July 9, 1957 E. C. CLEMENT 2,798,416

BOX MAKING DIE

Filed April 19, 1954 4 Sheets-Sheet 1

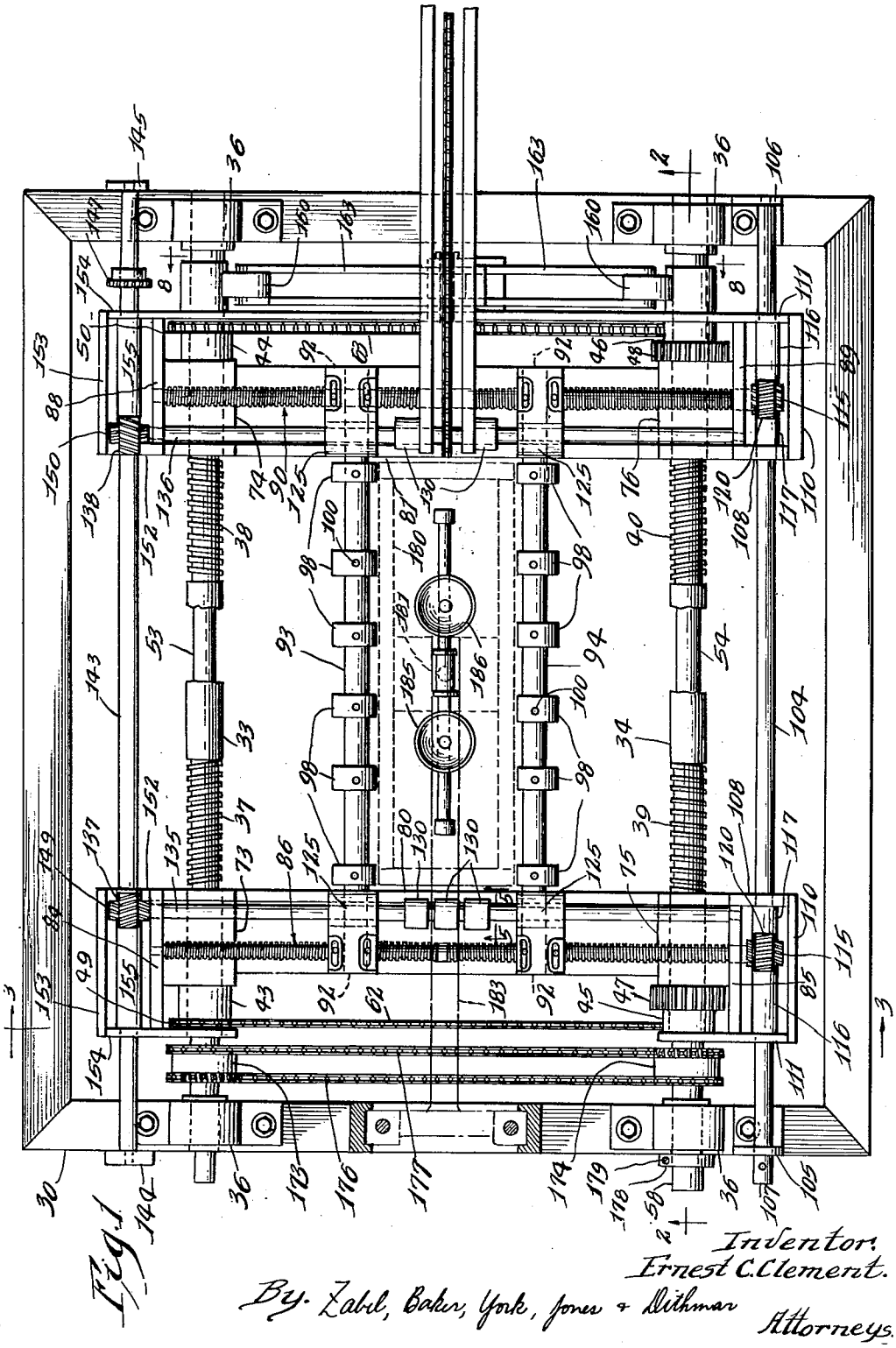


Fig. 1

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BOX MAKING DIE

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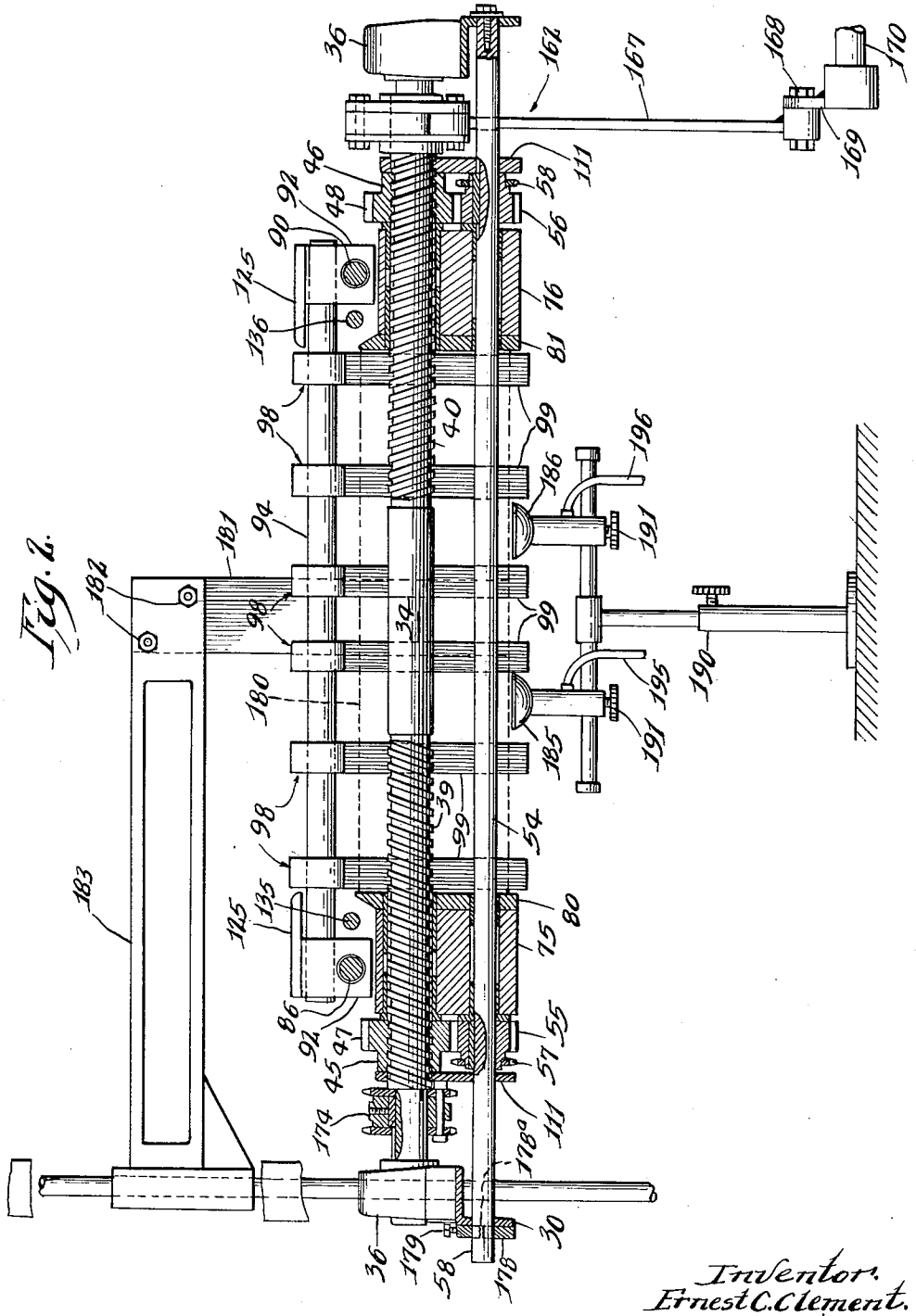



