Nov. 28, 1933. J. W. LOW 1,937,027

BOX FOLDING MACHINE

Filed Nov. 23, 1931 16 Sheets-Sheet 1

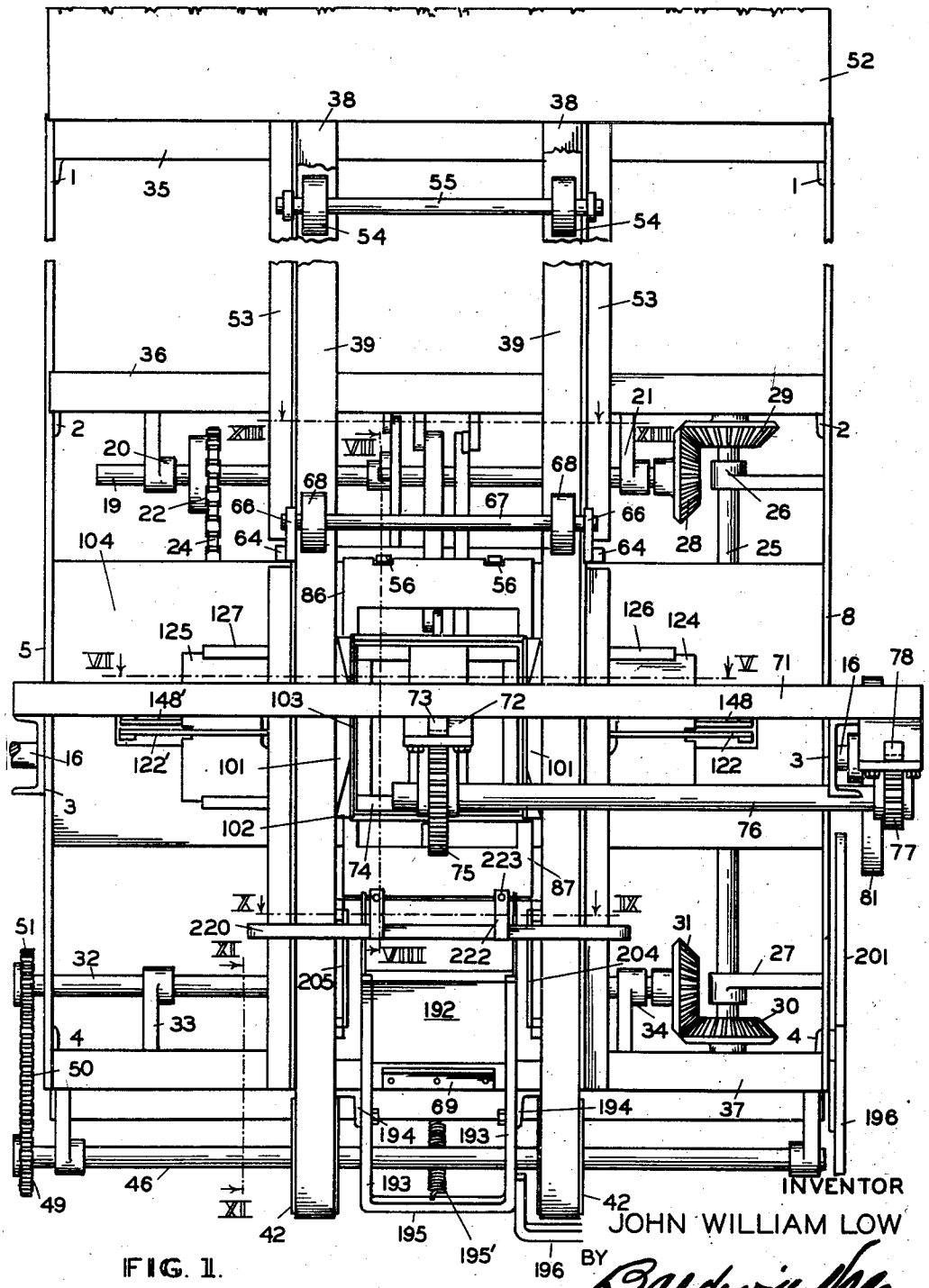

FIG. 1.

