United States Patent

[11] 3,552,244

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[54] **ROTARY DIE STRIPPING**
7 Claims, 6 Drawing Figs.

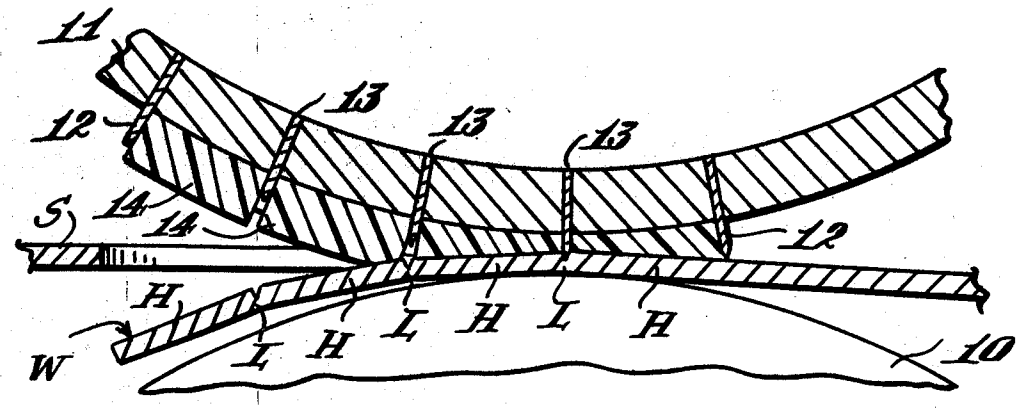
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[50] **Field of Search** 93/58, 58.1, 58.2; 83/9, 23, 27, 923, 102, 103, 113, 116, 117

[56] **References Cited**
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ABSTRACT: Waste sections of sheet material cut with a rotary die are stripped from the sheet material by means which divide the waste section into hinged, connected portions, the hinge lines lying substantially parallel to the axis of rotation of the rotary die. The hinged, connected portions of the waste section are effectively stripped, one after another, by the expelling action of ejection material, e.g., a resilient pad, mounted within the cutting die that cuts out the waste section.