Fig. 2.

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BOX MAKING DIE

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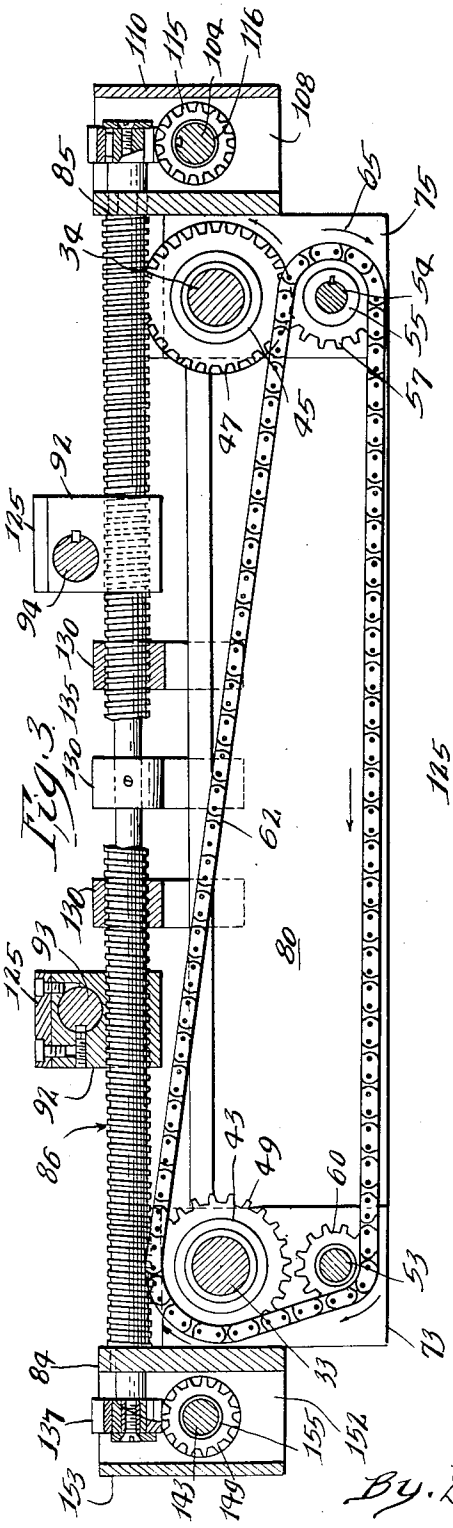


Fig. 3.

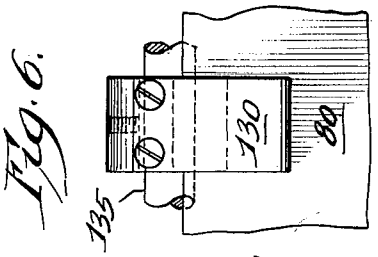


Fig. 6.

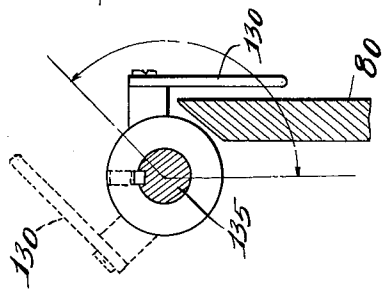


Fig. 5.

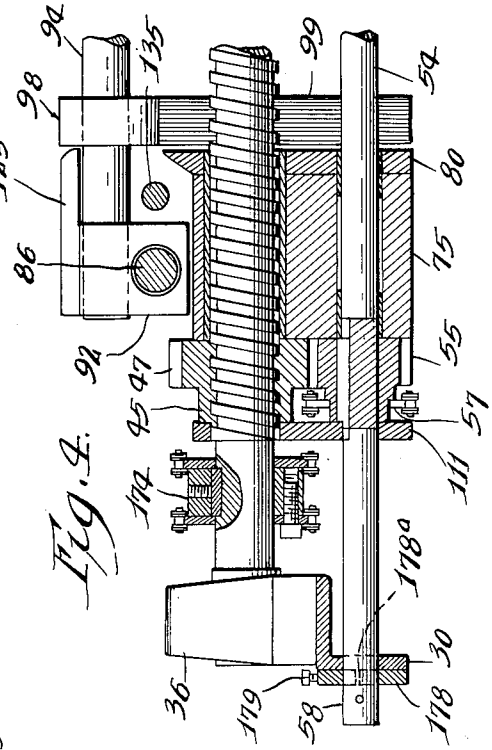


Fig. 4.

