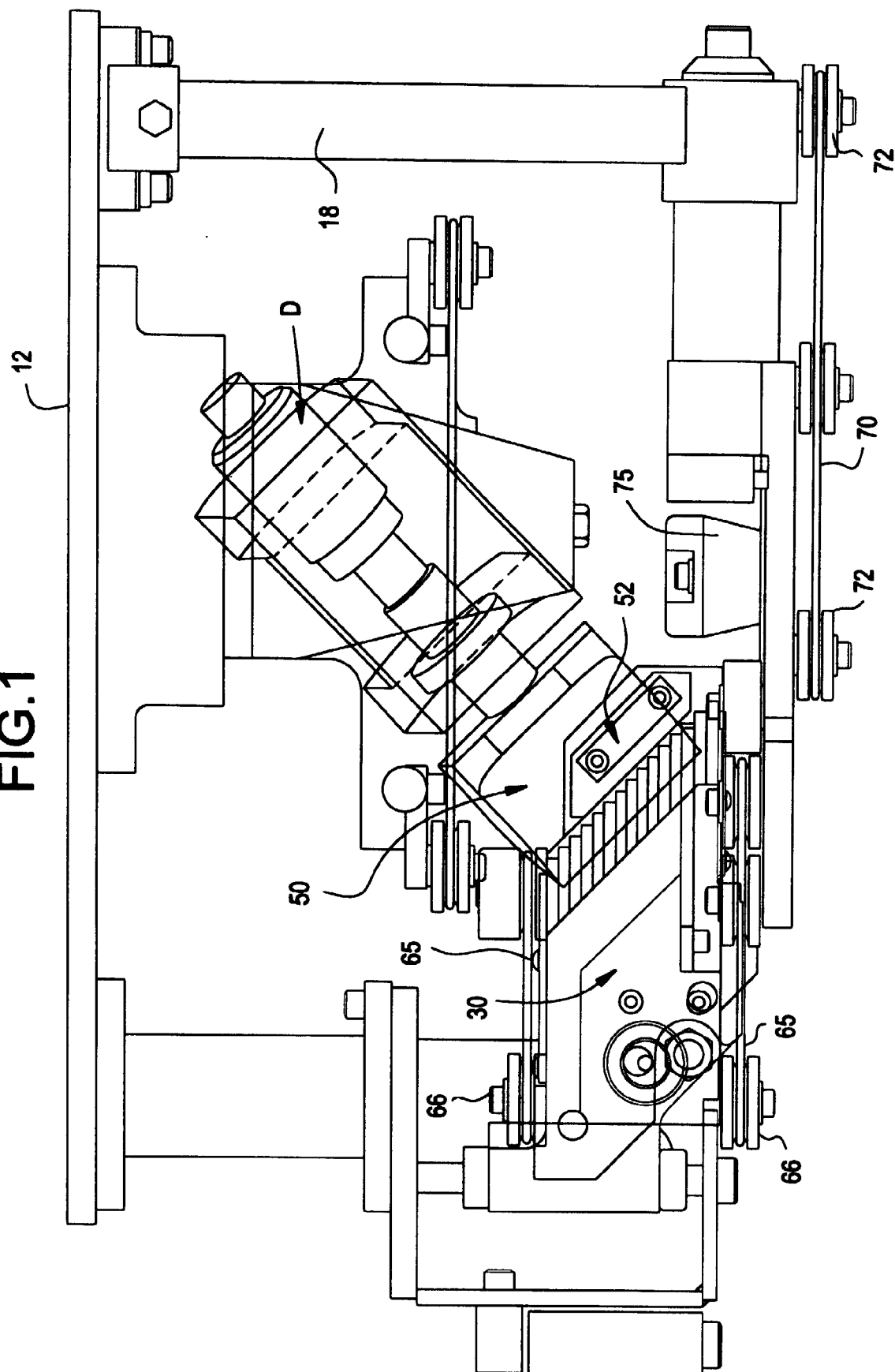
a cutting edge carried along a path across the web, and

c) supporting the underside of the web with and array of independently freely rotatable rollers contacting the web just forward of the cutting edge.

10. The method of claim 9, wherein a further set of independently rotatable rollers contact the upper side of the web preceding the cutting edge of the knife so as to form a gap through which the web may pass as the knife progresses, with minimum frictional resistance to the progress of the cutting action.

