May 13, 1969 T. D. BISHOP 3,443,490

APPARATUS FOR CUTTING AND CREASING CARDBOARD

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Fig. 1.

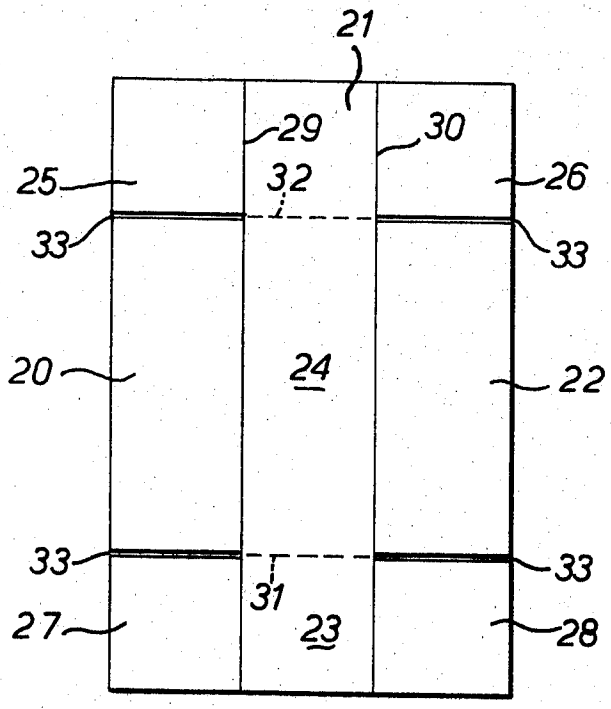

Fig. 2.
(PRIOR ART)

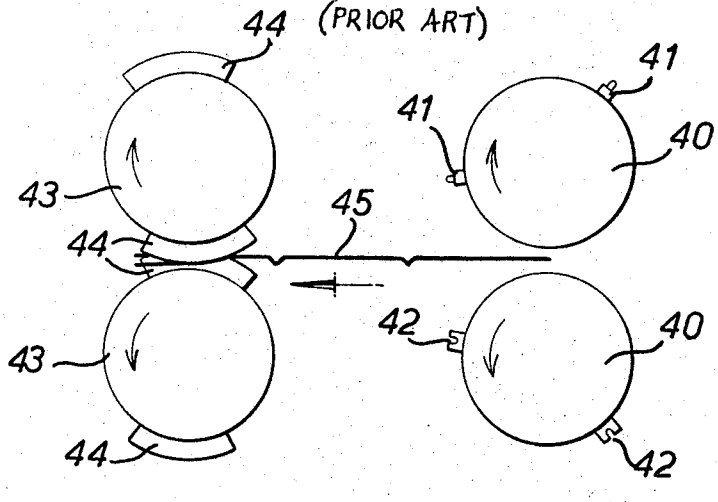

FIG. 3.

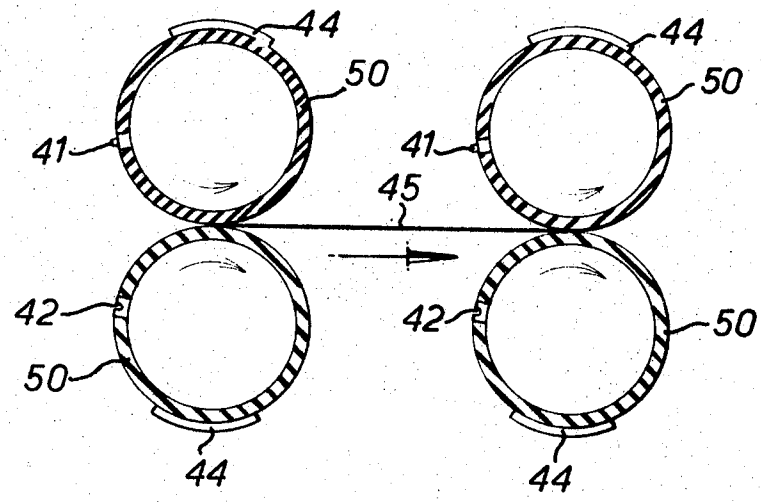

FIG. 4.