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BOX MAKING DIE

Filed April 19, 1954 4 Sheets-Sheet 4

Fig. 7.

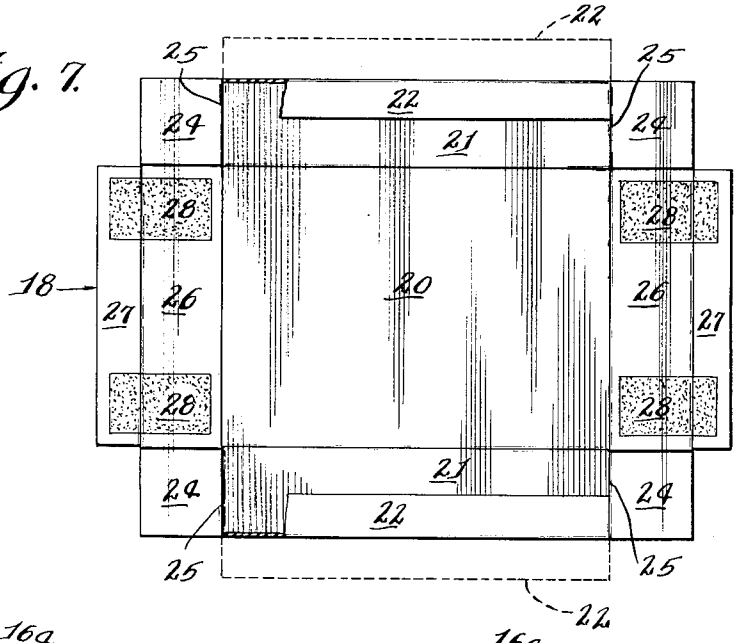
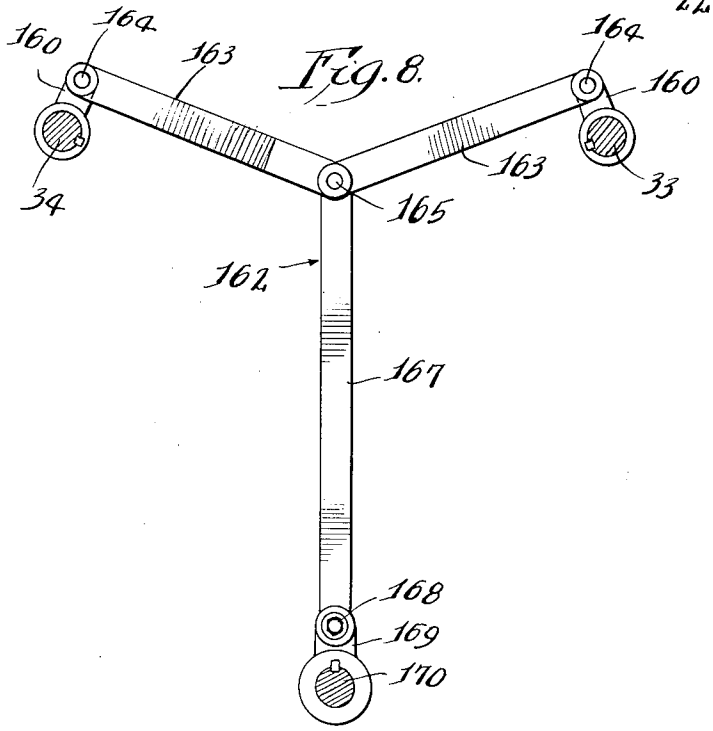



Fig. 8.




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2,798,416

# BOX MAKING DIE

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Application April 19, 1954, Serial No. 424,149

2 Claims. (Cl. 93—51)

This invention relates to a die for making boxes of cardboard or like material, and more particularly to a die which is capable of quick and easy adjustment for boxes of different sizes.

One important object of the invention is to provide a box making die which avoids the use of change parts for boxes of different sizes. Apart from simple, continuously variable adjustments of the die itself, the only element necessary for making a box of a particular size is a plunger having an exterior shape and size corresponding with the interior shape and size of the desired box. This plunger is of inexpensive construction and quickly and easily installed in a machine utilizing the die of the invention.

Another object of the invention is to provide a die capable of fabricating a box having double layer end walls, although the die is equally effective to form a box having single layer end walls.

Another object of the invention is to provide a box making die capable of an extremely high rate of production. This high productivity rate is made possible because the moving parts of the die exert an extremely high pressure on those portions of the box which are secured together by adhesive. As is well known, proper setting of the adhesive used is a function of both time and amount of applied pressure. Thus with pressure of maximum amount, as provided by the invention, the time required for application of the pressure is minimized with the result that the productivity rate of the die may be extremely high.

Another object of the invention is to provide a box making die of such construction that mechanical failure is not likely to occur in the event that two or more box blanks simultaneously are fed into the die. Prior dies of this general character have marginal castings or framework which are stressed as a result of the adhesive-setting pressure applied to the box by the moving parts of the die, and this marginal casting or framework is highly subject to failure when two or more box blanks accidentally enter the die. The present die does not have castings or framework members which are subject to such stresses.

Still another object of the invention is to provide a box making die wherein the amount of adhesive-setting pressure applied to a box by the die may be varied while the machine in whch the die is used continues in operation. In other words, it is unnecessary to stop the machine in order to make an adjustment which will increase or decrease the pressure applied by the movable die parts.

Still another object of the invention is to provide a box making die which utilizes more or less the same structural elements for the dual function of adjusting the distance between the movable parts of the die and for moving these parts under substantial pressure to set the adhesive used in the box ends.

Another object of the invention is to provide a box making die which is a self-contained unit, that is, a unit which bears a sub-assembly relationship to the box making machine in which the die is incorporated. Thus the die with all its adjustability features etc. may be fabricated apart from the machine and easily installed therein.



Other objects, advantages and details of the invention will be apparent as the description proceeds, reference being had to the accompanying drawings wherein one form of the invention is shown. It is to be understood, however, that the description and drawings are illustrative only and that the scope of the invention is to be measured by the appended claims.

