

June 10, 1969

T. D. BISHOP

3,448,646

TREATMENT OF CONTINUOUS WEBS

Filed Jan. 28, 1966

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FIG.1

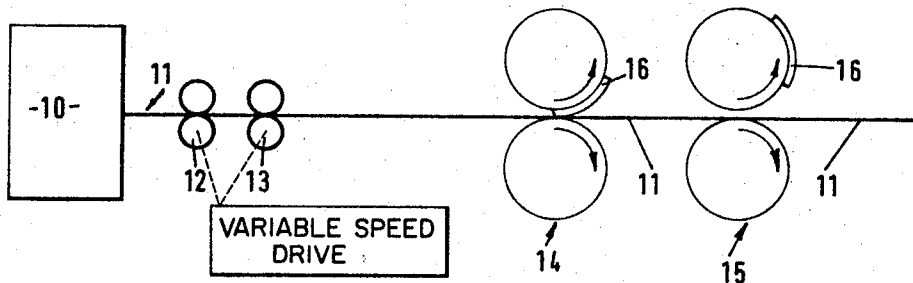


FIG.2

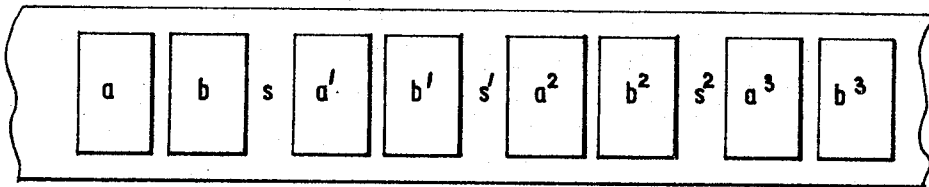


FIG.3

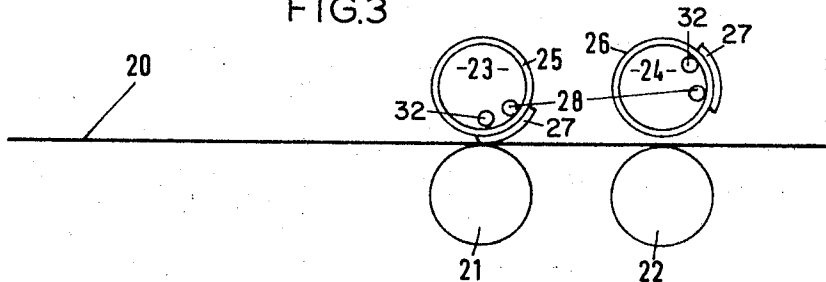
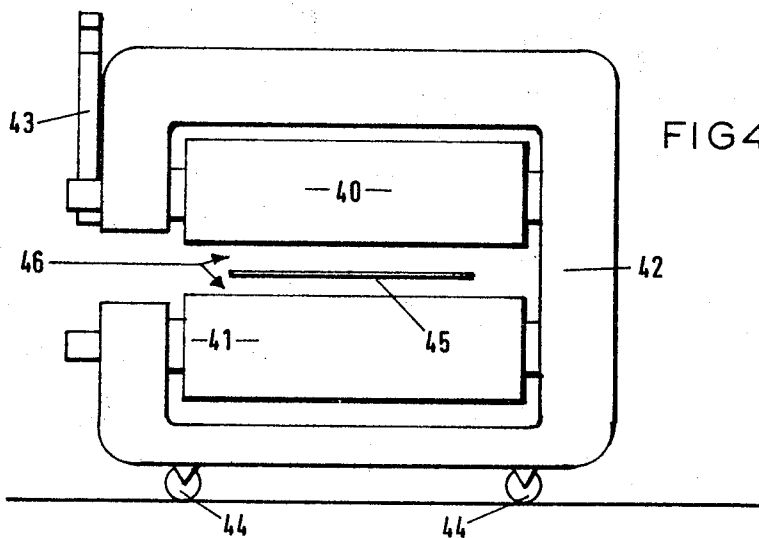


