Sept. 12, 1967 F. L. BOONE ET AL 3,340,778

APPARATUS FOR CUTTING, CREASING, SCORING, AND THE LIKE

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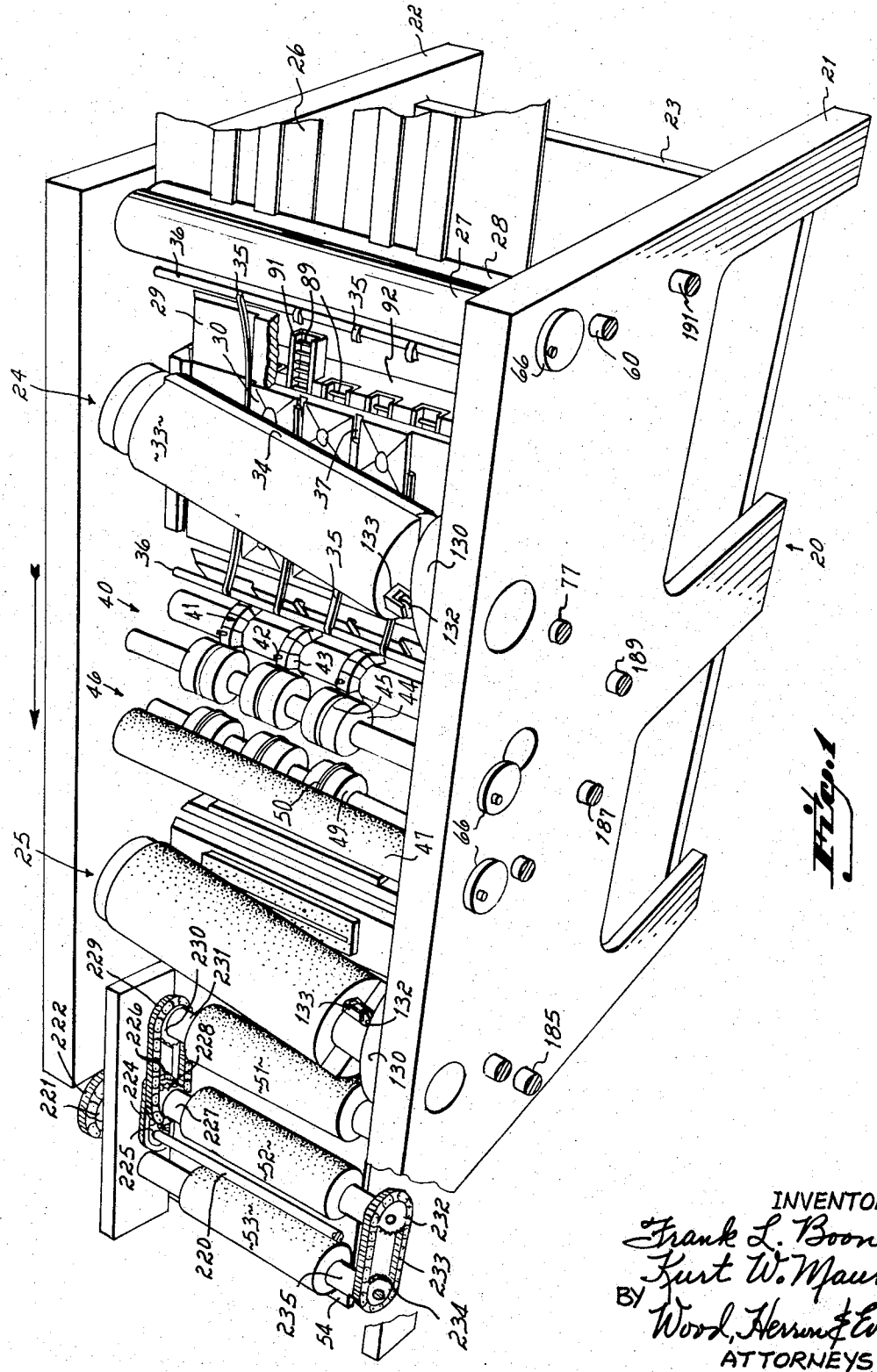


Fig. 1

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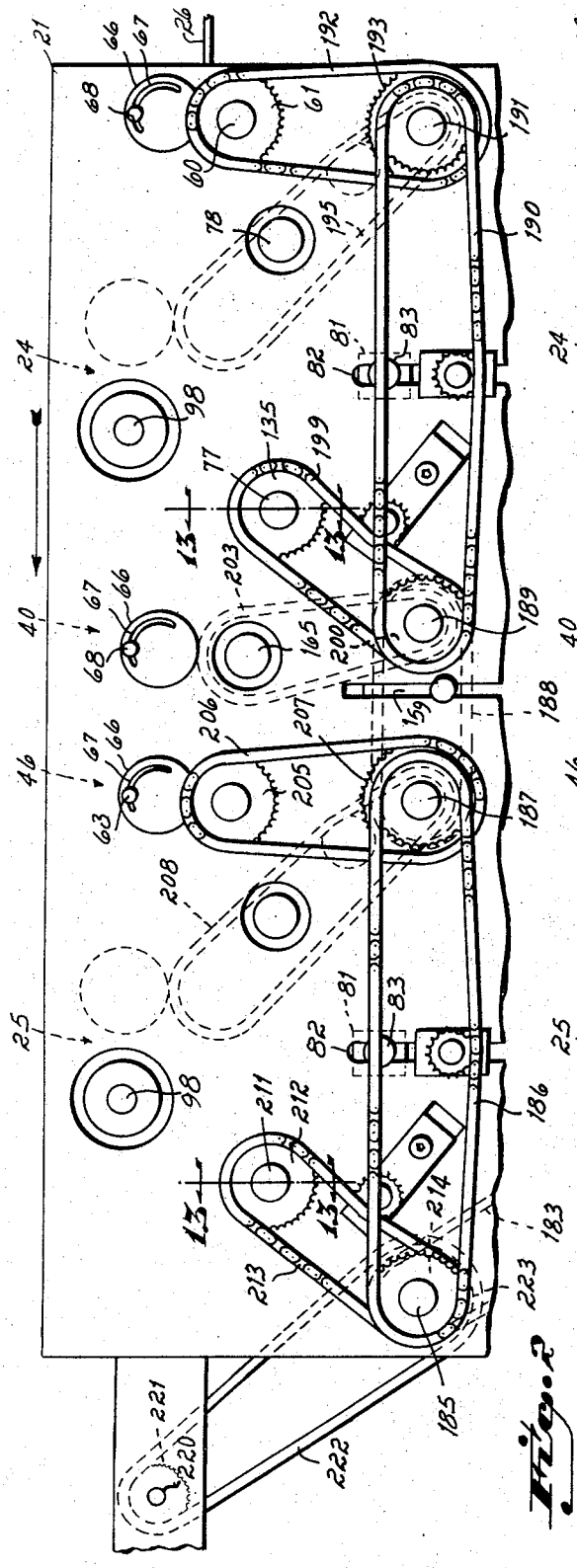


