

May 10, 1938.

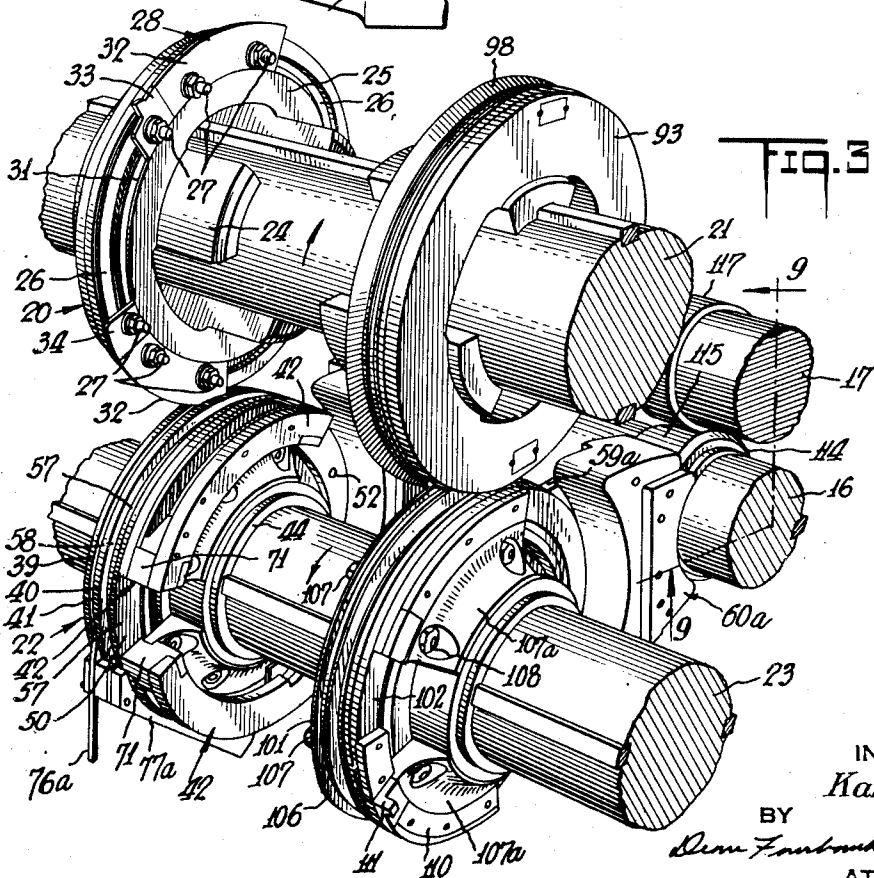
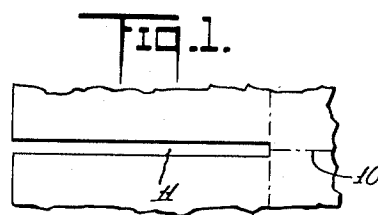
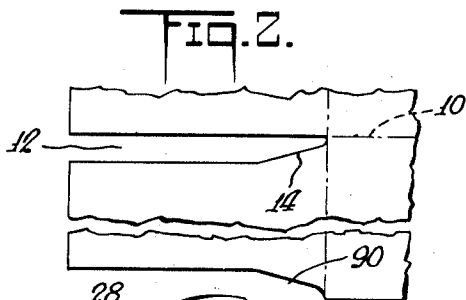
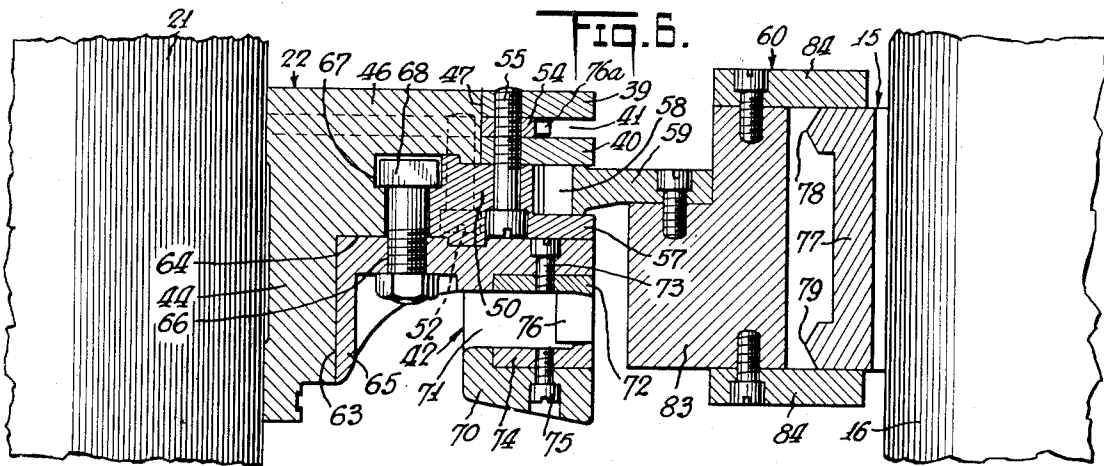
K. SIEG

