Nov. 14, 1961 R. E. TAYLOR, JR 3,008,366

PAPER PERFORATING MECHANISM

Filed Jan. 6, 1956

FIG. 1.

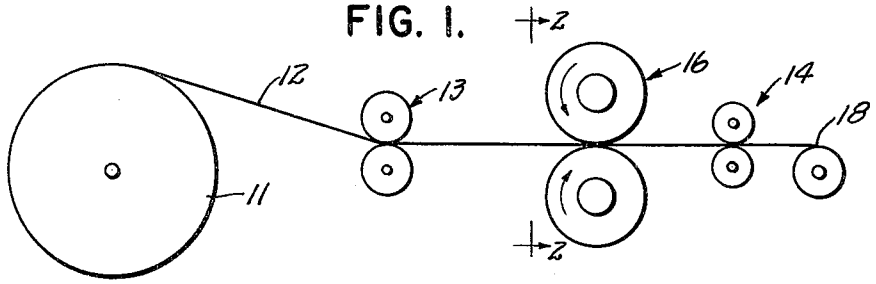
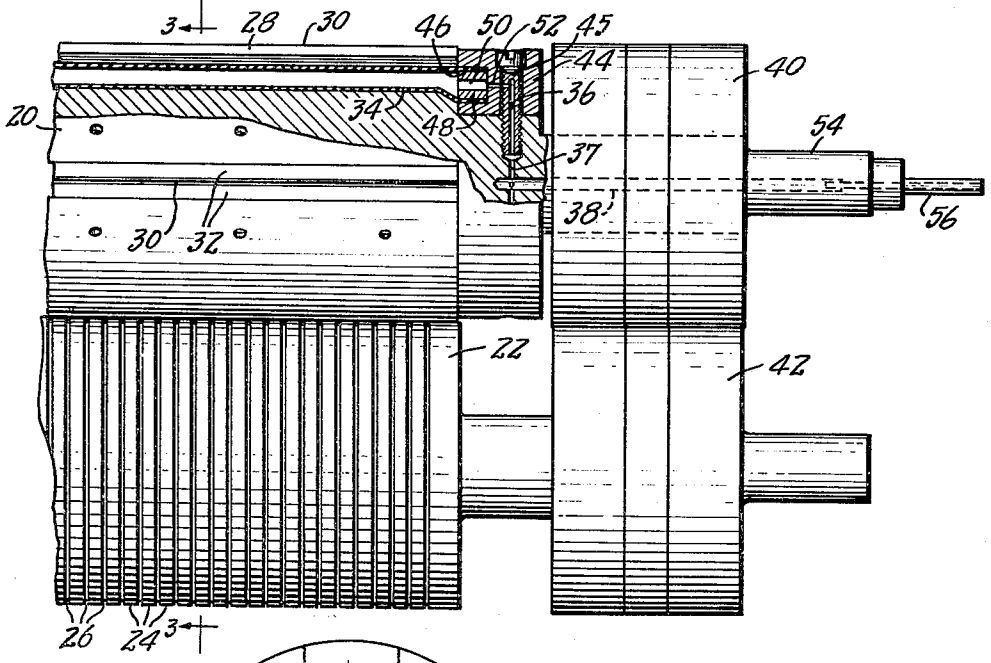



FIG. 2.



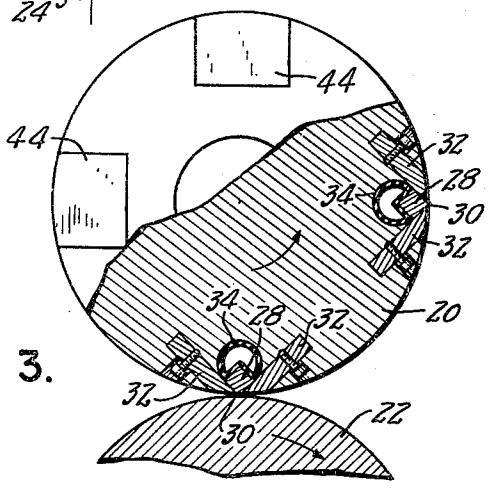




FIG. 3.

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# PAPER PERFORATING MECHANISM

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6 Claims. (Cl. 83—346)

This invention relates to a mechanism for perforating long strips of sheet material along generally equally spaced lines transversely of the edges of the strip, and more in particular to perforating toilet paper of the high quality tissue type.