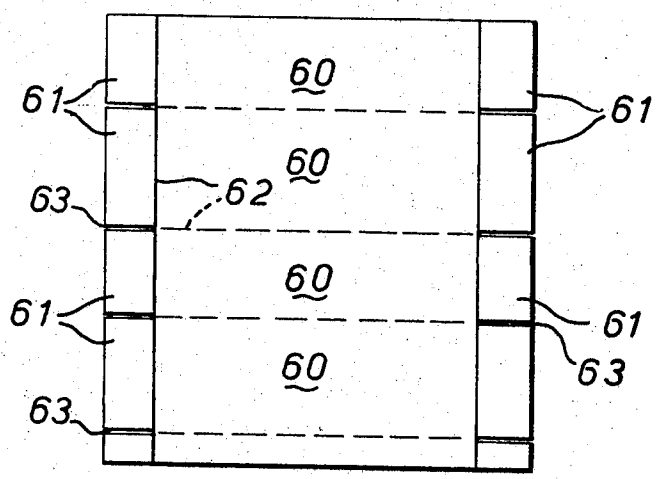

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Fig. 5

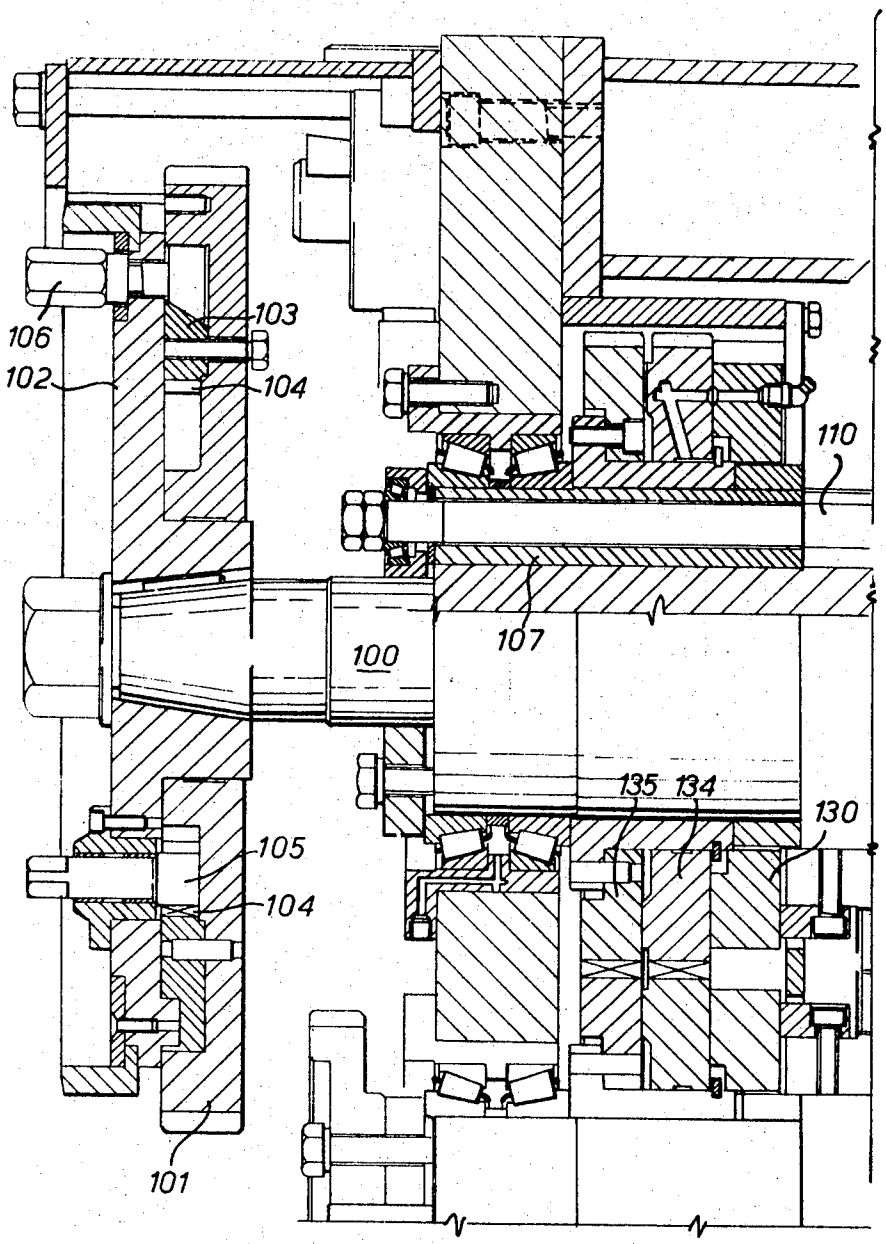

Fig. 5a