Fig. 2

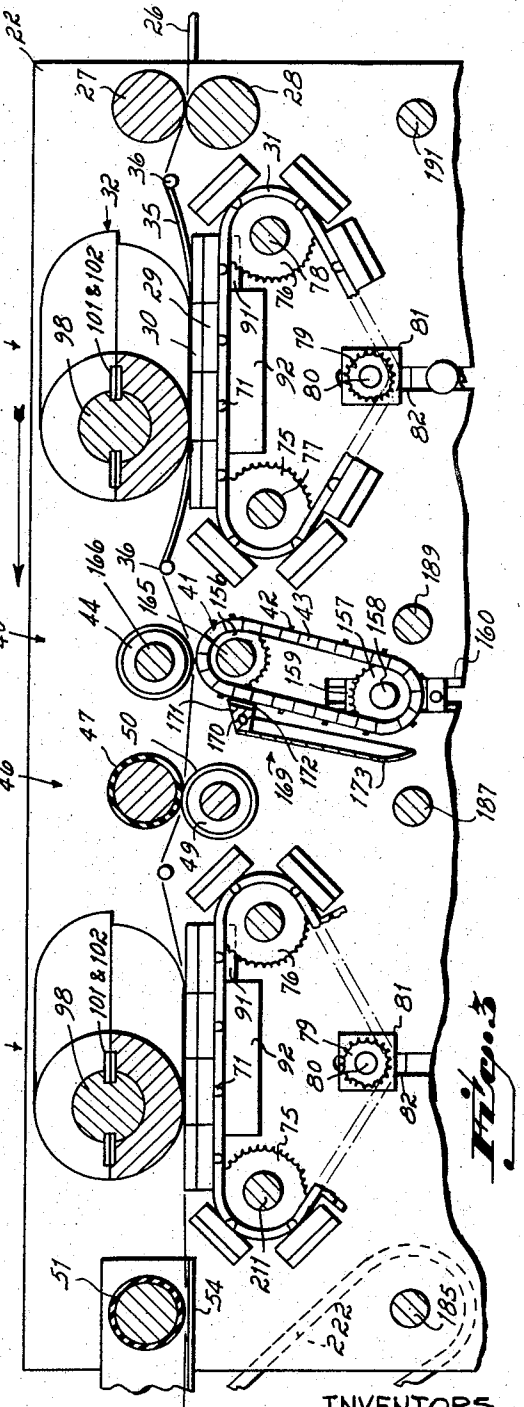


Fig. 3

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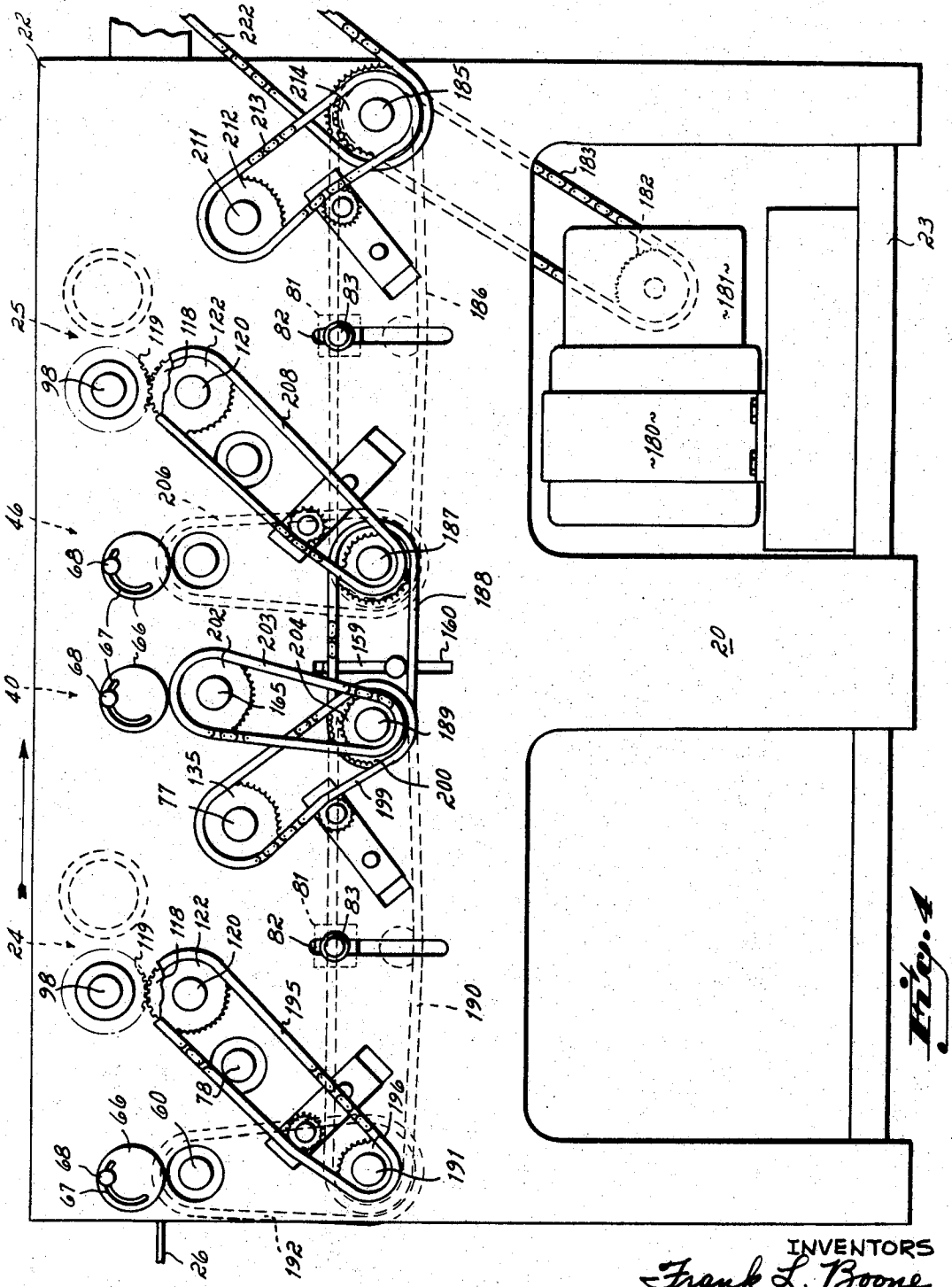


Fig. 4

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APPARATUS FOR CUTTING, CREASING, SCORING, AND THE LIKE

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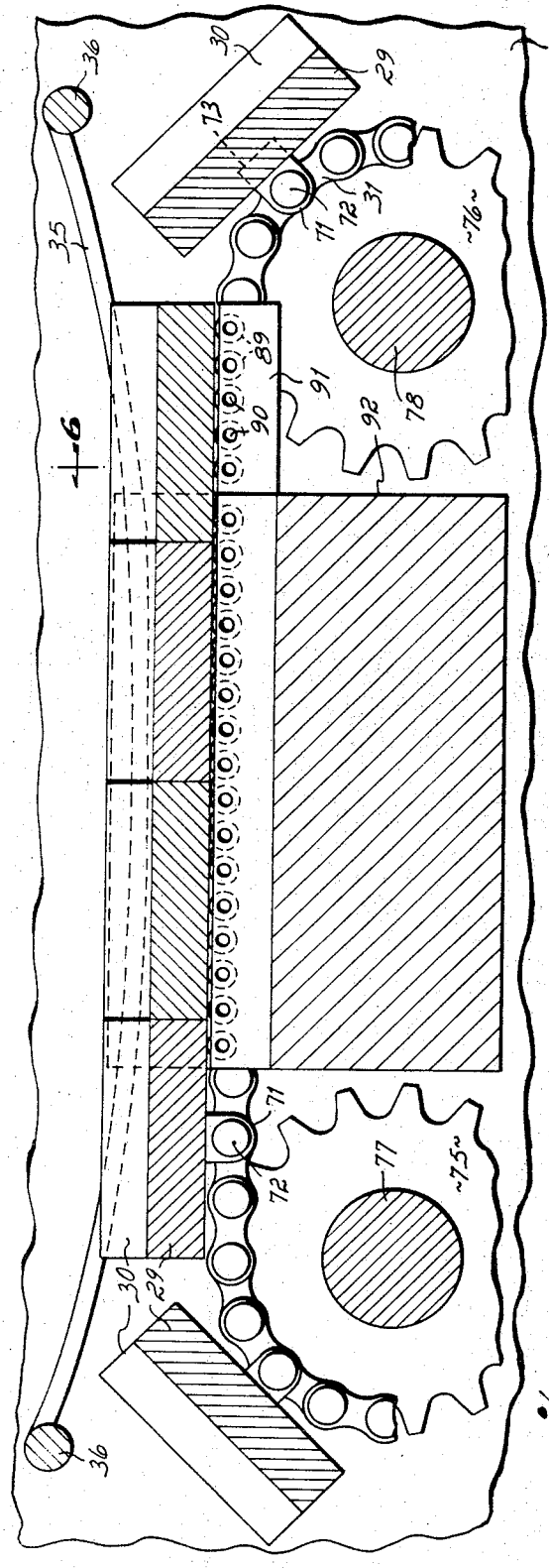