An object of this invention is to provide an improved perforating mechanism for a uniform perforated line in paper formed by sharply articulated cut and uncut regions, so that the paper can be torn easily and uniformly along this line without ragged ends. Another object is to provide such a mechanism which can be adjusted to give optimum performance at all times, for example, to compensate for variations in thickness. A further object is to provide such adjustment continuously, even during operation. A further object is to provide such a mechanism which is self-compensating for wear so that throughout its life it will perforate with substantially the same high efficiency. An additional object is to provide perforating mechanism of the above character which is simple in construction and operation, inexpensive to manufacture and maintain, and adaptable to many conditions of operation and use. These and other objects will be in part understood, and in part pointed out below.

In making toilet paper, wide sheet strips or webs first are perforated along equally spaced lines transversely of the length of the strips, and then the wide sheet strip is slit and the individual rolls are formed. The perforations provide for tearing off the short lengths or sheets of the final roll.

The prior type of these perforations have been formed by piercing the stock with a row of closely spaced sawtooth elements. However, the resulting perforations have ragged edges which extend above the surface of the sheet. More importantly, the perforations are not uniform so that the paper tears along one line of perforation, whereas it does not tear under the same force along another line; and this often causes the length of strip being torn from the roll to be longer or shorter than intended. Moreover, with this prior type of perforation, the paper sometimes tears partly along one line and partly along another, leaving dangling ends on the roll and on the strip end. The present invention avoids these difficulties by providing a low cost, long-wearing, trouble-free apparatus which produces a greatly improved perforated line.

In accordance with the present invention and in the specific illustrative embodiment thereof, a paper web or strip is fed from a supply roll to and through a perforating arbor mechanism where it is cut along successive lines with an impacting or impact-cut action. Each line of perforation is produced by a single transverse blade edge mounted in a unique way on a blade arbor and impacting against and moving with a mating lateral row of spaced, annular anvils carried on an anvil arbor. The paper is cut cleanly between the blade edge and each of the anvils as the paper moves between the arbors, so as to produce a line of spaced cuts or slits. Each perforation is a clean-cut slit with all of the fibers cut and with no projecting ends. After one line of perforation has been made, a second blade edge carried on the blade arbor produces another line by cooperating with the same anvils at an arcuately spaced line on the anvil arbor. This operation continues at a rapid rate.

A more complete understanding of the invention, together with a better appreciation of its many advantages,



will best be gained from a study of the following description given in connection with the accompanying drawings in which:

FIGURE 1 is a schematic side view of a paper handling mechanism;

FIGURE 2 is an enlarged fragmentary sectional view on the line 2—2 of FIGURE 1 with parts broken away; and,

FIGURE 3 is an enlarged sectional view of the perforating arbor mechanism on the line 3—3 in FIGURE 2.

The paper handling mechanism shown in FIGURE 1 includes a jumbo supply roll **11** from which a wide web or strip **12** of paper is drawn to the right by a pair of rolls **13** and it then passes through the perforating mechanism **16**. Here, the web or strip **12** is perforated along successive transverse lines and is then led through the slitter blades **14** where it is cut into a number of narrower strips, each equal in width, for example, to form toilet paper. After leaving the slitter, it is wound by wind-up mechanism **18** into individual rolls for sale and use.

The details of the perforating mechanism **16** are shown in FIGURES 2 and 3. This mechanism includes a top blade arbor **20** and an anvil arbor **22** which are rotated in opposite directions, with their adjacent peripheral surfaces moving together at the substantially same speed. These arbors are positioned closely together, but they do not pinch the web of paper between them, and the paper is driven forward by the wind-up mechanism. Arbors **20** and **22** are mounted at their ends in bearings **40** and **42**, the right-hand pair of which are shown. These arbors are driven by gears (not shown) upon the left-hand end of the arbors.

Evenly spaced across the surface of arbor **22** are the annular anvils **24** which are separated by the shallow annular grooves **26**. The web or strip passing between the arbors is cut on the anvils and it is not cut at the grooves so that a perforated line is made across the strip formed by alternately cut and uncut zones.

As seen in FIGURE 3, arbor **20** carries evenly spaced around its surface in elongated pockets or housing, four cutting blades **28**, each of which has a straight edge **30** resiliently urged radially outwardly and positioned slightly beyond the surface of arbor **20**. Thus, with the arbor **20** in the position shown, a blade edge **30** impacts the strip **12** against anvils **24** and cuts a slit opening in the strip. In the course of making a perforated line, the strip is pushed into the grooves between the anvils and the paper remains uncut at these areas.