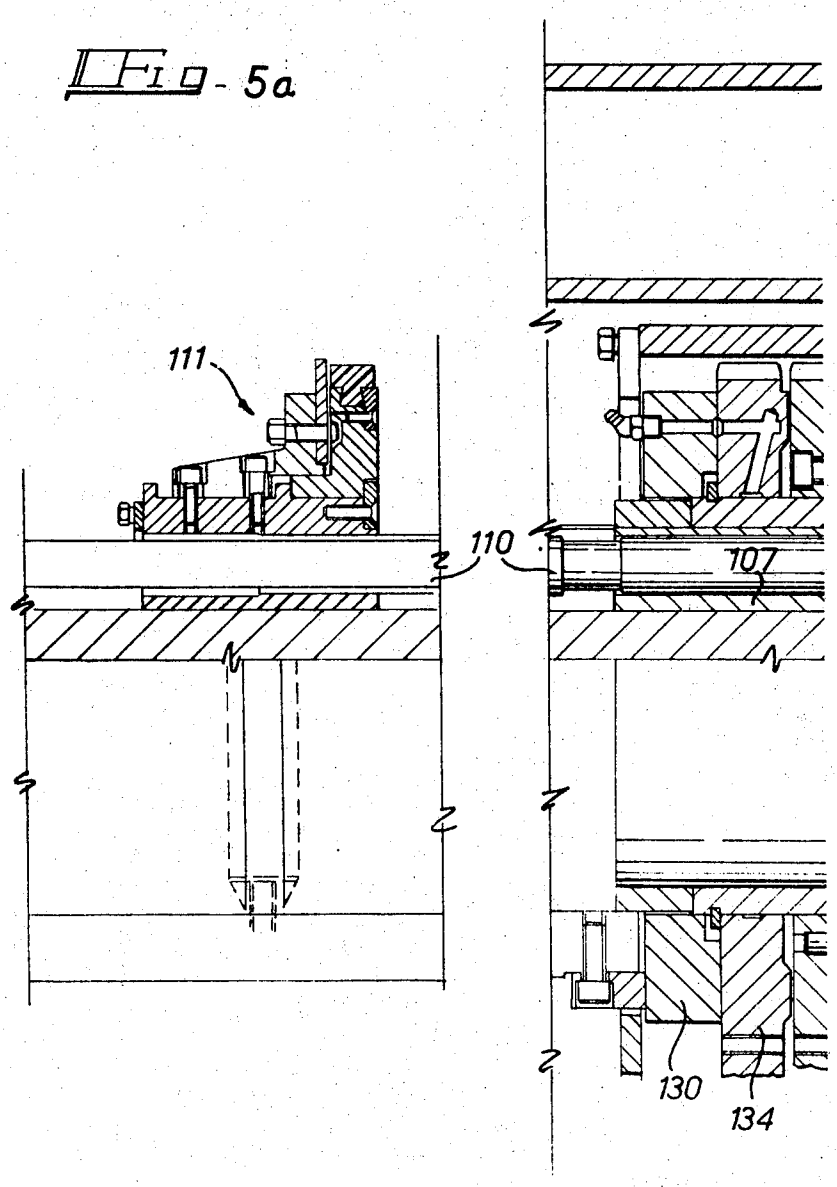

Fig. 5b

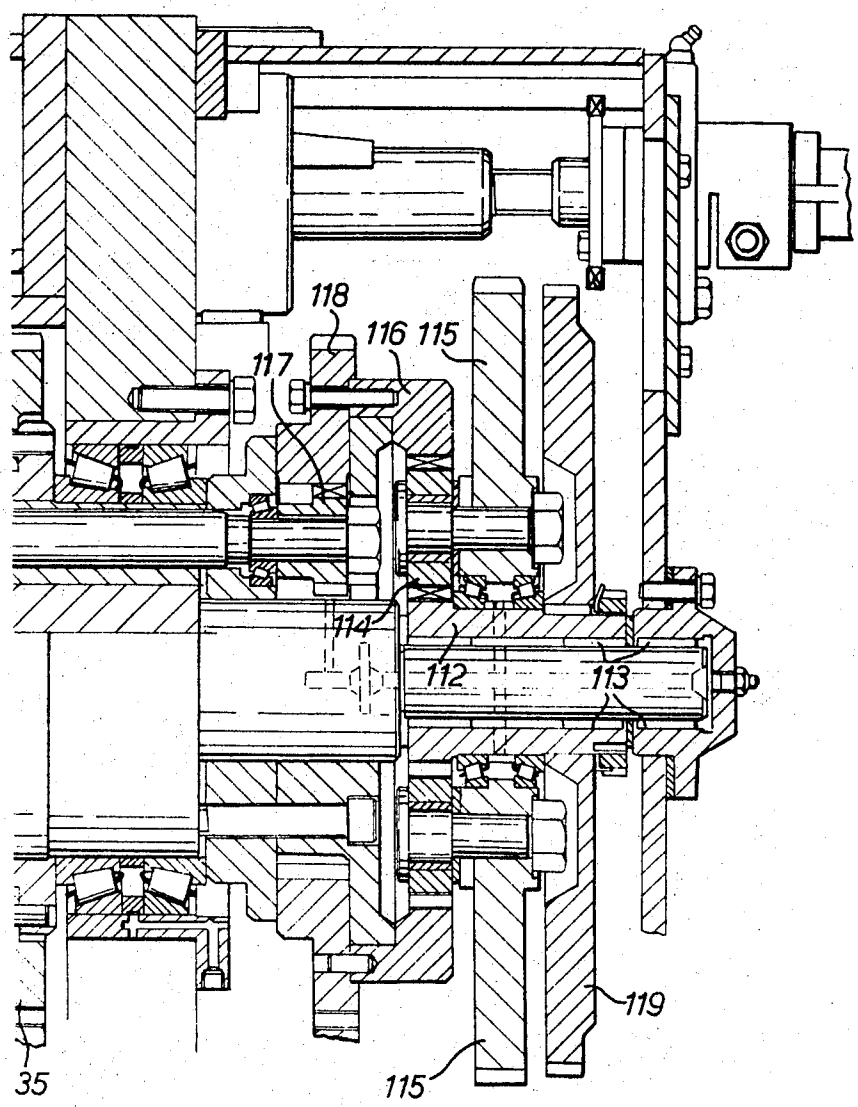

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Fig. 6

