March 1, 1966 C. J. GROSS 3,237,535

BOX FORMING MACHINES

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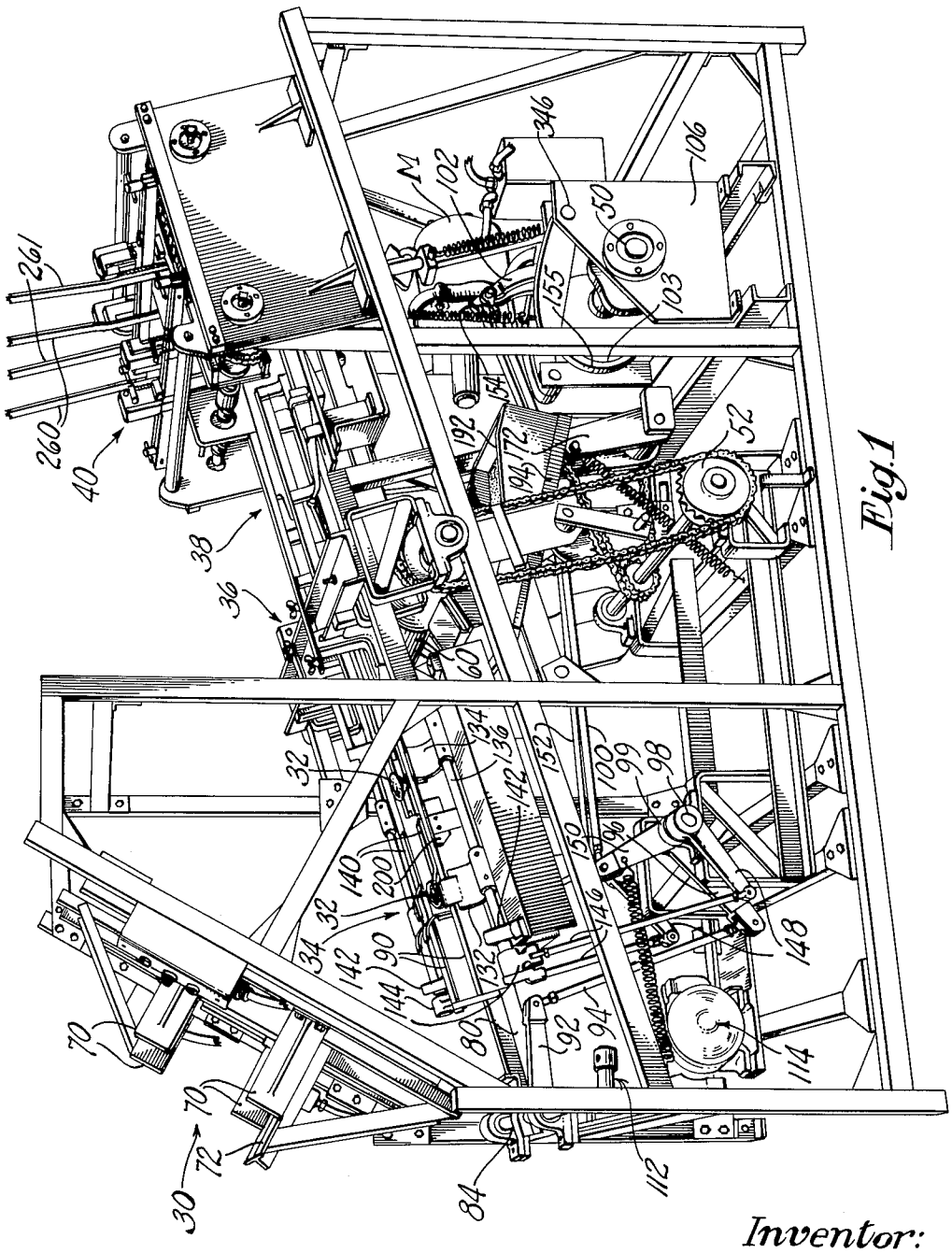


Fig. 1

Inventor:
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By his Attorney
Vincent G. White

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BOX FORMING MACHINES

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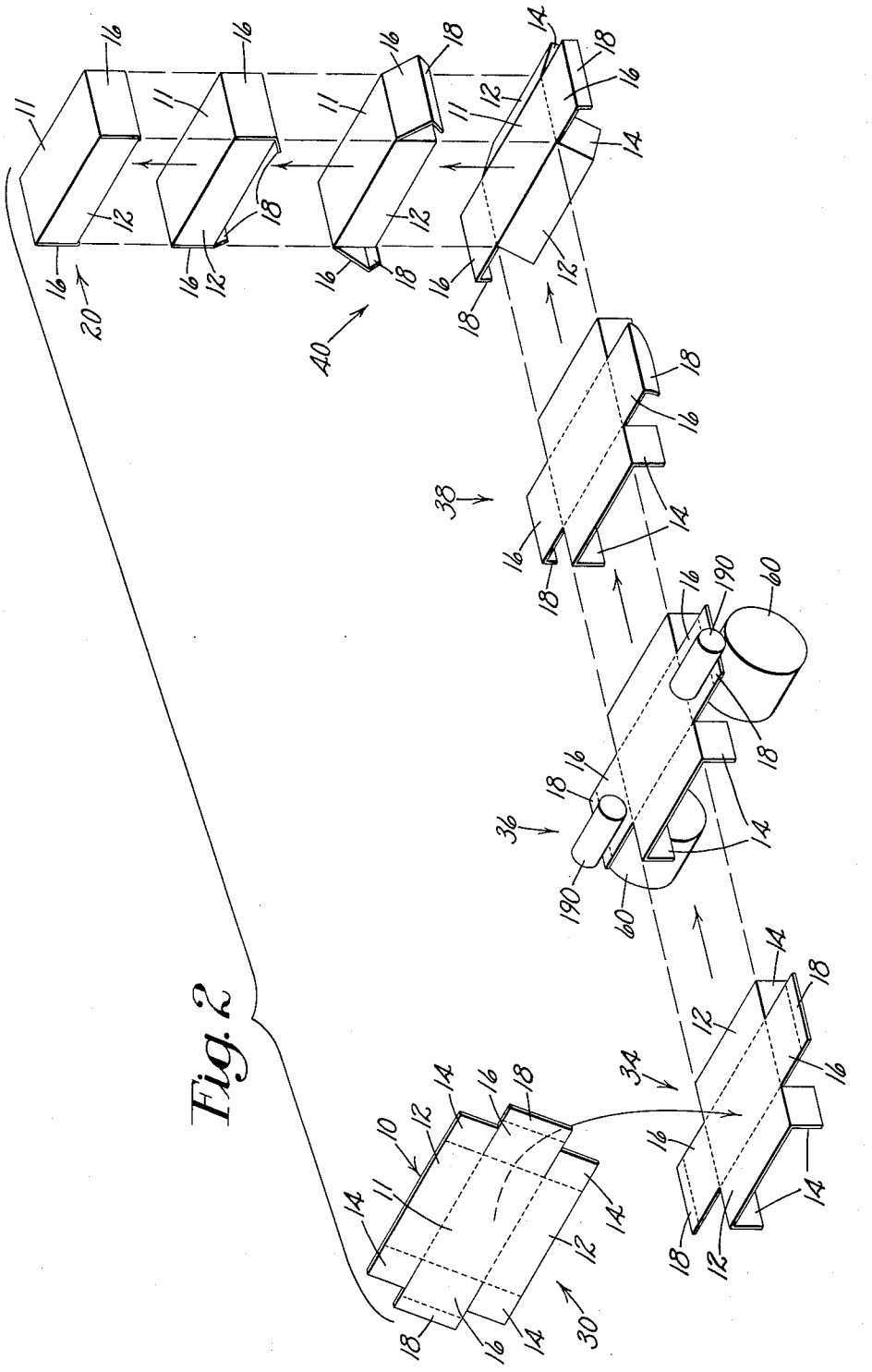