In the drawings:

Fig. 1 is a top plan view of a box making die embodying this invention, certain cooperating structure being shown in dotted lines;

Fig. 2 is a sectional view on line 2—2 of Fig. 1;

Fig. 3 is a sectional view on line 3—3 of Fig. 1;

Fig. 4 is an enlarged sectional view on a portion of line 2—2 of Fig. 1;

Fig. 5 is an enlarged sectional view on line 5—5 of Fig. 1;

Fig. 6 is a front elevational view of the elements shown in Fig. 5;

Fig. 7 is a top plan view of a box blank usable in the die of the invention, and

Fig. 8 is an elevational view, partly in section, on line 8—8 of Fig. 1, showing a toggle-joint forming part of the invention.

Following is a detailed description of the illustrated embodiment of the invention:

## BOX BLANK

As previously mentioned, the present die is capable of making boxes of cardboard or the like which have either single or double layer side and/or end walls. Double layer walls, of course, provide strength, and thus enable the use of somewhat lighter stock for the same strength than is required for boxes having single layer walls. This invention, it is believed, will find its greatest use in the manufacture of boxes having both double layer side walls and double layer end walls.

A blank **18** for such a box, suitable for use in the invention, is shown in Fig. 7. The central blank portion **20** constitutes the box bottom, the portions **21** constitute one layer of the two side walls and the portions **22** constitute the other layer of the side walls.

The side wall portions **21** and **22** are provided with suitable adhesive and portion **22** is folded over, as shown, and pressed into securing engagement with the portion **21** by conventional means before the blank reaches the die. Thus, the present die is not concerned with the formation of the double layer side walls, and, as mentioned above, use of same is optional.

At each end of side wall portions **21** is a tab **24** which is foldable along a scored line of attachment **25** with portion **21** to an ultimate position at right angles to the portion **21**. The die is effective to produce the required folding of tabs **24**, this folding being initiated just prior to the folding of the following described box end walls.

The end walls comprise portions **26** which are contiguous to bottom **20** and, in the case of double end walls, portions **27**.

Before a box blank **18** reaches the present die, suitable adhesive is applied by conventional means to the blank on predetermined areas such as those designated by **28** which embrace areas of both portions **26** and **27** of the end walls.

## GENERAL OPERATION OF THE DIE

A box blank **18**, as described above and illustrated in Fig. 7, is fed by suitable conveyor means to a centered position with respect to the present die, the blank lying

in a horizontal plane on the top of the die. A vertically movable plunger, later to be described in detail, having external dimensions which correspond generally with the internal dimensions of the box under construction descends into engagement with bottom portion **20** of the blank. As bottom portion **20** and the remaining portions of the blank are pushed downwardly by continued movement of the plunger, corner control elements of the die are effective to start the folding of corner tabs **24** before the folding of the other blank portions commences. This insures that tabs **24** ultimately will have proper relation with the end wall portions **26** and **27**.

As the plunger continues its downward stroke, tabs **24** continue to be folded with respect to side wall portions **21**. At the same time side wall portions **21** and end wall portions **26** are folded along their scored lines common with bottom portion **20** until they assume a generally right angle relationship with bottom portion **20**. When this relationship is reached the tabs **24** are at right angles to adjoined portions **21** and are flush against inside surfaces of the upturned end portions **26**.

In practice, the die may be constructed so that side wall portions **21** are folded through an angle which exceeds 90 degrees by a small amount so that following inherent "spring back" the final wall will have a more exact 90 degree relation with the box bottom.

When the plunger reaches its lowermost stroke position, bottom portion **20** of the blank is disposed in a plane defined by a plurality of suction means, later to be described, which are energized to retain bottom portion **20** in said plane. The plunger then is caused to move upwardly and out of the partially formed box, the latter being stripped from the plunger by reason of the suction means which holds the box against upward movement.

When the plunger is free of the partially formed box, a plurality of end wall tucking fingers function to fold end wall portions **27** inwardly and bring them into engagement with inner surfaces of the tabs **24** and portions **26** where they are held momentarily by the previously applied adhesive of areas **28**. The tucking fingers thereafter are withdrawn and the plunger immediately moves downwardly into the partially formed box.

When the plunger reaches its lowermost position, movable portions of the die, namely front and rear pressure plates which lie adjacent the end walls of the box, travel toward the plunger under extremely high pressure. This, of course, applies severe pressure to the end walls of the box, and the pressure is effective to set the adhesive in an extremely short period of time.

Thereafter, the movable portions of the die (pressure plates) move apart, the suction means are deenergized and the plunger travels upwardly carrying with it the now completely formed box. When the plunger and box clear the die, the succeeding box blank **18** is moved into position on the die. Thereafter a stripper removes the completed box from the plunger, the box dropping to the upper surface of the succeeding box blank. A suitable sweeper then functions to eject the completed box from the vicinity of the die and the above described sequence is repeated with the succeeding blank **18** then in position on the die.

## CONSTRUCTION OF THE DIE

### (*a*) *basic structure*

Referring now to Figs. 1–6 of the drawings, a die embodying this invention includes a supporting framework **30**. This framework, illustrated as a simple rectangle made up of angle irons, may be as shown or it may consist of a more or less equivalent framework which is a part of the more extensive framework of the entire machine of which the present die is a part. The present die, as will be seen, has only a few structural connections with supporting framework **30**; therefore the die proper may be constructed as a self-contained unit regardless of whether a separate framework **30** is provided or the framework **30** is a part of the framework of the entire machine. In either case, the die proper has a sub-assembly relationship to the entire machine.

Since the direction of box blank feed through the die is from right to left, looking at Fig. 1, the right hand portion of Fig. 1 will be referred to as the rear of the die and the left hand portion will be referred to as the front of the die. Also, the term "longitudinal" will refer to the direction between the front and the rear of the die while the term "transverse" will refer to the direction at right angles thereto or between the two sides of the die.

