United States Patent

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[54] APPARATUS FOR SLITTING ROLLED WEBS

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[51] **Int. Cl.** **B23b 3/04**

[58] **Field of Search** 82/46, 46.1, 70.1, 101; 83/102, 107, 472, 473, 477, 483, 490, 491, 649, 824; 242/56.4, 56.5, 56.7

[56] **References Cited**

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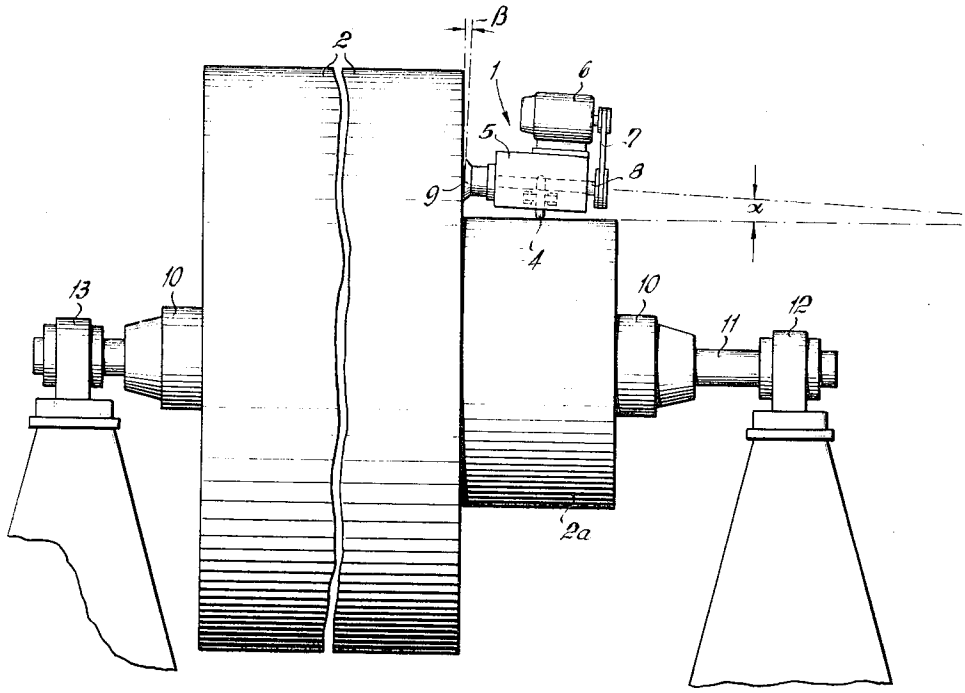
[57] **ABSTRACT**

Rolled webs of papers and the like are slit by means of a conical rotary cutter riding the rotating roll, and the severed web portion is unwound. The cutter is mounted on a carrier arm by means of a pivot located close to a vertical plane through the roll axis, and the orthogonal projection of the axis of rotation of the cutter in that plane is inclined relative to the roll axis at an angle of 1.5°–8° to minimize friction between the cutter blade and the radial slit face of the remainder of the roll.