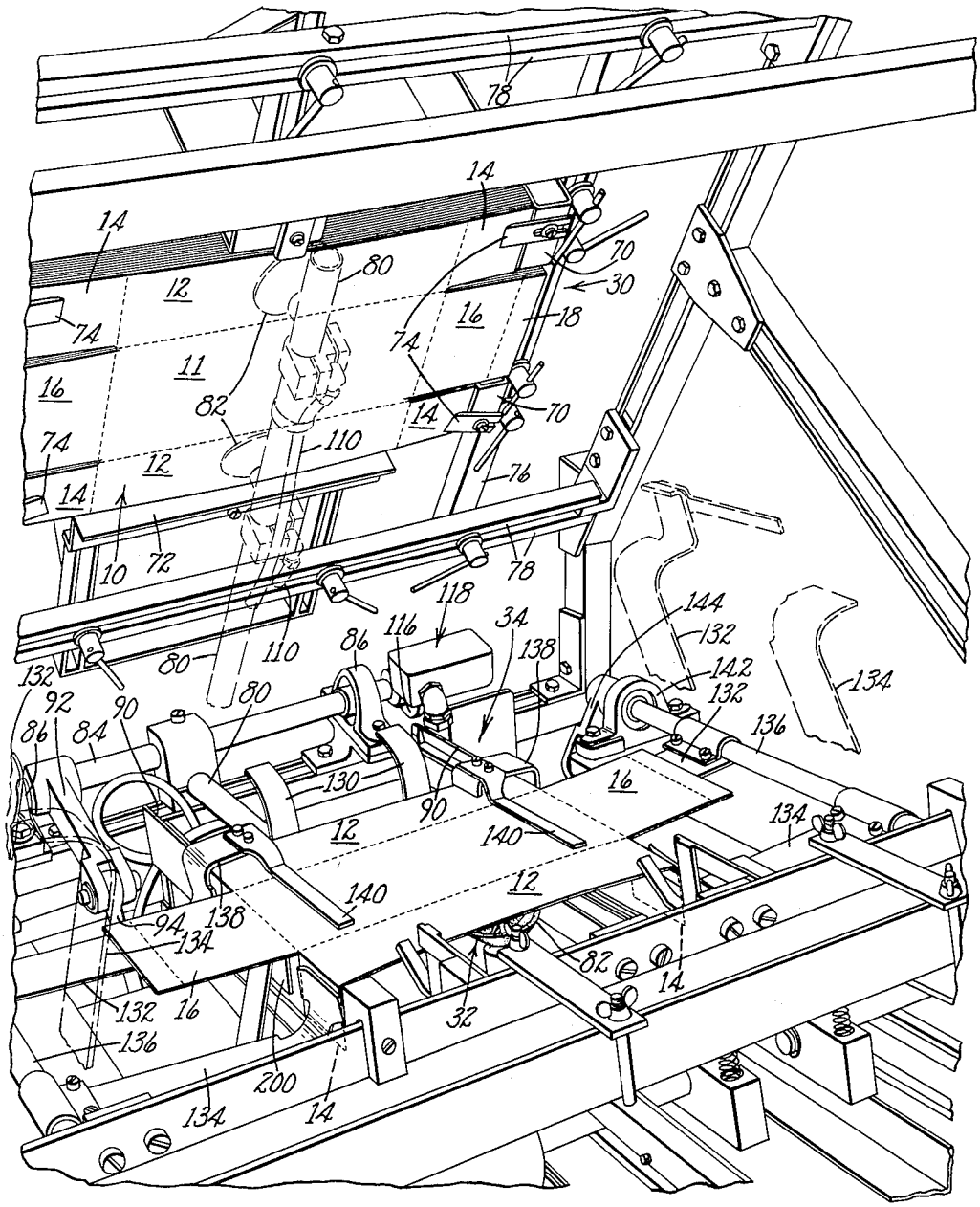
Fig. 2

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BOX FORMING MACHINES

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Fig. 3

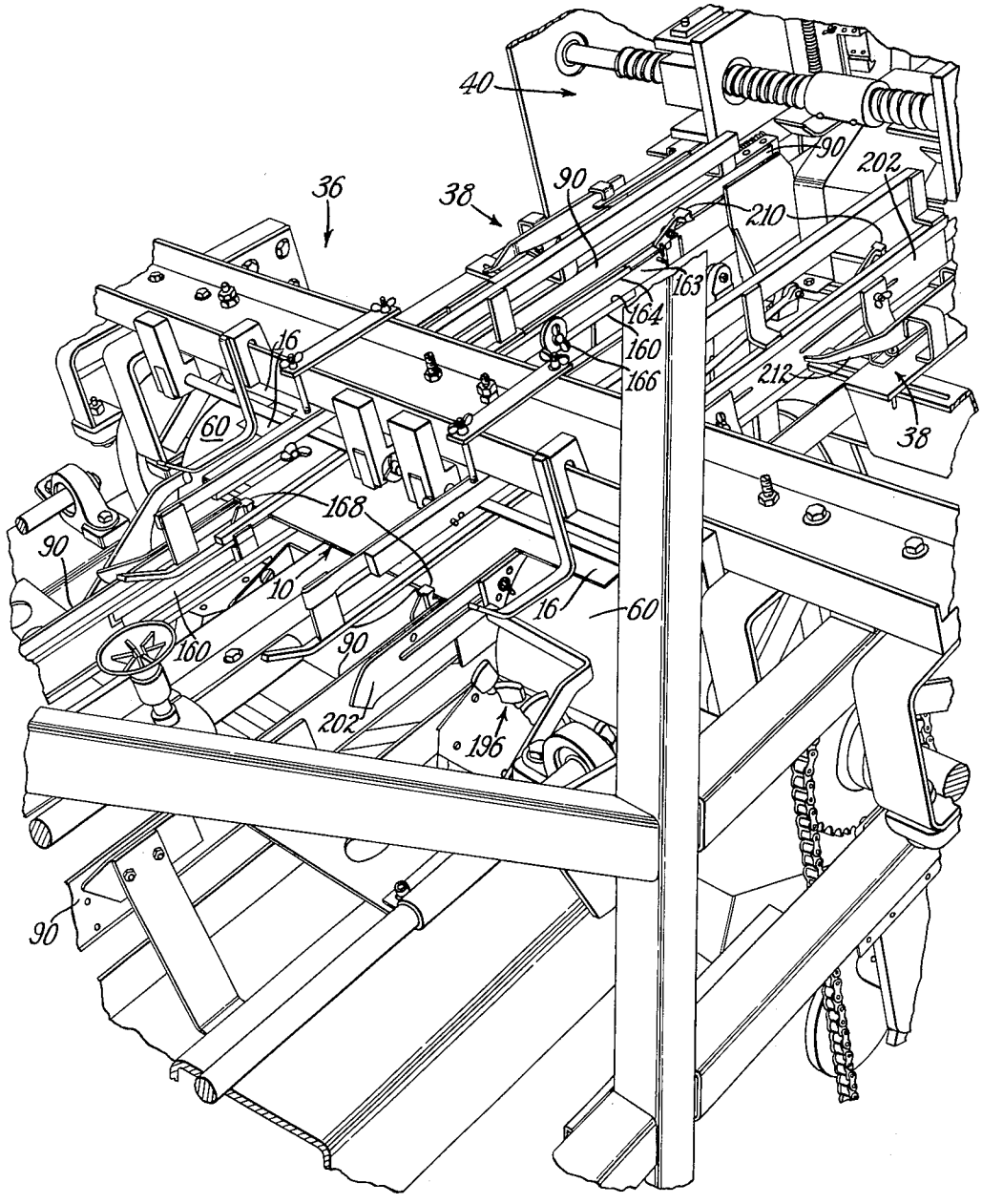


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BOX FORMING MACHINES

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Fig. 4



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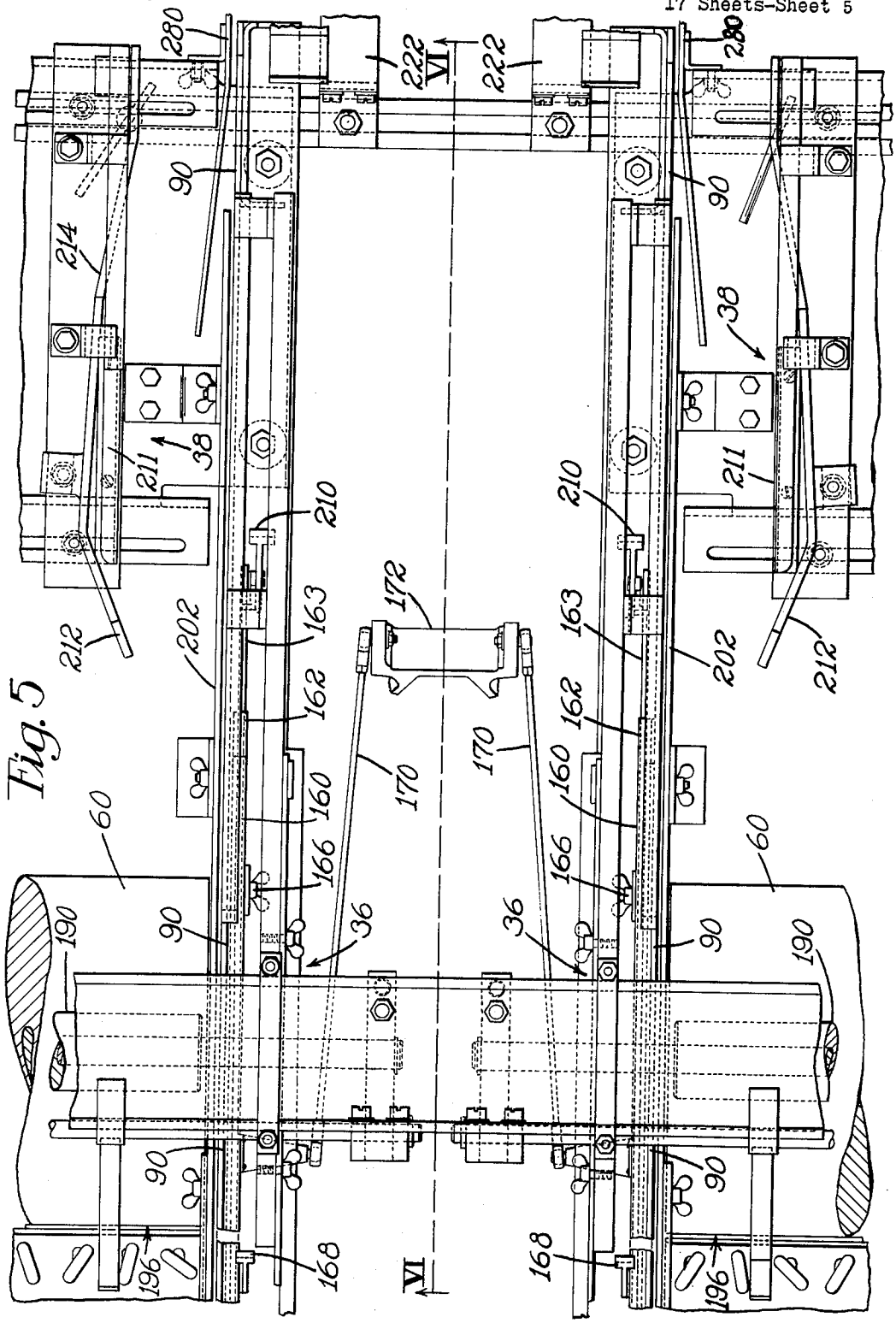


Fig. 5

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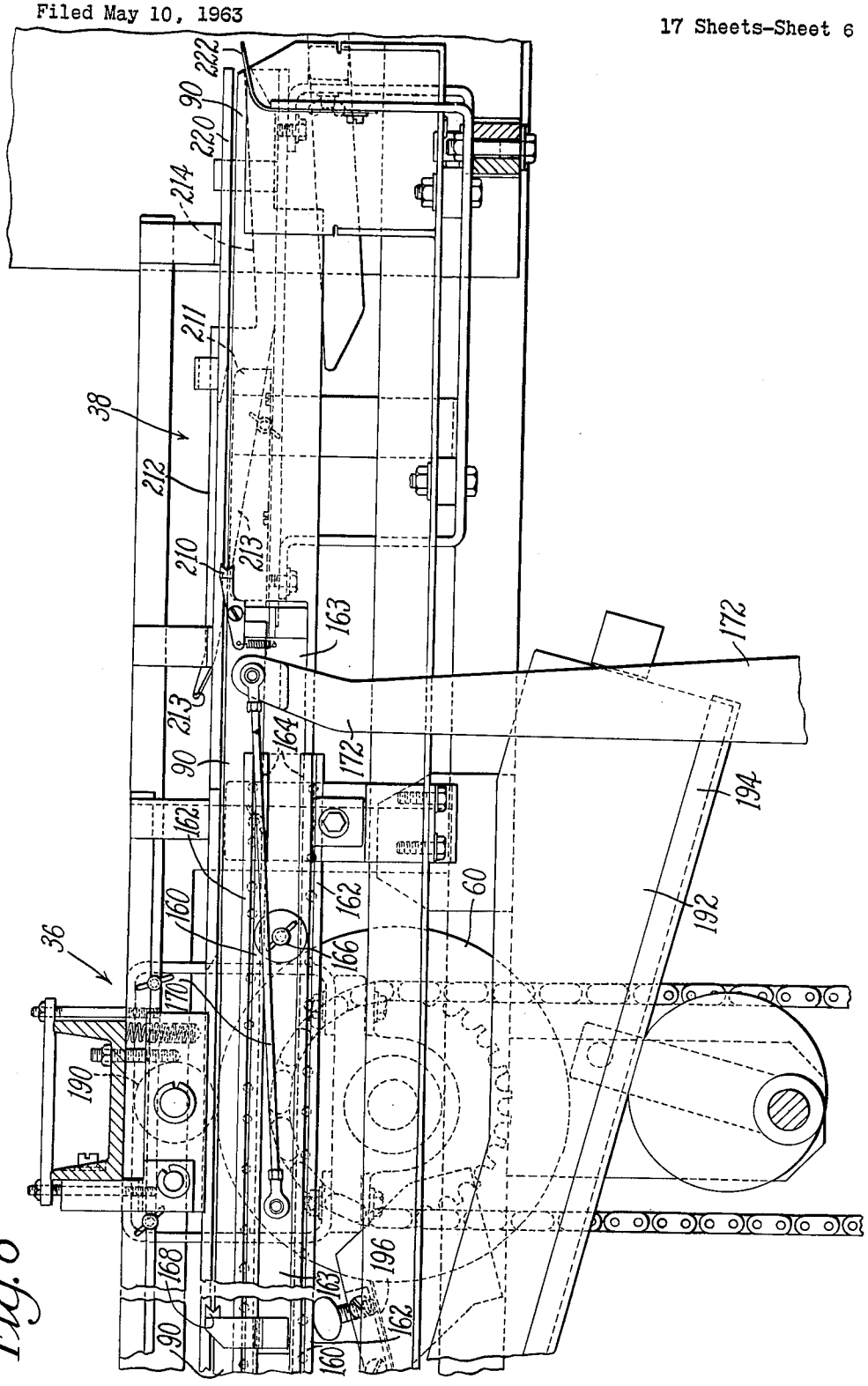