FIG.4



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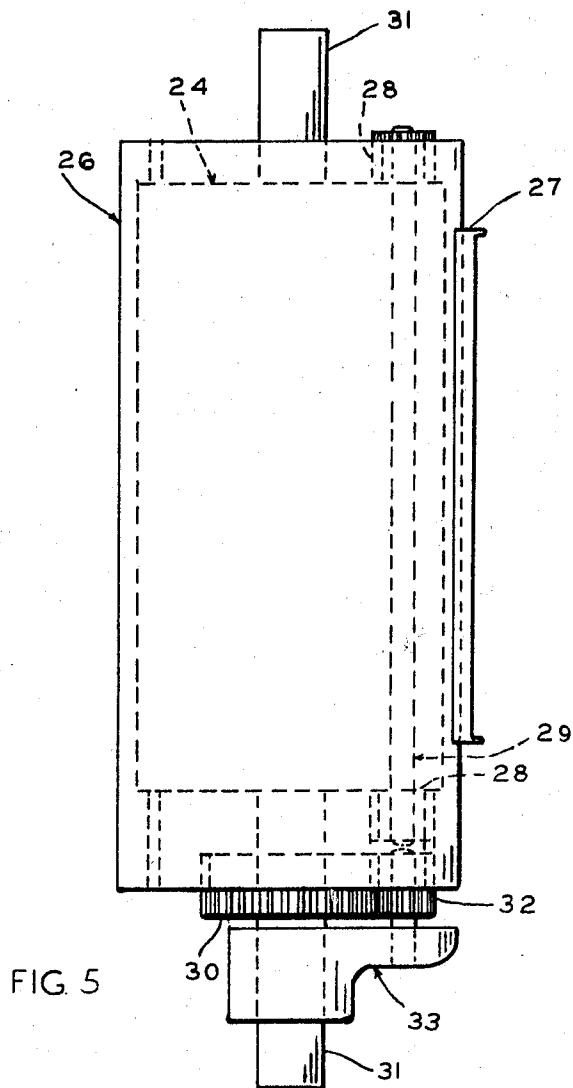
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Sheet 2 of 2



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TREATMENT OF CONTINUOUS WEBS

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1 Claim

ABSTRACT OF THE DISCLOSURE

Apparatus for die-cutting a continuous web, comprising at least two pairs of die-cutting cylinders which are arranged to make successive adjacent die-cuts in the advancing web, the periphery of each die-cutting cylinder consisting of a cutting portion and a non-cutting portion, mechanism for driving the cylinders, while their cutting portions are in cutting engagement with the web, at a peripheral speed equal to the linear speed of the web, and speed control mechanism for varying the relative speed of the cylinders and the web while the cutting portions of the cylinders are out of engagement with the web.

This invention relates to die-cutting a continuous web of board or like material in the manufacture, e.g., of box blanks, blanks for show cards and the like.

Summary of the invention

In accordance with the invention from a broad first aspect, a method of die-cutting a continuous web comprises providing two or more roll pairs located for consecutive operation upon alternate portions of the web, and controlling the speed of the web and/or the speed of the rolls whereby the scrap between blanks cut by the respective rolls is minimal.

In accordance with a feature of the invention the roll pairs are carried on roll stands which are individually mounted for movement lateral of the web, the stands having releasable means whereby the rolls may be moved onto and off the web.

Brief description of the drawings

Various embodiments of the invention will now be more particularly described with reference to the accompanying drawings wherein:

FIG. 1 is a diagrammatic end elevation showing one embodiment of the invention;

FIG. 2 is a diagrammatic plan of a die-cut web prior to stripping;

FIG. 3 is a view similar to FIG. 1 but of another embodiment;

FIG. 4 is a diagrammatic elevation of a die stand; and

FIG. 5 is a plan view, on a larger scale, of a portion of the apparatus shown in FIG. 3.

Referring now to FIG. 1 of the drawings, this illustrates, diagrammatically, the simplest case of the alternatives which are feasible by use of the invention, in which a board source 10, e.g., a roll of flexible board or a board-making machine issues a web 11 of board via feed rolls 12, 13 which are connected to speed control mechanism, which may consist of mechanism for driving the feed rolls at a variable speed. The web is fed between die-cutting cylinders consisting of roll pairs 14, 15 which are run at constant speed and carry dies 16 which, it will be noted, each extend over less than 180° of the roll periphery. (Should the dies extend over substantially 180°, they will be located out of phase, so that they run at a peripheral speed identical to that of the web which is then con-

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stant speed and the invention is not in use.) More usually however the blank length is either greater or less than a convenient ½ roll circumference, and the invention becomes necessary.