Fig. 5

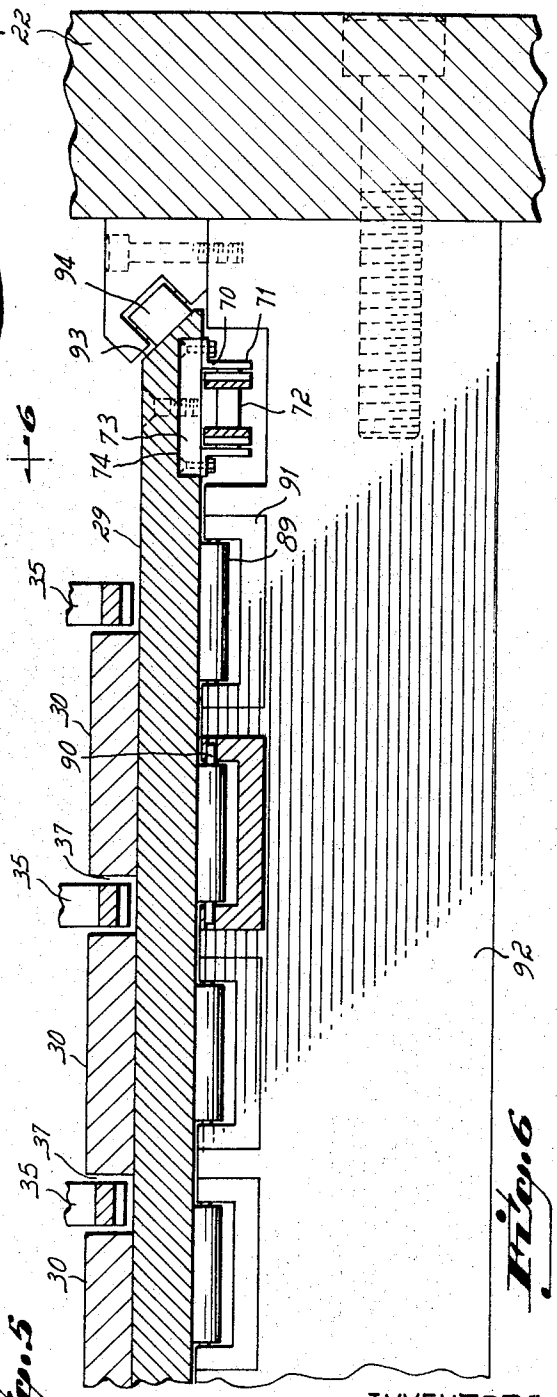


Fig. 6

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APPARATUS FOR CUTTING, CREASING, SCORING, AND THE LIKE

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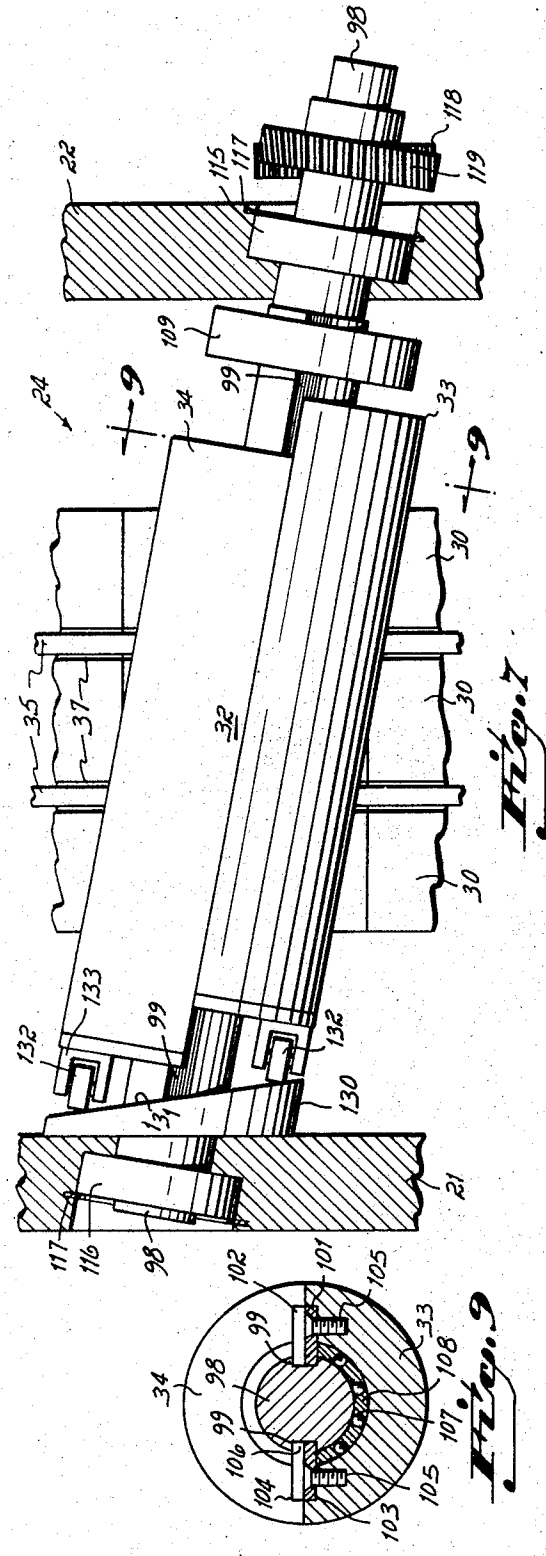