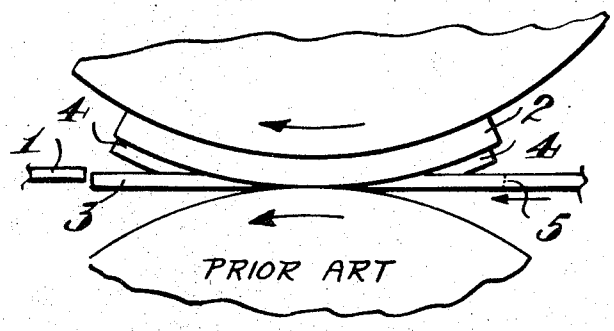


Fig. 1

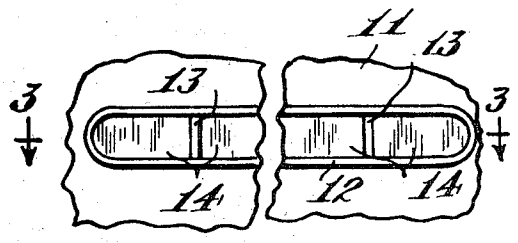


Fig. 2

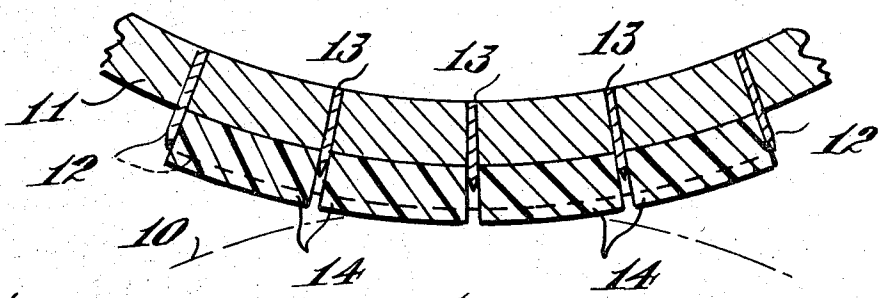


Fig. 3

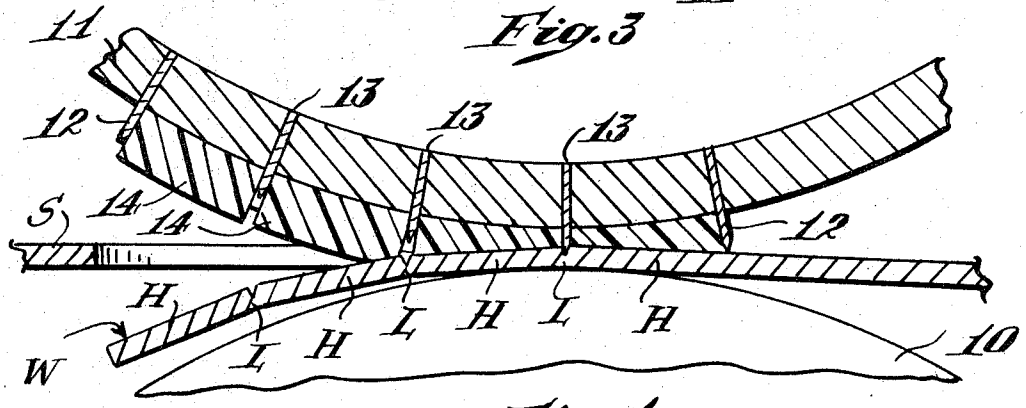


Fig. 4

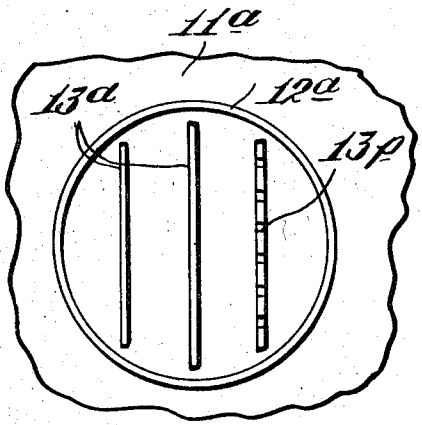


Fig. 5

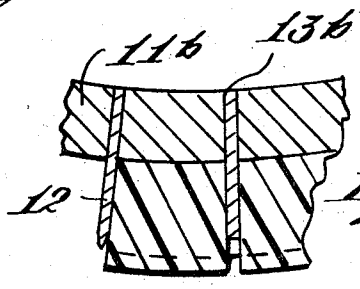


Fig. 6

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ROTARY DIE STRIPPING

BACKGROUND OF THE INVENTION

The field of the present invention relates to rotary cutting dies, and more particularly to the stripping of waste sections cut from sheet material by said rotary dies.

The container industry has developed rotary presses using curved serrated steel rule dies acting against urethane blankets to cut cartons from sheets of fiberboard or corrugated cardboard stock.

In the process of rotary die-cutting, the sheet passes between two cylinders for cutting, then drops onto conveyor belts. Long slots, circles or other waste sections are frequently to be cut from the carton blanks, and it is desirable that these waste sections be stripped from the blanks automatically after cutting. As each part of the cut sheet passes from between the cylinders to the conveyor belts, it is over empty space for a time, but gravity is ineffective to remove scrap pieces be cause tiny fibers from both sides of the cut cling together and hold the scrap in place. Hand stripping of inadequately removed sections substantially slows down the cutting process, and adds greatly to its expense.

A variety of solutions have been devised to the problem of stripping away waste sections cut out by rotary dies. One such solution is shown in Mitchell U.S. Pat. No. 853,712. Mitchell's solution is to use barbed pins to harpoon the cutout waste sections and then to provide means to thereafter strip the sections from the barbed pins. This solution has the drawback of complexity, since it requires dual stripping means, the drawback of unreliability, since the barbed pins are subject to breakage and dulling, and the drawback of incompatibility with current rotary press machinery, which oscillates the urethane blanket to avoid concentrated wear, and thus would also oscillate the barbed pin and make proper registration difficult or impossible. The requirement of registration also means that such barbed pins can be used only if the roll upon which they are mounted has the same circumference as the rotary cutting die; this requirement, of course, limits the utility of this solution since it is frequently desirable to have the urethane blanket roll of larger diameter to reduce wear.

The conventional method of stripping is to employ "ejection material," a resilient rubber pad mounted within the cutting die which compresses during cutting and thereafter expands to push the waste section away from the die and through the cut hole in the carton blank. To assist the action of the resilient rubber pads, pressure and/or vacuum systems are supplied to the sheet material to exert an expelling force on the waste section to be stripped is short in the circumferential direction of the rotary die. Where long slots or large diameter circles are to be cut, this method is frequency unsuccessful, and the percentage of successful strippage falls markedly.

When long slots or large circles are to be stripped from a carton blank, the current solution to inadequate stripping is to employ one or more chopping knives extending across the cutting die to sever the waste section into smaller portions which can be effectively stripped by the rubber pads on the pressure/vacuum devices or both. Unfortunately the provision of chopping knives is not a simple matter, since accurate butt joints and the like are necessary. Such chopping knives further contribute to rapid wear of the urethane blanket and are not altogether successful in providing full stripping.

SUMMARY OF THE INVENTION

Objects of the present invention are to provide means for effective and automatic stripping of waste sections cut from sheet material by rotary cutting dies, which means are inexpensive to provide, reliable and durable in operation, and compatible with current rotary cutting design.