FIG. 2 illustrates a length of the web showing pairs of successive blanks a, b, a^1, b^1, a^2, b^2 with scrap s, s^1, s^2 between the pairs. All of blanks a, a^1, a^2 and a^3 are cut by the roll pair 14 and blanks b, b^1, b^2 and b^3 by the roll pair 15, and the scrap pieces s, s^1 and s^2 represent the length of board which is fed by the feed rolls during the time that the latter slow down from the same linear speed as the peripheral speed of the rolls 14, 15 to zero, and then accelerate to the roll speed, under control of the variable speed drive. Hence the board travels at full speed while the cutting portions of the rolls 14, 15 are in cutting engagement with the web, as first one roll pair then the other die-cut the web, and then slows down to zero while the cutting portions of the rolls are out of engagement with the web, causing relative slip between the web and rolls 14, 15, until the latter have rotated to the position at which one of them is ready to cut once more.

Slip between the board and rolls is easily possible, because the rotary dies for cutting the board comprise cutting rule carried on the dies which may be of the order of ⅝" high, so that when the board is of say ¼" thickness, there is a clearance at the roll nip in excess of ½" when the dies are not in cutting position.

A further possibility is illustrated in FIG. 3, and in this case the web 20 is driven at a constant speed as are the impression rolls 21, 22 and the relatively massive cores 23, 24 on which hollow die-cutting cylinders 25, 26 carrying dies 27 are rotatably mounted. As shown in FIG. 5, both ends of the hollow cylinders 25, 26 extend axially beyond the ends of the cores 23, 24. The portions of the hollow cylinders 25, 26 that extend beyond the ends of the cores 23, 24 are provided with internal teeth which mesh with pinions 28 fixed on the ends of shafts 29 journaled in the cores 23, 24. The hollow cylinders 25, 26 are driven by an epicyclic gearset consisting of a gear 30 rotatably mounted upon a shaft 31 fixed to the core, and a planetary gear 32 rotatably supported on the end of an arm 33 that is also rotatably mounted upon the shaft 31. The planetary gear 32 meshes with the internal gear teeth which are formed on the interior of the overhanging end of the hollow cylinder 25 or 26. The sun gear 30 is driven by suitable mechanism (not shown) so that when the arm 33 remains stationary, the hollow cylinder 25 or 26 is driven by the sun gear 30 through the planetary gear 32 at exactly the same rotational speed as the supporting core 23 or 24. In accordance with the invention, provision is made so that the hollow cylinders 25, 26 may be driven with, slower or faster than the cores.

Most conveniently this is accomplished by imparting a first drive to the epicyclic gear sets at the sun gear 30 to give the minimum (or maximum) speed (as the case may be) and imparting a second drive in the same or a reverse sense to the arm 33 of the gear sets to give the variation when required. This arrangement provides precise control. The precise angle through which the arm 33 is moved between cutting cycles determines the exact amount by which the hollow cylinder 25 or 26 is advanced or retarded upon the constantly rotating core 23 or 24. The epicyclic gear set which is used to drive the hollow cylinder 26 in FIG. 5 is an example of a variable speed drive which may be used to drive one roll of the roll pair 12 and one roll of the roll pair 13. In any case, the speed control mechanism varies the relative speed of the die-cutting cylinders and the web while the cutting portions of the cylinders are out of engagement with the web.

It is known per se to apply two inputs to an epicyclic set driving, e.g., slitter blades in rotary blank cutting for the purpose of effecting adjustment of the slot position without stopping the machine—and such system is usually known as a “running register”; however it has not hitherto been adapted for continuous adjustment alternately in both senses and indeed rotary slitters of the kind referred to are adapted for use with discrete blanks only and not continuous board. The reference is made at this juncture only to demonstrate that the constructions involved in this form of the invention are known.