11. The method of claim 9 or 10, wherein the cut edges of the web and strip are guided apart as the knife proceeds across the web, avoiding further contact of the strip and web.

FIG.1



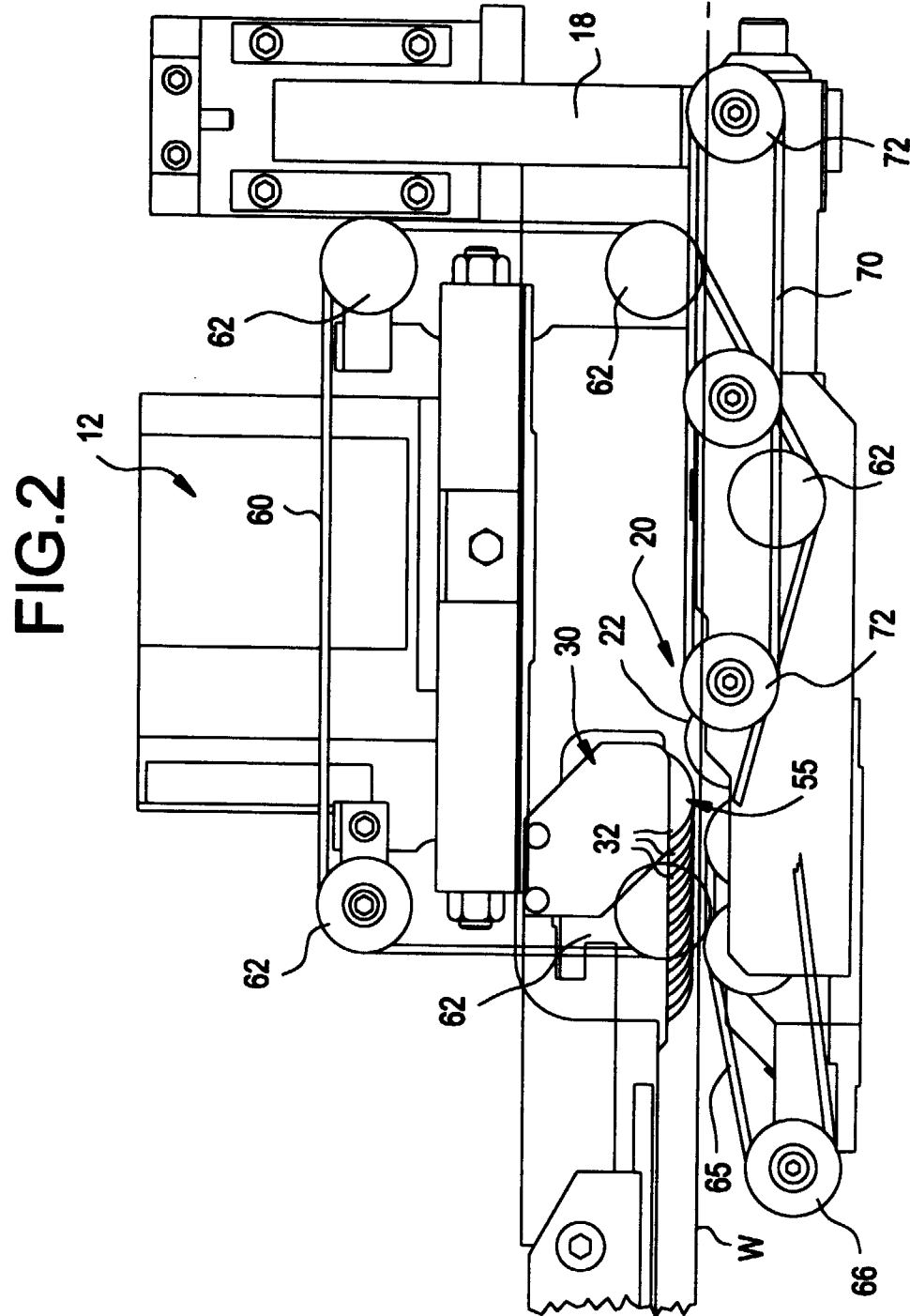


FIG.4

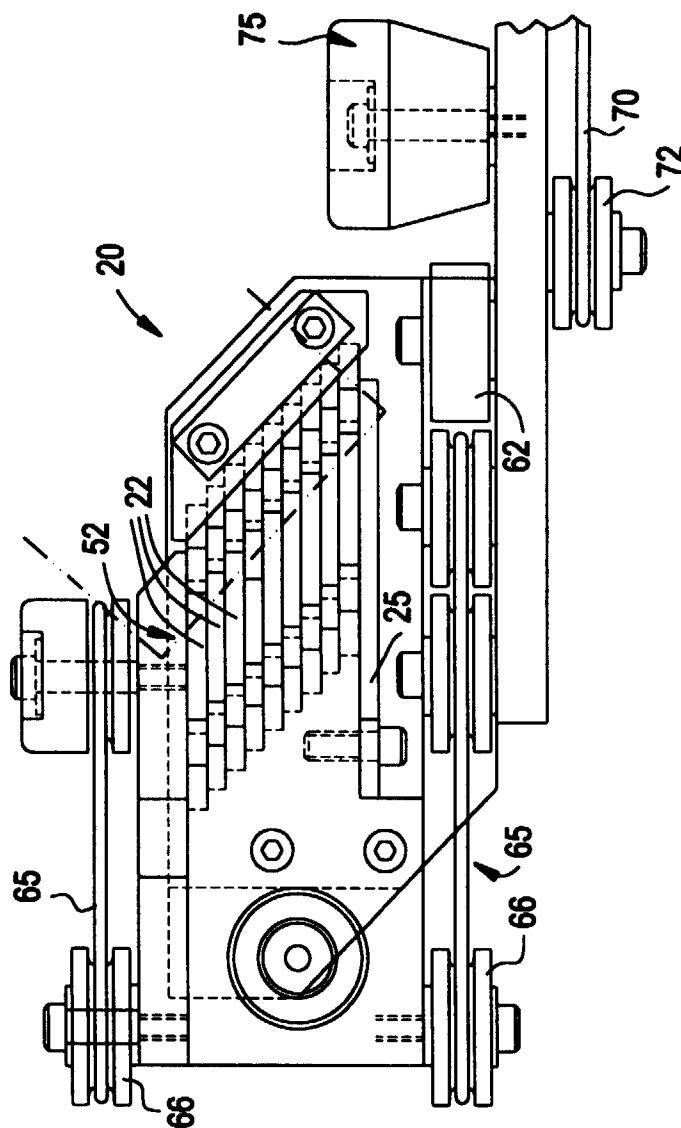


FIG.5

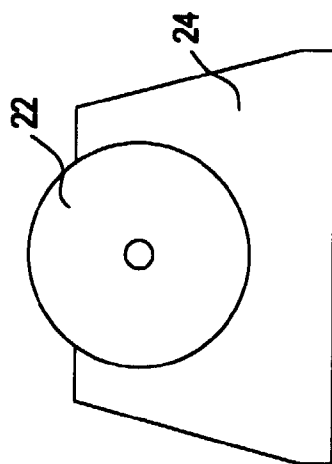