2,117,220

MACHINE FOR MAKING BOX BLANKS

Filed Sept. 10, 1936

5 Sheets-Sheet 1



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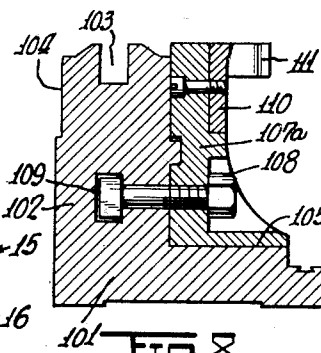
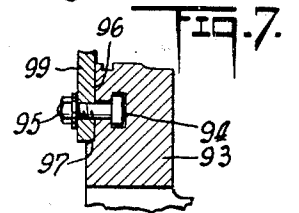
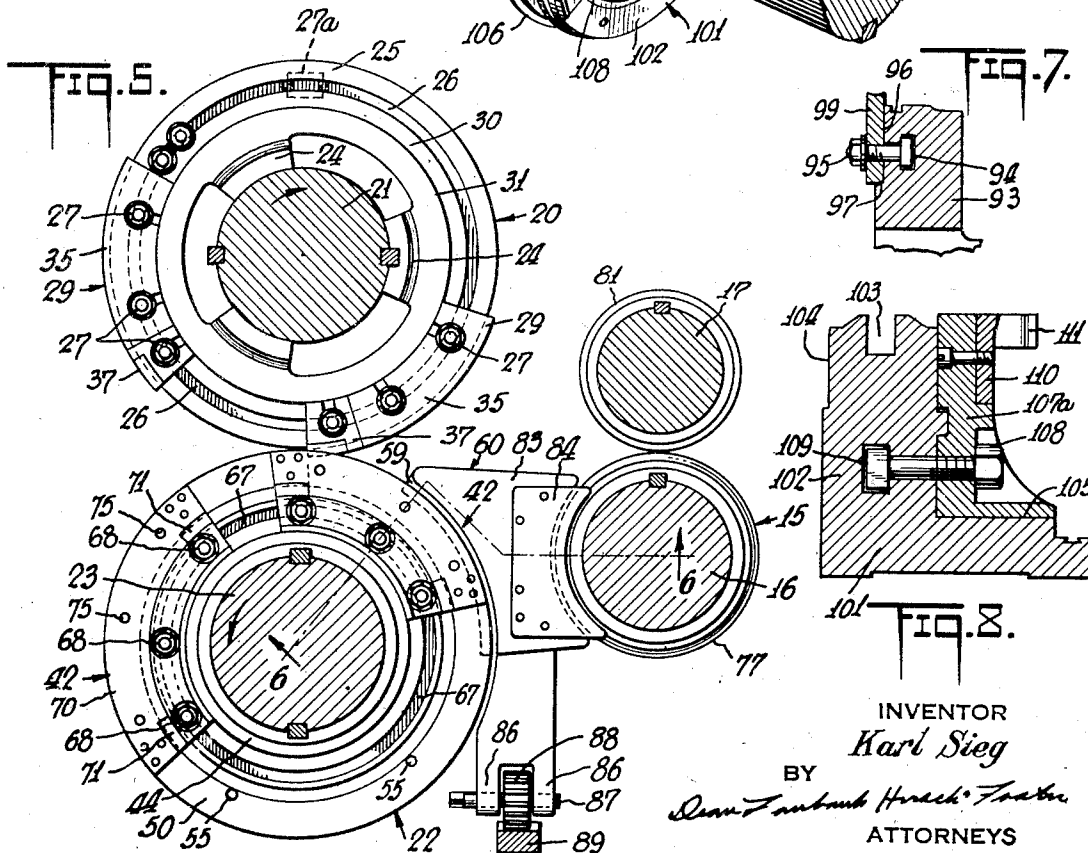
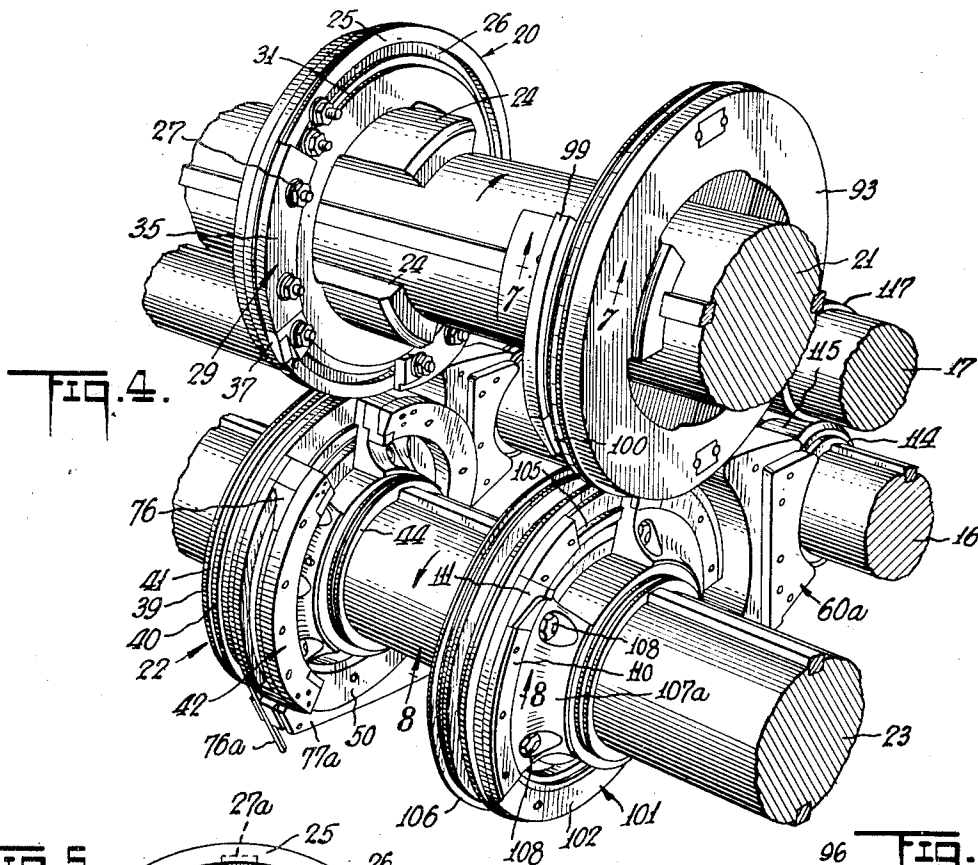
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2,117,220

MACHINE FOR MAKING BOX BLANKS

Filed Sept. 10, 1936

5 Sheets-Sheet 2



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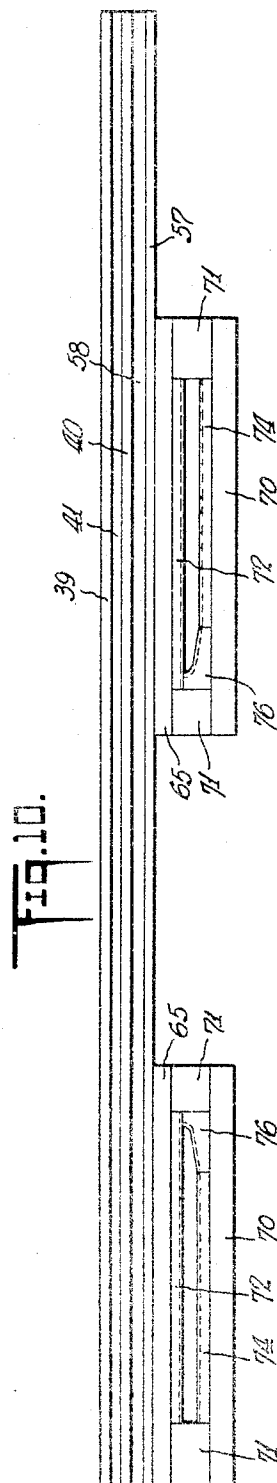
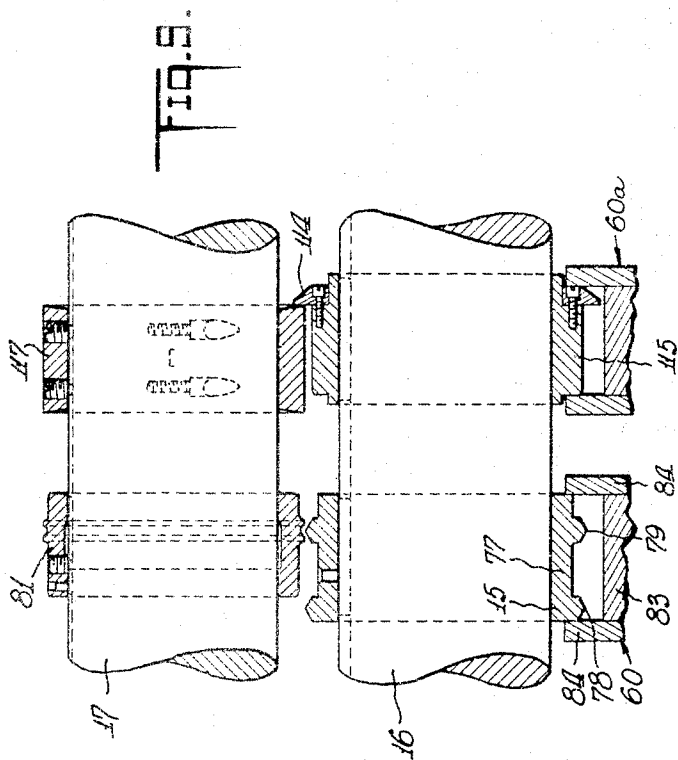
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MACHINE FOR MAKING BOX BLANK.