Each blade **28** is in the form of a square bar with sharp corner edges. The blade rides against a pair of slides or gibs **32** which are mounted lengthwise in slots in arbor **20** and form a V shaped support with a narrow slit between their adjacent ends through which edge **30** protrudes. Each of the gibs **32** has threaded into it a plurality of set screws having conical ends which are received in similarly shaped recesses in the arbor. During installation, each gib is put into position, and then its set screws are tightened so as to push the gib radially outwardly with respect to the axis of the arbor. This presses the gib against the side of the slot and away from the bottom of the slot. In this way, the width of slit is accurately determined, and the gibs are rigidly held in position. Each blade **28** is urged against its associated gibs by an air-filled expandable tube **34**. Hence, the blade is resiliently held in the position shown, but it may be moved radially inwardly away from gibs **32** and so that edge **30** no longer protrudes beyond the arbor surface. The air pressure in this tube is adjustable and controls the force exerted upon the blade, and the force with which the edge **30** bears against the sheet stock and the anvils.

Referring to FIGURE 2, each tube **34** is mounted at

its ends in a pair of blocks 44 (only one of which is shown) which are held in place by set screws 45. Each of these blocks has an opening 46 into which the end of the tube is anchored by an internal cylinder 48. The cylinder at the left is not shown, but it is solid so that it seals the end of the tube. The cylinder 48 at the right has a central opening 50 therein which is in alignment with a bore 52 in block 44. Bore 52 is connected by a bore 36 and a bore extension 37 to an axial bore 38 in the arbor shaft 54, which extends through the bearing 40 and provides an attachment for an air line 56. Thus, the air pressure in each tube 34 can be controlled externally while the arbors are in motion.

It has been indicated above that cutter blades 28 are square in cross-section, and each of the four edges on each blade is a cutting edge. Accordingly, when an edge of a blade becomes dull the arbors are stopped and the tube 34 for the blade is exhausted of its air so that the blade is no longer held rigid. The blade is then easily turned within its pocket to a position wherein another edge 30 protrudes from the cutter slot. Hence, the cutting edges are easily changed, and each blade may be kept in continuous service until all four of its edges require sharpening.

While arbors 20 and 22 are driven in unison at substantially the same speed, arbor 20 is driven slightly faster than arbor 22. Thus, during each rotation, blade edge 30 contacts a different line on the anvils 24 than it did the previous rotation, and this avoids abnormal wear on the anvil. Arbor 22 is is advantageously made of steel that can be surface hardened thereby reducing wear, and blades 28 are hardened steel, illustratively, one-half inch square. The circumference of the arbors 20 and 22 in this unit is about 18 inches, and they can be driven at up to 1000 feet per minute. As the speed of these arbors increases, less air pressure in tubes 34 is required for a proper cut because of the increase in centrifugal force on blades 28. The scuffing action between blades 28 and arbor 22 caused by slight differences in surface speed between blade edges 30 and arbor 22 and by the slight relative movement of the blades in their housings or pockets in arbor 20, may improve the cutting action. During each cutting action, the blade is pushed back somewhat toward or to the surface of arbor 20, but the resilient action of the air tube 34 permits this and yet insures a good cutting action.

In the specific illustrative embodiment of the invention herein disclosed, substantially eighty percent of the fibers along the perforated line are cut so that the web is held together by the remaining twenty percent. It has been found that this gives excellent results from the standpoint of avoiding an accidental tearing of the web or the individual strips after the slitting operation. Also, the web is cut sufficiently at each perforation to permit easy tearing. The particular manner of cutting permits very accurate control and, as indicated, all of the perforated lines are susbtantially identical from the strength standpoint.

The present invention permits great flexibility in the percentage of cut fibers and in the number and sizes of the slits which form the perforations. For example, arbor 22 may be easily removed and replaced by another arbor having more or less anvils of greater or less width, and the grooves between the anvils may be of a different width.

In the illustrative embodiment, there are four cutter blades, but the invention contemplates that more or less such blades may be used. For example, for some conditions of operation three blades are preferable. In the present embodiment, the web is drawn from the jumbo roll by the pair of driving rolls 13, but the invention contemplates that these driving rolls 13 may be omitted, and the jumbo roll is then driven. In either case, the unwinding drive is in synchronism with that of the wind-up mechanism 17. The web is moved in a straight web or sheet form which is not interfered with by the perforating mechanism.