10 Claims, 3 Drawing Figures



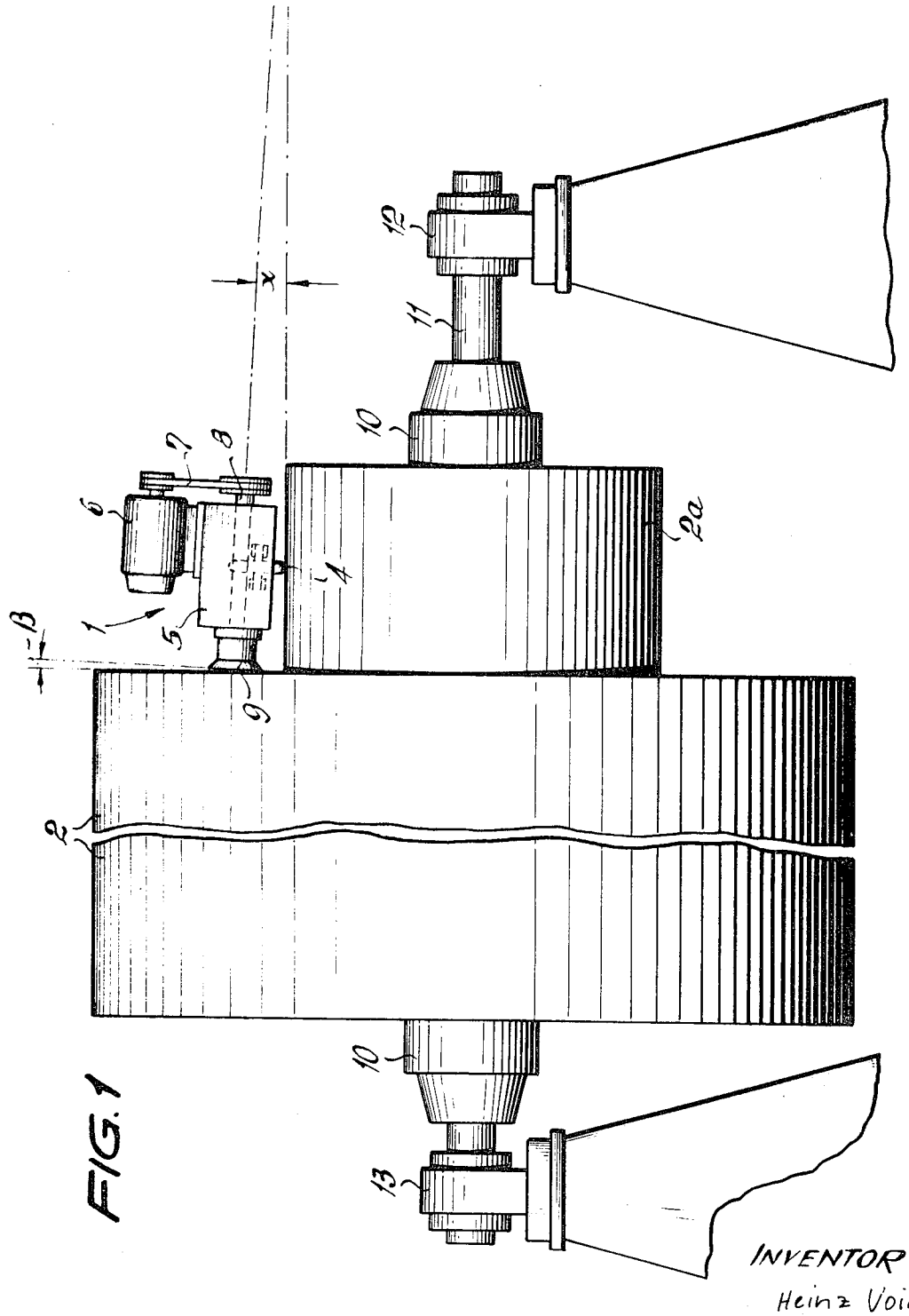


FIG. 1