Nov. 28, 1933. J. W. LOW 1,937,027

BOX FOLDING MACHINE

Filed Nov. 23, 1931 16 Sheets-Sheet 2

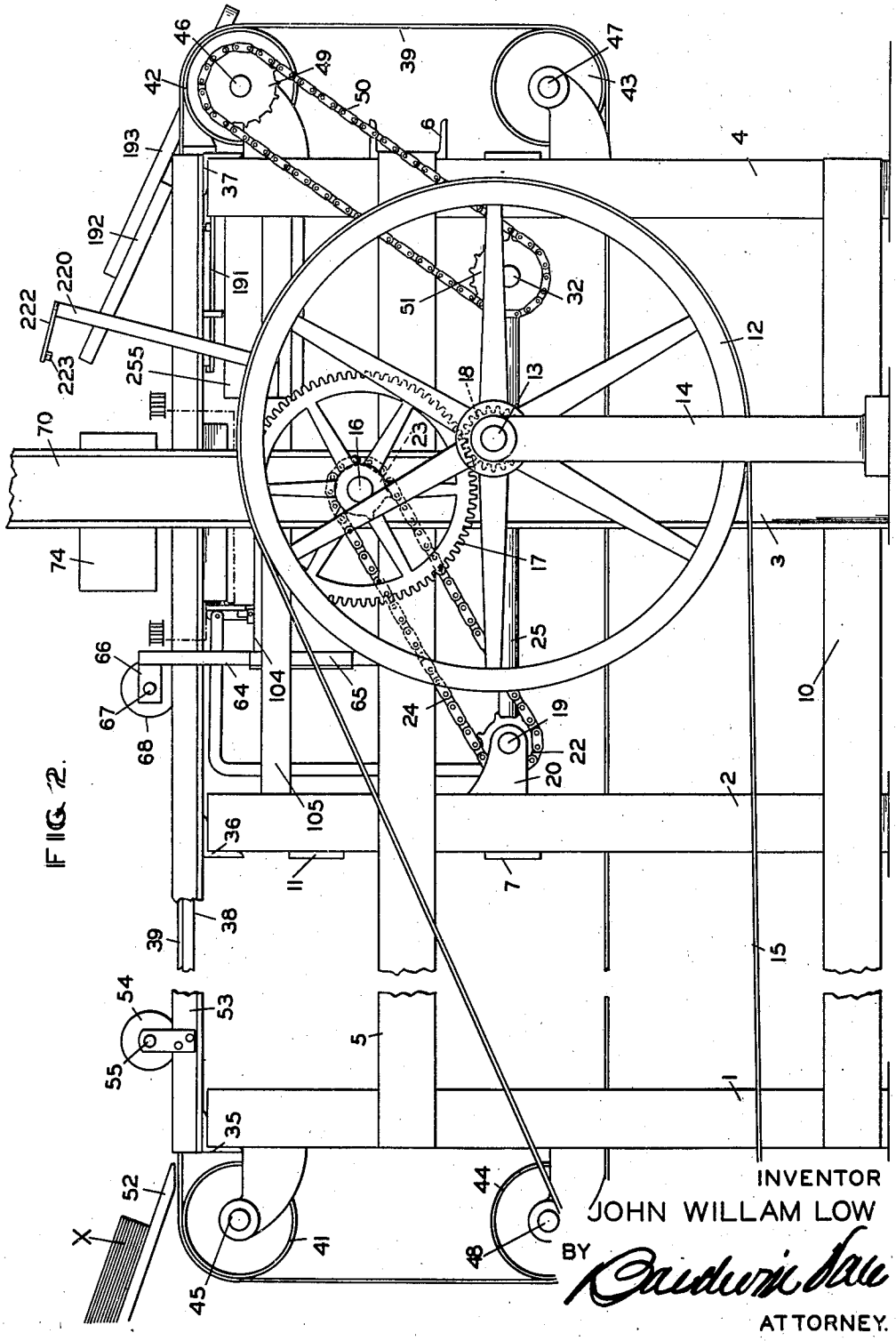

FIG. 2.

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ATTORNEY.