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5 Sheets-Sheet 3



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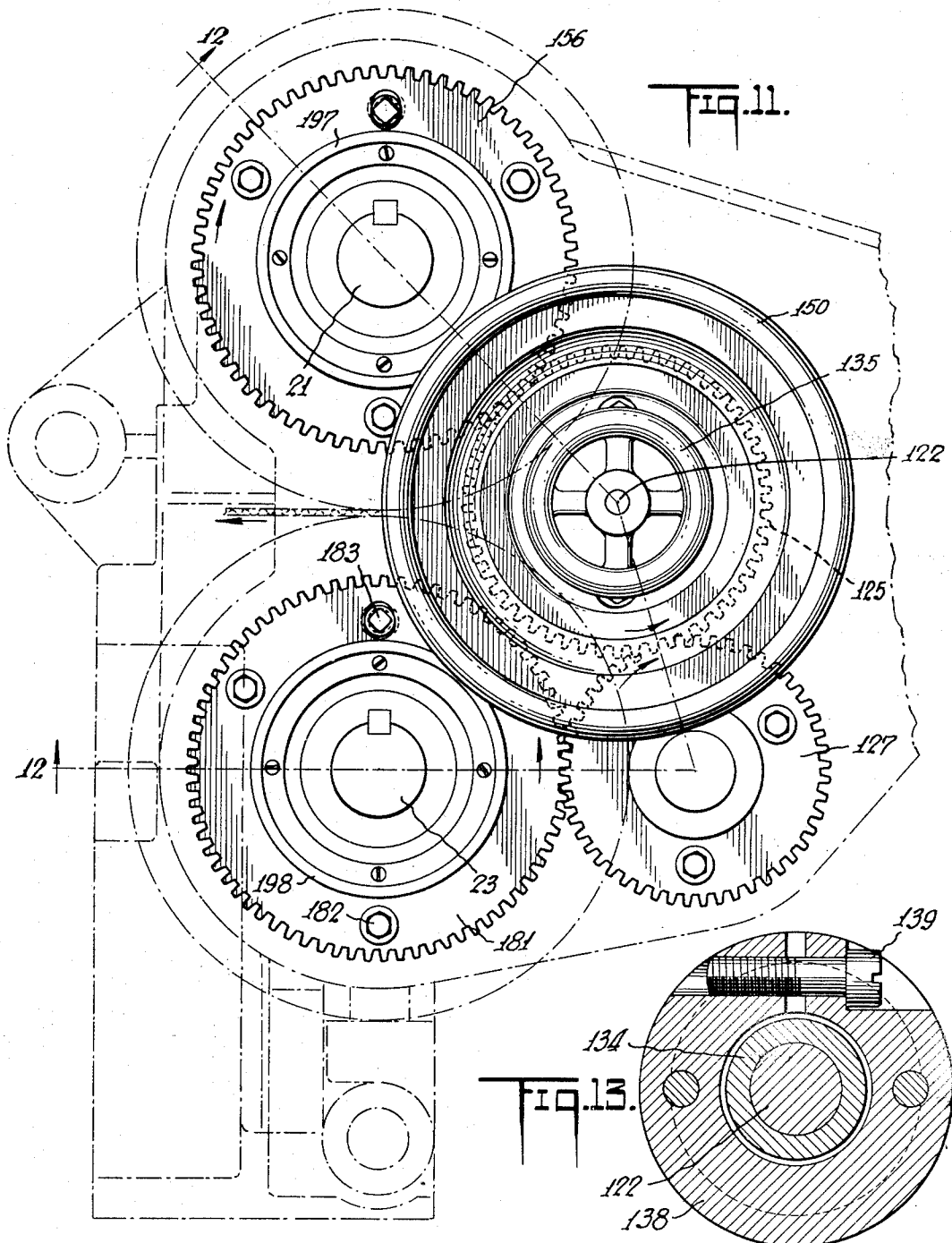
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MACHINE FOR MAKING BOX BLANKS

Filed Sept. 10, 1936

5 Sheets-Sheet 4



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MACHINE FOR MAKING BOX BLANKS

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Sheets-Sheet 5

FIG. 12.

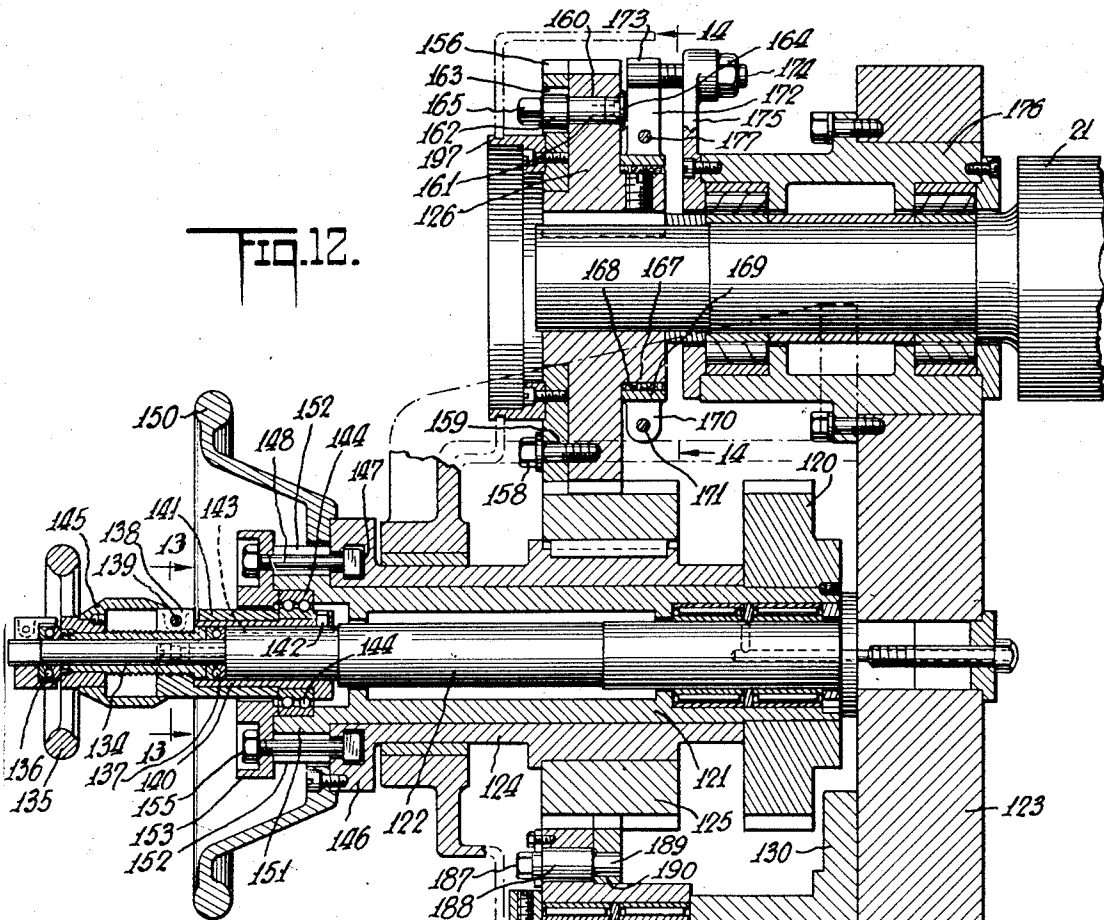
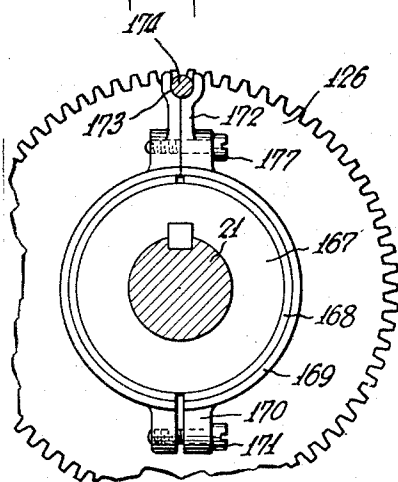


FIG. 14.