In the case of FIG. 3 also, the roll pairs cut successively on the web as in FIG. 2, but it will be appreciated that after die-cutting cylinder 25 has cut blank *a* it has an angular movement equal to the length of *b*+*s* in which to initially slow down and then speed up before cutting *a*¹ and similarly with cylinder 26, for the two cylinders may be arranged so that one is at maximum speed whilst the other is at minimum and vice versa.

When the two blanks of a pair, such as *a* and *b* or *a*¹ and *b*¹, are cut successively, precise, close spacing of the two blanks on the web is achieved if the relative speed of the web and the cylinder that makes the second cut remains constant from the time when the first cut is completed until the time when the second cut is completed. In the operation of the apparatus shown in FIG. 1, the width of the scrap *s*, *s*¹ may vary somewhat, depending upon the amount by which the web 11 is retarded or advanced between cutting cycles.

When each cutting die extends over less than half of the circumference of its supporting cylinder, it is possible to operate the two cylinders out of phase so that the two cuts of each pair such as *a*, *b* occur successively rather than simultaneously. When that is done, the speed of travel of the web relative to the speed of the rolls will be retarded after each pair of cuts in order to reduce the amount of scrap. For dies which occupy less than half the circumference of each cylinder the apparatus of FIG. 3 provides greater output, because the web 20 can be advanced at a linear speed equal to the maximum permissible cutting speed, and the cylinders 25, 26 can be accelerated momentarily after each pair of cuts such as *a*, *b* in order to reduce the amount of scrap. When each die occupies more than half of the circumference of its supporting cylinder, the two cuts such as *a*, *b* cannot be made successively in time, but can be made simultaneously. That is the case in which it is necessary, after the cutting of each pair of blanks, to accelerate the linear speed of the web relative to the speed of the cylinders, for example by retarding momentarily the cylinders 25 and 26 in FIG. 3. In this case, however, greater output would be achieved by using the apparatus of FIG. 1, and accelerating the web 11 momentarily after each pair of cuts.

Desirably the respective ends of the hollow cylinders 25, 26 are driven separately, for example by supplying power through the shaft 29 to the end of the hollow cylinder dies in exact alignment by preventing torsional deformation that is remote from the epicyclic gear set, to maintain the position of the hollow cylinders 25, 26 during cutting.

FIG. 4 illustrates, diagrammatically, a further feature of the invention according to FIG. 1 or FIG. 3, in which the rolls 40, 41 are supported on extended journals in one end standard 42 but are connected at the other end by a catch 43 (shown disconnected) whereby the complete roll set may be moved on wheels 44 laterally of the web 45.

Preferably the rolls are arranged to be driven at a speed at least near to that of the web but with a nip 46 greater than normal, and hence the complete unit may be wheeled into position, the catch 43 connected to bridge the rolls at the opposite side to standard 42, the rolls brought up to speed and only then have the nip 46 reduced to standard, e.g. by mechanical or hydraulic means in the two standards so as to bring the dies to bear on the web.

I claim:

1. Apparatus for die-cutting a continuous web, comprising mechanism for advancing a continuous web to be die-cut, at least two hollow die-cutting cylinders which are arranged to make adjacent die-cuts in the advancing web, the periphery of each hollow die-cutting cylinder consisting of a cutting portion and a noncutting portion, a coaxial core upon which each hollow die-cutting is mounted, mechanism for driving the cores at a speed such as to impart to the hollow die-cutting cylinders a peripheral speed equal to the linear speed of the web, and drive mechanism for rotating each hollow die-cutting cylinder relative to its coaxial core while the cutting portion of the cylinder is out of engagement with the web, said drive mechanism comprising an epicyclic gear set consisting of a rotatably mounted sun gear, coaxial with the hollow-die cutting cylinder, an internal gear on the hollow die-cutting cylinder, and a planetary gear which meshes with the sun gear and the internal gear and is journaled in a mounting that is rotatable about the axis of the sun gear, whereby the sun gear may be driven at a constant speed such that when the rotatable mounting of the planetary gear remains stationary the hollow die-cutting cylinder is driven at a peripheral speed equal to the linear speed of the web, and the rotatable mounting may be driven while the cutting portion of the hollow die-cutting cylinder is out of engagement with the web to rotate the cylinder relative to its coaxial core.

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