Fig. 7

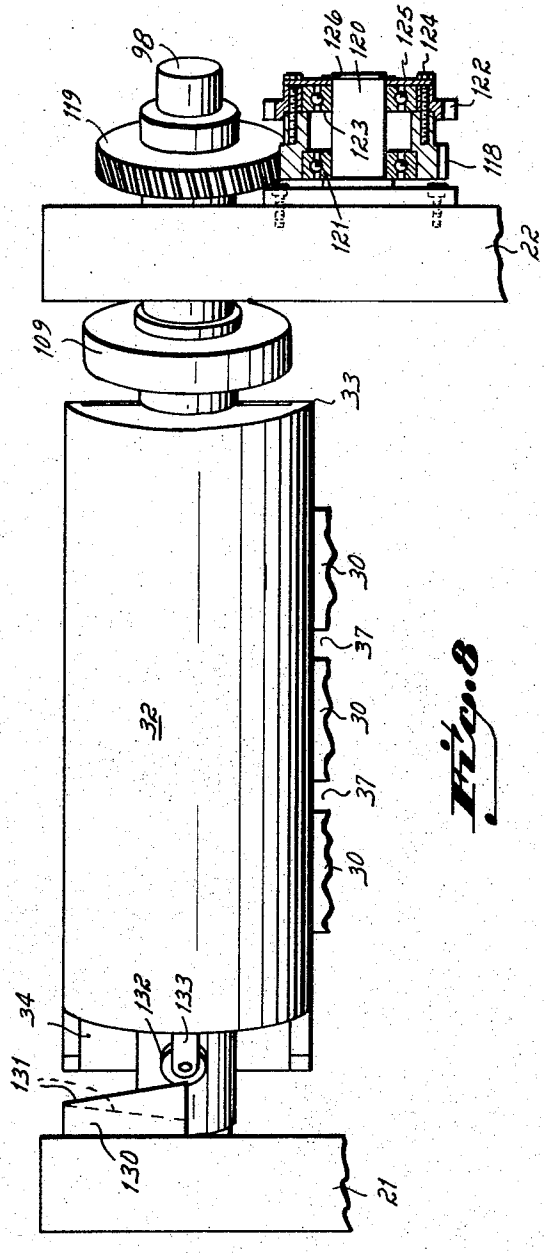


Fig. 8

Fig. 9

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APPARATUS FOR CUTTING, CREASING, SCORING, AND THE LIKE

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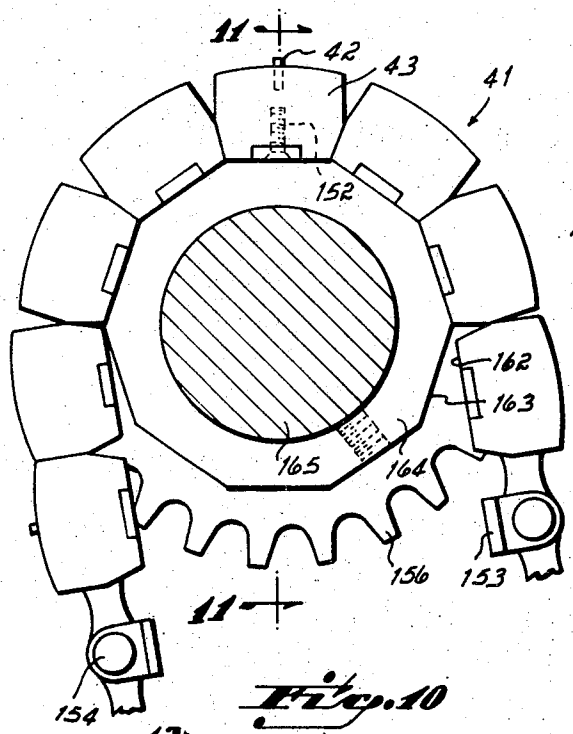


Fig. 10

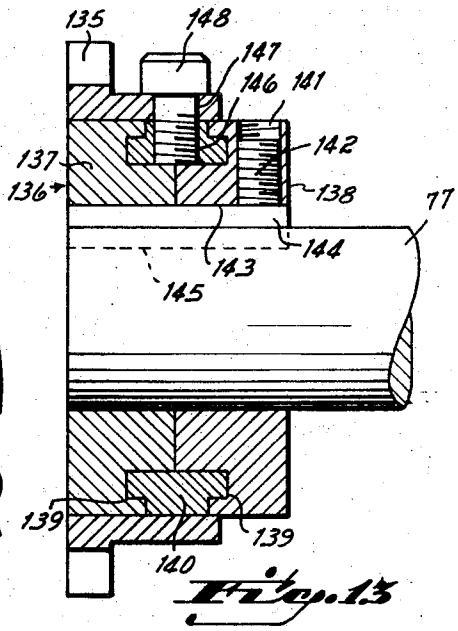


Fig. 13

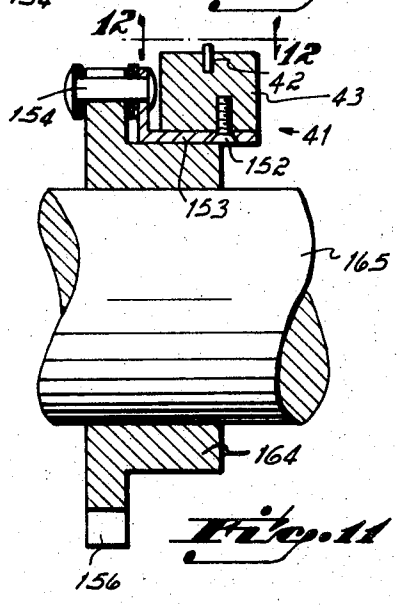


Fig. 11

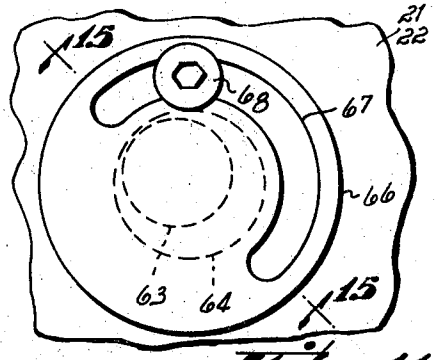


Fig. 14

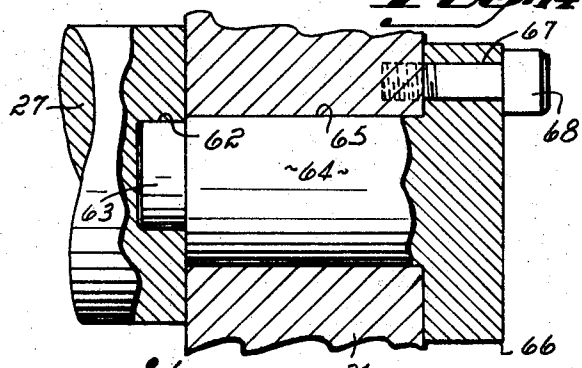


Fig. 15

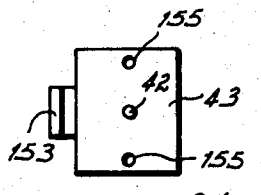


Fig. 12

21
22

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3,340,778

APPARATUS FOR CUTTING, CREASING, SCORING, AND THE LIKE

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Filed July 2, 1965, Ser. No. 469,114
9 Claims. (Cl. 93—58)

This invention relates to apparatus for cutting, scoring, creasing, and performing like operations on web stock, and, more particularly, the invention is directed to apparatus for cutting blanks from paperboard stock.

In the manufacture of cartons and other types of paperboard packages, paperboard web stock is cut, scored, and creased to form blanks, and the apparatus on which these operations are performed has been one of several types, each having its disadvantages. In one form of apparatus, the stock is passed between two cylindrical rolls, one of which has male die elements on it, the other of which is an anvil roll against which the male elements cut. Where creasing is required, the anvil roll may be slotted to receive the male creasing elements on the die roll. The use of such a rotary machine has the advantage of high speed production but the disadvantage of a very high cost of manufacturing the die roll. Further, in order to minimize the wear on the die roll in a long production run, it is common to use an anvil roll having a covering of rubber or other suitable composition so that the cutting is done against that resilient surface. Such a covered anvil roll has a limited life in view of the fact that bits of paperboard are driven against the roll by the die elements and become embedded in the roll until it loses its usefulness.

The other types of manufacturing apparatus are of a reciprocating character, permitting the use of a flat die. In one, for example, a flat die works against a flat anvil with the web stock being fed intermittently in much the same fashion as a punch press operates. Such types of presses have the advantage of a reduced set-up cost in the use of the flat die but have the disadvantage of a comparatively slow run required by the intermittent feeding of the web.

An objective of the present invention has been to provide apparatus for forming blanks from web stock wherein the advantages of a rotary press with its continuous high speed feeding of the stock are combined with the advantages of a flat bed reciprocating press insofar as the low cost of preparing the cutting die is concerned. To this end, the invention contemplates apparatus having a plurality of flat die plates mounted on an endless conveyor as, for example, a chain of die plates, the die plates being carried past a cylindrical anvil. With apparatus of this type, the web can be fed continuously between the die plates and the anvil roll at a high rate of speed, and the die plates can be economically manufactured because of the elimination of any curvature in the surface of them.