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UNITED STATES PATENT OFFICE

2,117,220

MACHINE FOR MAKING BOX BLANKS

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Application September 10, 1936, Serial No. 100,094

21 Claims. (Cl. 93—58.2)

The present invention relates to that type of mechanism for making box blanks, in which there is employed a series of scoring units for scoring an advancing sheet to define a series of fold lines, and a second series of slotting units for slotting said sheet inwardly from opposite edges at the ends of the score lines to separate adjacent sections adapted to be folded inwardly to form the end or closure flaps of a box.

In certain types of box blanks, the slots are formed with rectangular inner ends and extend in exact center line registry with their related score lines. When such a blank is folded into a box, the edges of the outside flaps are substantially flush with or project slightly beyond the outer surfaces of adjacent walls of the box. (See Fig. 6 of Langston et al. Patent No. 1,859,877.) During shipment or handling of the filled boxes, these edges of the flaps are often caught and pulled loose. If the slots with rectangular inner ends are offset from their corresponding score lines, the side edges of the outside flaps may be spaced inwardly from the adjacent side wall of the box, when folded, and therefore small openings may be formed at the corners of the box.

As one feature of my invention, I provide mechanism whereby the slots may be formed with the inner end very narrow and at least a part of one side edge inclined so that the side edges of the closure flaps will be spaced inwardly from the adjacent side walls of the box, and the corners of the box will be effectively closed.

As a further feature, the same mechanism is so designed that the box manufacturer may, by simple adjustment, make box blanks having slots which are either rectangular or tapered at their inner ends.

As one feature of the present invention, there is provided a rotary slotting mechanism which may be employed to form slots of either shape referred to.

As another feature, there is provided a rotary mechanism which may be employed to trim one side of the blank along a straight line and make slots with parallel sides, or to form two of the closure flaps so that the outer end portions will be narrower than the base end portions.

As another feature, there are provided two coacting series of rotary slotting and trimming heads carrying respectively shearing members having the desired oblique cutting outlines to form the slots or blank edges with oblique bases.

In order to vary the length of the slots in one edge of the blank in respect to those in the opposite edge, so that the slots in opposite edges may

be of equal length, the two series of slotting heads must be circumferentially adjusted with respect to the drive or feed mechanism.

Another object of the present invention is to provide means for adjusting the two cooperating slotting or trimming heads circumferentially in opposite directions, in unison and in respect to the drive, either while the machine is running or at rest, and without affecting the circumferential registrable relationship of the die members thereon.

A further object is to provide scoring mechanism which will be automatically adjusted axially upon axial adjustment of the slotting heads, and will act to form the score line in the proper position regardless of the particular shape of slot which is being cut.

Other objects, advantages and novel features will be pointed out hereinafter or will be apparent from a study of the specific form of apparatus shown in the drawings which show for the purpose of illustration, a form of machine embodying the present invention. In these drawings:—

Fig. 1 is a plan view of a fragment of a box blank having a slot with a rectangular inner end,

Fig. 2 is a plan view of a fragment of a box blank having a slot with an oblique base and having an end flap trimmed in a corresponding manner,

Fig. 3 is a fragmentary perspective view showing coacting rotary slotting and slitting heads in position to effect straight line slotting and trimming to form the blank of Fig. 1,

Fig. 4 is a fragmentary perspective view similar to that of Fig. 3, but showing coacting slotting and slitting heads in position to form the blanks of Fig. 2,

Fig. 5 is a transverse vertical section of the parts shown in Figs. 3 and 4 and also showing the scoring mechanism,

Fig. 6 is a section taken on the line 6—6 of Fig. 5,

Figs. 7 and 8 are sectional details taken on the lines 7—7 and 8—8 respectively of Fig. 4,

Fig. 9 is a section taken on the line 9—9 of Fig. 3,

Fig. 10 is a development of the circumference of the lower slotting head.

Fig. 11 is an end view of a portion of the machine, showing the means for circumferentially adjusting the slotting heads and for taking up the lost motion between the drive and said slotting heads,

Fig. 12 is a section taken on the line 12—12 of Fig. 11, and

Figs. 13 and 14 are sectional details taken on the lines 13—13 and 14—14 respectively of Fig. 12.

- 5 The machine illustrated is adapted to form a box blank with a series of score lines 10 along which the body of the blank may be folded to form the four sides of the box, and a corresponding series of rectangular slots 11 of the type shown
- 10 in Fig. 1 for forming the end flaps of the box. The machine may also form a box blank with slots 12 disposed in offset relationship with respect to their associated score lines 10, and having a portion of one side 14 extending obliquely
- 15 to meet the ends of said score lines, as shown in Fig. 2.

The unslotted and unscored blanks are stacked and successively fed by a feed mechanism which may be of any suitable construction, and they

20 may be fed successively through a pair of printing units if desired.

The scoring mechanism, in the specific form shown, includes a series of individual rotary units 15 each splined to a shaft 16 and coacting with a

25 second rotary member on a shaft 17 to form the score lines 10 on an advancing blank. The axial spacing of the scorers along these shafts may be set in accordance with the desired size and proportions of the box to be formed. The details of

30 these scoring units 15 will be more fully set forth hereinafter.

The slotting mechanism, if used to form three slots in a blank for a rectangular carton, includes three pairs of slotting heads axially spaced for

35 forming the three pairs of slots. As all three are alike only one pair is illustrated. The upper slotting heads 20 are splined to a shaft 21 and coact respectively with three lower slotting heads 22 splined to a shaft 23 parallel to the shaft 21.

40 Each upper slotting head 20 comprises a series of circumferentially spaced hub sections 24, one of which has a keyway engaging a key extending lengthwise of the shaft 21, and is provided with a flange portion 25 provided on one side thereof

45 with a circumferential T-shaped face groove 26, the enlarged portion of which is adapted to receive the heads of clamping bolts 27. The other side of the flange 25 is provided with one or more openings 27a (Fig. 5) communicating with the

50 groove 26 to permit the clamping bolts to be inserted therethrough into the T-shaped groove 26.

The upper slotting head 20 is adapted to interchangeably support two punching or shearing male dies 28 (Fig. 3) for cutting the rectangular

55 slots 11, or two punching or shearing male dies 29 (Figs. 4 and 5) for cutting the non-rectangular slots 12. The lengths of these punching dies 28 and 29 are at least equal to the length of the desired slots and they are circumferentially ad-

60 justable so that the distance between the two aligned slots will equal the height of the desired carton. In order to support the male die 28 or 29 against radial inward movement, the upper slotting head 20 is provided on the groove side of

65 the flange 25 with a radially outwardly facing circumferential seating shoulder 31.

The punching die 28 (Fig. 3) includes a segmental blade section 32 for making the side cuts of the slot 11, and a separable end section 33 or

70 34 for making the rectangular end cuts of the slots 11. The end section 33 is provided with a prong for making the end cuts of the forward slots at the end of a side cutting stroke, and the end section may be beveled to avoid hav-

75 ing the corners of the blade tear the back of

the slot as it clears the sheet at the beginning of a side cutting stroke. The segmental blades 32, with their associated end section 33 or 34, are seated on the shoulder 31, extend radially outwardly beyond the periphery of the flange 25, 5 and are detachably held in position by the clamping bolts 27.

For cutting the non-rectangular slots 12, each male die 29 as shown in Figs. 4 and 5 includes a blade section 35 for making the parallel side cuts 10 of said slots, and a separable end section 37 shaped to make the slanted end cuts of these slots. These die sections 35 and 37 are interchangeable with the die sections 32, 33 and 34 in the recess 30, and are similarly clamped in position by the bolts 27, with their cutting edges

15 extending radially outwardly beyond the periphery of the flange 25.