A feature of basic importance in a die embodying this invention is the provision of screw means which extends longitudinally of and are journalled on framework **30**. In the form of the invention shown this important screw means feature comprises a pair of laterally spaced main shafts **33** and **34** which extend between the front and rear ends of framework **30** and which are journalled for rotation with respect to the framework. Thus, each shaft end is journalled for rotation in a bearing or pillow block **36** which is suitably secured as by bolts to framework **30**. Bearing or pillow blocks **36** preferably are of the self-alignment type so as to avoid alignment problems and excessive, rigid structure otherwise necessary to maintain proper alignment.

Main shafts **33** and **34**, as will be seen, have dual functions. They cooperate both to provide adjustment for different box lengths and to apply adhesive-setting pressure to the box ends.

Main shaft **33** has its opposite end portions provided with threads of opposite hand, e. g. the left hand portion may have right hand threads **37** in which case the right end portion would have left hand threads **38**. Similarly, main shaft **34** has its opposite end portions provided with threads of opposite hand. While it is possible to thread corresponding ends of the two shafts with threads of the same hand, it is preferred to thread such corresponding ends with threads of opposite hand, in which case the left end portion of main shaft **34** is provided with left hand threads **39** and the right end is provided with right hand threads **40**. This relationship of threads, as will be seen, enables the use of and the mechanical benefits provided by a toggle-joint arrangement for rotating the main shafts **33** and **34** in connection with the pressure applying function of the shafts.

Each end portion of each main shaft **33** and **34** is provided with a nut which is threaded internally to cooperate with the threads of its associated end portion. Thus, referring to Fig. 1, main shaft **33** has nut **43** threaded on its left end portion and nut **44** threaded on its right end portion. Similarly, main shaft **34** has nut **45** threaded on its left end portion and nut **46** threaded on its right end portion.

Nuts **45** and **46** on main shaft **34** have an exterior portion comprising spur gears **47** and **48**, respectively. As shown, spur gears **47** and **48** are integral with nuts **45** and **46** but other equivalent arrangements may be used.

Nuts **43** and **44** on main shaft **33** have associated sprockets **49** and **50**, the sprocket **49** being best shown at the left in Fig. 3.

The various nuts **43**, **44**, **45** and **46** and their associated spur gears and sprockets are elements which, like main shafts **33** and **34**, have dual functions. As will be seen, they cooperate both to provide adjustment for different box lengths and to apply adhesive-setting pressure to the box ends.

Nuts **43**, **44**, **45** and **46** are ganged together to rotate in synchronism in such direction that the two left nuts (Fig. 1) move in one direction when the two right nuts move in the opposite direction. This movement of the nuts, responsive to nut rotation, is relied on to adjust the die for different box lengths. The illustrated means for rotating the nuts in proper synchronism will now be

described. This means also is effective, when not used to rotate the nuts, to restrain the nuts against rotation when the main shafts 33—34 are rotated in connection with the pressure applying function of the die.

*(b) Remaining elements providing box length adjustment*

Referring to Figs. 2 and 3, an adjusting countershaft is disposed directly below each of the main shafts 33 and 34, the countershafts being suitably journalled in framework 30, as best shown in Fig. 2. Thus, adjusting countershaft 53 is disposed in spaced relation below main shaft 43 and adjusting countershaft 54 is similarly disposed below main shaft 34.

Referring to adjusting countershaft 54, best shown in Fig. 2, spur gears 55 and 56 are splined thereto in such positions as to mesh with gears 47 and 48, respectively. Thus, gears 55 and 56 are slidable along countershaft 54 by virtue of the splined relationship. With this arrangement, rotation of countershaft 54 by, for example, a crank applied to left end 58 causes nuts 45 and 46 to rotate in the same direction, a direction which, incidentally, is opposite to that of the countershaft rotation. Due to the threads of opposite hand on the two end portions of main shaft 34, when the nuts 45 and 46 are rotated in one direction they move toward one another and when rotated in the opposite direction they move away from one another.

Still referring to Fig. 2, spur gears 55 and 56 have associated sprockets 57 and 58, respectively. The sprocket 57 also is well shown in Fig. 3 at the right.

Adjusting countershaft 53 has take-up sprockets 60 (Fig. 3 at left) splined thereto, one at each end below the sprockets 49 and 50 associated with main shaft nuts 43 and 44. Thus sprockets 60 are slidable longitudinally of countershaft 53.

Referring to Fig. 3, an endless chain 62 passes around sprocket 57 at the right, sprocket 49 at the left and take-up sprocket 60 at the left. A similar endless chain 63 (Fig. 1 at right) passes around sprocket 58 on countershaft 54, sprocket 50 on nut 44 of main shaft 33 and the sub-adjacent take-up sprocket 60 (not shown).

With this arrangement, when countershaft 54 is rotated by a crank applied to front end 58 in, for example, clockwise direction, as indicated by arrow 65, the chain will travel and the various sprockets 57, 60 and 49 will rotate in the directions indicated by the other arrows applied to Fig. 3. Thus, main shaft nuts 43 and 45 will rotate a like amount in opposite direction and, due to threads 37 and 39 of opposite hand on corresponding ends of main shafts 33 and 34, the nuts 43 and 45 will travel longitudinally of main shafts 33 and 34 through corresponding distances in like direction.

Similarly, nuts 44 and 46 at the opposite ends of main shafts 33 and 34 will travel longitudinally of the shafts through corresponding distances and in like direction, the travel direction of the latter nuts being opposite to that of nuts 43 and 45. This equal and opposite travel of the nuts at the two ends of main shafts 33 and 34 provides adjustments for boxes of different lengths, as will be seen.

The respective nuts 43, 44, 45 and 46 engage back-up blocks 73, 74, 75 and 76 (Fig. 1). As more clearly shown in Figs. 2 and 4, the back-up blocks are provided with apertures having internal bearing elements. Back-up block 75, for example, is mounted on main shaft 34 and sub-adjacent countershaft 54, the two shafts passing through the apertures and associated bearings. Thus, back-up block 75 is slidable along the two shafts and, as will be seen, its longitudinal movement is the same as that of associated main shaft nut 45. The other back-up blocks are similarly constructed and similarly mounted on their related two shafts in association with their co-operating main shaft nuts.