In the cutting of blanks, normally many transverse cuts are made across the web, that is, cuts which are perpendicular to the movement of the web through the machine. When the axis of the anvil roll is generally perpendicular to the direction of movement of the web, the die making the transverse cut strikes the anvil roll along the complete length of the transverse die. This striking of the anvil roll repeatedly and at high speeds imparts a considerable shock to the apparatus which greatly shortens its useful life as well as shortens the useful life of the cutting die. To eliminate this problem, it has been an objective of the invention to provide an angulated anvil roll, that is, a roll whose line of contact with the web is at an acute angle to the direction of movement of the web. The angulated roll permits the transverse die element to engage the roll first at one end and then to move progressively across the roll as the

die moves longitudinally and as the web passes through the apparatus. Thus, the transverse cut is made progressively in a sort of scissors or shear action.

Angulating the cutting roll does not provide a complete solution to the problem, for the angulation of the roll alone tends to cause the web to be forced in a sidewise direction as it moves longitudinally through the apparatus. A further objective of the invention, therefore, has been to provide an anvil roll which moves in a sidewise direction as it is caused to rotate by the web passing between it and the die plates. To effect the sidewise movement of the roll, a roll is formed from two or more segments which are slidable axially with respect to each other and have means permitting their reciprocation as the anvil roll rotates. In the preferred embodiment, each segment is a semi-cylinder, and, while one is in contact with the web or die plate and is therefore moving toward one side of the apparatus, the other is out of contact with the web or die plate and is moving toward the other side of the apparatus. It is preferable that the sidewise movement be effected by means of cams operating on the end surfaces of the roll segments to assure positive sidewise movement of the segments without placing any stress on the web.

These and other objectives of the invention will become more readily apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a perspective view of the apparatus according to the invention,

FIG. 2 is a fragmentary side elevational view of the side of the apparatus visible in FIG. 1,

FIG. 3 is a longitudinal cross sectional view viewed in the same direction as FIG. 2,

FIG. 4 is a side elevational view of the apparatus taken from the opposite side,

FIG. 5 is an enlarged fragmentary view of the conveyor and die plate structure,

FIG. 6 is a cross sectional view taken along lines **6—6** of FIG. 5,

FIG. 7 is a fragmentary top plan view of the anvil roll,

FIG. 8 is a fragmentary elevational view of the anvil roll,

FIG. 9 is a cross sectional view taken along lines **9—9** of FIG. 7,

FIG. 10 is a fragmentary side elevational view partly in section of the stripper bar,

FIG. 11 is a cross sectional view taken along lines **11—11** of FIG. 10,

FIG. 12 is a top plan view of a stripper segment taken in the direction of lines **12—12** of FIG. 11,

FIG. 13 is a cross sectional view taken along lines **13—13** of FIG. 12,

FIG. 14 is a fragmentary side elevational view of an eccentric adjustment for the upper drive rolls,

FIG. 15 is a cross sectional view taken along lines **15—15** of FIG. 14.

General organization

As shown in FIG. 1, the apparatus includes a base **20** formed by vertically spaced side plates **21** and **22** which are joined together by transverse members, such as indicated at **23**. In the illustrated apparatus, two blank forming stations are shown at **24** and **25** respectively, and it should be understood that the apparatus is adaptable for use with additional stations or with a single station, depending on the complexity of the blank to be formed. Upstream or ahead of the first forming station **24** is a feed plate **26** over which an incoming web passes and a pair of feed rolls **27** and **28** between which the web passes.

Adjacent the feed rolls is the first forming station **24**

which is constituted by a plurality of die plates 29 carrying male die elements 30 and supported at their ends on an endless conveyor formed by a pair of chains 31 (FIG. 3). The die plates 30 are conveyed under and in engagement with an anvil roll 32 formed of two semi-cylindrical segments 33 and 34. Four longitudinal stripper bars 35 are supported at their ends on rods 36 and extend between the die plates 30 and the anvil roll 32. The stripper bars curve downwardly toward the line of contact between the anvil roll and the die plates, the central portion of the two middle stripper bars being received in a longitudinal slot 37 between the die elements, and the two outer bars lying along the sides of the die elements. The web passes over the stripper bars, and, as it passes from the line of engagement between the anvil roll and the die elements, the stripper bars force the web to ride up out of engagement with the die elements on the die plates.

A knock-out section 40 is located adjacent the first forming station and downstream from it to knock out the paperboard sections which have been cut in the first forming station. The knock-out section 40 includes three stripper chains 41 having selectively positionable pins 42 secured to segments 43 fixed to each chain. The pins 42 cooperate with female rollers 44, each having an annular groove 45 into which the pins may pass to force the cut portions out of the web.

A pair of scoring rolls 46 and 47 are located adjacent the knock-out section. The upper roll 47 is a solid cylindrical back up roll covered with rubber or other suitable resilient composition. The lower roll is formed by three rolls 49, each having an annular scoring die 50 which engages the upper roll 47.

The second forming station 25 is located adjacent the intermediate feed rolls and, except for the configuration of the die elements on the die plates, is substantially identical to the first forming station 24.

At the discharge end of the apparatus, there are three rolls 51, 52, and 53, each of which is spaced a distance above a plate 54 which is less than the thickness of the web passing between the rolls and plate. The rolls 51, 52, and 53 engage the blanks which have been cut from the web and drive them into a suitable receptacle or onto conveyor apparatus for further processing.

Feed rolls

The feed roll 28 is fixed to a shaft 60 which is journaled in the side plates 21 and 22. One end of the shaft 60 is fixed to a drive sprocket 61 through which the feed rolls are driven, as will be described below in connection with the drive system for the apparatus. Referring to FIGS. 14 and 15, the upper feed roll 27 has a central recess 62 at each end which receives a stud 63 on which the roll is rotatably mounted. Each stud 63 is eccentrically positioned on a pin 64 mounted for rotation in a bore 65 in a respective side plate 21 or 22. The pin has at its outside end a flange 66 having a semi-circular slot 67. A set screw 68 passes through the slot 67 and is threaded into the side plate. When the set screws 68 are loosened to free the flanges at the opposite ends of the roller 27, the pins 64 may be rotated through an angle of 180°, whereby the studs 63 may be swung from an upper position to a lower position. Each pin and stud may be fixed at any position by tightening its set screw 68. Thus, the spacing of the roll 27 with respect to the roll 28 may be selectively varied in order to accommodate different thicknesses of paperboard.

Although this method of accommodating for different thicknesses of paperboard is illustrated and described in conjunction with the feed rolls 27 and 28, it is to be understood that the shaft carrying the annular grooved rolls 44 at knock-out station 40 and the back up roll 47 at scoring station 46 are secured to the side plates 21 and 22 in an identical manner.

Blank forming station

As indicated above, each end of each die plate 29 is mounted on a conveyor chain 31. Referring to FIGS. 5 and 6, each die plate 29 has, at each side, a pair of spaced, L-shaped lugs 70 having depending legs 71 which are fixed to a connecting pin 72 on the chain 31. The lugs are bolted to a block 73 secured in a slot 74 in the undersurface of the plate 29. The chain passes around a drive sprocket 75 and an idler sprocket 76 which are mounted on spaced parallel shafts 77 and 78 respectively. In the middle of the lower flight of each chain 31 (FIGS. 2 and 3) it passes over an idler sprocket 79 which is rotatably mounted on a stub shaft 80 fixed on block 81. The block is slidable in a slot 82 and may be fixed in any position along the slot 82 by set screw 83, whereby various lengths of the chain may be used for carrying the die plates. Thus it is possible to select a length of chain 31 which is an exact multiple of the length of the blank to be formed. The sprockets 75 and 76 are spaced apart a distance sufficient for a long horizontal flight of chain between the two sprockets, the distance of the flight being sufficient to accommodate four die plates in end to end abutment. The length of each die plate and the positioning of it on the chains is determined by the pattern of the blank. In the illustrated embodiment, the die plates are brought snugly together as they pass horizontally along the upper flight of the chain, this condition being illustrated in FIG. 5.