FIG.6

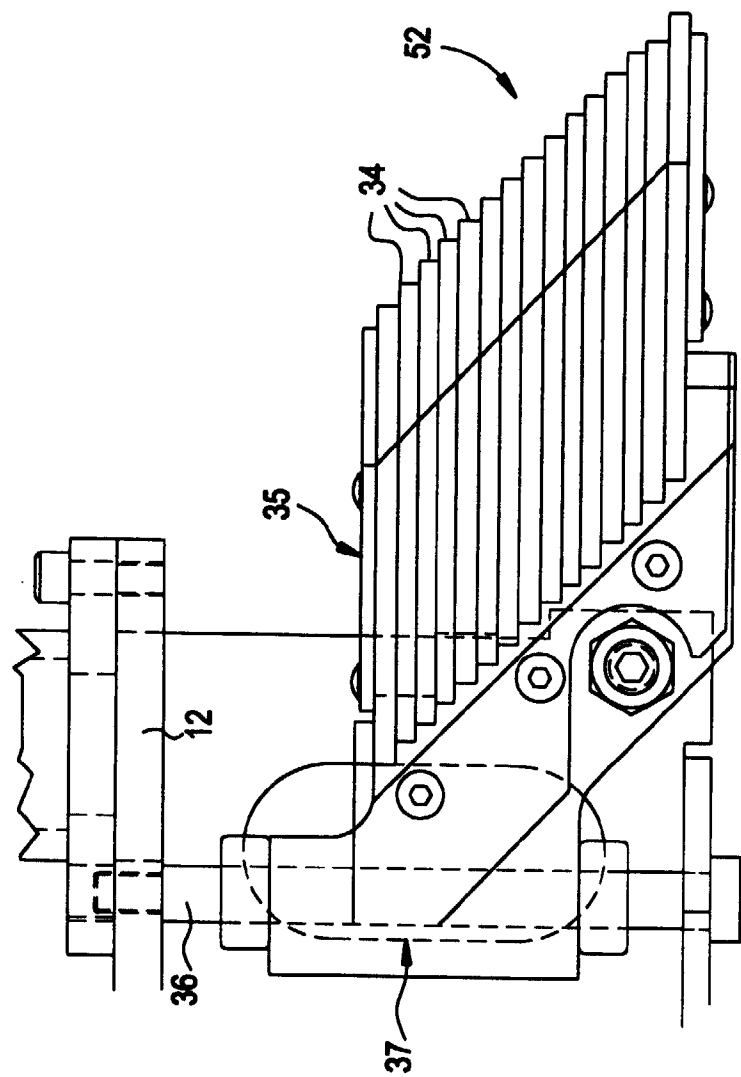


FIG.7

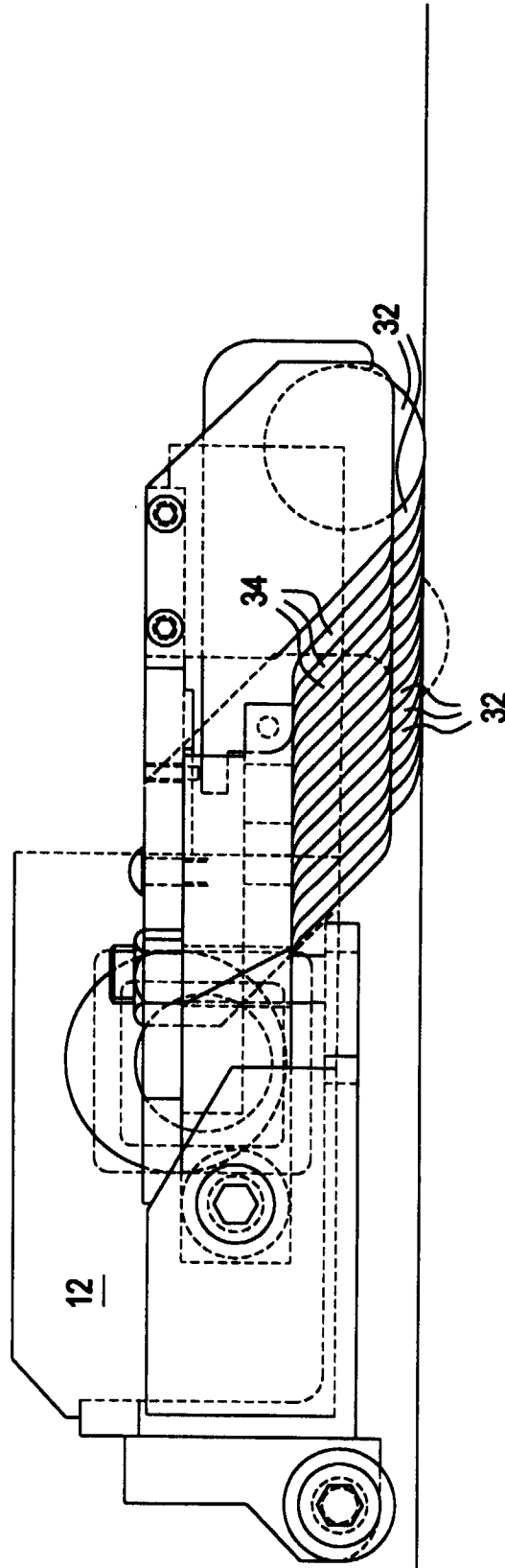


FIG.8

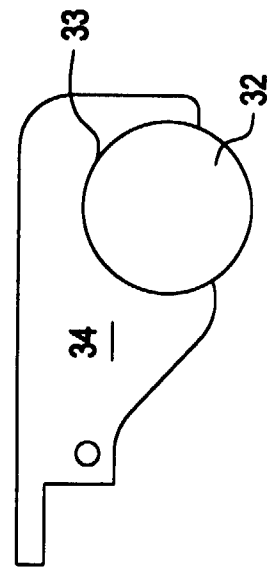


FIG.9