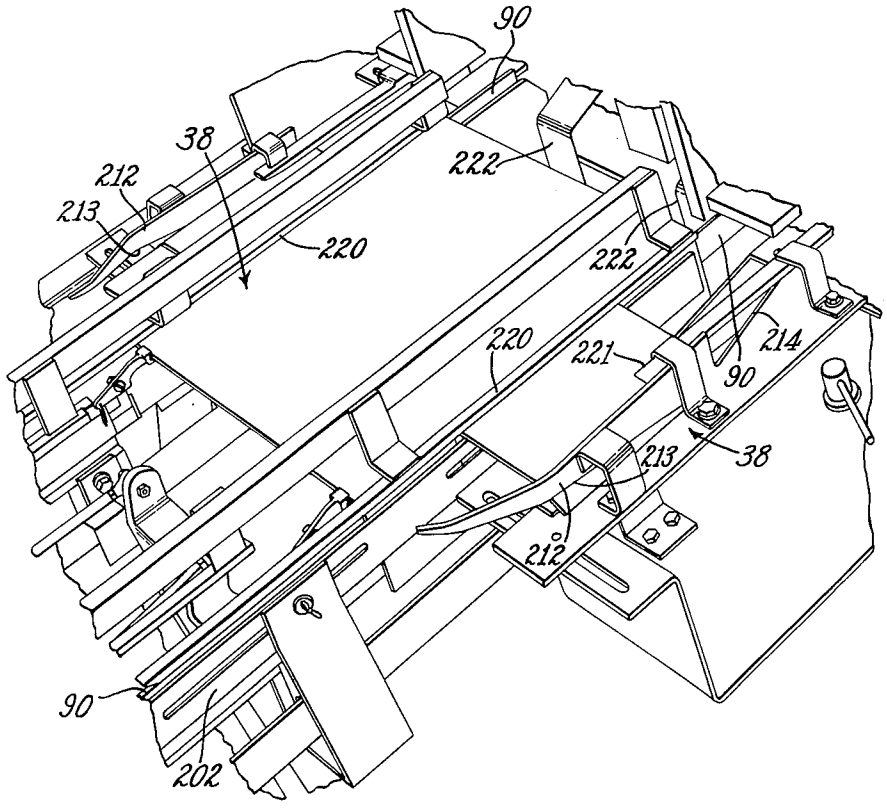
Fig. 6

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Fig. 7

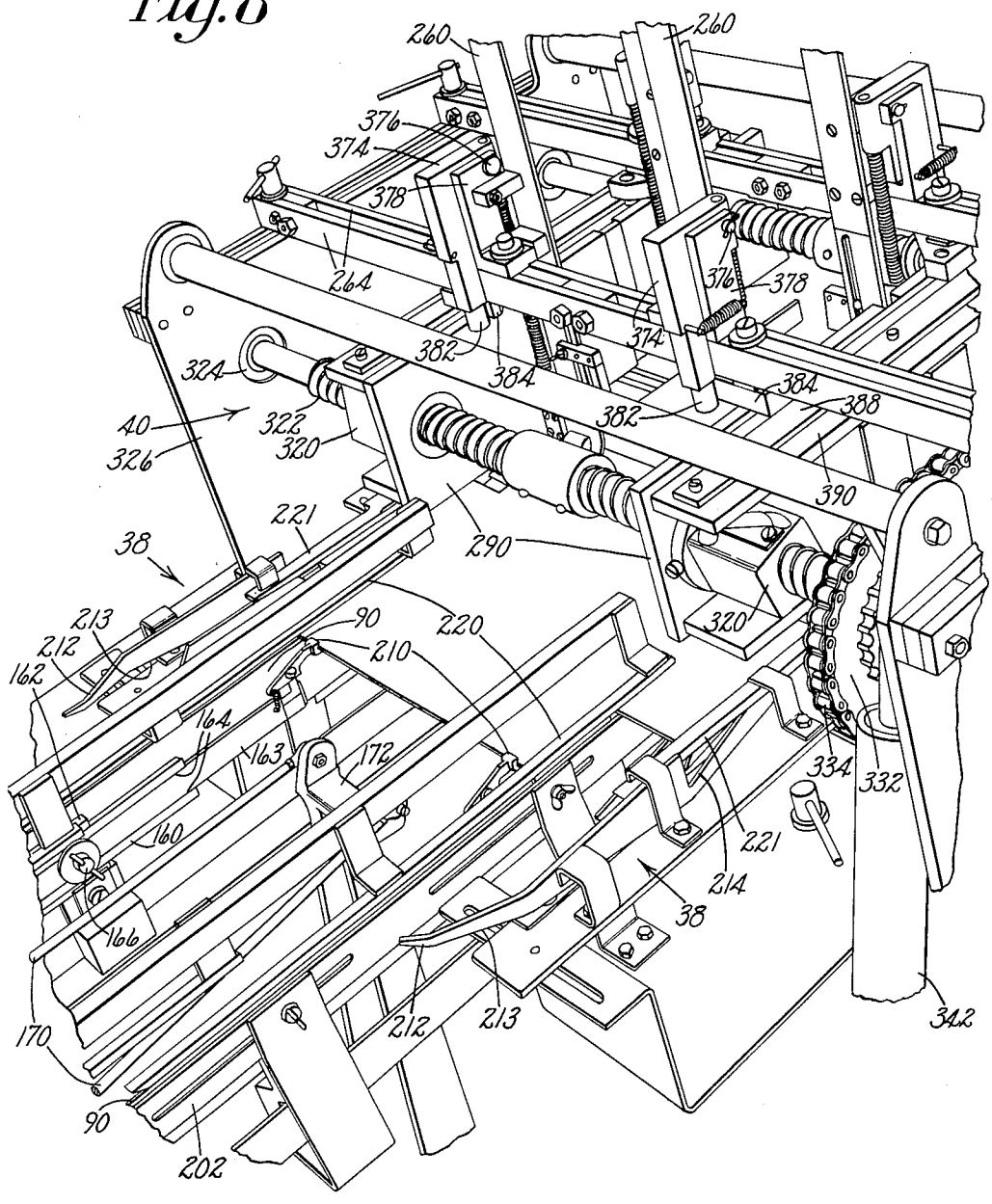


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BOX FORMING MACHINES

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Fig. 8



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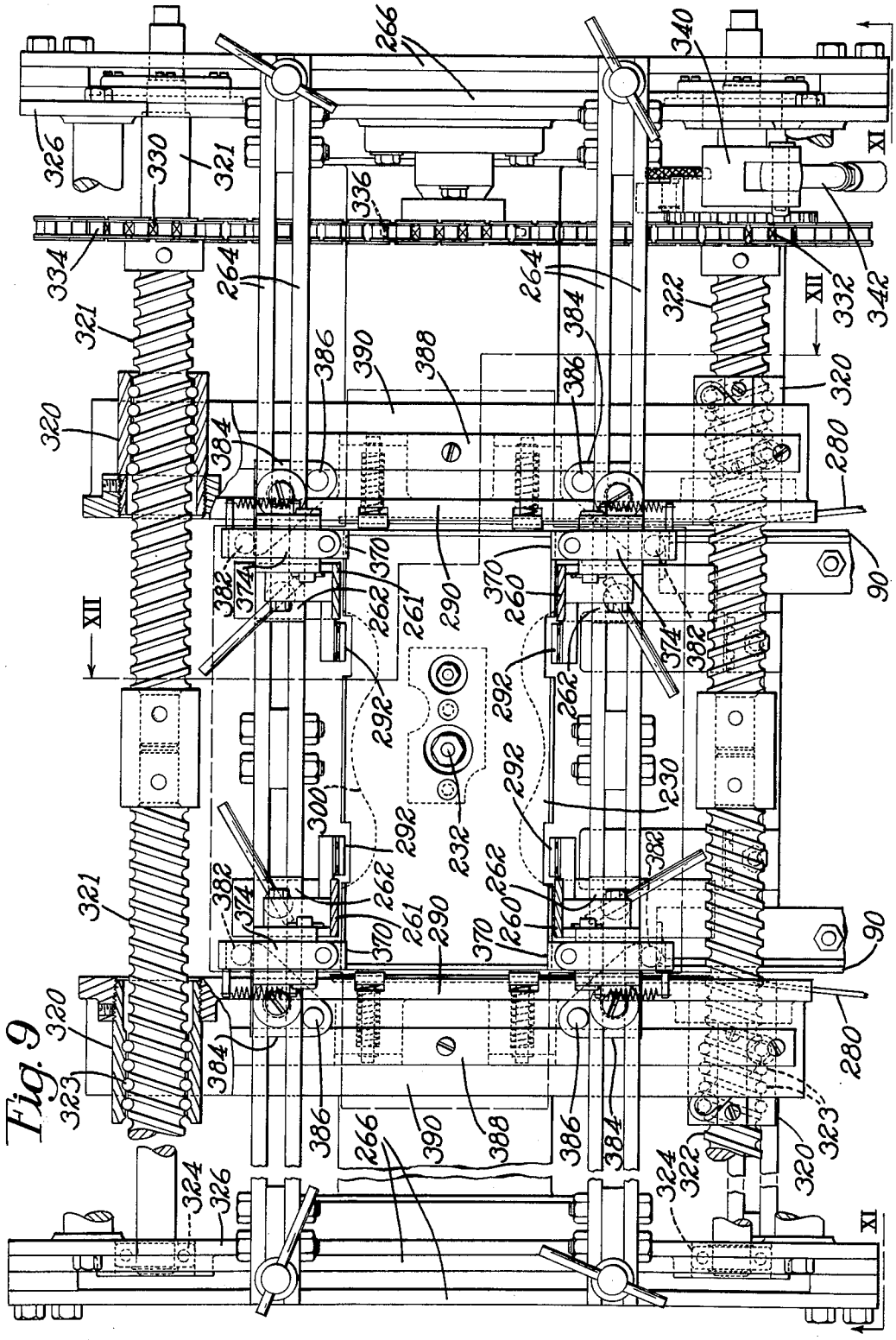