Nov. 28, 1933. J. W. LOW 1,937,027

BOX FOLDING MACHINE

Filed Nov. 23, 1931 16 Sheets-Sheet 3

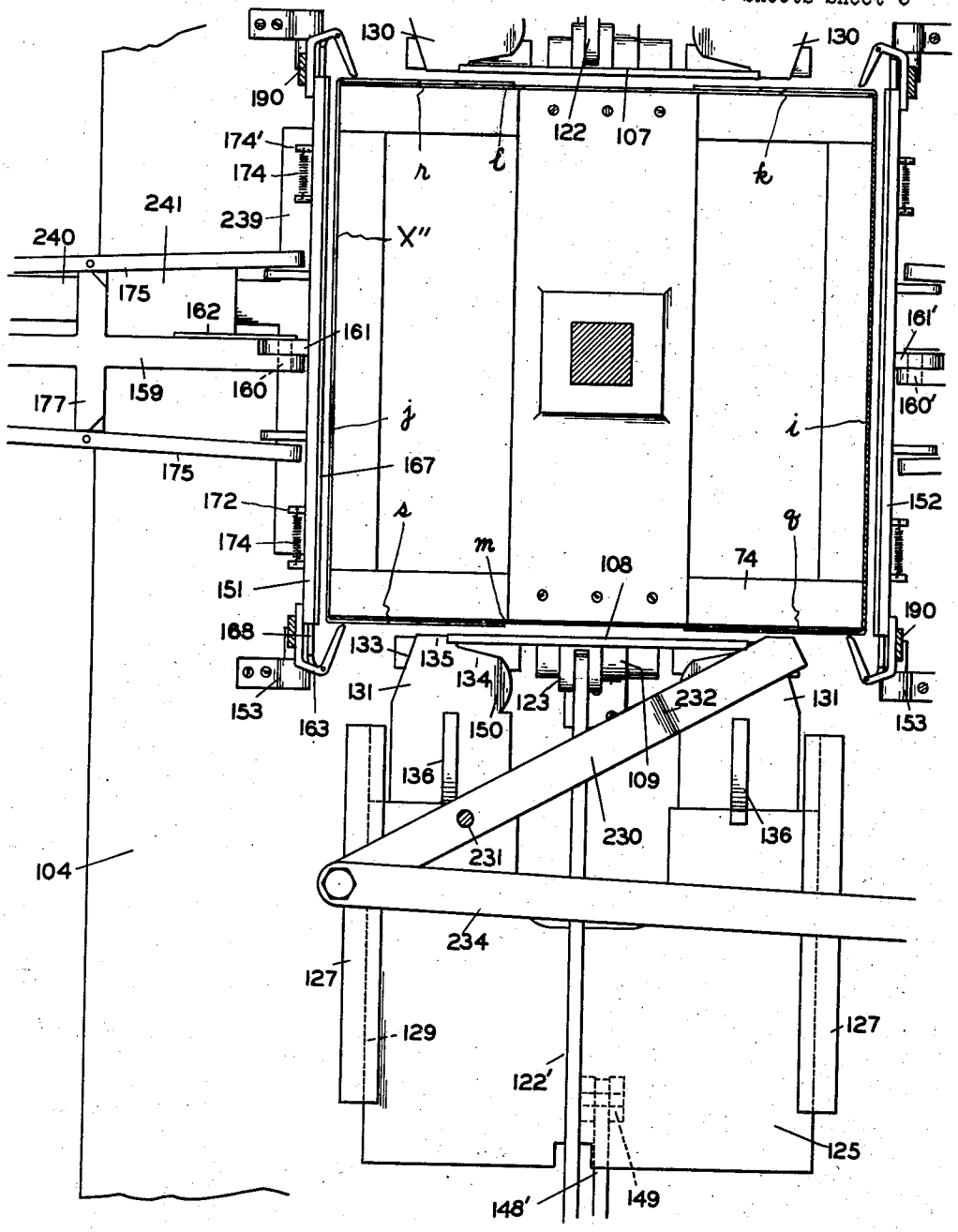

FIG. 3.