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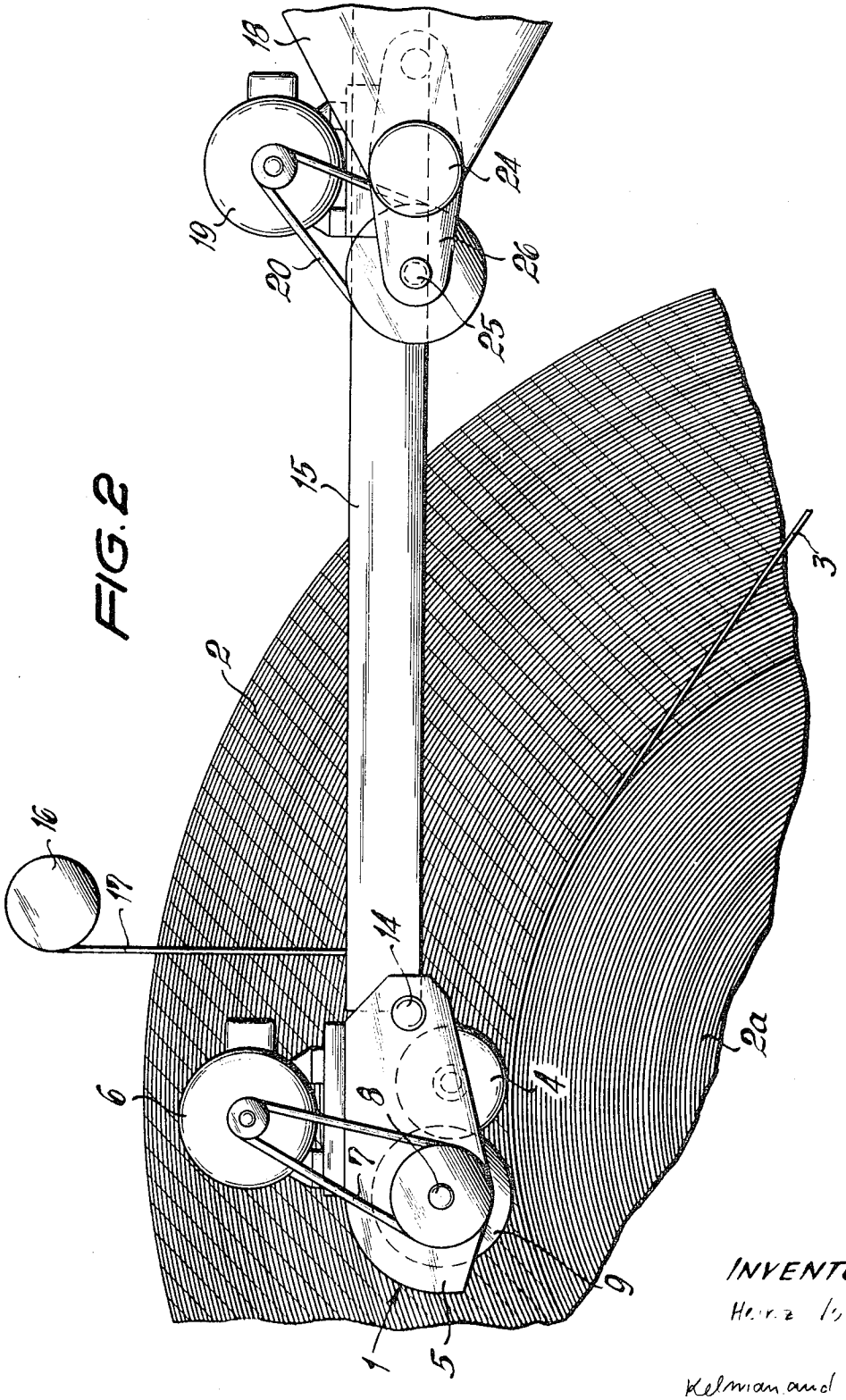
FIG. 2