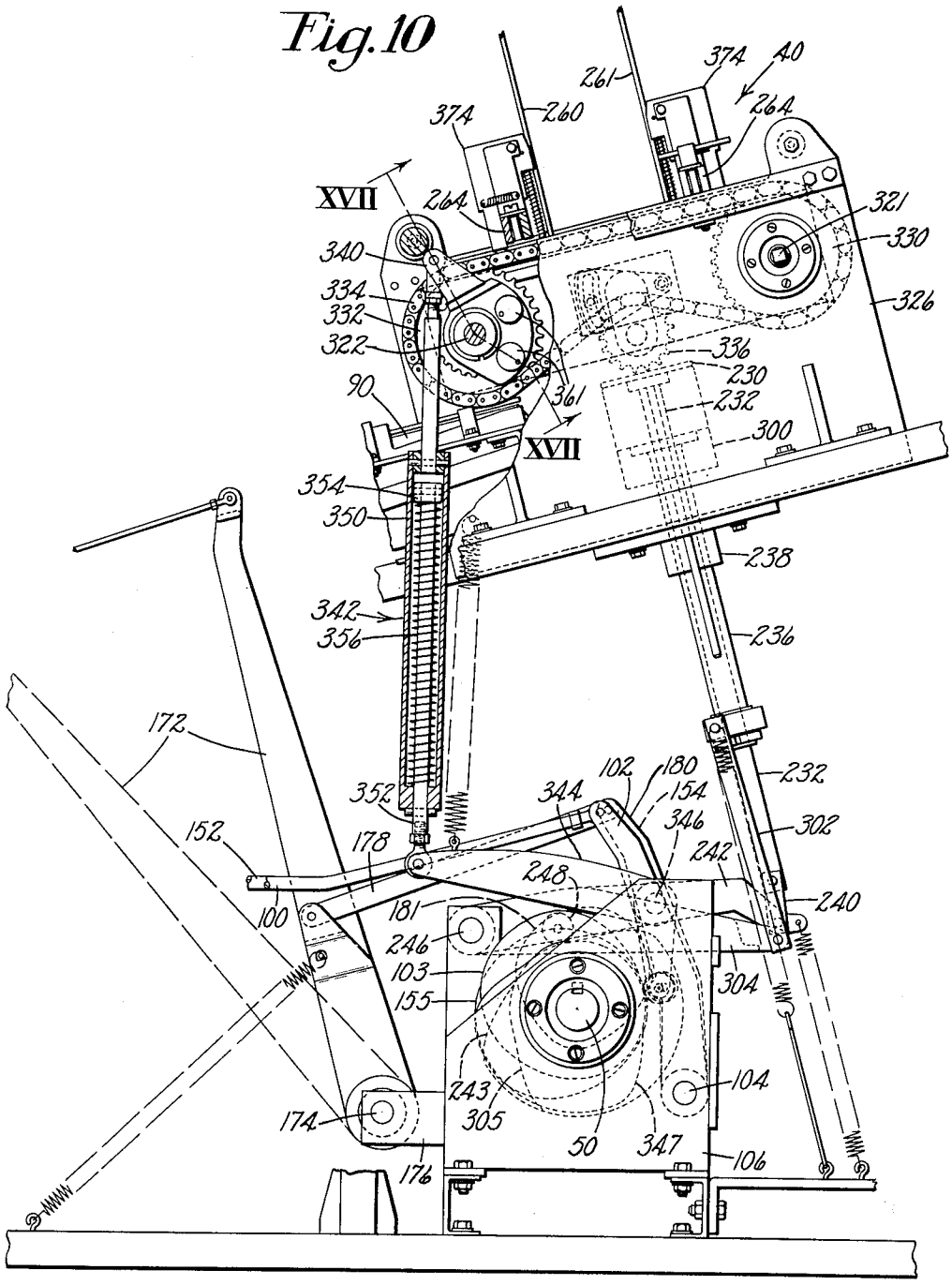
Fig. 9

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Fig. 10



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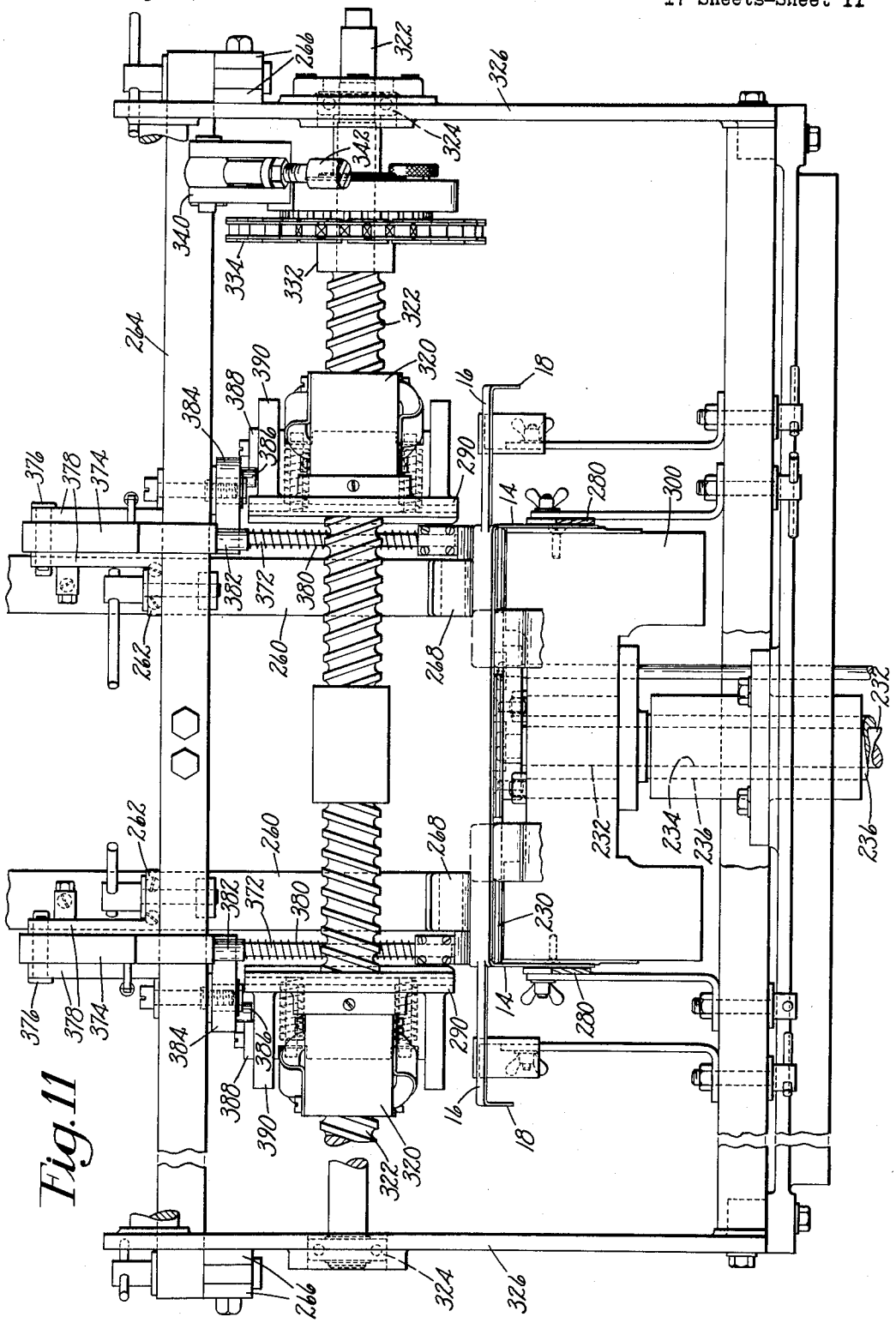