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BY Baldwin Wile
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Nov. 28, 1933. J. W. LOW 1,937,027

BOX FOLDING MACHINE

Filed Nov. 23, 1931 16 Sheets-Sheet 4

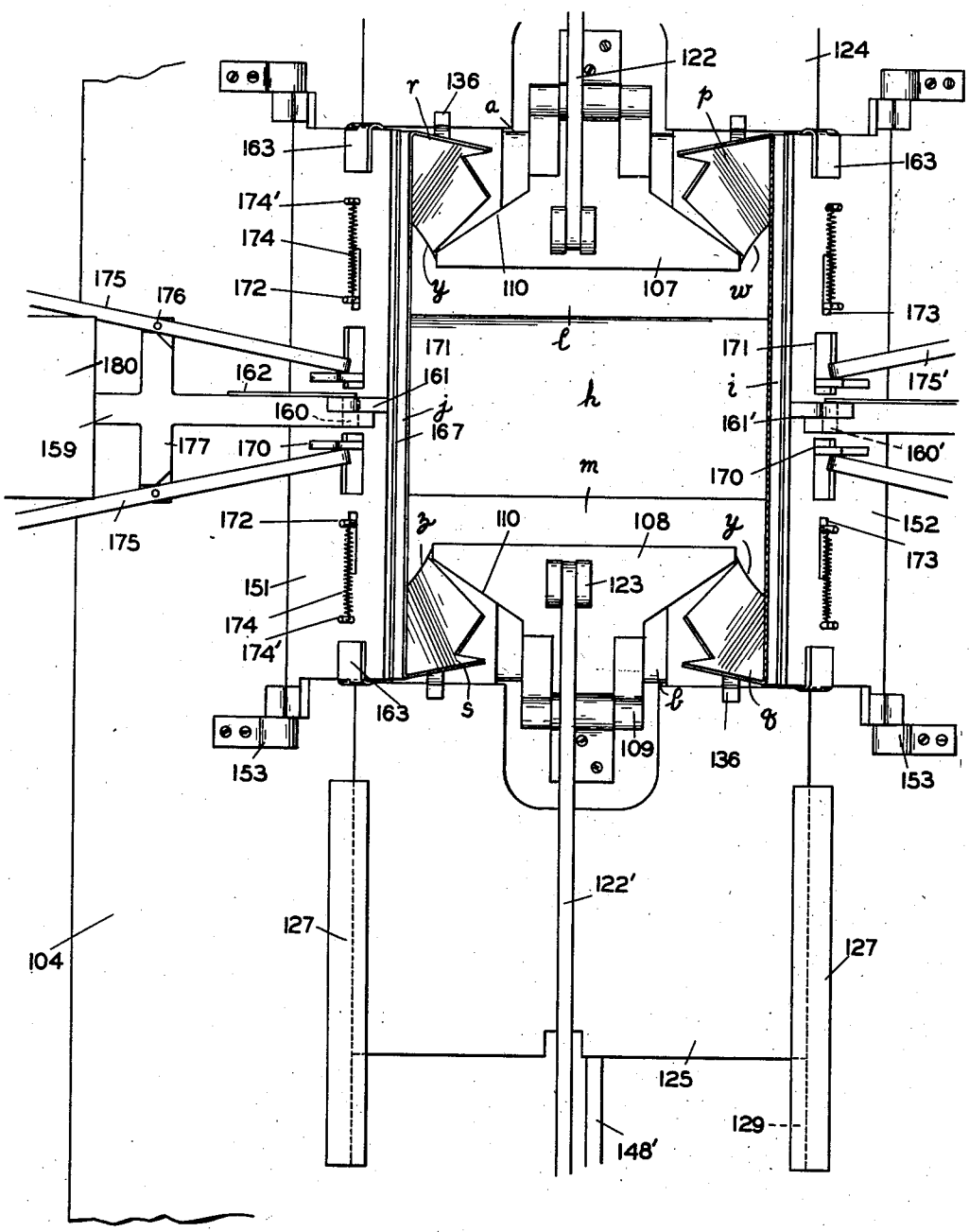

FIG. 4.