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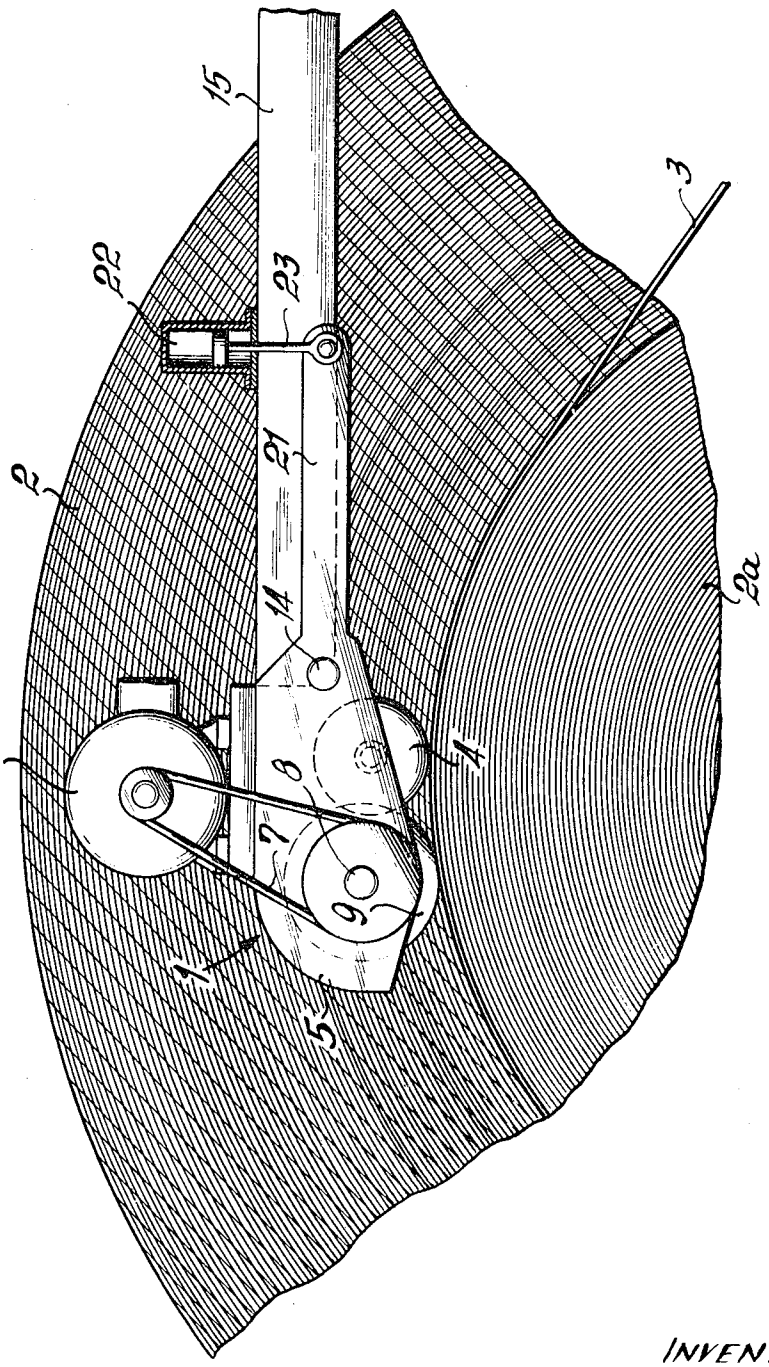

FIG. 3

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APPARATUS FOR SLITTING ROLLED WEBS

This invention relates to the slitting of webs tightly coiled in the form of rolls, and particularly to a cutter arrangement for slitting such rolled webs.

The invention will be described hereinafter with reference to the slitting of rolled paper, but other fields of application are contemplated and will be pointed out hereinafter.

It has been common practice heretofore to slit narrower webs from wide, elongated sheets of paper stored in the form of rolls by unwinding the material from a storage or supply reel, winding it on a take-up reel, and slitting the planar sheet material between the supply roll and the take-up reel. The entire roll of paper needs to be unwound and rewound even if only a narrow portion thereof is to be withdrawn from storage.

Attempts have been made to slit the paper sheet in the roll by means of a stationary blade applied to the surface of the rotating roll so that only the severed web portion could be unwound, leaving the remainder of the roll undisturbed. The method has been found unsuited to high unwinding speeds because the slit edges tended to twist, to shred, and to fray, and stress is concentrated in the slit edge of the web portion being unwound under tension so as to initiate transverse breaks in the web. At the low speeds at which the method is feasible, it is uneconomical.