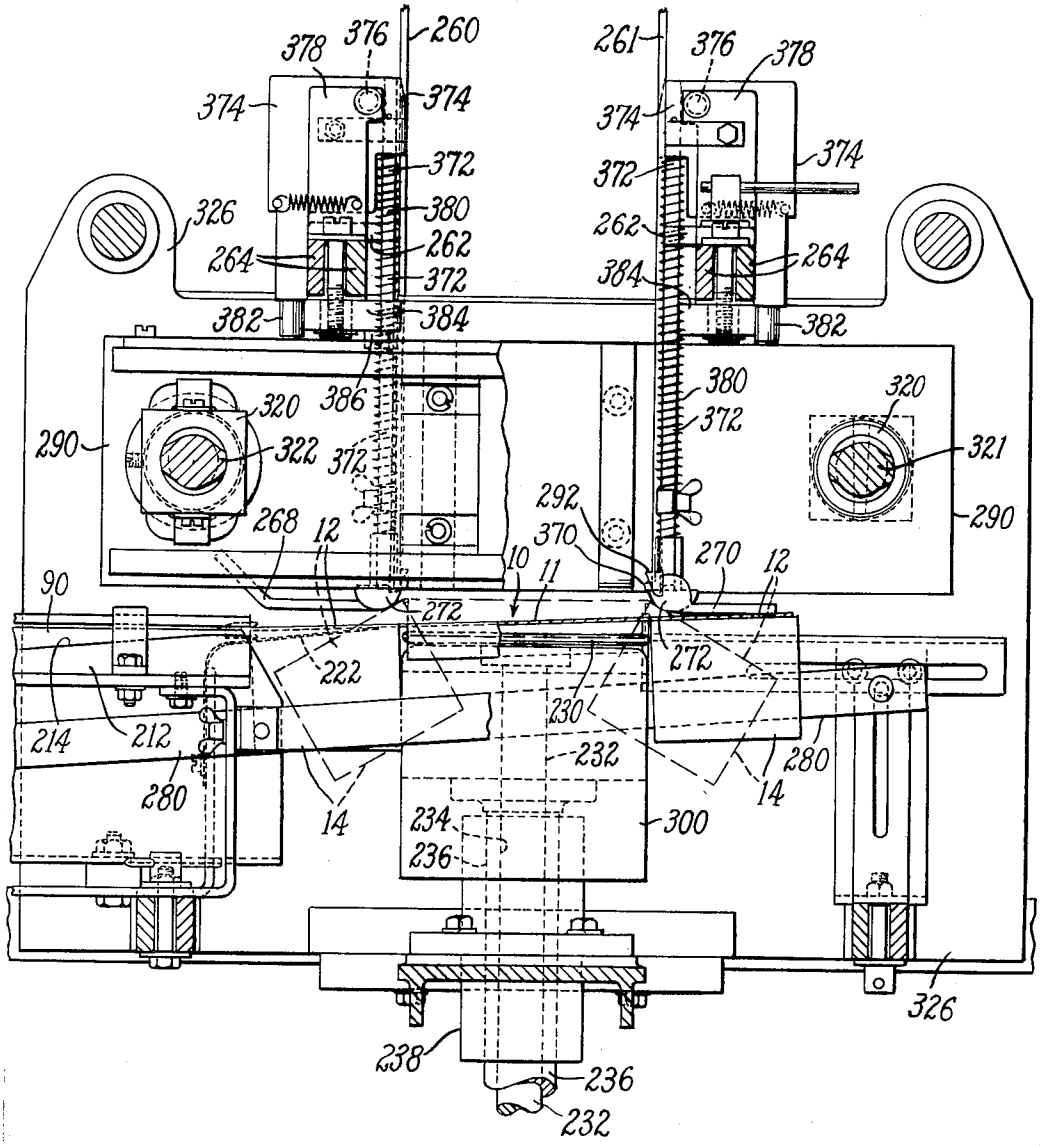
Fig. 11

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Fig. 12



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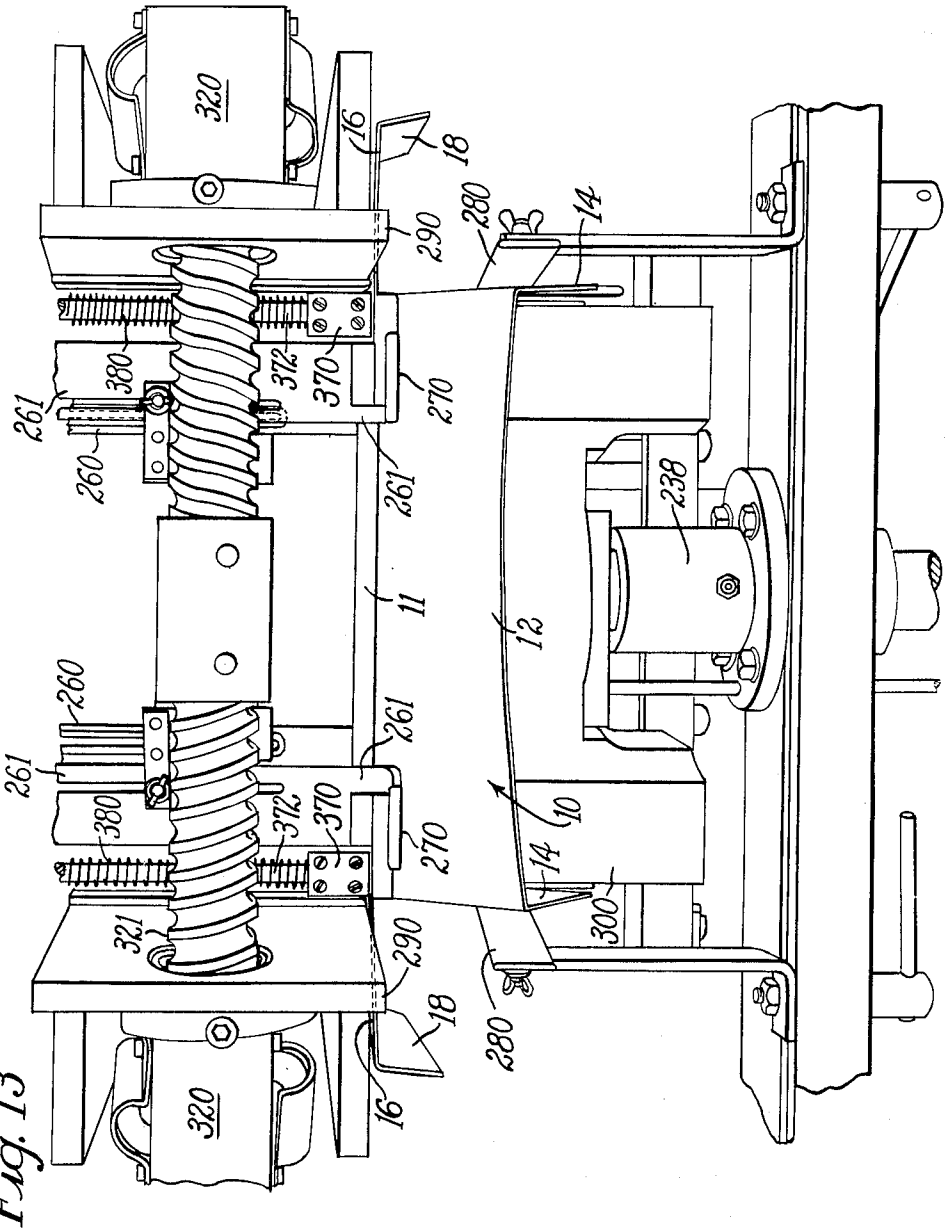


Fig. 13

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BOX FORMING MACHINES

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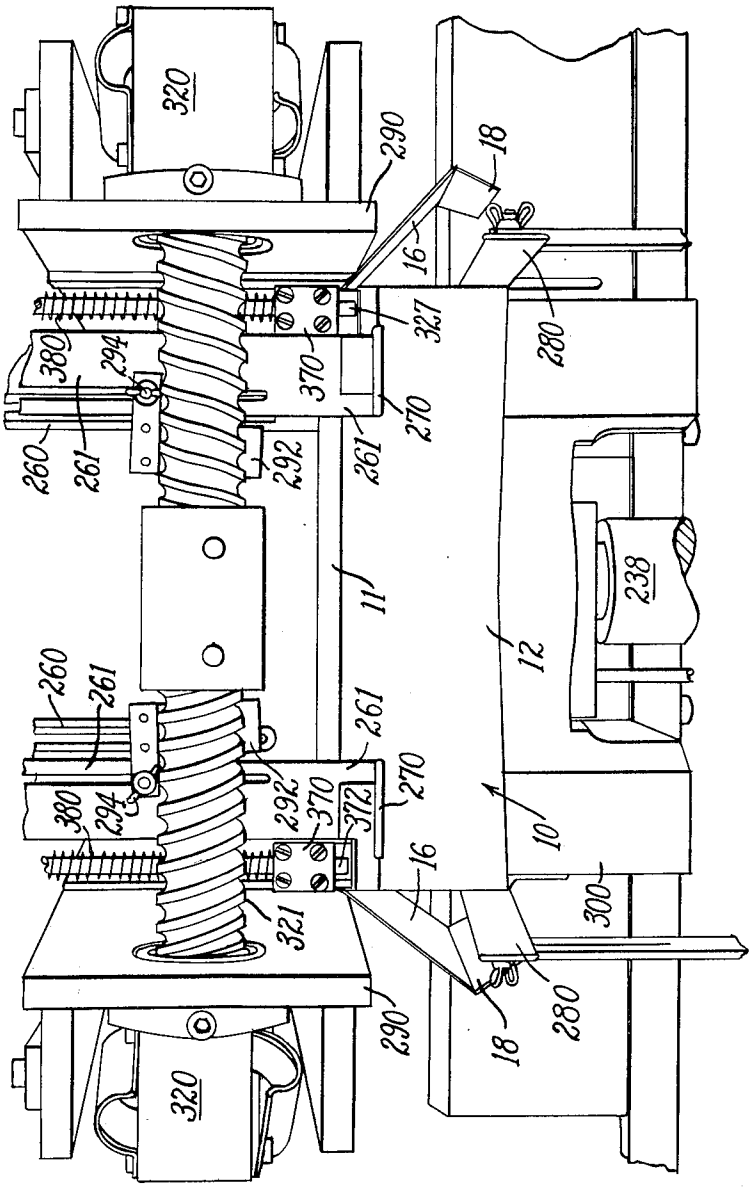


Fig. 14

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BOX FORMING MACHINES

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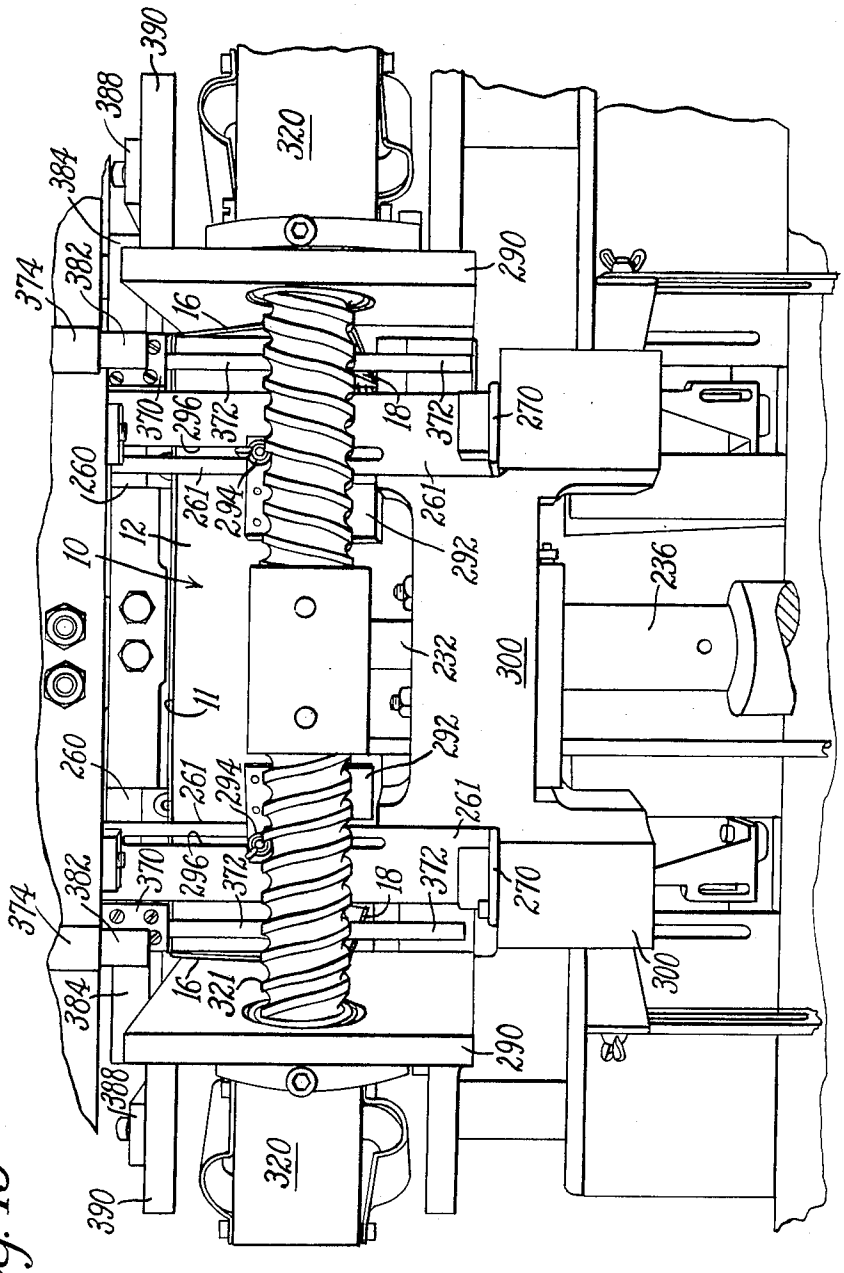