It has been indicated above that the arbors 20 and 22 are driven at slightly different speeds. The invention contemplates that this drive is accomplished, illustratively, by driving one of them directly, and by driving the other one indirectly through a pair of inflated tires. Illustratively a pair of such tires is mounted in contacting relationship upon the ends of the two arbors, and the tires are inflated, but at slightly different pressures. Hence, the one roll is driven from the other, but the tire which is inflated with the greater pressure has the greater effective periphery; the other tire with the lesser pressure, therefore, has its arbor turned at a slightly slower speed. In the illustrative embodiment of the invention, the web is slit prior to rewinding, but the invention contemplates winding the web into long rolls and then cutting the long rolls into lengths to form the individual rolls of toilet paper.

The above description of the invention is intended in illustration and not in limitation thereof. Various minor changes or modifications of the embodiment illustrated may occur to those skilled in the art and these can be made without departing from the spirit or scope of the invention as set forth.

I claim:

1. A high speed mechanism for perforating webs of paper and the like, said mechanism including a cutter arbor mounted for rotation around an axis, said arbor having a cavity along its length parallel to and spaced radially outward from said axis, said cavity being defined by opposed abutments disposed at generally equal but opposite angles relative to a radius of said arbor to provide a substantially V-shaped seat having smooth faces thereon, the apex of the V being cut away to form a slot, a straight bar-like cutter blade having at least two inclined faces which intersect and form a cutting edge, said blade being positioned on said smooth surfaces in said cavity with said cutting edge projecting beyond said slot, anvil means closely opposite said arbor and having a surface movable in the same general direction as said blade adjacent said web to support said web during cutting, compressible resilient means urging said blade outward against said abutments and permitting it to move inward simultaneously throughout its length and to rock about its axis when the edge of said blade strikes against the web, and means to rotate said arbor at high speed, the mass of said blade, the radial distance it is mounted from the axis of said arbor, and the speed of said arbor being such that said blade cuts said web by impact thereagainst, whereby said web is cleanly cut and said blade stays sharp for a considerable time.

2. The mechanism in claim 1 wherein said compressible resilient means includes a pneumatic tube mounted behind said blade and conforming to the shape thereof.

3. The mechanism in claim 1 wherein said blade has a plurality of cutting edges, said abutments comprising gibs, at least one of which is removable to permit removal of said blade.

4. A high speed mechanism for perforating webs of paper and the like, said mechanism including a cutter arbor mounted for rotation around an axis, said arbor having a plurality of cavities along its length parallel to and spaced radially outward from said axis, each of said cavities being defined by opposed removable gibs disposed at generally equal but opposite angles relative to a radius of said arbor to provide a substantially V-shaped seat having smooth faces thereon, the apex of the V being cut away to form a slot, a plurality of straight bar-like cutter blades each having at least two inclined faces which intersect and form a cutting edge, each blade being positioned in a respective cavity on said smooth surfaces with said cutting edge projecting beyond said slot, an anvil arbor rotatably mounted closely opposite said cutter arbor to support said web during cuting, a plurality of externally

controlled pneumatic tubes, each tube positioned behind a respective one of said blades and urging said blade outward against said gibs and permitting it to move inward simultaneously throughout its length and to rock about its axis when the edge of said blade strikes against the web, and means to rotate said cutter and anvil arbors at high speed, the mass of each blade, the radial distance it is mounted from the axis of said cutter arbor, and the speed of said cutter arbor being such that said blades cut said web by impact thereagainst, whereby said web is cleanly cut and said blades stay sharp for a considerable time.

5. The mechanism in claim 4 wherein said anvil arbor is rotated at a slightly different speed than the speed of said cutter arbor.

6. The mechanism as described in claim 1, wherein said anvil means is formed by an anvil arbor having a plurality of axially-spaced annular grooves with annular anvil surfaces therebetween.



**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 898,193 | Davidson | Sept. 3, 1908 |
| 1,280,367 | Barber | Oct. 1, 1918 |
| 1,577,620 | Gammeter | Mar. 23, 1926 |
| 2,191,497 | Potdevin et al. | Feb. 27, 1940 |
| 2,338,666 | Nelson | Jan. 4, 1944 |
| 2,340,852 | Wormeley | Feb. 8, 1944 |
| 2,341,503 | La Bombard | Feb. 8, 1944 |
| 2,405,598 | Miller | Aug. 13, 1946 |
| 2,598,820 | Neese | June 3, 1952 |
| 2,652,749 | Hagneister | Sept. 22, 1953 |
| 2,801,694 | Schneider et al. | Aug. 6, 1957 |