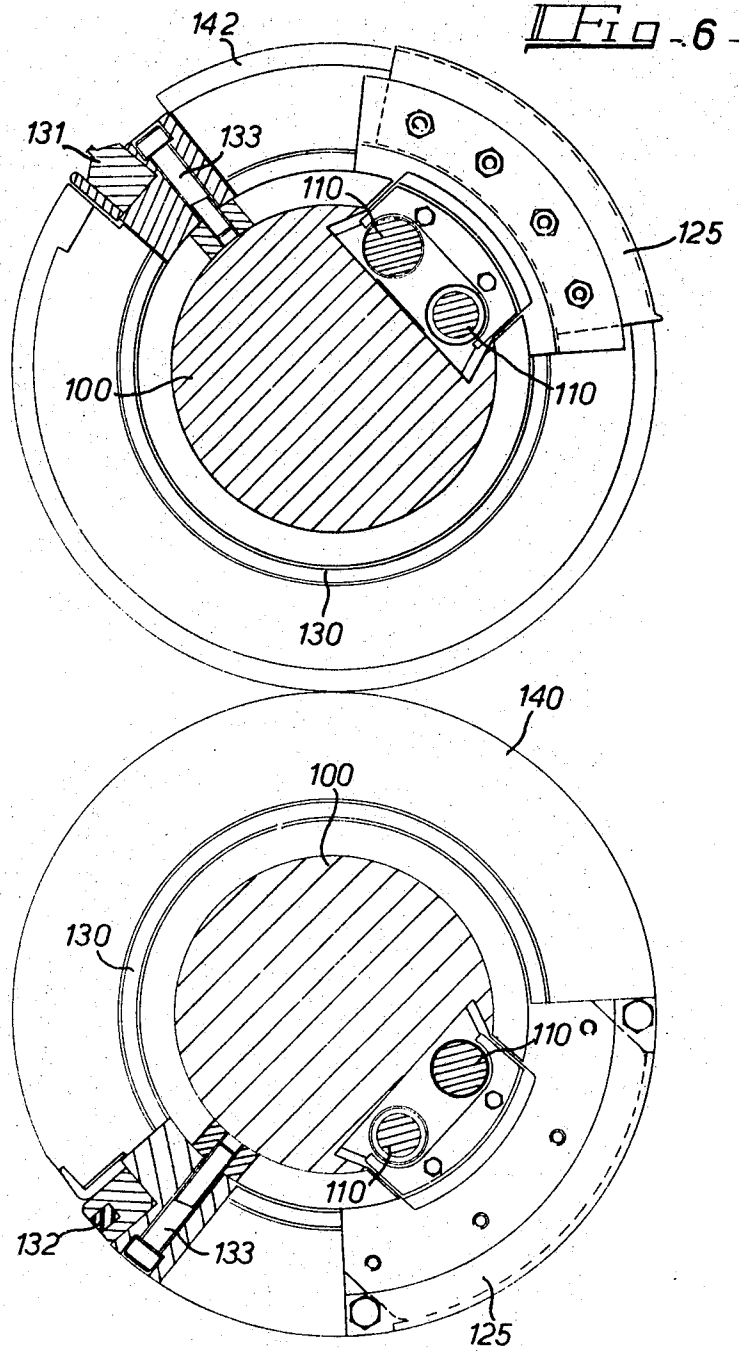

Fig. 7.

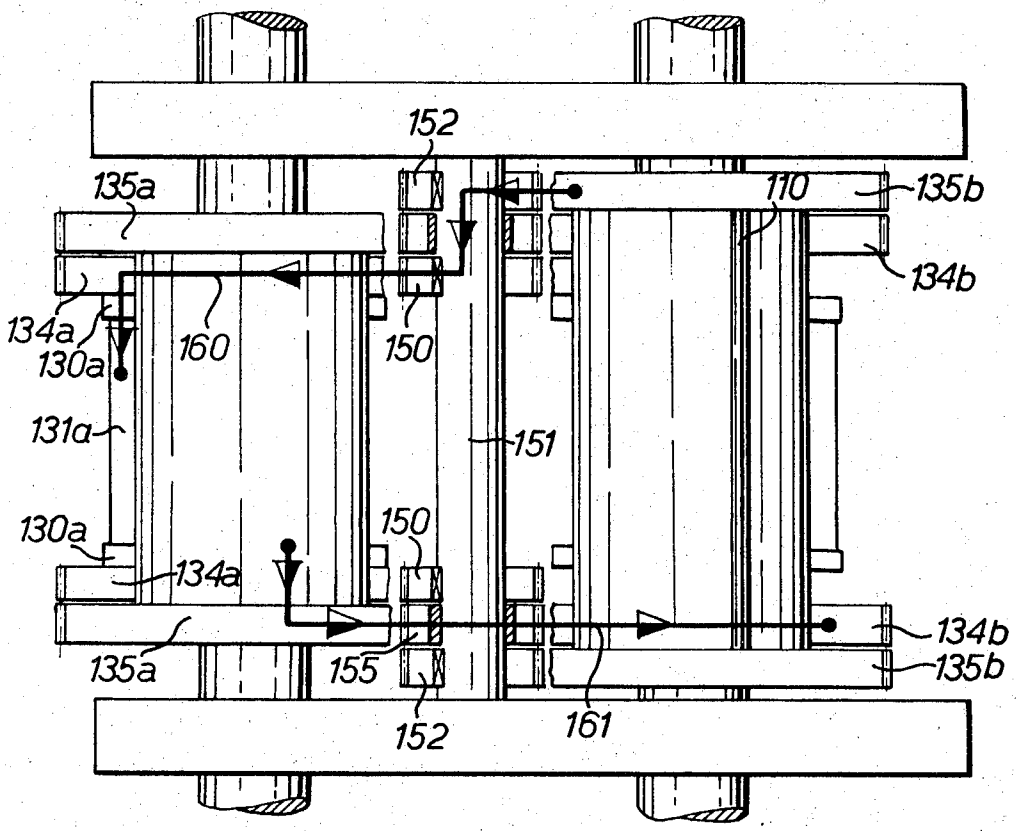
152
135a
110
135b
134b
134a
130a
160
150
131a
151
130a
150
134a
134b
135a
155
135b
152
161