INVENTOR
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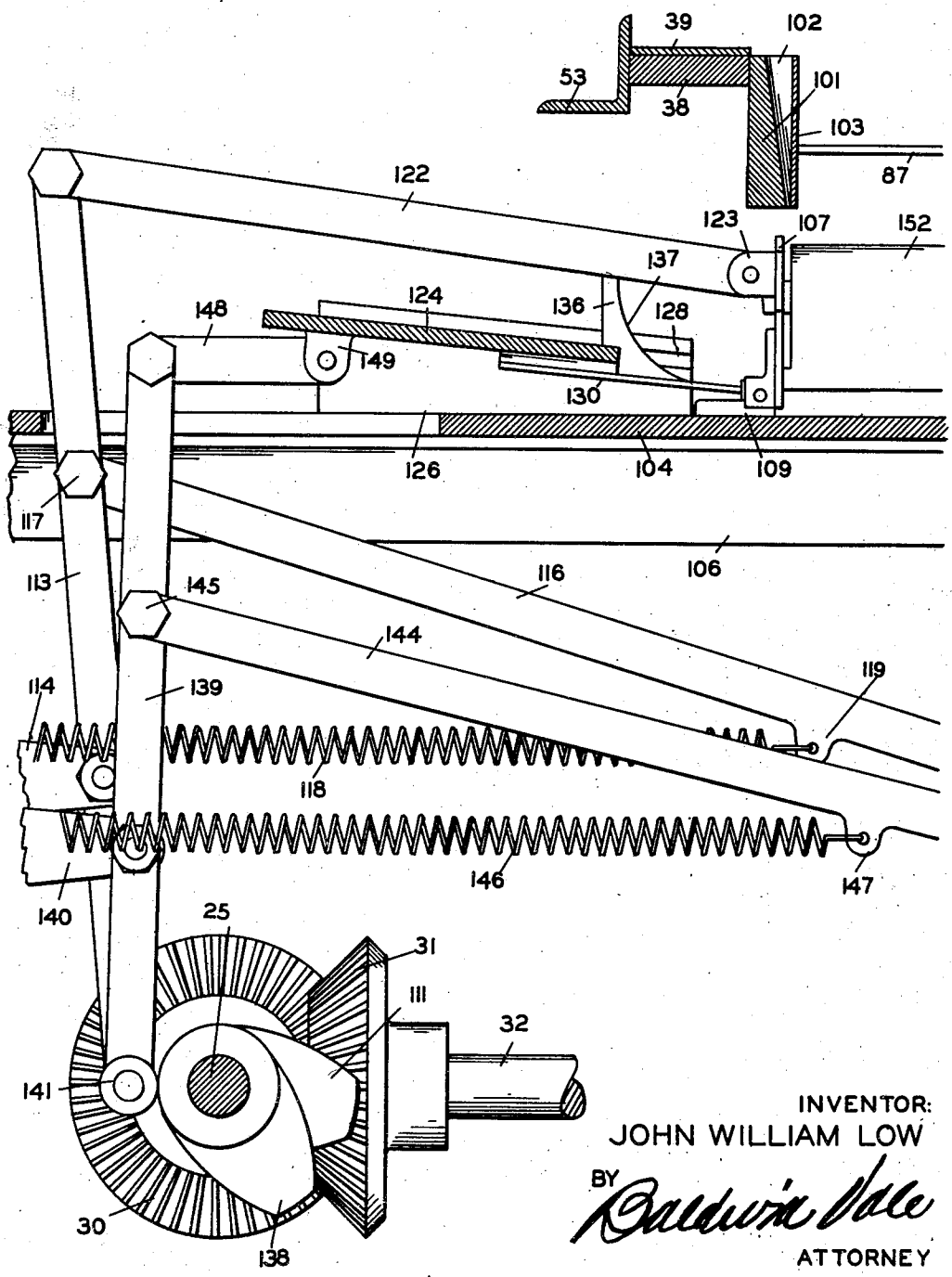
ATTORNEY

Nov. 28, 1933. J. W. LOW 1,937,027

BOX FOLDING MACHINE

Filed Nov. 23, 1931 16 Sheets-Sheet 5

FIG. 5.