Modifications of the afore-described slitting method which were intended to provide smoother edges were still unsuccessful in all cases in which the paper layers of the roll deviated significantly from a cylindrical shape. Because of the longitudinal tension under which all webs of paper and the like are wound in rolls, and because of the compressibility of the wound material, the layers deviate from a precisely cylindrical shape if they are remote from the outer roll surface. The inner layers are generally corrugated, ridges and troughs being elongated in the direction of the axis and alternating circumferentially. A blade set for cutting a surface layer of nominal radius therefore misses the lowermost portions of the troughs. The cut is discontinuous, and transverse tears are likely to start at the discontinuities. Similar problems arise if an entire roll is out of round because of faulty winding or because it was stored lying on its side.

An object of the invention is the provision of a slitting arrangement which permits portions of a sheet width to be unwound from a roll of paper or like material without unwinding the residual material, and to do so at high speed and without danger of transverse tearing even if the roll layers should deviate significantly from a precisely cylindrical shape.

With this object and others in view, as will hereinafter become apparent, the invention provides a slitting apparatus for rolled sheet stock in which a stand normally supports a roll of the stock for rotation about a first axis. A carrier arm mounted on a support extends from the same toward a roll mounted on the stand. The cutter head of the apparatus includes a frame, a conical blade mounted on the frame, and a driving device for rotating the blade on the frame about a second axis while in slitting engagement with the roll. A pivot located adjacent a vertical plane through the first-mentioned axis of rotation of the roll connects the frame of the cutter head to the carrier arm for pivoting movement about a third axis.

The several axes extend approximately in a common horizontal direction, but an orthogonal projection of the second axis, which is the axis of rotation of the cutter blade, in the afore-mentioned vertical plane through the first axis defines a very small acute angle with the first axis.

Other features, additional objects, and many of the attendant advantages of this invention will readily be appreciated as the same becomes better understood by reference to the following detailed description of preferred embodiments of the invention when considered in connection with the appended drawing in which:

FIG. 1 shows apparatus for dividing a paper web in front elevation;

FIG. 2 illustrates the apparatus of FIG. 1 in fragmentary side elevation; and

FIG. 3 shows a modification of the apparatus of FIGS. 1 and 2 in a view corresponding to that of FIG. 2.

Referring now to the drawing in detail, and initially to FIG. 1, there is seen a cutter head 1 in the process of dividing a wide roll of paper 2 by slitting the roll so that a narrower web 3 (FIG. 2) may be unwound, leaving behind a reduced portion 2*a* of the roll.

An abutment roller 4 downwardly projecting from the frame 5 of the cutter head 1 rides on the surface of the rotating roll portion 2*a* and guides the frame 5 at a substantially fixed distance from the shrinking scanned periphery of the roll portion 2*a*. An electric drive motor 6 mounted on the frame 5 is supplied with electric current by a non-illustrated cord and controls which permit changes in the motor speed. A belt 7 trained over the output pulley of the motor 6 and a corresponding pulley on a shaft 8 journaled in the frame 5 transmits torque from the motor to a rotary cutting blade 9 on the shaft 8. The blade severs the web 3 from the remainder of the paper roll.

Two collars 10 hold the roll 2 in a fixed axial position on a coaxial horizontal shaft 11 journaled in two elevated bearings 12, 13 of a roll stand, conventional in itself and not fully illustrated. The roll 2 and the shaft 11 are turned in the bearings 12, 13 by the reeling mechanism, not shown, which unwinds the web 3 from the roll 2. The frame 5 is vertically movable, as will presently be described, while the orthogonal projection of the axis of the cutter shaft 8 into a vertical plane through the axis of rotation of the roll 2 remains inclined at an angle α of about 5° relative to the axis of rotation of the roll 2. The angle is not significantly different when measured in a plane through the roll axis and any other portion of the frame 5.

As is seen in FIG. 2, the frame 5 is movably attached to a guide or carrier arm 15 by a pivot pin 14, and the weight of the arm is more than balanced by a spring-loaded reel 16 connected to the arm 15 by a flexible rope 17 so that the cutting blade 9 rests on the paper with a pressure corresponding to somewhat less than the full weight of the cutter head 1, the remainder of the weight being transmitted to the arm 15.