When passing along the upper flight of the chains 31, the die plates are supported on nylon covered rollers 89. The rollers 89 are mounted on pins 90 and are longitudinally spaced in a channel-shaped bearing block 91. Four such bearing blocks are spaced transversely across the top of a transverse support 92 which extends between the side plates 21 and 22.

The nylon rollers support the die blocks in relation to the anvil roll in such a position that the cutting edges of the dies are normally a few thousandths of an inch higher than the lowest extremity of the anvil roll. The cutting edges will therefore engage the anvil roll with considerable pressure during which the nylon rollers 89 will be radially compressed.

The die plates 29 have side edges which are chamfered as at 93, the chamfered surfaces being engaged by rollers 94 rotatably mounted on the side plates 21 and 22. The combination of the contact of the undersurface of the die plates with rollers 89 and the engagement of the chamfered edges with rollers 94 assures the precise transverse alignment of the die plates with respect to each other, thereby permitting one blank to be formed by plural die plates.

The construction of the anvil roll 32 and the manner in which it is mounted and driven are best illustrated in FIGS. 7–9. The anvil roll is constituted by the two semi-cylindrical segments 33 and 34 which are slidably mounted on a shaft 98. The shaft has two diametrically opposed keyway slots 99 which receive mating keys 101 and 102 fixed to the semi-cylindrical segments 33 and 34 respectively. More specifically, each segment is rabbeted to form a notch as at 103 and 104 to receive the keys 101 and 102. Each key is fixed in the notch of a respective semi-cylindrical segment by screws 105, as shown in the sectioned segment 33 at FIG. 9. Each key has an inwardly projecting portion 106 which engages the longitudinally extending keyway slots 99, the slots being wide enough to accommodate the two adjacent keys on the respective semi-cylinders. The semi-cylindrical segments are spaced from the shaft 98 by anti-friction means, such as bearing balls 107, which permit the free sliding movement of the segments 33, 34 with respect to the shaft 98. The balls are mounted in a race 108 which is formed by two semi-cylindrical plates mounted between the shaft 98 and the semi-cylindrical segments. A collar 109 is fixed to one end

of the shaft **98** to limit the longitudinal movement of the segments **33**, **34**.

The shaft **98** is mounted in bearings **115** and **116**, the bearings being fixed to the side plates **21** and **22** by means of snap rings **117**. As can be observed from FIG. 7, the axis of the shaft **98** is angulated with respect to the longitudinal direction of movement of the web so that it forms an acute angle of approximately 80° with the longitudinal direction of the apparatus, or, more specifically, an angle of 80° with the surfaces of the side plates **21** and **22**. The shaft is driven by a driving gear **118** in mesh with a driven gear **119** which is fixed to the shaft. As best illustrated in FIG. 8, the driving gear **118** is rotatably mounted on a stub **120** by anti-friction bearings **121**. The driving gear is fixed to a sprocket **122**, also rotatably mounted on the stub **120** by a bearing **123**, the sprocket being fixed to the driving gear **118** by screws **124** and a cover plate **125**, the assembly being held on the stub by a snap ring **126**.

A cam plate **130** surrounds the shaft **98** and is fixed to the side plate **21**. The cam plate has a cam surface **131** which is engaged by rollers **132** rotatably mounted on U-shaped yokes **133** fixed to the respective semi-cylindrical segments **33**, **34**. The inwardmost point of the cam surface **131**, indicated at **134**, lies in a horizontal plane passing through the axis of the shaft **98**, and the roller **132** on each semi-cylindrical segment is mounted on an axis approximately midway between the edges of the semi-cylindrical surface. Thus, the cam plate **130** drives the segments **33**, **34** only during the half revolution when they are out of contact with the web and die elements, the segments **33**, **34** being free to return or move toward the cam plate when they are engaged by the web and die elements.

In the operation of the illustrated embodiment, the segments **33**, **34** are moved transversely by the engagement of them by the web and die elements during the operative half of their revolution. That movement is toward the left as they are viewed in FIGS. 7 and 8 and could be positively effected by providing a cam similar to the cam **130** but oppositely oriented and mounted on the side plate **22**. The use of a cam for positively moving the segments **33**, **34** toward the left during the operational half of their revolution, that is, when in engagement with the web and die elements, relieves the web of any stress derived from its engagement with the segments and which would tend to move the web transversely of the apparatus.

Knock-out station

The structure of the second blank forming station **25** is the same in all material respects as that of the first blank forming station **24** which has been described above. It should be understood that additional similar blank forming stations may be used, depending upon the complexity of the forming operations which are to be performed at the several stations. In the illustrated embodiment, the second blank forming station **25** is used simply for the purpose of severing the blanks from the web. Thus, the die plates **29** contain only a single transverse cutting die, the cutting dies on the adjacent die plates being spaced apart a distance precisely equal to the length of the blanks.

As stated above, the chains **31** of the blank forming stations are supported on shafts **77** and **78**, shaft **77** being a driven shaft and shaft **78** being an idler shaft. The shaft **77** is driven at both of its ends by chains passing over sprockets **135**. The sprocket **135** is specially designed to permit its angular position to be adjusted with respect to the shaft **77**. As shown in FIG. 13, the sprocket is mounted on a split bushing **136** formed by an outside member **137** and an inside member **138**. The facing surfaces of the bushing members **137** and **138** are annularly grooved as at **139** to receive a clamping ring **140**. The bushing member **136** has a threaded bore **141** which receives a set screw **142**. Both bushing members are transversely slotted as at **143** to receive a key **144** located in a slot **145** in the shaft **77**. The set screw clamps the key and the whole sprocket and bushing assembly to the shaft **77**.

The clamping ring **140** has a plurality of threaded holes **146** and the sprocket **135** has holes **147** alignable with the holes **146**. Clamping bolts **148** pass through the holes **147** and are threaded into the holes **146** to clamp the ring **140** against the inside surface of the sprocket **135**, thereby sandwiching the bushing parts between the clamping ring and the sprocket to clamp the assembly together.

By loosening the bolts **148**, the split bushing and the shaft **77** can be rotated with respect to the sprocket **135** and clamping ring **140**; or, more importantly, the die plate carrying chains **31** at one forming station may be moved independently of the chains at the other forming station. In this way, precise registration of the die elements at one station can be made with respect to the die elements of the other forming station.

As the web passes through the blank forming station **24**, holes are cut into it as by the die **30**. Preferably, the dies have slight interruptions so that they do not cut completely around the portion to be removed from the web. Thus, when the stripper bars **35** lift the web from the die, the cut-out portions are lifted away from the die blocks with the web. At the stage **40**, the cut-out portions are stripped away from or knocked out of the web and dropped downwardly to a waste container (not shown). As indicated above, the knocking out operation is performed by the engagement of the pins **42** with the portions to be knocked out of the web. The pins pass into the annular groove **45** in the rolls **44** to push the cut portions away from the web while the web is blocked from movement by its engagement with the rolls **44**.