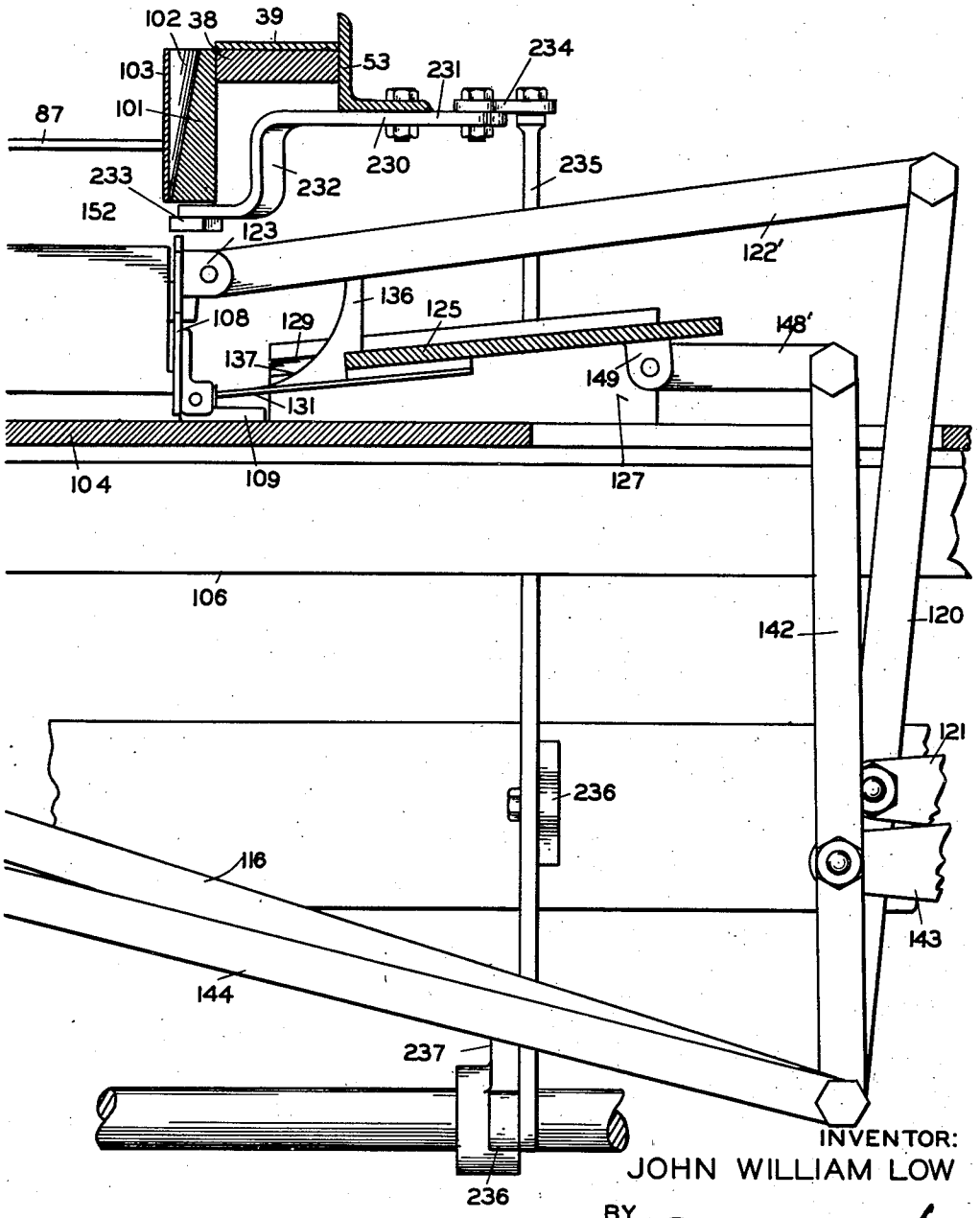
INVENTOR:
JOHN WILLIAM LOW
BY Baldwin Vale
ATTORNEY

Nov. 28, 1933. J. W. LOW 1,937,027

BOX FOLDING MACHINE

Filed Nov. 23, 1931 16 Sheets-Sheet 6

FIG. 6.