A front pressure plate 80 is carried by the two back-up blocks 73 and 75, the plate extending transversely of the die. Similarly, a rear pressure plate 81 is carried by back-up blocks 74 and 76, this pressure plate also extending transversely of the die and in parallelism with front pressure plate 80. As shown in Figs. 2 and 4, pressure plates 80 and 81 have a substantial vertical dimension which enables them to accommodate boxes of different predetermined heights. The two plates are suitably apertured as shown in Fig. 2 to pass the main shafts 33—34 and the countershafts 53—54.

The longitudinal spacing of pressure plates 80 and 81 is adjusted by the adjusting arrangement described above, and, generally speaking, the adjusted distance between the plates determines the length of the box formed by the die. It will be seen from the relative lengths of main shaft threads 37, 38, 39 and 40 in Figs. 1 and 2 that the die is capable of adjustment for boxes of widely different lengths and that no change parts, other than the simple plunger previously referred to, are necessary for conditioning the die for these different lengths.

As previously mentioned, the aforesaid adjusting arrangement also is effective to restrain the nuts against rotation when the main shafts 33—34 are rotated, as will be seen, in connection with moving the pressure plate under adhesive-setting pressure.

*(c) Elements providing box width adjustment*

Referring to Figs. 1 and 3, the back-up blocks 73 and 75 respectively carry side plates 84 and 85. A transversely extending front side guide adjusting screw 86 has its ends journalled in side plates 84 and 85. Similarly, back-up blocks 74 and 76 have side plates 88 and 89 in which are journalled the ends of a rear side guide adjusting screw 90.

Front and rear side guide adjusting screws 86 and 90 each have opposite end portions threaded with threads of opposite hand. Corresponding end portions of the two adjusting screws have threads of like hand.

Each end portion of the side guide adjusting screws 86 and 90 carries a nut 92 (best shown in Figs. 2 and 4) having appropriate threads for the screw threads it engages. These nuts, as will be seen, are held against rotation, and, accordingly, the two nuts on each screw travel toward or away from each other depending on the direction the screw is turned.

A pair of side guide shafts 93 and 94 extend longitudinally of the die. The ends of shaft 93 are slidably carried and keyed within the nuts 92 (Fig. 1) associated with like end portions of screws 86 and 90 while the ends of shaft 94 are slidably carried and keyed within the nuts 92 on the opposite end portions of screws 86 and 90.

The side guide shafts 93 and 94 each carry a plurality of downwardly extending guides 98, there being six such guides 98 illustrated in Figs. 1 and 2. A guide 98 has a hub slidably carried on a shaft 93 or 94 and a downwardly extending, more or less flexible portion 99. Set screws or the like 100 are provided in the guides 98 to secure the guides to their associated shafts and enable the guides to be moved closer together or farther apart depending on the requirements of box length.

The general relationship between depending portions 99 of the guides and the horizontal is a right angle but the inwardly facing surfaces of the depending portions 99 may be contoured in a convex manner to cooperate with matching contours of the plunger sides so as to fold the box sides through an angle slightly in excess of 90 degrees, thereby providing a margin so that the box sides will be more or less exactly 90 degrees with respect to the box bottom following the inherent "spring back" of the material.

As shown in Fig. 2, depending portions 99 of the guides have a substantial vertical dimension to accommodate a reasonable range of box heights, the vertical dimension being comparable to the corresponding dimension of pressure plates 80 and 81.

Side guide adjusting screws 86 and 90 are ganged together for synchronous rotation in like direction by means of a side guide adjusting shaft 104 (located near the bottom of Fig. 1). This shaft 104 has its ends journalled for rotation in upstanding plates 105 and 106 mounted on framework 30. Left end 107 of shaft 104 is adapted to receive a crank (not shown) for rotating the shaft in either direction.

Shaft 104 extends through aligned apertures in lateral extensions 108 (Figs. 1 and 3) of pressure plates 80 and 81.

The lateral extensions 108 each carry a longitudinally extending plate 110 (Fig. 1). Plates 110, in turn, carry transversely extending plates 111 which are provided with apertures through which pass adjusting shaft 104, main shaft 34 and countershaft 54. Transverse plates 111 and their relationship with shafts 34 and 54 are well shown in Fig. 2. These transversely extending plates 111, in addition to cooperating with the presently to be described side guide adjustment assembly, also cooperate to provide proper relationship between nuts 45 and 46 and associated back-up blocks 75 and 76. Thus, when nuts 45 and 46 travel toward the ends of main shaft 34 they carry with them the transversely extending plates 111 which, in turn, are connected by longitudinally extending plates 110 and extensions 108 to the pressure plates 80 and 81. Since the pressure plates 80 and 81 are secured to back-up blocks 75 and 76 respectively, the latter likewise move toward the ends of main shaft 34.

A helical gear 115 (Fig. 1) is splined on each end portion of side guide adjusting shaft 104, the helical gears 115 being longitudinally disposed on shaft 104 in the respective regions between pressure plate extensions 108 and their associated transversely extending plates 111. Helical gears 115 are fixed on said shaft in sub-adjacent relation with the ends of side guide adjusting screws 86 and 90 by means of sleeves 116 and 117 which respectively extend between each helical gear 115 and the adjacent extension 108 and the adjacent transversely extending plate 111. Thus, as a pressure plate extension 108 and its associated transversely extending plate 111 travel along adjusting shaft 104, the helical gear 115 between the two plates will travel in its spline along adjusting shaft 104, this latter travel being assured by sleeves 116 and 117.

The side guide adjusting screws 86 and 90 each carry a helical gear 120 which meshes with one of the helical gears 115 splined to side guide adjusting shaft 104. Thus, when adjusting shaft 104 is rotated by a crank applied to end 107, the pairs of helical gears 115 and 120 are effective to rotate side guide adjusting screws 86 and 90 in synchronism, thereby moving the side guides 98 toward or away from each other.

Each nut 92 on the end portions of side guide adjusting screws 86 and 90 is capped by a corner tab control block 125. These corner tab control blocks 125 also are well illustrated in Figs. 2 and 4. These blocks function, as previously mentioned, to initiated and complete the folding of the tabs 24 of the box blank 18.