The mounting structure for the pins **42** is best illustrated in FIGS. 10–12. The pins **42** are fixed in the segments **43**, each segment being fixed by a screw **152** to an L-shaped bracket **153**, one leg of which is fixed to the stripper chain **41** by a pin **154** which joins the chain links. Each segment **43** has three equally spaced holes **155** in which a pin **42** is selectively positionable. As shown in the plan view FIG. 12, a pin **42** is located in the central hole with the two side holes remaining open. The holes **155** are spaced from each other by a distance of approximately ¼", thereby permitting the positioning of the knock-out pins **42** so as to be able to engage the cut portion of a web regardless of the longitudinal position of the cut portion on the web.

The chain **41** is positively connected to the drive means for the chain **31** which carries the die blocks as will be described below. The chain passes over a driving sprocket **156** at its upper end and over an idler sprocket **157** at its lower end. The idler sprocket is mounted on a stub shaft **158** fixed in a block **159** which may be fixed in any vertical position in a slot **160**. Thus, the stripper chain **41** may have a length which is an exact multiple of the length of the blank to be formed. Once the position of the knock-out pins **42** is set, the pins always appear in proper relation to the portions in the web which have been cut by the die blocks.

The segments **43** have flat bases as indicated at **162**, the flat bases engaging the flat side **163** of a decagonal surface constituted by the hub **164** of the sprocket **156** over which the chain **41** passes. The flat surface **163** provides thrust bearing surfaces which support the segments **43** as the pins which they carry engage the web.

The chain **41** and the rolls **44** with which they cooperate are transversely shiftable on their respective shafts **165** and **166** in order to accommodate any selected transverse location of cut portions in the web to be knocked out. Thus, the combination of the multiple pin location provided by the holes **155** in the segments **43** and the transverse positioning feature of the chain **41** and the rolls **44** permits the apparatus to accommodate any design of blank to be cut by the apparatus.

A pin stripper **169** (FIG. 3) is located adjacent the

upper end of the chains 41 at the side opposite from the blank forming station 24 to strip from the pins 42 the knocked-out portions of paperboard. The pin stripper 169 comprises a rod 170 mounted between the side plates 21 and 22 and a plurality of triangular blocks 171 slidably mounted on the rod 170. Set screws (not shown) are threaded into the blocks 171 and are engageable with the rod 170 to fix the blocks in a selected position. A clearance groove 172 is formed in each of the blocks 171 to permit the passage of the knock-out pins 42. A guard plate 173 extends downwardly from the pin stripper to prevent the paperboard pieces from flying into the stripper chain and its sprocket.

The drive system

The power for the drive system is derived from a motor 180 which is connected through a gear box 181 to a sprocket 182 connected to a main drive chain 183. The main drive chain is connected to a sprocket (not shown) fixed to a main drive shaft 185. A second drive chain 186 passes over sprockets on the main drive shaft 185 and on a second drive shaft 187. A third drive chain 188 passes over sprockets fixed to the second drive shaft 187 and a third drive shaft 189. A fourth drive chain 190 passes over sprockets fixed to the third drive shaft 189 and a fourth drive shaft 191.

The fourth drive shaft drives the feed rolls 27, 28 and the anvil roll 32 at the first blank forming station 24. The fourth drive shaft 191 is connected by a chain 192 passing over sprockets 193 and 61 fixed to the shafts 191 and 60 respectively, the shaft 60 being fixed to the lower feed roll 28. The shaft 191 drives the anvil roll 32 through a chain 195 which passes over a sprocket 196 fixed to the shaft 191 and the sprocket 122 rotatably mounted on the stub 120. As described above, the sprocket 122 is fixed to a drive gear 118 in mesh with the gear 119 fixed on shaft 98 which drives the anvil roll. The chains 31 which carry the die blocks and the chain 41 carrying the knock-out segments are driven from the third drive shaft 189. The chains 31 which support the die plates 29 pass over sprockets 75 and 76 fixed to shafts 77, 78 at their leading and trailing ends respectively. The shaft 78 at the leading end of the die chain is an idler shaft journaled in the side plates 21 and 22. At the trailing end of the die chain, the shaft 77 is journaled in the side plates 21 and 22 and has the adjustable sprocket 135 fixed to it over which passes a chain 199. The chain 199 is connected to the third drive shaft 189 by a sprocket 200. A sprocket 202 is fixed on the shaft 165 and is driven by a chain 203 passing over a sprocket 204 fixed to the third drive shaft 189.

The scoring rolls 49 and the anvil roll 32 at the second blank forming station 25 are driven from the second drive shaft 187. The scoring rolls 49 are fixed to shaft 48. A sprocket 205 is fixed to the shaft 48 and is driven by a chain 206 passing over a sprocket 207 fixed to the second drive shaft 187. The drive for the second anvil roll 32 is substantially identical to that of the first anvil roll and is constituted by a chain 208 which is connected to a sprocket 209 fixed to the second drive shaft 187. The chain 208 engages the sprocket 122 on the gear 118 which meshes with the gear 119 on the shaft 98 of the anvil roll.

At the second blank forming station, the chains 31 which support the die blocks are driven from a shaft 211 to which a sprocket 212 is fixed for adjustment through a split bushing similar to bushing 136. Sprocket 212 is driven by a chain 213 which passes over a sprocket 214 fixed to the main drive shaft 185.

The three discharge rolls 51, 52, and 53 are driven from a shaft 220 through a sprocket 221 fixed to the end of a chain 222 passing over the sprocket 221 and over a sprocket 223 fixed to the main drive shaft 185. The shaft 220 drives the discharge roll 52 through a chain 224 passing over sprockets 225 and 226 fixed to the shaft 220 and a shaft 227, respectively. The discharge roll 52 is fixed to the shaft 227. A second sprocket 228 is fixed to the shaft 227 and engages a chain 229 passing over a sprocket 230 fixed to a shaft 231 which is journaled between the side plates 21 and 22 and carries the discharge roll 51. A third sprocket 232 is fixed on the shaft 227 and engages a chain 233 which passes over a sprocket 234 fixed to a shaft 235 journaled between the side plates 21 and 22. Discharge roll 53 is fixed to the shaft 235.

Operation

The length of the blank to be formed in the apparatus is measured and from this measurement the length of the chains 31 in the forming stations and the length of the stripper chains 41 are selected. For example, if a ten inch blank is to be formed, a length of the die carrying chains 31 of thirty inches may be selected, and the length of the stripper chains may be selected as twenty inches. The idler sprockets 79 over which the chains 31 pass and the idler sprockets 157 over which the chains 41 pass are adjusted vertically to accommodate the different lengths of chains required for different sizes of blanks.

The die elements 30 are formed with the cutting dies in a manner which is well known in the art. The die plates are mounted on the chains 31. The knock-out pins 42 are properly positioned on the stripper chains 41 in a proper relation to those cutting dies on the die plates adapted to cut out portions of the web so that when the cut portions of the web pass over the stripper chain, the knock-out pins will engage them.

When two forming stations such as forming stations 24 and 25 are used, it is necessary that there be proper registration between the die elements in one station and the die elements of the succeeding station. This registration is effected by loosening the clamp on the sprocket 135 of one of the stations, preferably the downstream station, and moving the die plate carrying chains 31 of that station until precise registration is attained. The sprocket is then clamped to the split bushing 136 which is keyed to the shaft 77.

These steps having been performed, the apparatus is ready for the performance of its blank making function. A web of paperboard is fed into the feed rolls 27 and 28, the feed rolls feeding the blanks between die elements 30 and the anvil roll 32. As the web passes between the die elements 30 and the anvil roll 32, the anvil roll segment in engagement with the web moves laterally as the anvil roll rotates. After a half revolution of the anvil roll, one roll segment moves out of engagement with the web while the other roll segment moves into engagement with the web. The segment moving out of engagement with the web is engaged at its end roller 132 by the cam plate 130. Through the next half revolution, the cam plate forces the roll segment to return to its original position ready for engagement with the web.