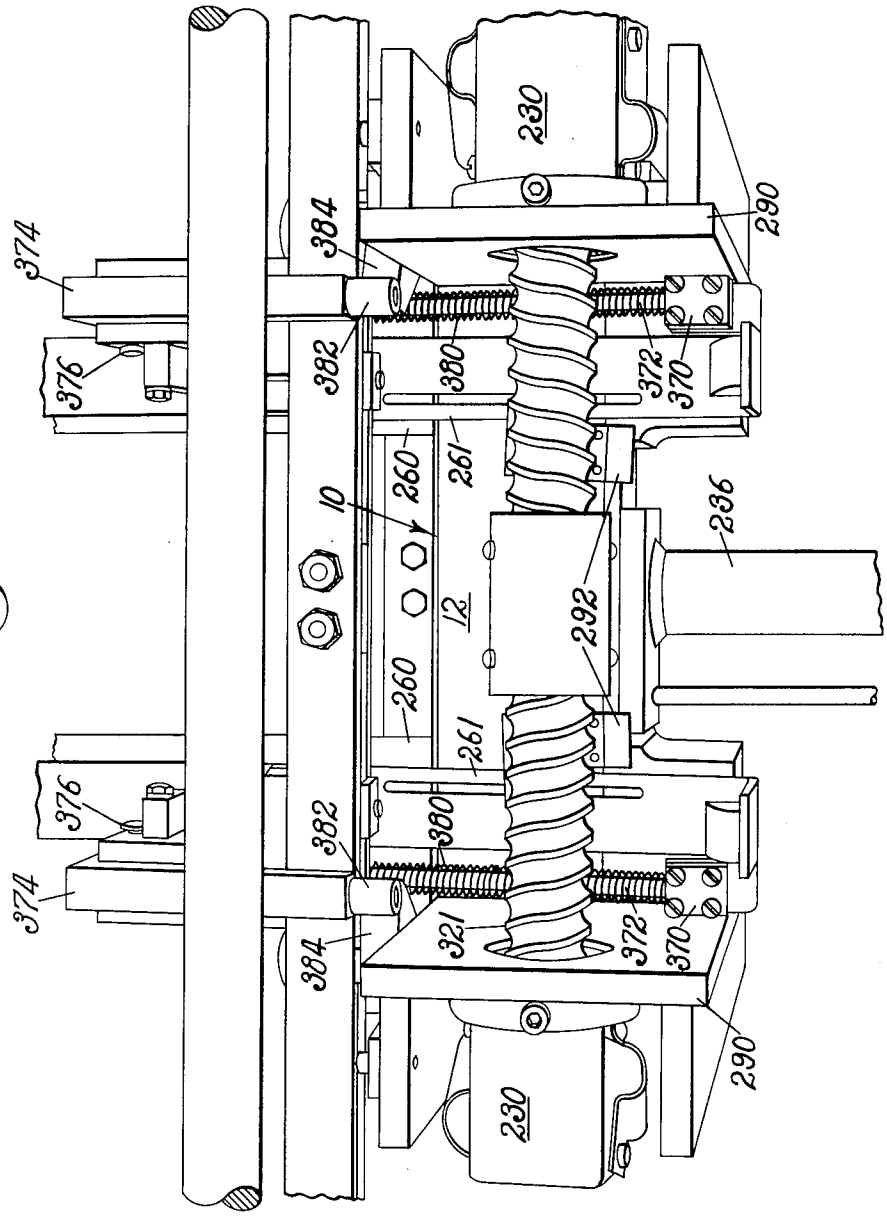
Fig. 15

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Fig. 16



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Fig. 17

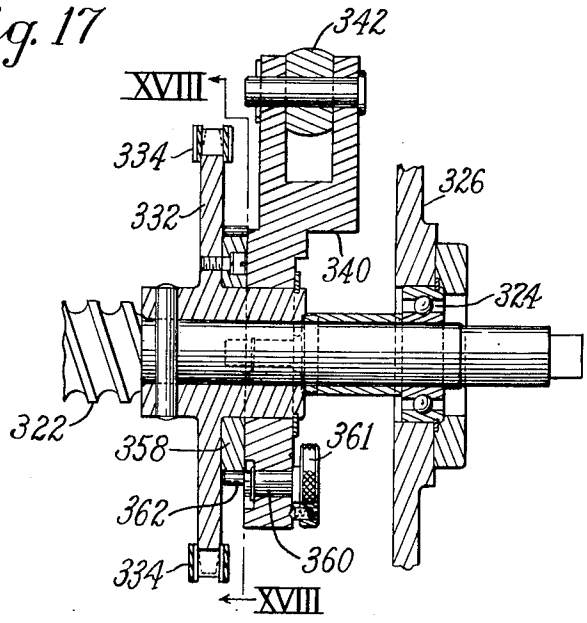
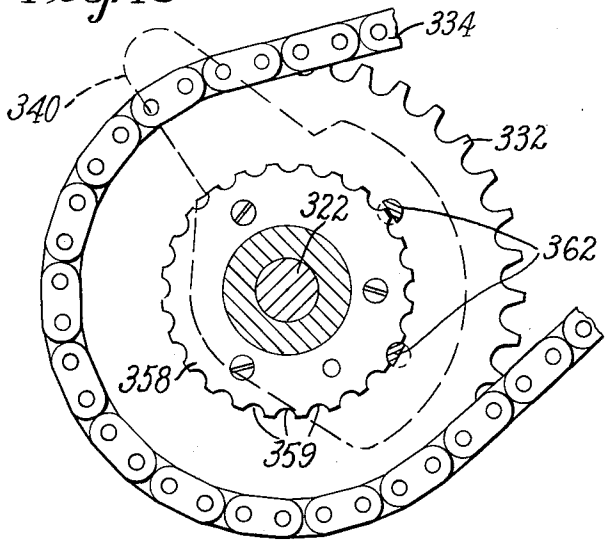


Fig. 18



United States Patent Office

3,237,535

Patented Mar. 1, 1966

3,237,535

BOX FORMING MACHINES

Charles J. Gross, Winchester, Mass., assignor to Hoague-Sprague Corporation, Lynn, Mass., a corporation of Massachusetts

Filed May 10, 1963, Ser. No. 279,419
15 Claims. (Cl. 93—49)

This invention relates generally to box forming machines and more particularly is directed to automatic machines for setting up boxes or cartons of various sizes and shapes from flat blanks of sheet material.

It is a general object of the present invention to provide a greatly improved machine for forming boxes or cartons of a superior quality at a high rate of speed from flat blanks having a rectangular bottom portion, side wings and end wings foldably connected thereto and corner laps and extensions foldably connected to the side wings and end wings respectively. To this end the machine is provided with a magazine for holding a stack of flat blanks, each of which is automatically placed at a first bending station where the corner laps are folded to provide guide surfaces. From this station the blanks are individually fed to an adhesive applying station where the end wings are coated with adhesive. Thereafter the blanks are fed through a second bending station where the end wing extensions are flexed to impart a permanent bend thereto, and finally fed to a forming station where the various parts of the blank are folded over a form and pressed to form a finished box. While the machine is especially suited to operate on blanks of the above type it should be understood that many of the features embodied therein make it well suited to operate on blanks of other types without departing from the scope of the invention.

According to one feature of the invention each blank is transferred from the magazine onto a pair of rails at the first bending station. The rails are spaced apart a distance equal to the length of the side wings of the blank and extend through the other stations to the forming station. At the first bending station means are provided to bend the corner laps over the outsides of the rails to provide guiding surfaces on the blank to confine the blank to a predetermined path as it is fed along the feed plane defined by the rails. Guide means are also provided adjacent the outside of the rails to define a closed path in which the corner laps are confined. In this manner surfaces of the blank are used for guiding purposes for more precise location of the blank than is possible in machines that utilize the edges of the blank for this purpose.

According to another feature the blank is guided as above provided with the end wings outspread in the plane of the rails through the adhesive applying station in which rolls underlying the feed plane coat one side of the end wings with adhesive. This feature provides means for coating only the end wings of the blank in a simple and precise manner.

A further feature of the invention provides means for flexing the extensions of the adhesively coated end wings to impart a permanent bend thereto to facilitate subsequent operations in the forming station. With this feature an operation is performed progressively while the blank is fed, thus avoiding the necessity of complex bending mechanism in the forming station.

The above and other features of the invention together with various novel details of construction and combinations of parts will now be described with particular reference to the accompanying drawings and thereafter pointed out in the claims.

In the drawings,

FIG. 1 is a perspective view of the entire machine embodying the present invention;

FIG. 2 is a diagrammatic view showing the condition of the box blank as it is fed progressively through the machine;

FIG. 3 is a perspective view of a portion of the machine showing the magazine and means for separating and partially forming the lowermost blank in the magazine.

FIG. 4 is a perspective view of the glue applying section of the machine;

FIG. 5 is a plan view of the same portion of the machine shown in FIG. 4;

FIG. 6 is a section on line VI—VI of FIG. 5;

FIG. 7 is a perspective view showing the end wing extension bending means;

FIG. 8 is a perspective view of substantially the same portion of the machine as seen in FIG. 7 but with the box blank being moved into the forming station;

FIG. 9 is a plan view of the box forming station;

FIG. 10 is a side elevation of the box forming station with parts broken away;

FIG. 11 is a section substantially on line XI—XI of FIG. 9;

FIG. 12 is a section on line XII—XII of FIG. 9;

FIG. 13 is a perspective view of one end of the box forming station with the parts shown in the initial box forming positions;

FIG. 14 is a view similar to FIG. 13 but with the parts in a more advanced position;

FIG. 15 is a further progressive view similar to FIG. 13;

FIG. 16 is another perspective view of the box forming station with the parts shown in their positions upon completion of their box forming movement; and

FIG. 17 is a section substantially on line XVII—XVII of FIG. 10;

FIG. 18 is a section substantially on line XVIII—XVIII of FIG. 17.

Referring to FIG. 1 it may be seen that the machine includes a magazine **30** for holding a stack of box blanks **10** to be formed into boxes, a blank separating device **32** for transferring one blank at a time from the bottom of the magazine to a corner lap bending station **34**, a station **36** for applying adhesive to the end wings, an end wing extension bending station **38** and a box forming station **40**. FIG. 2 illustrates the various folded conditions of the box blank **10** as it is fed through the various operating stations of the machine. In its initial flat condition the blank **10** comprises a rectangular bottom portion **11** from which project opposite side wings **12** and end wings **16**, the side wings and the end wings being connected to the bottom portion along prescored fold lines. The opposite ends of the side wings have corner laps **14** foldably connected thereto while the end wings are provided with foldable extensions **18**. Referring particularly to FIG. 2, the condition of the box blank is shown as flat as it is fed from the magazine to the station **34** where the corner laps **14** are folded down. The blank is then fed through the station **36** where adhesive is applied to the undersides of the end wings **16** and thereafter through the unit **38** which flexes the end wing extensions **18**. Finally the blank is fed into the forming station **40** where the side wings and the end wings are down folded and the end wing extensions **18** are infolded over the combined corner laps **14** and end wings **16**. After the blank is folded in this manner, pressure is applied to the folded ends to complete the forming of a box **20**. For operating the various instrumentalities of the machine there is provided a motor M (FIG. 1) which through a variable speed drive (not shown) acts to rotate a cam shaft **50**

and through a chain and sprocket arrangement **52** also acts to rotate adhesive applying rolls **60**.

As seen in FIGS. 1 and 3, the magazine **30** includes four upstanding rails **70** which guide the stack of box blanks by engagement with the ends of the corner laps **14** of the box blank and also includes a plate **72** on which rests one edge of the side wings of the blanks. The magazine is also provided with plates **74** (FIG. 3) which support the stack by engagement with the lowermost blank. The rails **70** are adjustably mounted on bars **76** which in turn are adjustably secured to bars **78** carried by the machine frame so that the magazine may be adjusted to accommodate box blanks of various sizes and shapes. The support plate **72** is also adjustably mounted on the bars **78** for the same purpose.