INVENTOR:
JOHN WILLIAM LOW

BY Baldwin Hale

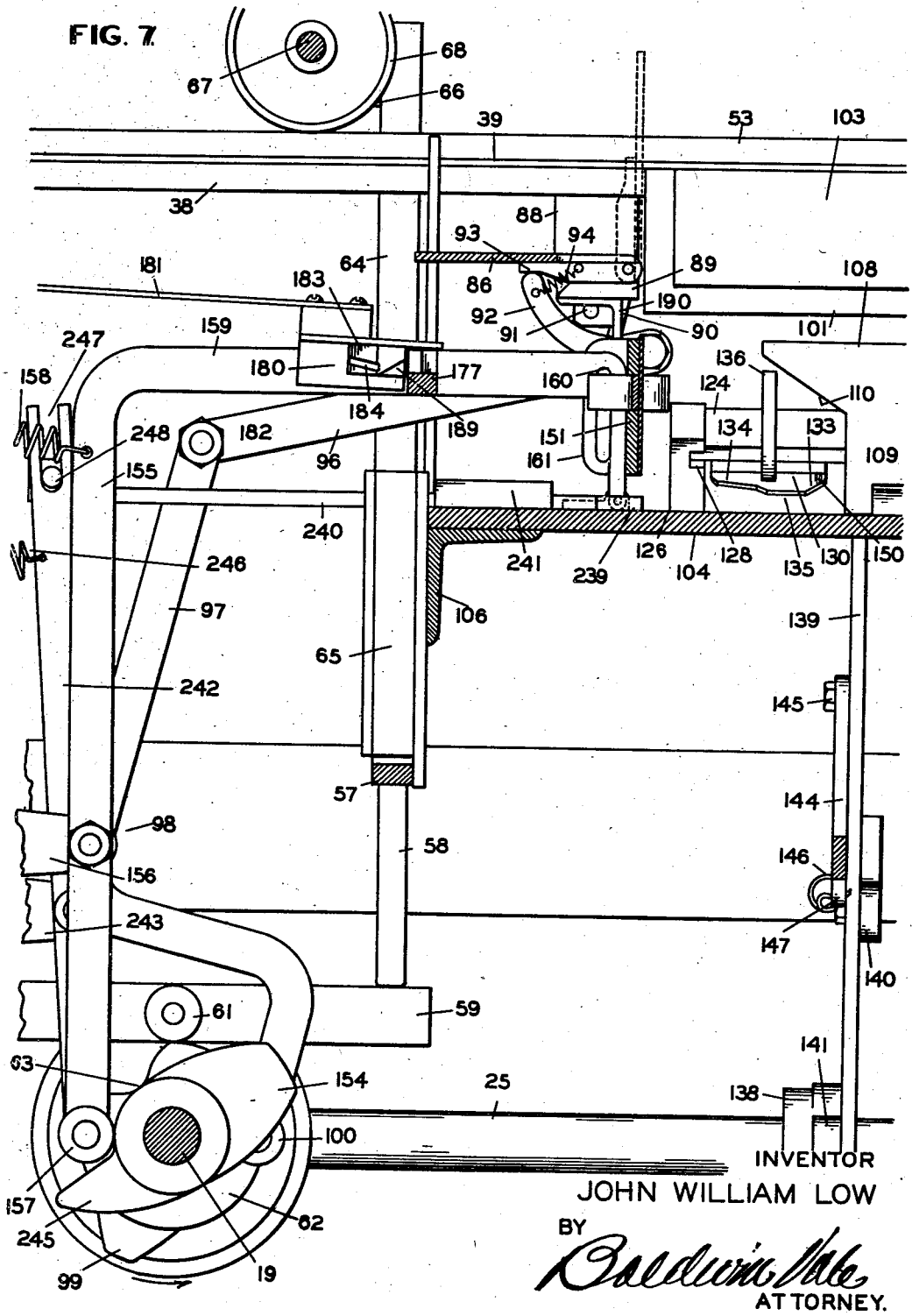
ATTORNEY.