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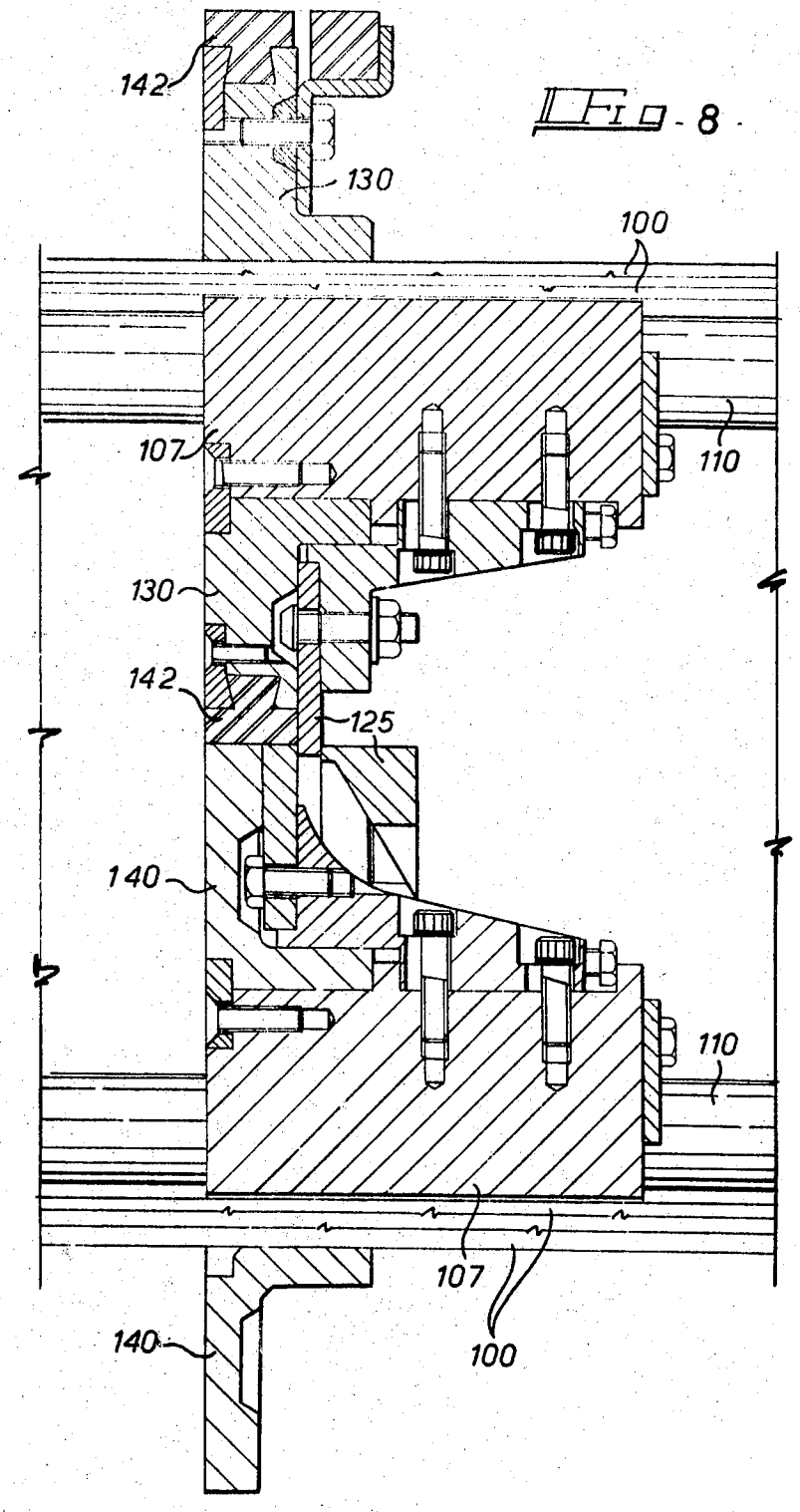
Fig. 8.



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3,443,490

APPARATUS FOR CUTTING AND CREASING CARDBOARD

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Claims priority, application Great Britain, June 15, 1965, 25,326/65
Int. Cl. B31b 1/22
U.S. Cl. 93—58.2 3 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus for slotting and creasing blanks, which includes first and second pairs of rolls arranged to operate successively on each blank, and in which each pair of rolls is provided with (a) one set consisting of two complementary creasing tools, one tool of the set being mounted on the surface of each roll and extending parallel to the axis of the roll, (b) at least one set consisting of two complementary slotting tools, one tool of each set being mounted on the surface of each roll and lying in a plane perpendicular to the axis of the roll, and (c) at least one set consisting of two complementary drive bands, one drive band of each such set being mounted on the surface of each roll and extending from one side of the creasing tool around the roll to the other side of the creasing tool, the slotting tools being adjustable circumferentially relative to the creasing tool and drive bands on each roll to vary the spacing of the two creases produced by the two pairs of rolls on each blank.