The present invention is based on the discovery that insufficient stripping results because the inherent stiffness of the sheet material, which is cut into a shape of a cantilever as the slot or circle is formed, acts in opposition to the rubber pad and tends to keep the waste section in place, held by friction at the cut edges. This state of affairs is illustrated in FIG. 1, entitled PRIOR ART. The sheet material 1 is cut by die 2 to form a slot or circle, leaving a waste section 3 to be removed. As shown in FIG. 1, the waste section 3 is partially cut and forms the "cantilever" of stiff material resisting the downward force of rubber pad 4 with an upward force. At the end 5 of the slot or circle, of course, the "cantilever" of waste is cut off and its stiffness no longer resists the rubber pad. However, at this point, the rubber pad 4 acts only on a small portion of the waste because of the curvature of the die 2 and pad 4, and it is often incapable of rejecting the waste because of friction at the cut edges. In many instances, the rubber pad 4 merely pushes down the end of the waste section, causing it to pivot at a frictional pivot point at the cut edges.

The present invention avoids the foregoing difficulties by providing, within the die that cuts the waste section, one or more means that locally reduce the stiffness of the sheet material and permit it to hinge so that it will not so strongly resist the rejecting action of the resilient rubber pads. The preferred means is a cutter die which cuts partially through the waste section, on a line substantially parallel to the rotary die axis, to permit it to hinge. The rubber pad effectively rejects the short connected portions of waste section so provided. Other means for dividing the waste section into hinged connected portions to facilitate stripping comprise blunt crease dies, or cutter dies which cut completely through the thickness of the waste section but do not cut the entire width of the waste section (e.g., a perforator die), leaving unsevered bridges of reduced stiffness connecting the hinged portions.

These and other objects and novel aspects of the invention will be apparent from the following description of preferred embodiments.

DESCRIPTION OF THE DRAWING

FIG. 1 is an essentially schematic side view of prior art illustrating the problem solved by the present invention;

FIG. 2 is a developed view, looking toward the axis of rotation, of a rotary cutting die according to the present invention;

FIG. 3 is a section on line 3–3 of FIG. 2;

FIG. 4 is an essentially schematic side view, similar to FIG. 1, illustrating the operation of the invention in stripping waste sections;

FIG. 5 is a developed view similar to FIG. 2, showing another embodiment of the invention; and

FIG. 6 is a side sectional view, similar to FIG. 3, showing a further embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIGS. 2, 3 and 4 illustrate the invention as embodied in a steel rule die of the type frequently used for cutting cartons from cardboard, corrugated material, or pasteboard. The illustrated rotary cutting die assembly comprises a lower cylindrical member 10, covered, for example, with a urethane blanket, mating with an upper cylindrical die board or plate 11, customarily made of plywood, which mounts a cutting rule 12 forming a closed cutting edge which cuts a waste section W (FIG. 4) from sheet material S. As illustrated in FIGS. 2 and 3, the waste section W to be stripped from the sheet material S is to provide a long, narrow slot, a shape which has proved to be very difficult to strip. The invention is, of course, applicable to various other shapes which the waste section may take, for example, circles, ovals, rectangles, other polygons, and so forth.

Mounted on the die board 11, within the cutting rule 12, are a plurality of cutters 13. As shown in FIGS. 2 and 3, the height of the cutter knives 13 is less than the height of the cutting die 12, so that they cut only partially through the thickness of the waste section W, thereby to divide it into a number of hinged, connected portions H (FIG. 4). As shown in FIG. 2, the cutter knives 13 extend substantially parallel to the axis of rotation of the rotary cutting die assembly so that they lie along the line of contact of upper and lower rolls 10 and 11, and they also extend substantially fully across the waste section W. It is not

necessary that the cutter dies 13 extend all the way across the waste section W, and in practice it is convenient to make them very slightly shorter, so that it is unnecessary to form accurate butt joints with the cutter rule 12.

Also mounted in the interior of cutting rule 12 is ejection material in the form of conventional pads 14 of resilient rubber secured to the mounting plate 11 with adhesive. The resilient pads 14 act as they do in the prior art devices, compressing during the cutting operation and thereafter exerting an expelling force on the waste section W. However, with the provision of cutter knives 13, as described above, the resilient pads 14 are capable of effectively stripping the waste section W. As FIG. 4 shows, the cutters 13, by mechanically weakening the waste section W along the hinge lines L to divide it into hinged portions H, permit the rubber pads 14 to act upon the incremental portions H without opposition by a contrary force arising from the stiffness of the sheet material. Each portion H is in turn expelled by its rubber pad 14, and since previous portions H have already been stripped, there are reduced frictional edge forces to obstruct stripping.