As the web passes between the die plates and the anvil roll, cutting elements on the die plates cut configurated holes in the blank, the cut-out portions remaining attached to the web so as to be stripped free of the die plates as the web passes beyond the die plates. In the illustrated embodiment, the stripping of the web from the die plates is performed by the stripper bars 35 which force the web to move up away from the die plates. Alternatively, the die plates could be covered with a resilient material such as rubber, the exposed surface of the material being flush with the cutting edges. As the die plates with this material pass under the anvil roll, the paperboard depresses the resilient material as the cutting elements engage the anvil roll. As the cutting elements pass beyond the anvil roll, the compressive stress on the resilient material is relieved, and, as it rises to its normal position with respect to the cutting elements, it strips the paperboard from the cutting elements. The latter stripping arrangement, which is well known in the art, may be employed quite satisfactorily when single ply paperboard blanks are formed. However, when thicker paperboard, for example, corrugated paper-

board blanks are cut, the stripper bars **35** are preferred in order to prevent the crushing of the paperboard as it passes between the die plates and the anvil roll.

As the web is fed from the forming station **24**, it passes between the stripper chains **41** and the cooperating rolls **44**. The pins **42** on the stripper chain engage the cut-out portions of the web and push them away from the web, thereby freeing them from the web as the pins pass through the grooves **45** in the rolls **44**. The pieces of paperboard adhering to the pins are subsequently stripped from the pins as the pins pass through the grooved blocks **171** on the pin stripper **169**.

The web then passes between the scoring dies and backup roll **49** and **47** respectively to form longitudinally extending creases in the blanks. The use of these scoring rolls and the numbers of them is, of course, determined by the configurations of the blank which is to be manufactured.

At forming station **25** in the illustrated embodiment, the web passes between the die plates **30** and the anvil roll. As illustrated, a single transversely extending cutting element simply severs the blanks from the web. Alternatively, additional configurations could be cut into the blank at the station **25** or, as still another alternative, the die plates at the station **25** could be used for scoring. When used for scoring, with all of the cutting being done at station **24**, the anvil roll preferably would be covered with a resilient material such as rubber. If station **25** is used for scoring, then an additional forming station which performs the blank severing operation would be installed on the apparatus.

After the blanks are severed from the web, the discharge rolls **51**, **52**, and **53** pick up the blanks and discharge them from the apparatus.

We claim:

1. Apparatus for forming blanks from a web comprising,
- a base,
- a pair of endless chains movably mounted on said base,
- means for driving said chains,
- a plurality of dies mounted on said chains,
- a generally cylindrical anvil mounted on said base adjacent said chains for engagement by said dies,
- said anvil being constituted by at least two segments having cylindrical surfaces and being slidably mounted on a shaft whose axis is at an acute angle to the path of movement of said chains,
- and means for axially reciprocating said segments on their shaft as said dies move into and out of engagement with them.

2. Apparatus for forming blanks from a web comprising,
- a base,
- an endless support movably mounted on said base,
- means for driving said support,
- a pluralty of dies mounted on said support,
- a generally cylindrical anvil mounted on said base adjacent said support for engagement by said dies,
- said anvil being constituted by a pair of semi-cylinders slidably mounted on a shaft whose axis is at an acute angle to the path of movement of said support,
- and means for axially reciprocating said semi-cylinders on their shaft as said dies move into and out of engagement with them.

3. Apparatus for forming blanks from a web comprising,
- a base,
- an endless support movably mounted on said base,
- means for driving said support,
- a plurality of dies mounted on said support,
- a generally cylindrical anvil mounted on said base adjacent said support for engagement by said dies,
- said anvil being constituted by a pair of semi-cylinders slidably mounted on a shaft whose axis is at an acute angle to the path of movement of said support,
- and cam means mounted on said base and semi-cylinders for driving said semi-cylinders in an axial direction toward one side of the apparatus during a fraction of a revolution of said anvil.

4. Apparatus for forming blanks from a web comprising,
- a base,
- an endless support movably mounted on said base,
- means for driving said support,
- a plurality of die holding plates mounted on said support,
- a plurality of resilient rollers rotatably mounted on said base on horizontal axes extending perpendicularly to the path of movement of said support,
- a generally cylindrical anvil mounted on said base adjacent said support for engagement by said dies,
- said anvil being constituted by at least two segments having cylindrical surfaces and being slidably mounted on a shaft whose axis is at an acute angle to the path of movement of said support,
- and means for reciprocating said segment on their shaft as said dies moves into and out of engagement with them,
- said rollers supporting said plates below said anvil roll with said die holding plates engaging said anvil roll while compressing said resilient rollers.

5. Apparatus for forming blanks from a web comprising,
- a base,
- a pair of endless chains movably mounted on said base,
- means for driving said chains,
- a plurality of die carrying plates mounted on said chains, said die carrying plates having at least one longitudinal slot,
- a generally cylindrical anvil mounted on said base adjacent said chains for engagement by said dies,
- said anvil being constiuted by a pair of semi-cylinders slidably mounted on a shaft whose axis is at an acute angle to the path of movement of said chains,
- means for axially reciprocating said semi-cylinders as said dies move into and out of engagement with them,
- a curved longitudinally extending stripper bar supported at its ends above said plates and having its central portion curving downwardly into said slot,
- and means for feeding said web between said anvil and plates over said stripper bar.

6. Apparatus for forming blanks from a web comprising,
- a base,
- two blank forming stations spaced from each other and mounted on said base, each station being constituted by:
  - a pair of endless chains passing over sprockets fixed on shafts rotatably mounted in said base,
  - means including a drive sprocket on at least one of said shafts for driving said chains,
  - means for varying the angular position of said drive sprocket with respect to said shaft,
  - a plurality of dies mounted on said chains,
  - and a generally cylindrical anvil mounted on said base adjacent said chains for engagement by said dies.
- said blank forming stations adapted to be brought into registration by rotating a shaft of one of said stations while holding its drive sprocket and the other station fixed.

7. Apparatus for forming blanks from a web comprising,
- a base,
- a pair of endless chains passing around sprockets rotatably mounted on said base,
- means for driving said sprockets
- at least one of said sprockets being adjustably position-

able to permit variations in the length of said chains,
a plurality of dies mounted on said chains,
and a generally cylindrical anvil mounted on said base adjacent said chains for engagement by said dies.

8. Apparatus for forming blanks from a web comprising,
a base,
a pair of endless chains passing around sprockets rotatably mounted on said base,
means for driving said sprockets,
at least one of said sprockets being adjustably positionable to permit variations in the length of said chains,
a plurality of dies mounted on said chains,
a generally cylindrical anvil mounted on said base adjacent said chains for engagement by said dies,
said anvil being constituted by at least two segments having cylindrical surfaces and being slidably mounted on a shaft whose axis is at an acute angle to the path of movement of said chains,
and means for axially reciprocating said segments as said dies move into and out of engagement with them.

9. Apparatus for forming blanks from a web comprising,
a base,

a pair of endless chains passing around sprockets rotatably mounted on said base,
means for driving said sprockets,
at least one of said sprockets being adjustably positionable to permit the length of said chains to equal a multiple of any length blank to be formed,
a plurality of dies mounted on said chains,
a generally cylindrical anvil mounted on said base adjacent said chains for engagement by said dies,
at least one stripper chain passing around sprockets rotatably mounted on said base, said stripper chain having knock-out pins projecting from it,
at least one of said stripper chain sprockets being adjustably positionable to permit the length of said chain to equal a multiple of any length blank to be formed.

References Cited

UNITED STATES PATENTS

2,329,256	9/1943	Edelman	83—326
3,192,856	7/1965	Gavin.	
3,272,047	9/1966	Ward	82—659 X

BERNARD STICKNEY, *Primary Examiner.*