Background of the invention

This invention relates to apparatus for the cutting and creasing of cardboard and like materials particularly in the manufacture of blanks for subsequent erection into boxes.

A typical cardboard box blank is illustrated in FIGURE 1 of the accompanying drawing and comprises portions **20–24** which are all substantially rectangular and are integral and which form four sides of the box and the bottom, i.e. a central rectangular base and four flaps each forming one side of the box, together with four further flaps **25–28** which connect the sides at the box corners. This involves the production of two transverse creases **29**, **30** and two longitudinal creases **31**, **32** and slots **33** which are continuations of or parallel to the latter one set of creases and terminate on the other set of creases and which form the edges of the flaps.

It is customary for the purposes of manufacturing box blanks to link a bar-bender for example as illustrated diagrammatically in FIGURE 2 (i.e. a pair of rolls **40** carrying on one roll a pair of creasing tools **41** extending along the roll and adjustable thereabout and carrying complementary and likewise adjustable tools **42** on the other roll) with a slotter (e.g. a second pair of rolls **43** carrying a number of pairs of cutting knives **44**, the knives of each pair being relatively adjustable to adjust the length of the slot, and the knives being adjustable also lengthwise of the roll to vary the slot spacing in one direction and being adjustable about the roll for the same purpose in the other direction). It has been proposed in our prior U.S. Patent No. 3,111,067 (and the proposal practised successfully) to link the bar-bender and slotter by a mechanism which allows the crease positions to be altered relative to each blank **45** and simultaneously adjusts the slotter knives so that after an initial setting up the slots always terminate on the one set of creases so that the flaps are truly cut. Such combination only produces one set of creases and all of the slots, and therefore conventionally a separate rotary creaser is used to make the longitudinal creases.

One of the disadvantages of the known apparatus is that, of necessity the bar-bender and slotter tools project from the respective roll surfaces, so that the blanks are gripped by the tools but not elsewhere. This would tend to lead to inaccuracies through blanks warping etc. and also slipping. It is therefore customary to apply pads or blanks of packing material to the rolls to take up the gap so that the blank is gripped and positively driven throughout its passage through the apparatus. However, the pads have to be replaced by shorter or longer pads according to requirements when some adjustments are made.

One of the objects of the invention is to overcome this disadvantage and provide means to grip the blank without adjustment when the bend spacing is varied.

A further object of the invention is to provide an improved apparatus whereby the separate rotary creaser may be coupled for adjustment synchronously with the bar-bender/slotter combination thereby simplifying setting-up and adjustment.

Summary of the invention

In accordance with a first aspect of the invention, a bar-bender/slotter combination is characterised by the provision of one bar-bender set on each of two coupled roll pairs and one or more pairs of slotter tools on each roll pair.

Hence, as shown in the diagrammatic illustration of the apparatus according to the invention shown in FIGURE 3, in which like reference numerals are used to those in FIGURE 2, when the spacing of the slots along the roll is constant, each roll may be wrapped by a single pad **50** of constant length which extends from one side of the bar-bend tool **41**, **42** about the roll to the other side of that tool, and adjustment of the position of that bar-bend tool relative to the one on the other roll pair will not alter the pad length so that the pad may remain and provide constant drive to the blank. When the slotter positions are varied the pads will need adjustment axially along the roll only and in a practical embodiment the pads are carried on sleeves to slide on the roll during adjustment. FIGURE 3 shows each roll wrapped as aforesaid, but it may be preferred to provide encircling rings of pads of rubber or other hard or yielding driving material on the rolls carrying the male bar-bend tools, and use steel rings on the roll carrying the female tools.

Another unexpected advantage of this arrangement is that for a given roll diameter larger blanks can be made than is the case if the bar bending is carried out on one roll pair and the slotting entirely on the other roll pair.

The position of the bar-bend tools angularly of the rolls and in relation to one another may be varied by interconnecting the two tools of each pair by gears whereby the two tools are varied synchronously so that mesh is maintained, and the two pairs may be varied by a running register arrangement using gears which are normally held relative to one another but which can be released to turn (or vice versa) for such adjustment.

In accordance with a further aspect of the invention, apparatus for the purpose specified comprises two roll pairs namely first and second pairs each having one or more pairs of slotter tools which are adjustable along the roll length, and a separate rotary creaser tool having a plurality of creasing tool sets likewise adjustable along an axis, all of said tools being coupled to be simultaneously and synchronously adjustable to maintain the slots in line with the creases formed thereby.

It will be appreciated that in a container, for example as shown in the accompanying FIGURE 4, which shows a blank for a closed box having parallel panels **60** forming its sides, and its lid and base formed from flaps **61**, a

different number of transverse and longitudinal creases **62** made by bar bends and rotary creaser and slots **63** etc. are required, but the invention is still applicable.

Brief description of the drawings

FIGURE 1 is a plan view of a cardboard box blank which may be produced by an apparatus embodying the present invention.

FIGURE 2 is a diagrammatic elevation of two pairs of rolls showing the conventional arrangement of creasing and slotting tools.

FIGURE 3 is a diagrammatic elevation of an apparatus embodying the invention, showing how the arrangement of creasing and slotting tools differs from the conventional arrangement shown in FIGURE 2.