The lower slotting head 22 carries a pair of annular blades 39 and 40 axially spaced to form a 20 circumferential cutting groove 41. This groove 41 has a width corresponding to the width of the slot 11 of Fig. 1 to be formed in the blank, and serves as a female die or counter for the punching dies 28.

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The lower slotting head 22 is also provided with a pair of female dies 42 axially spaced from the groove 41, and adapted to receive and cooperate with the male dies 29 to form the non-rectangular slots 12 as shown in Figs. 4 and 5.

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In order to provide for the mounting of the cutting blades 39 and 40 and the female dies 42, the lower slotting head 22 comprises a main hub section 44 splined on keys in the shaft 23 and having a radially outwardly extending flange 46 at one end thereof presenting a cylindrical peripheral seating surface 47 (Fig. 6). A flange member 50 is secured to the inner side of the flange 46 by a series of machine screws 52. The blades 39 and 40 are seated on the cylindrical surface 47 of the flange 46, are spaced apart by a spacer ring 54, and are connected to the flange member 50 by means of a series of machine screws 55. The flange 50 has a radially outwardly extending portion 57 spaced from the inner blade 40 to form a circumferential groove 58 which is adapted to receive a plate 59 forming part of an interlocking device 60 between the scoring unit 15 and the lower slotting head 22, as will be more fully described hereinafter.

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The hub section 44 of the lower slotting head 22 is provided with a radially outwardly facing cylindrical seat 63 extending from an axially facing shoulder 64 and forming therewith a recess or rabbet for adjustably receiving the female dies 42. Each die 42 includes a segmental bracket 65 seated on the surface 63 and abutting the shoulder 64. The bracket 65 has a plurality of circumferentially spaced holes 66 in registry with a T-shaped circumferential groove 67 formed between the hub section 44 and the flange 50 and adapted to receive clamping bolts 68. These bolts 68 have their heads extending into the enlarged portion of the groove 67 and may be moved circumferentially therein in any desired adjusted position.

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Supported from each bracket 65 is a segmental member 70 axially spaced therefrom by means of end pieces 71. Extending along the inner side of the bracket 65 in an arcuate recess or rabbet 70 formed therein is a shearing blade 72 detachably secured to said bracket by machine screws 73. Similarly, a shearing blade 74 extends in an arcuate recess in the inner face of the member 70, and is connected thereto by means of ma-

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chine screws 75. Between the blades 72 and 74 at one end thereof and detachably secured by suitable machine screws is an end shearing section 76 corresponding to the shape of the male die section 37 and cooperating therewith to cut out the oblique bases of the slots 12 shown in Fig. 2.

In the operation of the machine so far described, when it is desired to make, for instance, the rectangular slots 11 shown in Fig. 1, the male dies 28 are secured on the upper slotting heads 20 in the desired circumferential position, and the upper and lower slotting heads are moved relatively axially to bring these dies 28 into the plane of operation of the cutting grooves 41 (Fig. 3). The outer peripheries of the female dies 42 do not extend beyond the peripheries of the grooves 41 so that it is not necessary to remove these dies 42 when making rectangular slots 11.

When it is desired to make the non-rectangular slots 12, the male dies 28 are replaced by the male dies 29 in the desired circumferential position, and the upper and lower slotting heads are moved relatively axially to bring these heads into the cooperative relationship shown in Figs. 4 and 5.

In order to remove the waste tabs from the groove 41 during the operations of making the rectangular slots 11, each slotting unit has associated therewith a U-shaped band 76a anchored near the ends to an axially movable block 77a and extending circumferentially into the upper side of the groove 41. This band 76a being stationary during slotting operations, the waste tabs in the groove 41 are carried by the sides of said groove along the band, and then out of the groove.

No waste ejector is necessary for the female dies 42 since the radially inner sides of these dies are open to permit the waste tabs to fall out therethrough.

The scoring units 15 are constructed so that they may cooperate either with the slotting groove 41 or the female dies 42. For that purpose, each scoring unit comprises a rotary member 77 splined to the shaft 16 for axial movement therealong, and having a pair of V-edge scoring blades 78 and 79, the scoring edge of the blade 78 being disposed in alignment with either the center line or one side of the groove 41 while the scoring edge of the blade 79 is in alignment with one side of the recess of the die 42. Cooperating with one of these scoring blades is a platen roller 81 splined to the shaft 17 and having a hardened plain cylindrical face. This roller 81 may be axially moved to cooperate either with the scoring blade 78 or the scoring blade 79, depending on the slotting operation to be effected.

The rotary member 77 is interlocked with the lower slotting head 22 for axial movement therealong by means of the interlocking device 60, so that the scoring blades 78 and 79 will maintain a fixed relationship with their corresponding die recesses on said slotting head. This interlocking device in the form shown includes a block 83 having a pair of plates 84 secured to the sides thereof and engaging the opposite ends of the rotary member 77. The plate 84 extending into the groove 58 is secured to the block 83.

Each scoring head 15 and its associated lower slotting head may be moved in unison by any suitable means. For instance, the lower portion of each interlocking block 83 may have a pair of spaced lugs 86 in which is journaled a shaft 87 carrying a pinion 88 meshing with a fixed rack 89, said shaft being shaped at one end to receive

a suitable turning tool. By rotating the shaft 87 the scoring units with their associated lower slotting heads may be moved axially in selective positions along their respective shafts in accordance with the desired shape of the blank. This mechanism for moving the scoring member 77 and the slotting head 22 is shown somewhat diagrammatic for the purpose of illustration, but in actual practice, the shaft 87 will be below the lower end of the slotting head or will slant downwardly towards the left (Fig. 5) outwardly beyond the line of tangency of the periphery of said slotting head, so that said shaft will be readily accessible for turning from the left-hand side of the lower slotting head 22.

At one end of the series of slotting heads, there is provided a rotary trimming mechanism which may be used for trimming the entire end of the blank along a straight line, or which may be easily and readily converted to trim the end flaps on one side of the blank with beveled cut-outs or recesses 90 (Fig. 2) to correspond with the opposite sides of said flaps. For that purpose there is provided an upper trimming head 93 splined to the upper shaft 21 for axial movement therealong, and provided on the inner side thereof with a circumferential T-shaped face groove 94 (Fig. 7) for receiving suitable clamping bolts 95. This trimming head 93 is provided on this side thereof with a recess or rabbet 96 presenting a radially outwardly facing cylindrical seat 97.

When it is desired to trim the entire end of the blank along a straight line, there is mounted in the recess 96 a circular shearing knife 98 (Fig. 3) secured to the trimming head 93 by means of the clamping bolts 95 and extending radially outwardly beyond the periphery of said head.

When it is desired to trim the outer edges of the end flaps with beveled cut-outs 90, the circular knife 98 is replaced by a pair of arcuate shearing blades 99 (Figs. 4 and 7) and a pair of cutting end pieces 100 shaped in accordance with the desired oblique end cuts to be made. These are held in position by clamping bolts 95 and extend beyond the periphery of the trimming head 93.

Cooperating with the upper trimming head 93 is a lower trimming head 101 splined to the lower shaft 23 for axial movement therealong, and having a radially outwardly extending flange 102 provided on opposite sides with recesses or rabbets 104 and 105 (Figs. 4 and 8).

When it is desired to trim the entire side of the blank along a straight line, there is disposed in the recess 104 a circular slitting blade 106 (Fig. 3) extending radially outwardly beyond the periphery of the flange 102 and detachably secured thereto by means of machine screws 107. This blade 106 cooperates with the blade 98 to trim the blank to the desired width.