For removing one box blank at a time from the lower side of the magazine, the machine is provided with a transfer arm **80** having suction cups **82** adjustably secured thereto. The arm is fixed to a shaft **84** which is rotatably mounted in bearings **86** fixed to a portion of the machine frame so that the arm may be swung from the position shown in phantom lines in FIG. 3 where the suction cups **82** engage and grip the lowermost box blank in the magazine to the position shown in full where the separated box blank is deposited on a pair of rails **90**. During removal from the magazine the blank flexes sufficiently to be pulled out of engagement with the plates **74**. For swinging the arm **80** the shaft **84** has fixed thereto an arm **92** connected by a link **94** to one arm of a bell crank **96** which is fulcrumed on a shaft **98** journalled in bearings **99** secured to the machine frame. The other arm of the bell crank is connected by a link **100** to a cam lever **102** fulcrumed on a shaft **104** in a composite bracket **106** (see also FIG. 10) secured to the machine frame. The cam lever **102** is adapted to be oscillated to raise and lower the arm **80** by a cam **103** secured to the cam shaft **50**. Each of the suction cups **82** (FIG. 3) is connected through a tube **110** with a solenoid operated valve **112** which controls the suction applied by a vacuum pump **114** (FIG. 1). The shaft **84** carrying the arm **80** at one end is provided with a cam **116** adapted to actuate a switch **118** which controls energization of the valve **112**. The arrangement is such that as the arm **80** approaches its upper position, as seen in phantom lines in FIG. 3, the suction is applied to the cups **82** as they engage the lowermost blank in the magazine. As soon as the arm is moved to its lowermost position where the blank is deposited on the rails **90**, the cam **116** actuates the switch **118** to de-energize the valve **112** to remove the suction from the cups **82** thereby releasing the box blank.

At this time the box blank is resting on the rails **90** at the lap bending station **34** with the trailing edge of the blank positioned against a pair of curved rails **130**. The alignment of the blank is such that the fold lines between the corner laps **14** and side wings **12** overlie the outer edges of the rails **90**. For bending the corner laps there are provided four bending arms **132, 134** secured at opposite sides of the machine on shafts **136**. As the box blank is being deposited on the rails **90**, the arms **132, 134** are in their raised position shown in phantom lines in FIG. 3. As soon as the blank is resting on the rails the arms are swung downwardy to the positions shown in full lines and during this movement the innermost curved ends of the arms act to bend the corner laps **14** downwardly over and outside the rails **90**. To avoid undue bowing of the body of the box blank and to retain it on the rails, the arms **132** are provided with extensions **138** to which are secured guide rails **140** adapted to rest on the upper surface of the blank. For raising and lowering the arms **132, 134** the shafts **136** are journaled in bearings **142** secured to the machine frame and are provided with arms **144** connected by links **146** to a pair of arms **148** (FIG. 1) fixed at opposite ends of the shaft **98**. The shaft **98** also has fixed thereto an arm **150** adjacent the bell crank **96**. This arm is connected by a link **152** to a

cam lever **154** (FIG. 10) also pivoted on the shaft **104** and adapted to be oscillated by a cam **155** fixed on the cam shaft **50**.

After the corner laps **14** are bent downwardly by the arms **132, 134** the blank is moved along the rails **90** and through the adhesive applying station **36**. For so moving the blank, the machine is provided with a pair of feed slides **160** (FIGS. 4, 5, and 6) which are mounted for reciprocating movement in linear ball bearings carried by a pair of rails **162** fixed to the inner sides of the rails **90**. Each of the slides is provided with a bar **163** mounted in guideways **164** in the slide. The bar is adapted to be adjusted in the guideways to accommodate blanks of different sizes and is fixed in adjusted position on the slide **160** by a thumb screw **166**. At their rearward ends the bars are provided with upstanding feed lugs **168** which are adapted to engage the trailing end of each successive blank deposited on the feed rails **90**. For moving the blank along the rails each slide **160** is connected by links **170** to the upper end of an arm **172** which is mounted for swinging movements on a shaft **174** (FIG. 10) carried by lugs **176** extending from the bracket **106**. The arm is connected by a link **178** to a cam lever **180** also mounted for swinging movement on the shaft **104**. The cam lever is adapted to be oscillated for reciprocating the feed slide by a cam **181** fixed on the cam shaft **50**.

While the blank is moved along the rails **90** through the adhesive applying station **36**, the outspread end wings **16** are fed between the glue applying rolls **60** and opposed pressure rolls **190**. The lower side of the rolls **60** rotate in a pair of trays **192** containing adhesive and carried by rails **194** adjustably secured to the machine frame. As the rolls **60** are rotated clockwise, as seen in FIG. 6, adhesive is picked up on the surface of the roll and is thereafter spread to a uniform thickness by a doctor blade device **196** arranged adjacent each roll **60**. The surface speed of the applying rolls **60** is substantially the same as the linear movement of the box blank so that a substantially uniform layer of adhesive is deposited on the underside of the end wings as the blank is fed through the adhesive applying station **36**. During its feeding movement the blank rests on the top edge of the rails **90** and is guided by the downturned corner laps passing between the inner ends of the arms **132, 134** and the outer surfaces of the guide rails **90**. Additional guiding surfaces are provided by guide plates **200** arranged between the arms **132, 134**. As the blank is fed through the adhesive applying station **36** and subsequent stations, additional guide rails **202** which also are arranged adjacent the guide rails **90** act not only to guide the box blank but also to maintain the corner laps **14** in their downturned condition.

After feeding the blank through the station **36** the feed slides **160** are returned to their initial positions in readiness for transporting the next successive blank separated from the magazine by means of the feed lugs **168**. For transporting the first fed blank to successive stations of the machine, the forward ends of the feed bars **163** are provided with yieldable feed lugs **210**. During the next reciprocation of the feed slides the lugs **210** engage the trailing end of the first fed box blank and feed it further along the rails **90** through the station **38** which is adapted to flex the end wing extensions to impart a permanent bend thereto in preparation for the final forming operations on the blank. FIG. 7 shows the blank as it is being fed through the bending station **38** while FIG. 8 shows the blank as it is being fed beyond this station and into the box forming station **40**. The bending station **38** is provided with a pair of plates **211** (FIGS. 5 and 6) which are spaced outside the rails **90** to support the end wings **16** at the fold lines connecting the extensions **18**. A pair of folding members **212** are provided with surfaces **213** (see

especially FIG. 6) which converge into and below the plane of movement of the extensions from the upper side of a blank on the rails 90. As the blank is fed by the lugs 210, the extensions 18 are progressively folded downwardly over the rails 211 by the surfaces 213. The downturned extensions next are engaged by further surfaces 214 which converge upwardly into their path of movement to further fold the extensions inwardly to an extent insufficient to cause the adhesive coated surfaces of the end wings and their extension to make contact yet sufficient to impart a permanent bend to the extensions. So that the blank is completely guided at this time and to resist the upward forces bending the extensions 16, the machine is provided with additional guide members 220, 221 which engage the upper surface of the blank as it is fed through this station. As the blank is fed into the forming station it passes over a pair of spring plates 222 to further guide the blank as it passes beyond the rails 90.

As the blank is fed from the station 38 into the forming station 40, the spring plates 222 insure that the blank passes over a forming plate 230. The plate has a rectangular outline substantially corresponding to the bottom portion 11 of the blank and is secured to the upper end of a rod 232. The rod is guided for heightwise sliding movement normal to the upper surface of the plate in a bore 234 formed in a rod 236 which in turn is guided for coaxial heightwise sliding movement in a bearing 238 secured to the machine frame. At its lower end the rod 232 is connected by a link 240 (FIG. 10) to a cam lever 242 pivotally mounted on a shaft 246 journaled in the bracket 106. For raising and lowering the plate 230 during its box forming movement the lever 242 is provided with a cam roll 248 adapted to engage a cam 243 fixed on the cam shaft 50. During the upward movement of the form plate 230 the bottom portion 11 of the blank is moved up between four rails 260, 261 (FIGS. 9–16) having lugs 262 by which they are adjustably secured to cross bars 264. The forming rails 260 are spaced apart at opposite sides of the form plate a distance corresponding to the width of the bottom of the blank where the end wings 16 are connected. The bars 264 at opposite ends in turn are adjustably secured to bars 266 to provide for additional size adjustment. At their lower ends one pair of rails 260 is provided with horizontal extensions 268 having upturned ends for guiding the box blank as it enters the forming station. The other pair of rails 261 at their lower ends are also provided with horizontal extensions 270. At their junctures with the members 260, 261 the horizontal extensions 268 and 270 form curved surfaces 272 adapted to be engaged by the side wings 12 of the box blank as it is moved upwardly by the plate 230 to commence the down folding movement of the side wings. At this time the downturned corner laps 14 of the blank are retained in their bent position by a pair of plates 280. As the plate 230 continues its upward movement the end wings 16 of the blank engage the lower edges of a pair of pressure plates 290 as best seen in FIGS. 12 and 14. As it may be seen, the corner laps 14 are being guided by the plates 280 so as to be folded inside the end wings 16. Continued movement of the plate 230 raises the box blank to the position shown in FIG. 15 where the side wings and end wings are fully folded. At this time, the lower edges of the side wings 12 have moved beyond stripper lugs 292 yieldably mounted on the rails 260, 261. The lugs are secured to the plates 260, 261 by means of thumb screws 294 (FIGS. 14 and 15) which pass through slots 296 formed in the members 260, 261 so the lugs may be adjusted heightwise to accommodate other sizes of boxes. The lugs act to prevent retrograde movement of the formed box during the retracting movement of the plate 230. As soon as the form plate 230 has reached its uppermost position as seen in FIG. 15 a main box form 300 which conforms substantially to the shape and size of the interior of the box is adapted to be moved heightwise following the direction of movement of the form plate 230. To this end the form 300 is fixed to the upper end of the rod 236 which at its lower end is connected by links 302 (FIG. 10) to a cam lever 304 also pivoted on the shaft 246 and adapted to be oscillated by a cam 305 fixed on the cam shaft 50. As the form 300 is raised it engages the inwardly bent extensions 18 on the end wings 16 and folds them upwardly over the inturned corner laps 14. The final position of the form 300 is shown in FIG. 16 where the folded blank is supported from the inside substantially by the form 300.

At this point in the machine cycle the pressure plates 290 are moved inwardly to press both ends of the folded blank against the opposite ends of the form 300 so that the formed box ends become adhesively secured. To this end each of the pressure plates has secured thereto a pair of ball nut units 320 which threadably receive a pair of screw shafts 321, 322 which extend across the machine and are journalled in bearings 324 fixed in upstanding end plates 326 secured to the machine frame. Each of the screw shafts 321, 322 is provided at opposite ends with threads of opposite hand in which run ball bearings 323 (FIG. 9) in the nut units so that simultaneous rotation of the screws cause the presssure plates 290 to be moved toward or away from each other depending on the direction of rotation of the screw shafts. So that the screw shafts 321, 322 are rotated in synchronism they are provided with sprockets 330, 332 (FIG. 10) over which runs a chain 334. To maintain the chain under tension, an adjustable sprocket 336 is provided. At one end, the ball screw 322 has adjustably secured thereto an arm 340 which is connected by a yieldable link 342 to a cam lever 344 mounted for swinging movement on a shaft 346 journaled in the bracket 106. The cam lever 344 is in the form of a bell crank and the other arm thereof carries a roll which rides on a cam 347 fixed to the cam shaft 50. As best seen in FIG. 10, the yieldable link 342 comprises a body portion 350 which is connected to the arm 340 and a rod 352 which is connected to the cam lever 344. The rod 352 has an enlarged head 354 which engages the upper end of a spring 356 on the rod, the lower end of the spring being contained by a shoulder in the body portion 350. Since the ball screws 321, 322 are rotated to apply pressure to the box ends upon downward movement of the cam lever 344 it may be seen that upon solid engagement of the pressure plates 290 with the ends of the box further downward movement of the cam lever 344 acts to compress the spring 356 so that only a predetermined pressure will be applied to the box ends.