FIGURE 4 is a plan view of another cardboard box blank which can be produced by an apparatus embodying the present invention.

FIGURES 5, 5*a*, and 5*b* are an elevation, partly in section, showing the drive to one roll and also to the slotting tool thereon.

FIGURE 6 is an end view also partly in section, showing the two rolls of one pair and their relationship.

FIGURE 7 is a diagrammatic plan view showing the interconnections.

FIGURE 8 is a section showing the slotters engaged.

Referring first to FIGURE 5, the roll shaft **100** is driven from a main gear **101** which is normally clutched to a plate **102** by a cone arrangement **103** carrying an internal gear **104** meshed with pinion **105** whereby, after easing the clutch via bolt **106** the pinion may be hand rotated to vary the position of shaft **100**. Located on shaft **100** and in a dovetail rebate in the same are housings **107** carrying one or more parallel spindles **110** bushed therein and which serve to carry the slotter heads generally indicated at **111** to rotate the heads with shaft **100**. Each spindle is screw threaded and the spindles **110** are connected by an epicyclic gear set seen at the right hand side of FIGURE 5.

The gear set comprises a (usually) stationary sun pinion **112** carried in bearings **113** by an end plate forming part of the stationary machine structure, and meshed with individual planet pinions **114** carried by a main drive gear **115**. The planets are meshed with annulus gear **116** which also has a gear ring meshing with wheels **117** on the individual spindles **110**. Annulus gear **116** further carries an external gear ring **118** and the sun is splined or keyed to a gear wheel **119** and both the ring **118** and wheel **119** will be further described hereafter.

Associated with wheel **119** is a pinion (not shown) constantly meshed with wheel **119** to drive the latter selectively when needed, for example by a motor (not shown). The motor incorporates a brake and for convenience the wheel **119** of one roll of each pair may be meshed with the not shown pinion, and this arrangement ensures that wheels **119** which form part of the inching gearing are held fixed when adjustment is not wanted, and are moved in synchronism when needed.

Gear **115** transmits drive from the same source which drives gear **101** so that normally the slotter head carrying spindles remain individually stationary and only move with shaft **100** about the axis of the latter and at the same speed as the latter and do not individually rotate.

Referring now to FIGURE 6, all of shafts **100** are seen to carry pairs of spindles **110** so that if and when rotated, by ring **118**, the slotter heads may be moved along the shafts to move the slots, transversely of the blank. It will be appreciated that a plurality of heads may be provided, ones of which are bushed on one spindle and have for example left hand threads engaging with another, left hand threaded spindle **110** and others may have right hand threads to engage with a right hand threaded spindle (being bushed on the left hand threaded spindle) so that the transverse spacing may be varied when all of the spindles are rotated in the same sense.

The slotter knives are indicated at **125**.

Encircling each shaft at each end is a ring **130** journalled on the shaft **100** and the two rings on each shaft carry the bar-bend tools **131**, **132** secured thereto by bolts **133**, so that the tools extend along the length of the shaft angularly spaced from the slotter knives. It will be appreciated that a plurality of bar-bend tools could be provided on the rolls. The rings **130** are fast with respective gears **134** (see FIGURE 5) which are immediately adjacent gears **135** fast with shaft **100**.

The female bar-bend tools **132** are located, at intervals along their length, in slots or gaps in driving rings **140** which encircle the shaft **100** and are arranged immediately adjacent the female slotter knives, see FIGURE 8 so as to slide on the shaft with the slotters when the latter are adjusted therealong.

The male bar-bender tools **131** similarly carry driving rings **142** which include a peripheral dovetailed rubber or like band, and the blanks, when fed through the roll nips are continuously driven by these bands and rings **140**, **142** and any adjustment of the bar-bender and slotters does not affect this drive of the blanks.

Referring now to FIGURE 7, this illustrates diagrammatically the drive adjustment connections between bar-benders and slotters which enable the slot cut by the knives on one roll pair to be precisely positioned to terminate on the crease made by the bar bend tools on the other roll pair, and vice versa, even when one pair of bar bend tools are moved angularly relative to the rolls, by moving the associated slotters on the other rolls by a like amount.

FIGURE 7 shows the bar bend tools, diagrammatically, indicated by the reference numerals **131***a* and **131***b* differentiated by the letters *a* and *b* to indicate the rolls concerned. FIGURE 7 shows, by way of example, the connections between the top rolls of the two roll pairs. Similar connections are used between the lower rolls of the pairs. Moreover, the drive from the bar bend tool on one roll to the slotter which cooperates therewith on the next roll is the same as that between the slotter on the said one roll and the bar-bend tool which cooperates therewith on the said next roll.

Gears **134***a* mesh with intermediate pinions **150** fast with a layshaft **151** to transmit drive to gears **135***b* on the next roll, so that normally gears **135***b* on one roll and gears **134***a* on the next roll rotate together and at the same speed so that the mesh between the bar bender driven by gears **134***a* and the slotter and shaft driven together via **135***b* is maintained. Each pinion **150** has a second part **152** splined to the same layshaft **151** to take the drive between the axially spaced gears in question. This drive is indicated by the heavy arrowed line **160**. This drive is duplicated at each end of the layshaft.