For making the beveled cut-outs 90 at the outer sides of the flaps, there is provided a pair of arcuate brackets or blade holders 107a (Figs. 4 and 8) disposed in the recess 105 and adjustably held in position by means of bolts 108 extending from a circumferential T-shaped groove 109 on the outer side of the flange 102. These holders 107 have secured thereto blades 110 and end pieces 111 shaped to cooperate with the blades 99 and the end pieces 100 respectively.

The lower trimming head 101 is movable axially along the shaft 23 to bring the lower knife 106 into cooperative position with the upper knife 98 as shown in Fig. 3, for straight line trimming, or to bring the blades 110 into cooperative relationship with the arcuate blades 99 as shown in

Fig. 4 when making the beveled cutouts 90. To effect the desired axial movement of the lower trimming head 101 there is provided an interlocking mechanism 60a similar to the interlocking mechanism 60 and similarly provided with a plate 59a extending into a peripheral groove 103 formed in the flange 102 of the lower trimming head 101. This interlocking mechanism 60a is moved lengthwise of the shaft 23 by a rack and pinion arrangement similar to that shown in Fig. 5 in conjunction with the operation of the interlocking mechanism 60.

The blades 110 with their associated end pieces 111 need not be removed during the straight line trimming operation since they do not extend beyond the periphery of the flange 102, and therefore do not interfere with this operation. Also during the cutting of the beveled cutouts 90 the trimming knife 106 need not be removed since it will not interfere with the operation of the knives 99 and 110.

When making the blank with straight sides, trimming of the blank to the desired width is effected by the cooperating knives 98 and 106 as already pointed out. However, when making the bevel cutouts 90 at the outer sides of the flaps, the blank is first trimmed to the desired width before passing between the upper and lower slotting units. For that purpose there is provided at each end of the scoring mechanism a trimming knife 114 which is connected to one end of a collar 115 splined on the shaft 16 and which overlaps one end of a shearing roller 117 fixed to the shaft 17. The shearing end of this roller 117, cooperating with the trimming knife 114, is in the plane of the extreme outer cutting edges of the end pieces 111 so that during the cutting of the bevel cutouts these cutting edges will meet the trimmed edges of the body portion of the blank.

The trimming knife 114 is moved along the shaft 16 according to whether the blank is to be provided with bevel cutouts or straight line edges. For that purpose the combined knife 114 and the collar 115 are engaged on opposite sides by the interlocking mechanism 60a, so that the movement of this mechanism along the shaft 16 causes not only the movement of the lower trimming head 101, but also causes a corresponding movement of the trimming knife 114.

When making the bevel cutouts 90, the knife 114 will be in the shearing position shown in Fig. 9 to trim the blanks before they reach the slotting mechanism. When the blank is to be provided with straight line sides, the lower trimming head 101 will be in its extreme right hand position shown in Fig. 3, and the knife 114 will be in a corresponding position to the right of the shearing end of the roller 117 and in inoperative position for cutting.

In order to vary the length of the slots in one edge of the blank in respect to those in the opposite edge, the upper slotting heads 20 must be circumferentially adjusted with respect to the drive or feed mechanism. When the machine is set for cutting non-rectangular slots, the lower slotting and trimming heads must be circumferentially adjusted in accordance with the circumferential adjustment of the upper slotting and trimming heads to maintain registrable relationship of the die or shearing elements on said heads.

Also, when the machine is so set the upper and lower slotting and trimming heads must be

driven in synchronism to maintain this relationship of the die or shearing elements.

For carrying out these operations, there is provided a drive gear 120 driven from the source of power as that which operates the blank feeding mechanism, and fixed to one end of a long sleeve 121. This sleeve 121 is mounted for anti-frictional rotation around a stud shaft 122 which is rigidly secured at one end to some part of the frame structure 123 of the machine. Normally locked to and embracing the sleeve 121 for rotational movement therewith is an outer sleeve 124 having keyed or otherwise fixed thereto a gear 125 meshing with a gear 126 keyed to the outer end of the upper slotting shaft 21.

For driving the lower slotting head shaft 23 there is provided an intermediate gear 127 meshing with the gear 125 and mounted for anti-frictional rotation on a stud shaft 128 which is secured to a bracket 130 supported on the frame structure 123. This gear 127 meshes with a gear 131 keyed to the outer end of the lower slotting head shaft 23 so that said shaft is driven in synchronism with the upper shaft 21.

For circumferentially adjusting the two shafts 21 and 23 in unison without interfering with the continuous drive and rotation thereof, the gears 125, 126, 127 and 131 between the two shafts have helical gear teeth, and one of said gears such as the helical gear 125 is axially movable with respect to the other gears. For effecting this axial movement there is provided a hollow externally threaded screw 134 encircling the stud shaft 122 for rotation thereon and firmly secured at its outer end to the hub of a hand wheel 135. This screw 134 is held against axial movement between a pair of end thrust bearings 136 and 137 and has a threaded engagement with a nut 138 which is rigidly secured to a sleeve 140 encircling the stud shaft 122 and which has a tubular extension 141 embracing said sleeve 140. This sleeve 140 is splined to the stud shaft 122 for axial movement therealong by a key 142 carried by said sleeve and extending into a keyway 143 in said stud shaft. The axial movement of the sleeve 140 is transmitted to the sleeves 121 and 124 through a double thrust bearing 144.

When the machine is running the hand wheel 135 is at rest. The rotation of the hand wheel 135 causes a corresponding rotation of the screw 134. This causes the axial movement of the nut 138 outwardly from the position shown in Fig. 12 and the corresponding axial movement of the gears 120 and 125 through the two interlocked sleeves 121 and 124. As the gear 120 and the driving gear (not shown) meshing therewith are straight toothed gears, the axial movement of the gear 120 does not cause any relative rotation of these gears, but as the gear 125 and the other gears meshing therewith are helical, the endwise movement of this gear 125 causes rotation of both shafts 21 and 23 in unison with respect to the drive gear 120 without interfering with the rotation of said shafts.

In order to prevent the accidental rotation of the screw 134 resulting from vibration or other causes, the nut 138 is split and held tightly around said screw by a stud 139 passing through the split portion of said nut.

The gear 125 is wider than the gears 126 and 127 meshing therewith so as to maintain said gears 126 and 127 in full intermeshed relationship with the gear 125 within the range of movement of said latter gear.

In order that the drive gear 120 and its inter-

meshing driving gear (not shown) be maintained in full intermeshing relationship within the range of axial movement of said drive gear, one of said gears, as for instance the driving gear (not shown), is made the wider gear.

The extent of rotation of the hand wheel 135 may be observed by a sleeve 145 connected at one end to the hub of said wheel for rotation therewith, and having its other end encircling the nut 138 and indicatively cooperating with a series of calibrations on the periphery of said nut.

Easily disconnectable means are provided which permit or prevent the free rotation of the two slotting head shafts 21 and 23 with respect to the drive while the machine is at rest. For that purpose the outer end of the sleeve 124 has a radially outwardly extending flange 146 provided with an annular T-groove 147 for the reception of a series of clamping bolts 148 and having fixed thereto a hand wheel 150 for rotating said sleeve.

The outer end of the inner sleeve 121 is provided with an outwardly extending flange 151 having a pair of radially extending peripheral slots 152 for the reception of the bolts 148 and having an end plate 153 secured to said flange and provided with apertures for said bolts, the mouths of these apertures being enlarged to receive the nuts 155 of the bolts 148. The end plate 153 and the flange 151 form an annular recess for the reception therein of the outer peripheral portion of the double end thrust bearing 144, while the inner peripheral portion of said bearing is held between the inner end of the tubular extension 141 of the nut 138 and a flange at the inner end of the sleeve 140.