So that the machine may be suitable for forming a wide variety of box sizes and shapes, provision is made for adjusting the spacing between the pressure plates 290 to accommodate different sizes of box forms. To this end the arm 340 is adapted to be disconnected from the screw shaft 322 so both screw shafts may be simultaneously rotated by hand. For this purpose both shafts are provided with squared ends to receive a handle (not shown). As best seen in FIGS. 17 and 18 the sprocket 322 has fixed thereto a plate 358 having semi-circular depressions 359 equally spaced about its circumference. The portion of the arm 340 adjacent the plate 358 carries two rotatable pins 360 having knobs 361 (see also FIG. 10) and semi-cylindrical ends 362 adapted in one rotatable position to be received in driving engagement with one of the depressions 359 and in the other rotatable position to be disengaged and in non-driving position outside the circumference of the plate 358. As seen in FIG. 18 one of the pins is in driving position so the arm 340 is connected to the shaft 322. By rotating the engaged pin 180°, the arm is easily disocnnected to permit manual rotation of the shaft to adjust the spacing between the pressure plates 290. The spacing between the pins 360 is such that only one pin may be engaged at a time with the other pin positioned between two depressions 359. This permits a

fine adjustment of the relative positions of the arm 340 and sprocket 332.

During the initial upward folding movement of the forming plate 230, the box blank is held against the upper surface of the plate by lugs 370 (FIGS. 9–16) which are carried for heightwise sliding movement on rods 372 depending from members 374 (FIGS. 11 and 12). Each of the members 374 is pivotally mounted on pins 376 journaled in brackets 378 secured to the cross bars 264. Upward movement of the members 370 on the rods 372 is resisted by springs 380 on the rods, the upper end of the spring being contained by the member 374 as best seen in FIG. 12. The member 374 is generally L-shaped and at its lower end is provided with a roll 382 which is engaged by one arm of a bell crank member 384 (see FIGS. 9 and 11) which is pivotally mounted on the underside of the cross bars 264. The other arm of the bell crank member is provided with a depending roll 386 adapted to be engaged by a bar 388 secured to a lug 390 extending outwardly from the associated pressure plate. The upward movement of the lugs 370 is limited to correspond to the movement of the forming plate 230. Thus, during the upward movement of the form 300, further upward movement of the box blank is prevented to ensure that the end wing extensions are properly folded and that the form 300 is fully received in the interior of the box. During the inward pressing movement of the pressure plates 290 the bars 388 engage the rolls 386 to swing the bell crank members 384 causing the members 374 to be swung outwardly thus also swinging the lugs 370 out of engagement with the upper surface of the box blank, the members 370 being then moved downwardly by the springs 380. This action releases the completed box for removal and positions the lugs for engagement with the next blank to be formed.

From the foregoing description of the various operating instrumentalities of the machine it should be apparent that many of the features are separately useful on other types of box forming machines. It should further be apparent that the unique principles involved in the pressure applying mechanism of the forming station are also useful in other types of machines without departing from the scope of the invention.

Having thus described my invention what I claim as novel and desire to secure by Letters Patent of the United States is:

1. In a machine for forming boxes from blanks of sheet material having a bottom portion, side wings and end wings foldably connected thereto and corner laps foldably connected to the side wings, a first station, a pair of rails at the first station and extending therefrom along a desired plane of movement of the blank, said rails being spaced apart a distance equal to the length of said side wings, means for placing a single blank on said rails at the first station with the side wings extending across said rails, bending means at the first station for bending the corner laps over said rails, feed means effective after said laps are bent for feeding the blanks along said rails, and guide means adjacent the outer surfaces of said rails and forming with said rails a substantially closed path for maintaining the corner laps in bent condition whereby the blank is guided by its corner laps in a predetermined path along said plane as it is fed along the rails.

2. A box forming machine as described in claim 1 in which the end wings remain outspread beyond the rails and in said plane after operation of the bending means and which also includes a second station having adhesive applying means outside said rails for coating one side of the outspread end wings as the blank is fed along said rails.

3. A box forming machine as described in claim 2 in which the adhesive applying means comprise adhesive applying rolls at one side of the plane of movement of the end wings, and pressure rolls at the other side of said plane.

4. A box forming machine as described in claim 1 in which the end wings of the blank are provided with extensions foldably connected thereto, said end wings and their extensions remaining outspread beyond the rails and in said plane after operation of the bending means, said machine also including a third station having support plates spaced outwardly from said rails and adapted to support the end wings at the fold lines connecting said extensions to the end wings, folding members having first surfaces converging from one side of the blank into the plane of movement of said extensions as the blank is fed along said rails for progressively bending the extensions over said plates.

5. A box forming machine as described in claim 4 in which said folding members are provided with additional surfaces converging from the opposite side of the blank into the plane of movement of said extensions after bending by said first converging surfaces for further bending the extensions in the same direction to impart a permanent bend thereto.

6. In a machine for forming boxes from blanks of sheet material having a bottom portion, side wings and end wings foldably connected thereto, and corner laps and extensions foldably connected to the side wings and end wings, respectively; a first station, a pair of rails at the first station and extending therefrom along a desired plane of movement of the blank, said rails being spaced apart a distance equal to the length of said side wings, means for placing a single blank on said rails at the first station with the side wings extending across said rails, bending means at the first station for bending the corner laps over said rails with the end wings and their extensions remaining outspread beyond the rails and in said plane, feed means effective after said laps are bent for feeding the blanks along said rails, guide means adjacent the outer surfaces of said rails forming with said rails a substantially closed path for maintaining the corner laps in bent condition whereby the blank is guided by its corner laps as it is fed along the rails in said plane, a second station through which extend said rails and having adhesive applying means outside said rails for coating one side of the outspread end wings and their extensions as the blank is fed along said rails, a third station through which said rails extend and having support plates spaced outwardly from said rails and adapted to support the end wings at the fold lines connecting said extensions to the end wings, and folding members having first surfaces converging from one side of the blank into the plane of movement of said extensions as the blank is fed along the rails for progressively bending said extensions over said plates, said members also being provided with additional surfaces converging from the opposite side of the blank into the plane of movement of said extensions after bending by the first converging surfaces for further bending said extensions in the same direction to an extent sufficiently to cause a permanent bend to be imparted to said extension without causing the adhesively coated surfaces of the end wings and their extensions to become engaged.

7. A box forming machine as described in claim 1 in which the bending means comprise arms swingable from open to closed positions for bending the corner laps over the rails, said arms having surfaces on their inner ends spaced from the outer surfaces of said rails when said arms are in their closed positions for forming with said rails a portion of said closed path for guiding the blank by its corner laps as it is fed along said rails.

8. A box forming machine as described in claim 7 in which said arms are also provided with extensions engaging one surface of the bottom portion of the blank for maintaining the blank on said rails with the corner laps in said closed paths.

9. A box forming machine as described in claim 1 in which retaining plates engageable with the opposite surface of said blank from that engaging said rails are pro-

vided for forming with said rails a closed path for movement of the blank in said plane.

10. In a box forming machine as described in claim 1 and which also includes a forming station at the ends of said rails, said forming station including a form having one surface aligned with said rails at one side of said plane and corresponding substantially in outline to the bottom portion of the blank, said form also having other surfaces aligned with the outer surfaces of said rails and defining a portion of said closed path, additional guide means adjacent said other form surfaces and forming a continuation of said closed path for retaining the corner laps in bent condition as the blank is fed over said one surface, side wing folding members spaced apart a distance corresponding to the dimension of said bottom portion where the side wings are connected, said folding members being aligned with further surfaces of said form and extending perpendicularly from the other side of said plane, and means for moving said form toward said folding members for moving the bottom portion of the blank bodily out of said plane and between the folding members to cause the side wings to be folded over the form, said additional guide means acting to maintain the corner laps in bent condition as the side wings are folded.

11. In a box forming machine as described in claim 5 and which also includes a forming station into which the blank is fed after passing through said third station, said forming station including a two-part form, one plate-like part of which has a surface aligned with said rails in said plane, said surface having an outline corresponding to the bottom portion of the blank, a pair of opposed pressure plates spaced apart a distance slightly greater than the dimension of the bottom portion of the blank where the end wings are connected, means for moving the plate-like part of the form normal to said surface for moving the bottom portion of the blank bodily out of said plane and between the pressure plates to cause the end wings to be folded over the plate-like form part, the end wing extensions due to their permanent bend extending inwardly of the end wings after folding, the other part of the form being shaped to be received inside the folded end wings, and means for moving said other form in the same direction following the movement of the plate-like part for folding the inwardly extending end wings extensions over the end wings, said other form part thereafter acting to support the ends of the formed box upon subsequent application of pressure by the pressure plates.

12. In a box forming machine as described in claim 11 and including holddown members disposed in the path of movement of the plate-like part of the form and engageable with the bottom portion of the box blank, means mounting said holddown members for yielding movement in the same direction and to the same extent as the movement of the plate-like part which causes the end wings of the blank to be folded, said holddown members being effective during the movement of the other part of the form to prevent movement of the blank while the end wing extensions are being folded by said other form part.

13. In a box forming machine as described in claim 12 in which means are provided for retracting the holddown members from engagement with the box blank bottom portion after completion of the movement of the other form part whereby the formed box is removable from the forming station and the holddown members are returned to their initial positions for engagement with the next blank to be formed.

14. In a machine for forming boxes from flat blanks of sheet material having a bottom portion, side wings and end wings foldably connected thereto and extensions foldably connected to the end wings, means for imparting a permanent bend to said extensions out of the flat plane of the end wings, a forming station into which a blank is fed after the extensions are bent by the imparting means, said forming station including a two-part form, one plate-like part of which has a surface having an outline corresponding substantially to the bottom portion of the blank, a pair of opposed pressure plates spaced apart a distance slightly greater than the dimension of the bottom portion of the blank where the wings are connected, means for moving the plate-like part of the form normal to said surface for moving the bottom portion of the blank bodily between the pressure plates to cause the end wings to be folded over the plate-like form part, the end wing extensions due to their permanent bend extending inwardly of the end wings after folding, the other part of the form being shaped to be received inside the folded end wings, means for moving other said form part in the same direction following the movement of the plate-like part for folding the inwardly extending extensions inwardly over the end wings, holddown members disposed in the path of movement of the plate-like part of the form and engageable with the bottom portion of the box blank, means mounting said holddown members for yielding movement in the same direction and to the same extent as the movement of the plate-like part while the end wings are being folded, said holddown members being effective during the movement of the other part of the form to prevent movement of the blank while the end wing extensions are being folded by said other form part.

15. In a box forming machine as described in claim 14 in which means are provided for retracting the holddown members from engagement with the box blank bottom portion after completion of the movement of the other form part whereby the formed box is removable from the forming station and the holddown members are returned to their initial positions for engagement with the next blank to be formed.

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