*(d) Elements for forming double layer end walls*

In order to form double layer end walls the box blank portions 27 must be folded through 180 degrees to overlie the folded corner tabs 24 of the blank. This folding operation is accomplished, as previously mentioned, after the side wall portions 21 and the first layer portions 26 of the end walls have been folded to a position at right angles to the box bottom 20. At this time the plunger moves upwardly and out of the partially formed box.

When the plunger is clear of the box end wall, tucking fingers 130 (Fig. 5) adjacent each box end move from the dotted line position to the full line position and fold in the box blank portions 27 to form the second layer of the double layer end wall. Immediately after reaching the full line position in Fig. 5, fingers 130 return to the dotted line position so the plunger may again enter the box. Thus, fingers 130 oscillate between their two limiting positions.

Tucking fingers 130 are secured to a pair of transversely extending finger shafts 135 and 136, best shown in Fig. 1. Finger shaft 135 has its ends journalled in side plates 84 and 85, and finger shaft 136 has its ends journalled in side plates 88 and 89. It will be remembered that side plates 84, 85, 88 and 89 are carried by back-up blocks 73, 75, 74 and 76, and thus they move longitudinally back and forth with the blocks and other associated apparatus.

Finger shafts 135 and 136 are ganged together to oscillate in synchronism in opposite direction in order properly to actuate the several tucking fingers 130 carried thereby. The oscillating movement is imparted to the shafts by means of a pair of helical gears 137 and 138, the former being carried on shaft 135 and the latter on shaft 136. The teeth on the helical gears 137 and 138 have opposite sense so that the two shafts 135 and 136 may be oscillated in opposite direction by means of a single operating means.

The single operating means may take the form of a longitudinally extending shaft 143 (at top of Fig. 1) which has its ends journalled in plates 144 and 145 carried respectively on the front and rear ends of framework 30. A sprocket 147 secured to shaft 143 near its rear end engages a chain (not shown) which oscillates the sprocket in timed relation with the aforesaid movement of the plunger.

Helical gears 149 and 150 are splined to shaft 143 and these gears mesh with helical gears 137 and 138, respectively, carried on the transverse finger shafts 135 and 136. Splined helical gears 149 and 150 must, of course, slide longitudinally along shaft 143 to maintain proper relation with gears 137 and 138 as the latter move back and forth for box length adjustment.

The gears 149 and 150 are retained in a cage arrangement substantially like that provided for side guide adjusting gears 115. Thus, pressure plates 80 and 81 have lateral extensions 152 which carry longitudinally extending plates 153 which in turn carry tranversely extending plates 154. The plate 154 at the rear end of the die may be a continuation of its counterpart plate 111 of the side guide adjustment apparatus. The helical gears 149 and 150 each bear on one side against a pressure plate extension 152, and a sleeve 155 extends between the opposite side of the gear and a transversely extending plate 154.

The transversely extending plates 154, as in the case of plates 111 on the opposite side of the die, have apertures which pass oscillating shaft 143 (counterpart of side guide adjusting shaft 104), main shaft 33 and countershaft 53. These plates 154, therefore, cooperate with pressure plates 80 and 81 to provide cage arrangements which confines the back-up blocks 73–74 and their associated nuts 43–44 and take-up sprockets 60. The aforesaid elements thus maintain proper relationship as they travel longitudinally along main shaft 33 and countershaft 53.

*(e) Remaining elements for moving pressure plates 80 and 81 under high pressure*

As previously mentioned, one important function of the present die is to apply extremely high adhesive-setting pressure to the box ends. The higher the pressure, the shorter may be the time of pressure application. When only a short time is required, as is possible with this invention, the productivity rate of the die may be extremely high.

The high pressure is applied by pressure plates 80 and 81 which are caused to travel toward each other when the plunger is at lowermost position in the second of the two strokes necessary in the manufacture of a box.

This high pressure movement of pressure plates **80** and **81** is produced by rotating main shafts **33** and **34** through a portion of a revolution, the main shaft nuts **43**, **44**, **45** and **46** being at that time restrained against rotation. Following movement of pressure plates **80** and **81** toward each other they are moved away from each other through the same distance. Thus, these two movements may be accomplished by oscillating the main shafts **33** and **34** in synchronism, the oscillations, of course, being in timed relation with the second stroke of the plunger.

Various means may be provided to oscillate main shafts **33** and **34** in synchronism. With the threads of the main shafts as indicated at **37**, **38**, **39** and **40**, it is preferred to utilize a toggle-joint arrangement for oscillating the two shafts. Such an arrangement has a highly desirable mechanical advantage which cooperates with the mechanical advantage afforded by the threaded main shafts to develop extremely high pressure. One form of toggle-joint arrangement is shown in plan view in Fig. 1, in side elevation in Fig. 2 and in end elevation in Fig. 8, the latter being a sectional view on line **8—8** of Fig. 1.

Referring to Figs. 1 and 8, shafts **33** and **34** each are provided with a crank arm **160**. These crank arms, of course, are keyed to the respective shafts.

A toggle-joint **162** has toggle-links **163** pivoted at their free ends to the crank arms **160**, as shown at **164**. The opposite ends of toggle-links **163** are pivoted together at a common pivot **165**.

Suitable means are provided to reciprocate pivot **165** so as to oscillate the main shafts **33** and **34**. As illustrated in Figs. 2 and 8, toggle-joint link **167** has one end pivoted to common pivot **165** of the toggle-joint and the other end pivoted at **168** to a crank arm **169** carried on a rotatable shaft **170**. The latter, of course, is rotated in properly timed relation with the second plunger stroke.

Referring to Figs. 1 and 2, the forward ends of shafts **33** and **34** respectively carry double sprockets **173** and **174**. These double sprockets are keyed to the shafts as shown in Fig. 2 and they may be referred to as "coordinating sprockets" since they cooperate to insure that main shafts **33** and **34** oscillate in opposite directions in exactly equal amount.