When the clamping bolts 148 are loosened, the sleeve 124 is free to rotate with respect to the sleeve 121 without disturbing the drive gear. In this condition the hand wheel 150 may be turned to rotate the gear 125 and thereby correspondingly adjust the two slotting shafts 21 and 23 in unison and approximately in the proper circumferential relationship with respect to the drive gear 120. When this approximate adjustment has been made, the clamping bolts 148 are tightened in position, and the fine adjustment of the two shafts 21 and 23 effected while the machine is running through the operation of the hand wheel 135 as already set forth.

The means for adjusting the gears between the drive gear 120 and the upper slotting head shaft 21 for backlash or lost motion, includes a comparatively thin helical backlash adjusting gear 156 seated in a recess formed at one end of the gear 126 and meshing with the gear 125. This gear 156 matches the helical gear 126 and is connected thereto by a series of screw studs 158 to form a gear unit therewith.

In order to permit circumferential adjustment of the gear 156 with respect to the gear 126 to take up backlash between said latter gear and the gear 125, the studs 158 pass through circumferentially elongated slots 159 in said gear 156 and are threaded into said gear 126. This circumferential adjustment is effected through a stud 160 having a cylindrical shank 161 extending in the correspondingly shaped hole in the gear 126 for rotation therein. This stud 160 has a cylindrical boss 162 which is eccentric to the shank 161 and which has a close rotary fit in a radially elongated slot 163 formed in the gear 156. The stud 160 is held against outward axial displacement by a button 164 connected to one

end of the shank 161 and terminates at its outer end in a head 165 shaped to receive a suitable turning tool.

Brake means are provided for holding the shaft 21 against rotation during backlash adjustment. For that purpose the gear 126 is provided with a cylindrical brake flange 167 having a suitable brake lining 168 thereon. Encircling this brake flange 167 is a brake band 169 split on one side and formed on said side with a pair of spaced lugs 170 interconnected by a screw stud 171 for clamping said brake band tightly around said brake flange. In order to hold the brake band 169 against rotation during backlash adjustment, the opposite side of the brake band 169 is provided with a radially extending arm 172 terminating at its outer end in a slot 173. Extending through this slot 173 is a stud 174 which is threaded in a bracket 175 fixed to the end of a stationary sleeve 176 forming part of the bearing for the shaft 21.

To permit easy mounting or removal of the brake band 169 said band is made of two separate complementary pieces held together by a bolt 177. By this construction, the two halves of the brake band 169 may be moved radially into or out of position.

For effecting backlash adjustment of the gears between the drive gear 120 and the lower slotting head shaft 23, the helical gear 131 has a recess receiving a comparatively thin backlash adjusting helical gear 181 which matches said gear 131 and which is connected thereto by screw studs 182 to form a gear unit therewith. This gear 181 meshes with the gear 127 and is circumferentially adjusted with respect to the gear 131 by an eccentric stud 183 similar to the stud 160 and operating in a similar manner. The screw studs 182 passing through circumferentially elongated slots in the gear 181, permit limited rotary movement of said gear with respect to the gear 131.

The gear 181 serves to effect backlash adjustment between the gear 131 and the gear 127. For effecting backlash between the gear 127 and the gear 125 there is provided a thin helical gear 185 matching the gear 127 and connected thereto by screw studs 186 to form a gear unit therewith. This gear 185 meshes with the gears 131 and 125 and is circumferentially adjusted with respect to the gear 127 by means of the stud 187 having a cylindrical body 188 extending in a corresponding cylindrical hole in the gear 127 and a shank 189 at one end which is eccentric with respect to said body 188 and which extends through a radially elongated slot 190 in the gear 185. The other end of the stud 187 is shaped to receive a suitable turning tool.

In order to permit limited rotary movement of the gear 185 with respect to the gear 127, the holes 191 in the gear 127 through which the screw studs 186 pass are circumferentially elongated.

The two backlash adjusting gears 181 and 185 are arranged so that the gear 181 meshes with one end of the gear 127 while the gear 185 meshes with the opposite end portion of the gear 131.

The braking of the shaft 23 during backlash adjustments is effected in a manner similar to that of the shaft 21 through a brake flange 193 and a brake band 194 cooperating therewith and held against rotation by the stud 195 fixed to the arm 196.

Before making backlash adjustments the two shafts 21 and 23 must be set into their accurate die registrable relationship. The brake bands 169

and 194 are then mounted and tightened on their respective brake flanges 167 and 193 to hold the shafts 21 and 23 against rotation in said die registrable position. The screw studs 158, 182 and 186 of the backlash adjusting gears 156, 181 and 185 respectively, are loosened, said gears rotated through the operation of their respective eccentric studs as far as the gears meshing therewith will permit, and said screw studs then tightened.

The direction of adjustment of these backlash adjusting gears 156, 181 and 185 is contra to their direction of rotation during normal operations to eliminate the lost motions between the stationary and running positions of the main transmission gears. For instance, with the direction of rotation during slotting operations indicated in Fig. 11, the gear 156 must be rotatably adjusted in counterclockwise direction and the gear 181 in a clockwise direction. Once the backlash adjustment has been made, it does not have to be repeated except to take up backlash formed by the wearing out of gears, or by the loosening or shifting of the backlash adjusting gears through incessant use or vibrations.

The brakes serve not only to effect the initial backlash adjustment of the two shafts 21 and 23, but also serve to maintain sufficient friction against direction of rotation while the machine is running, to counteract any backlash that may subsequently develop.

In order that the operator may determine the extent of the rotation of the two shafts 21 and 23 with respect to the drive, the backlash adjusting gears 156 and 181 may carry, respectively, flanges 197 and 198 each having a groove in which a calibrated tape may be mounted. A pointer on some stationary part of the machine may terminate adjacent to each of said tapes.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. A machine for cutting slots in the opposite edges of a box blank, including a pair of coaxing rotary slotting heads, one having means for interchangeably and detachably mounting thereon two male slotting dies of different cutting outlines, and the other having a female slotting groove adapted to cooperate with one of said male dies to form a slot with parallel sides, and means on said latter slotting head for supporting a female die for registry with the other of said male dies to form a slot with an inclined portion.

2. A machine for cutting slots in the opposite edges of a box blank, including a pair of coaxing rotary slotting heads, one having a circumferential cutting groove and a female slotting die axially spaced from said groove and provided with a substantially bevel shaped cutting outline on one end to form a slot having an oblique base, the other slotting head having means for detachably mounting a male slotting die thereon to cooperate with either said cutting groove or said female die.

3. A machine for cutting slots in the opposite edges of a box blank, including a rotary slotting head having means for interchangeably mounting thereon two male slotting dies, one having a rectangular cutting outline, and the other having a non-rectangular cutting outline at one end, and a second rotary slotting head coaxing with said first slotting head and having a circumferential cutting groove for cooperating with said rectangularly outlined slotting die, and an arcuate die recess member axially spaced from said cutting groove and provided with a cutting out-

line at one end extending less than 360° and corresponding to the other slotting die, said slotting heads being relatively movable axially to bring either said groove or said die recess member into slotting relationship with the first mentioned slotting head.

4. A machine for making cuts in the opposite edges of a box blank, including a disk-like rotary member, means for interchangeably and detachably mounting on said member two knives, one having a circular cutting edge extending in a plane at right angles to the axis of rotation of said member, and the other having a cutting edge extending obliquely with respect to said plane, and a second disk-like rotary member having means adapted to cooperate with either one of said knives for shearing operations.

5. A machine for trimming the sides of a box blank, including a disk-like rotary head having a pair of axially spaced shearing members provided with cutting edges of different configurations, and a second disk-like rotary head having means for detachably mounting a knife thereon to cooperate with either one of said members.