Between the parts of pinion **150**, **152** is a third pinion **155** rotatable on the layshaft **151** which serves to transmit drive from gears **135***a* which are fast with rolls **100** and hence with the slotters to gears **134***b* fast with the bar bend tools. This drive is shown by the heavy arrowed line **161**.

It will be noted that the positions of gears **134** and **135** vary axially of the respective shafts to enable these connections to be made.

Variation of the position of the bar bender tools and slotters, angularly of the rolls, to vary the dimension of the blank to be creased and slotted whilst maintaining registration of creases and slots, is effected by easing the cone clutch **103** by means of the bolt **106** and rotating the pinion **105** by hand as hereinbefore described, so that shaft **100** turns in rings **130** and alters the relationship between the slotter and bar benders on the first roll pair, i.e. between gears **134** and **135** on such one shaft, whilst the resultant drive connection between the rolls (arrowed lines **160**, **161**) causes the corresponding bar bend tools and slotters on the next roll pair to move by corresponding amounts. In order to permit the position of the shaft

100 to be varied by manual rotation of the pinion 105, it is necessary that the drive to the gear 115 at the other end of the shaft be declutched. When the adjustment is made in this way, the shaft 100 and slotters of the first roll pair are moved angularly, and the rings 130 and bar benders on the other roll pair are moved angularly by an equal amount, while the other parts remain stationary. Another and more convenient method of adjustment consists in releasing the said cone clutch arrangement 103 by loosening the bolt 106, while leaving the gears 115 clutched to the drive, on the driven roll of each roll pair. Then while the shaft 100 of the driven roll of each roll pair is thus declutched from its driving gear 101, the gear wheel 119 which is provided on one roll of each roll pair is driven by a motor driven pinion (not shown) which is in mesh with the gear wheel 119 that is provided on one roll of each pair. This causes the annulus gears 116 to be driven through the planet pinions 114. Since the shafts 100 are now free from the main driving gears 101, the driving of the gear wheels 119 will not cause the pinions 117 and shafts 110 to rotate individually, but instead will move the shafts 100 bodily, thus adjusting the angular positions of the slotting tools carried by the shafts. In this way, the angular positions of the slotting tools on all four rolls are adjusted simultaneously, while at the same time the angular positions of the bar bend tools on all four rolls are adjusted correspondingly through the drive connections 160 and 161 illustrated in FIGURE 7. It will be appreciated by reference to FIGURE 3 that when the bar bend tools on the first roll pair (the left hand one in that figure) are thus advanced to move the first crease nearer the centre of the blank, those on the second roll pair are retarded, move the second crease an equal amount nearer the centre of the blank, and the slotters are moved in the same way so that each slot terminates on the appropriate crease.

An independent adjustment may be provided in the drive between the source and gears 115 for use only in setting up to obtain perfect registration on the first occasion, and all subsequent adjustments for blank length, bar bend spacing and slot spacing transverse of the blanks will be made with uniformly accurate registration quite automatically.

The rotary creaser, not illustrated, may have creasing tools carried and driven substantially similarly to the slotters and supported on screw-threaded spindles in the same way as the slotters and the spindles may be driven by gears meshed with the gear rings 118 to maintain the creases formed by the creasing tools in line with the slots, and this adjustment will then be effected automatically. Preferably the upper roll of one set and the lower roll of the next are provided with epicyclic gear sets each including a gear wheel 19 coupled to the motorised inching pinion, and each thus coupled roll is connected to the next roll on the same level by the FIGURE 7 arrangement.

The apparatus may be set up so that the first and last creases on each blank are made in the first and second pairs of rolls respectively, or vice versa.

Moreover, whilst the described arrangements use epicyclic sets in which various members are held stationary or rotate at shaft speed, it is possible, and for practical reasons it may be necessary to use differential speeded parts and use input speed increments on the reaction members to restore the speeds to synchronism.

I claim:

1. Apparatus for slotting and creasing blanks, comprising first and second pairs of rolls arranged to operate successively on each blank, characterized in that each of said two pairs of rolls is provided with (a) one set consisting of two complementary creasing tools, one tool of the set being mounted on the surface of each roll and extending parallel to the axis of the roll, (b) at least one set consisting of two complementary slotting tools, one tool of each such set being mounted on the surface of each roll, and lying in a plane perpendicular to the axis of the roll, and (c) at least one set consisting of two complementary drive bands, one drive band of each such set being mounted on the surface of each roll and extending from one side of the creasing tool around the roll to the other side of the creasing tool, the slotting tools being adjustable circumferentially relative to the creasing tool and drive bands on each roll to vary the spacing of the two creases produced by the two pairs of rolls on each blank.

2. Apparatus according to claim 1 wherein the adjustments of the slotting tools and creasing tools on the two rolls of each pair are synchronized to maintain each set of complementary tools in registry, and the adjustment of the slotting tools on one pair of rolls is synchronized with the adjustment of the creasing tools on the other pair of rolls to maintain the ends of the slots on each blank in registry with the two creases when the spacing of the two creases is varied.

3. Apparatus according to claim 1, wherein the slotting tools are adjustable axially of each roll by threaded shafts which are driven by the output member of an epicyclic gear set having a normally stationary reaction member which, when driven, rotates the output member relative to the roll to rotate the threaded shafts.

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U.S. Cl. X.R.

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