Referring to Fig. 1, each pair of transversely aligned sprockets of the double sprockets **173** and **174** are connected by a length of sprocket engaging chain. Thus, chain **176** connects the left hand (Fig. 1) transversely aligned sprockets and chain **177** connects the right hand aligned sprockets. The end of each chain wraps around a portion only of its associated sprocket and the two chains are so arranged on the sprockets that they cross at a point midway between the double sprockets **173** and **174**. The referred to crossing of the chains is such that it would be observed by looking at the chains from the left end of Fig. 1.

As will be understood, chains **176** and **177** provide a connection between main shafts **33** and **34** which insures that the illustrated toggle-joint will oscillate the two shafts in opposite directions through angles of exactly equal amplitude, a condition necessary for proper pressure application.

Generally speaking, the various gears in the box length adjustment system usually provide enough friction to lock the adjustment against change due to the pressures exerted by the above described high pressure system. However, it sometimes is desirable to provide a separate lock arrangement for example on countershaft **54** (Figs. 1, 2 and 4) to insure that no creep occurs in the box length adjustment.

Such a lock arrangement may take the form of an apertured plate **178** secured to frame **30**. End **58** of countershaft **54** passes through the aperture. Plate **178** has a slit **178***a* (Fig. 4) extending between a point on the periphery and the aperture, and a screw **179** is threaded into the plate and across the slit. Screw **179** is tightened to clamp the plate on countershaft end **58** to thus lock the shaft against creep.

*(f) The vertically movable plunger*

The previously referred to plunger is not, strictly speaking, a part of the present die. Rather, it is an element with which the die cooperates in forming boxes, as heretofore described.

A simple plunger **180** is illustrated in dotted lines at the center of Fig. 1. Generally speaking, plunger **180** has an exterior size and shape which corresponds with the interior size and shape of the box for which the plunger is designed. Plunger **180** also is shown in dotted outline in Fig. 2.

Plunger **180** (Fig. 2) has an upstanding portion **181** which is detachably secured as by bolts **182** to an arm **183** mounted for up and down movement. The means for slidably mounting arm **183** for up and down movement and imparting such movement thereto in timed relation with the box making operation are beyond the scope of this invention and hence no further detail is given.

It should be noted, however, that a plunger **180** is a simple and inexpensive element and it is easily attached to and detached from its arm **183**. These factors are of importance inasmuch as the plunger is the only change part required by the present die in making boxes of different sizes.

*(g) Suction means for holding box bottom*

Referring to Figs. 1 and 2, a pair of spaced suction cups **185** and **186** are mounted below the die with their effective surfaces lying in a common plane. As shown in Fig. 2, suction cups **185** and **186** should be adjusted vertically so that the aforesaid plane is parallel to and closely adjacent the plane of the plunger bottom when the plunger is in lowermost position. To accommodate plungers of different dimensions, vertical adjustment **190** for the suction cups may be provided.

As shown in Figs. 1 and 2, suction cups **185** and **186** are laterally spaced longitudinally of the die. If desired, means **191** may be provided to vary this longitudinal spacing in accordance with different box lengths.

Suction cups **185** and **186** are energized and deenergized through tubular connections **195** and **196** with a suction source (not shown) which in turn is energized and deenergized in timed relation with machine operation.

As previously mentioned, the suction cups **185** and **186** are energized when plunger **180** reaches its lowermost position in its first stroke of a single box making operation, the suction cups then being effective to hold the box bottom in the plane of the suction cups when the plunger rises to permit formation of the double layer end walls. The suction cups are deenergized thereafter so that the completed box may rise with the plunger as the latter completes its second stroke of the box making operation.

It will be observed from the foregoing description that a die embodying this invention is free of heavy castings or other rigid structure which heretofore has been used in connection with developing high pressures and obtaining proper alignment of bearings. Such castings or structure, as previously mentioned, are subject to harm in the event that two box blanks accidentally are fed simultaneously into the die. The super-stresses developed in the present die on such an occurrence are opposed by the extremely high tensile strength of main shafts **33** and **34** which may be of high quality steel. Thus, the chance of damage resulting from the operation of the die on two box blanks is virtually negligible.

If during a run of boxes it is found that the adhesive is not properly set, as evidenced by completed boxes which open up, a slight adjustment of the pressure plates toward each other can be made even while the machine is in operation. Such an adjustment will provide an increase in the applied adhesive-setting pressure.

From the above description it is thought that the construction and advantages of the invention will be

readily apparent to those skilled in the art. Various changes in detail may be made without departing from the spirit or losing the advantages of the invention.

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

1. A box making die comprising a supporting framework, a pair of laterally spaced main shafts extending longitudinally of and journalled on said framework, each main shaft being threaded on opposite end portions with threads of opposite hand, a nut threaded on each end portion of each main shaft, front and rear pressure plates mounted to travel longitudinally with said nuts, means rotating said nuts for varying the distance between pressure plates to provide box length adjustment, a crank arm carried on each main shaft, a toggle-joint located generally between said main shafts and having links pivoted respectively to said crank arms and to each other, means reciprocating the pivot common to said links whereby said main shafts oscillate in synchronism through a small angle in oposite directions to move said pressure plates toward and away from each other under substantial pressure, and means coordinating the rotation of said main shafts comprising double sprockets fixed one on each of the two main shafts, said double sprockets being in lateral alignment, and a pair of sprocket engaging chains cooperating with said double sprockets, each chain having its ends wrapped around a portion only of the engaged sprockets, the chains being so arranged on the sprockets that they cross at a point midway between said double sprockets.



2. In a box making die having a pair of laterally spaced main shafts rotatable in opposite direction to develop self-equalizing box-forming pressure, the combination therewith of means for rotating said main shafts comprising a crank arm carried on each main shaft, a toggle-joint located between said main shafts and having links pivoted respectively to said crank arms and to each other, a crank driven member pivoted to the common connection of said links, and means coordinating the rotation of said main shafts comprising double sprockets fixed one on each of the two main shafts, said double sprockets being in lateral alignment, and a pair of sprocket engaging chains cooperating with said double sprockets, each chain having its ends wrapped around a portion only of the engaged sprockets, the chains being so arranged on the sprockets that they cross at a point midway between said double sprockets.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 541,953 | Taylor | July 2, 1895 |
| 2,371,046 | Gregoire | Mar. 6, 1945 |