6. A machine for trimming the edges of an advancing box blank, including a disk-like rotary head having a pair of axially spaced shearing members, one having a circular cutting edge in a plane at right angles to the axis of rotation of said head, the other having a cutting edge a portion of which is parallel to said plane and an end portion of which extends obliquely with respect to said plane, and a second disk-like rotary head coaxing with said first rotary head and having means for detachably mounting knives adapted to cooperate with one of said members to trim said blank either in a straight line or in an angular line.

7. A machine for cutting slots in the opposite edges of a box blank, including a rotary axially movable slotting head having a pair of axially spaced annular peripheral grooves one presenting cutting edges and the other non-cutting edges, a second rotary slotting head coaxing with said first slotting head and having a cutting member coaxing with the first mentioned of said grooves to cut the slots in said blank, a rotary axially movable scoring element, and means extending in the other groove and held against axial movement in respect to the scoring element whereby axial adjustment of the first slotting head and said scoring member may be effected in unison.

8. A machine for cutting slots in the opposite edges of a box blank, including a pair of coaxing rotary slotting heads, one being axially adjustable and having a pair of axially spaced female dies of different outlines, and the other having means for mounting a male punching die thereon to cooperate with one of said female dies, an axially adjustable rotary scoring member having a pair of axially spaced scoring blades extending respectively in alignment with said female dies, and means interlocking said scoring member and said first axially adjustable slotting head whereby the axial adjustment of said scoring member and said latter slotting head may be effected in unison.

9. A machine for cutting slots in the opposite edges of a box blank, including a rotary slotting head having a pair of axially spaced female dies, a second rotary slotting head having means for mounting thereon a male punching die adapted to cooperate with one of said female dies, a rotary scoring member having a pair of axially spaced scoring blades extending respectively in

alignment with said female dies, a platen roller adapted to cooperate with one of said scoring blades, and means for axially adjusting said platen roller and said scoring member relatively to bring said platen roller in cooperative relationship with either one of said scoring blades.

10. A machine for cutting a slot in the edge of a box blank, including a pair of rotary coacting shearing heads having respectively an arcuate female slotting die of less than 360° , and an arcuate male slotting die cooperating with said female die and also less than 360° , a drive for said heads, and means for circumferentially adjusting said heads simultaneously and in unison in respect to the drive while the machine is running to vary the length of the slot inwardly from the edge of the blank.

11. A machine for cutting a slot in the edge of a box blank, including a pair of rotary coacting shearing heads having respectively an arcuate female slotting die of less than 360° , and an arcuate male slotting die cooperating with said female die and also less than 360° , a drive for said heads, a rotary hand wheel, and means operable upon rotation of said hand wheel for circumferentially adjusting said heads simultaneously and in unison while the machine is running to vary the length of the slot inwardly from the edge of the blank.

12. A machine for cutting slots in the opposite edges of a box blank, including a pair of coacting rotary heads, means on said heads for making angular cuts on said blank, a drive for said rotary heads, an adjustment control member, and means operable upon operation of said control member for circumferentially adjusting said heads simultaneously and in unison while the machine is running to vary the length of the slots inwardly from the edges of the blank without varying the circumferential cooperating relationship of said heads.

13. A machine for cutting the opposite edges of a box blank, including a rotary head having means for mounting thereon one of two shearing members having cutting edges of different configurations, a second rotary head having a pair of shearing members with cutting edges corresponding respectively to the cutting edges of said first mentioned shearing members, and adapted to cooperate respectively with said latter members for shearing operations, a drive for said rotary heads, and means for circumferentially adjusting said heads simultaneously and in unison with respect to said drive while the machine is running to vary the lengths of the cuts in said box blank without varying the cooperating circumferential relationship of said rotary heads.

14. A machine for slotting box blanks, including a pair of rotary coacting slotting heads having respectively an arcuate female slotting die of less than 360° , and an arcuate male slotting die cooperating with said female die and also less than 360° , a drive for said slotting heads, and means for circumferentially adjusting said slotting heads simultaneously in opposite directions and in unison in respect to the drive while the machine is running to vary the position of the slots in respect to the edge of the blank while keeping the slotting elements in registry.

15. A machine for slotting box blanks, including a pair of parallel shafts, a pair of slotting heads mounted respectively on said shafts and having respectively an arcuate female slotting die of less than 360° , and an arcuate male slotting die cooperating with said female die and also less

than 360° , a drive for said shafts, a transmission between said drive and said shafts and including a pair of intermeshing helical gears, and means for moving one of said helical gears axially to effect the circumferential adjustment of said slotting heads simultaneously and in unison with respect to the drive while the machine is running.

16. A machine for cutting slots in the opposite edges of a box blank, including a pair of coacting slotting heads having respectively an arcuate male slotting die of less than 360° , and an arcuate male slotting die cooperating with said female die and also less than 360° , a drive for said heads, manually operable means for rotatably adjusting said slotting heads simultaneously and in unison in respect to said drive while the machine is running to vary the lengths of the slots, and readily disconnectable means for preventing or permitting free rotation of said slotting heads in unison while the machine is at rest.

17. A machine for slotting box blanks, including a pair of coacting rotary slotting heads, a drive for said heads, a gear train between said drive and said slotting heads for driving said slotting heads in unison, means for taking up the backlash between said drive and said slotting heads to maintain the same circumferential relationship of the slotting heads when operating as when at rest, and a frictional brake yieldingly resisting rotation of said slotting heads and holding them in predetermined circumferential relationship while backlash adjustment is being effected.

18. A machine for slotting box blanks including a pair of parallel shafts, a first helical gear on one of said shafts, a second helical gear on the other of said shafts, a pair of slotting heads mounted respectively on said shafts and having respectively an arcuate female slotting die less than 360° , and an arcuate male slotting die cooperating with said female die, and also less than 360° , a drive shaft between said first mentioned shafts, a third helical gear mounted for rotation with said drive shaft and meshing with said first mentioned helical gear, a fourth idler helical gear between said second and said third helical gear, and means for moving said third helical gears axially to effect the circumferential adjustment of said slotting heads simultaneously and in unison with respect to said drive shaft while the machine is running.

19. A machine for slotting box blanks including a pair of parallel shafts, a pair of slotting heads mounted respectively on said shafts, a drive for said shafts, a transmission between said drive and said shafts and including a train of intermeshing helical gears, one being connected to said drive shaft, a backlash adjusting gear contiguous with one of said helical gears and rotatable therewith, and means for moving the helical gear on said drive shaft axially to effect the circumferential adjustment of said slotting heads simultaneously and in unison with respect to said drive, while the machine is running.

20. A machine for slotting box blanks including a pair of parallel shafts, a pair of slotting heads mounted respectively on said shafts, a drive for said shafts, a transmission between said drive and said shafts including a train of intermeshing helical gears one being connected to said drive shaft, a comparatively thin backlash adjusting gear contiguous with one of said helical gears and rotatably mounted therewith, an eccentric stud for rotatably moving said backlash gear with respect to said last mentioned helical gear, and

means for moving the helical gear on said drive shaft axially to effect the circumferential adjustment of said slotting heads simultaneously and in unison with respect to said drive while the machine is running.

21. A machine for cutting slots in the opposite edges of a box blank, including a rotary axially movable slotting head having a pair of axially spaced slotting die members presenting cutting edges, and an annular peripheral groove between said die members and having non-cutting edges, a

second rotary slotting head coacting with said first slotting head and having a cutting member coacting with one of said die members to cut the slots in said blank, a rotary axially movable scoring element, and means extending in said groove and held against axial movement in respect to the scoring element whereby axial adjustment of the first slotting head and said scoring member may be effected in unison.

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