The depth of cut and the spacing between adjacent cutters 13 are not critical, although it must be appreciated that if the cutters are spaced too far apart or cut too shallow, the rubber pads 14 will face the same problem as in the prior art (FIG. 1). Similarly, if the cutters 13 are appreciably skewed with respect to the rotary press axis, the rubber pads 14 may not be effective to cause hinging. Minimum skewing is generally desirable. The appropriate depth of cut and spacing for the cutters 13 is determined by the radius of the rotary die assembly, the rejecting forces exerted by rubber pads 14, the stiffness of the sheet material S, and the configuration of the waste section W to be stripped. In practice it has been found that appropriate depths and spacings can be determined rather easily by trial and error, the goal being to arrive at the minimum number of cutters (to lower expense) consistent with an acceptable rate of stripping. As an example of suitable dimensions, cutter spacings of about 1½ inches gave a stripping rate of 100 percent in cutting out one-half inch wide slots from one-sixteenth inch fiberboard using serrated steel rule dies mounted on a standard die board with a diameter of 19 in. (66 in. circumference).

FIG. 5 illustrates a modified form of the invention. In FIG. 5, a circular steel rule die 12*a* has cutting rules or knives 13*a* mounted therewithin to a die board or mounting late 11*a* for the purpose of dividing a waste section into hinged, connected portions as before. In this modification the cutter knives 13*a* are the same height as the cutters 12*a*, so that they cut completely through the waste section. As shown in FIG. 5, however, the cutter knives 13*a*, which extend substantially parallel to the axis of the rotary cutting assembly as before, do not extend fully across the waste section. Instead, they stop before contacting the cutter die 12*a* to provide short uncut lengths of the waste section which connect together or bridge the hinged portions. These uncut lengths are relatively weak, and permit the hinged portions to bend about the cutting line, in much the same manner as is shown in FIG. 4. Instead of having the uncut portions at the end of the dies as illustrated by dies 13*a*, they can be distributed throughout their length, as in the case of the perforator die 13*p* shown in FIG. 5.

FIG. 6 illustrates another modification of the invention. In this modification, the waste section is divided into short, hinged connected portions by means blunt crease dies 13*b*. The creases 13*b* extend like cutters 13 substantially across the waste section and substantially parallel to the axis of the rotary cutting die assembly. Their height, in relationship to the height of the cutting edge of cutter 12, is selected to cause the desired mechanical weakening of the waste section along the line of contact of the creases therewith, to thereby divide the waste section into short portions able to hinge about the crease line with respect to one another.

It should be understood that the present disclosure is for the purpose of illustration, and that the invention includes all modifications falling within the scope of the appended claims.

I claim:

1. A rotary cutting die assembly adapted to strip cutouts from sheet material comprising:

a mounting cylinder;

cutting means mounted on said cylinder to cut out of said sheet material the waste section to be stripped; and

resilient means mounted within said cutting means, said resilient means radially compressing during cutting and thereafter exerting an expelling force on said waste section of sheet material to strip it from the remainder of said sheet material; characterized by means mounted within said cutting means for dividing said waste section into hinged, connected portions to facilitate bending of the waste section by said resilient means during stripping, the hinge line extending substantially parallel to the cylinder axis.

2. A rotary cutting die assembly according to claim 1 wherein said dividing means comprises at least one cutter mounted on said cylinder, extending substantially parallel to the cylinder axis, the edge of said cutter being positioned in height to cut partially through said waste section, thereby to weaken it and permit it to hinge about the cutting line.

3. A rotary cutting die assembly according to claim 1 wherein said dividing means comprises at least one blunt creaser mounted on said cylinder, extending substantially parallel to the cylinder axis, the blunt edge of said creaser being positioned in height to crease said waste section, thereby to weaken it and permit it to hinge about the crease line.

4. A rotary cutting die assembly according to claim 1 wherein said dividing means comprises at least one cutter mounted on said cylinder, extending substantially parallel to the cylinder axis, the edge of said cutter being positioned in height to cut completely through said waste section, said cutter being shorter than the distance across said waste section to provide an uncut bridge connecting said portions and bending to permit the hinging of said portions about the cutting line.

5. A rotary cutting die assembly according to claim 4 wherein said cutter is a perforator.

6. A rotary cutting die assembly according to claim 1 wherein said dividing means comprises means for mechanically weakening said sheet material along a line to permit it to hinge thereabout.

7. A process for stripping waste sections cut from sheet material by a rotary die assembly having cutting means to cut the waste section from said sheet material, comprising:

while cutting, dividing said waste section into hinged, connected portions with the hinge lines lying substantially parallel to the axis of said assembly; and

expelling said portions from the sheet material, one after another, with resilient means mounted within said cutting means and adapted to compress during cutting and to thereafter expand to exert a force on said waste section portions.