The end of the arm 15 remote from the cutter head 1 is pivotally mounted on a bar 24 extending over the length of the shaft 11 between two fixed brackets 18, and may be moved along the bar for setting the width of the web 3 that it is desired to cut from the roll 2. A reversible electric motor 19 is connected by a belt 20 to a pulley on a threaded spindle 25 threadedly engaging the arm 15 in a manner not shown in detail. The motor 19 and the spindle 25 are mounted on rockers 26 which pivot with the arm 15. The motor 19 is remotely controlled in a conventional manner for setting the position of the cutter blade 9 on the roll 2.

The apparatus of FIG. 2 is only partly illustrated in FIG. 3 for the sake of clarity. The frame 5 carries a fixed extension arm 21 which projects beyond the pivot 14. The cylinder of a shock absorber 22 is mounted on the carrier arm 15. The piston rod 23 of the shock absorber is pivoted to the free end of the extension arm 21 for damping oscillations of the cutter head 1 on the rapidly rotating roll 2 if the roll surface is not precisely cylindrical, and thereby keeping the roller 4 engaged with the moving roll surface.

While the shock absorber may be of the conventional type employed in automotive vehicles, it is preferred to use a shock absorber whose cavity is divided into two compartments by a piston, the piston sealing the compartments from each other, and compressed air being supplied to both compartments through separate adjustable reducing valves and shut-off valves, not shown, which permit the air pressure in the shock absorber to be set in accordance with the shape of the roll 2 and its rotary speed.

The operation of the apparatus will be evident from the description of its structure. The arm 15 moves angularly about the bar 24 under the forces of gravity as the roll portion 2*a* shrinks, such movement being counteracted by the reel 16 and rope 17, but not prevented. The cutter head 1 moves angularly on the pivot 14 in response to deviations of the roll surface from a precisely cylindrical shape. Because the radial distance

between the axis of the pivot **14** and the axis of the shaft **8** is small, and much smaller than the length of the arm **15**, the blade **9** can follow the roll surface even at very high rotary speeds of the roll **2**, and continuously cut the web portion **3** from the remainder of the paper. Skipping of the blade is reliably prevented so that the slit edge of the web **3** is straight and smooth, and transverse tearing of the web which may be caused by imperfect slitting is avoided.

It has also been found that the inclination of the shaft **8** relative to the shaft **11** significantly reduces friction between the blade **9** and the radial face of the remaining roll portion. The operating temperature of a blade mounted on an obliquely inclined shaft, as shown, is sufficiently lower than that of a blade mounted on a shaft parallel to the axis of roll rotation to significantly increase the useful life of the blade between trips to the repair shop for sharpening.

The lower blade temperature also has been found to have beneficial effects on the quality of the slitted paper stock. Even at high slitting speeds, charring or other heat damage to the slit paper stock along the cut radial face on the remaining roll portion is not observed when only the actual cutting edge of the blade touches the paper. The web **3** also is not significantly heated by contact with the blade **9**, and thus does not show heat marks.

The angle between the axes of the shafts **11** and **8**, as defined above, should not be smaller than 1.5° nor greater than 8° on an average during each revolution of the roll **2**. The angular setting of the cutter shaft permits the use of sturdy conical blades and it is not necessary to employ very thin, flat blades which are mechanically less strong. The circular cutting edge of the blade **9** is formed by the flat base face and a circumferential face portion of the blade **9** which tapers conically away from the base face. Both faces and the shaft **8** are located in the space axially bounded by the plane of the cutting edge. This plane is perpendicular to the axis of the shaft **8** and inclined at a small acute angle β to the face of the roll **2** which is radial relative to the axis of the shaft **11**. The optimum angle between the two shafts varies somewhat with the precise shape of the blades, but also with the material that is to be slit, and the frame **5** is preferably adjustable on the pivot **14** for varying the angle. By suitable adjustments of the blade position, the apparatus illustrated has been used successfully on such widely different additional materials as aluminum foil and polyethylene film.

Depending on the nature of the slit stock and on the slitting speed, it may be desirable to cool the cutting area by means of air discharged from nozzles or by an air stream generated by vanes mounted on the shaft **8** immediately adjacent the blade **9**. The circumferential speed of the cutting blade should be between 0.5 and 1.2 times the linear speed at which the web portion **3** is unwound from the roll **2**. When the blade speed is lower, the temperature of the blade rises unduly, and the blade is dulled fast. When the blade speed is too high, the slit stock is unnecessarily heated by friction, and may tear. The best speed ratio between the unwinding mechanism and the cutter shaft **8** varies with the slit material within the limits indicated above, and the motor **6** should therefore be of the variable speed type referred to above unless only webs of uniform composition, thickness and other properties are to be cut.

The depth of cut should preferably not exceed one thickness of the rolled web. It is therefore preferred to mount the scanning roller **4** on vertically adjustable bearings, not shown, and conventional in themselves. Because of the resilience of the rolled web, the depth of cut also depends on the effective weight which rests on the cutter blade **9**. The depth of cut may thus be changed by varying the spring bias on the reel **16** or by changing the pressure distribution in the shock absorber **22**.

It should be understood, of course, that the foregoing disclosure relates only to preferred embodiments of the invention, and that it is intended to cover all changes and modifications of the examples of the invention herein chosen for the purpose of the disclosure which do not constitute departures from the spirit and scope of the invention set forth in the appended claims.

What is claimed is:

1. Apparatus for slitting rolled sheet stock comprising, in combination:

a. stand means for supporting a roll of said stock for rotation about a first axis;

b. a support;

c. a cutter head including

1. a frame,

2. a shaft rotatable on said frame about a second axis,

3. a blade mounted on said shaft for rotation therewith in slitting engagement with said roll, said blade having two face portions jointly forming a circular cutting edge in a plane perpendicular to said second axis,

4. said face portions and said shaft being located in a space bounded by said perpendicular plane in the direction of said second axis;

d. drive means for rotating said shaft about said second axis; and

e. guide means on said support for guiding said cutter head along a plane radial relative to said first axis in a position in which said radial plane and said perpendicular plane define a very small acute angle.

2. Apparatus as set forth in claim **1**, wherein said acute angle is 1.5° to 8°.

3. Apparatus as set forth in claim **2**, wherein one of said face portions is flat in said plane.

4. Apparatus as set forth in claim **3**, wherein the other face portion is conical about said second axis and tapers away from said plane.

5. Apparatus as set forth in claim **1**, wherein said guide means include a carrier arm mounted on said support and extending from the same toward a roll supported on said stand means, and pivot means adjacent a vertical plane through said first axis and connecting said frame to said carrier arm for pivoting meovement about a third axis, said first, second, and third axes extending approximately in a common horizontal direction, and an orthogonal projection of said second axis in said plane and said first axis defining a very small acute angle.

6. Apparatus as set forth in claim **5**, further comprising control means for holding said cutter head in a fixed position relative to the surface of said roll and for thereby controlling the cutting depth of said blade.

7. Apparatus as set forth in claim **5**, wherein said carrier arm is mounted on said support for angular movement about a fourth axis extending in said approximate direction, said third axis being much nearer to said second axis than to said fourth axis.

8. Apparatus as set forth in claim **7**, including balancing means engaging said carrier arm for counteracting downward angular movement of said carrier arm about said fourth axis under the influence of gravity.

9. Apparatus as set forth in claim **7**, further comprising damping means interposed between said carrier arm and said frame for damping oscillations of said frame about said third axis.

10. Apparatus as set forth in claim **7**, further including adjusting means for shifting said carrier arm on said support in the direction of said fourth axis.

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