Nov. 28, 1933. J. W. LOW 1,937,027

BOX FOLDING MACHINE

Filed Nov. 23, 1931 16 Sheets-Sheet 7

FIG. 7



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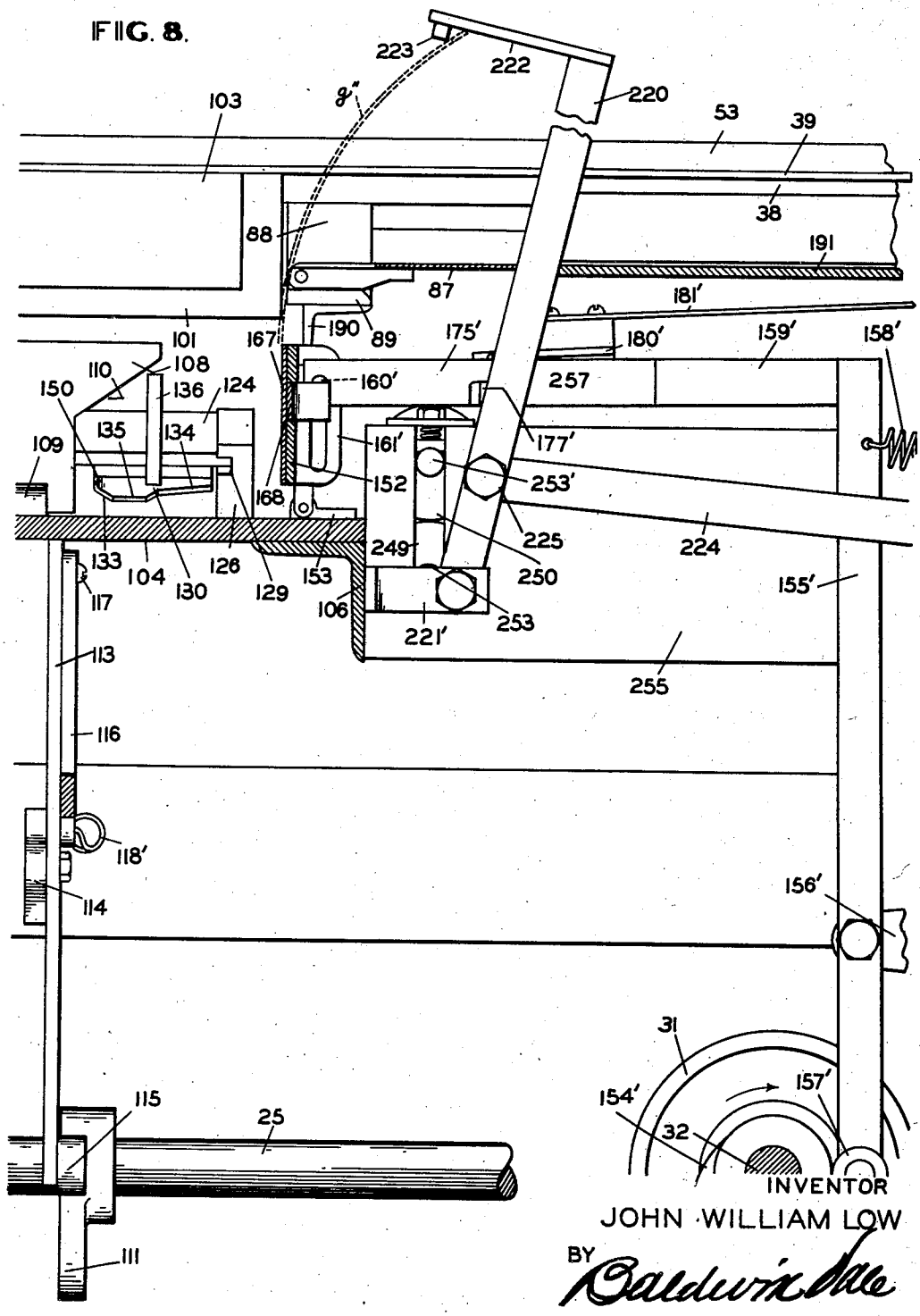
Nov. 28, 1933. J. W. LOW 1,937,027

BOX FOLDING MACHINE

Filed Nov. 23, 1931 16 Sheets-Sheet 8

FIG. 8.



INVENTOR

JOHN WILLIAM LOW

BY Baldwin Sale

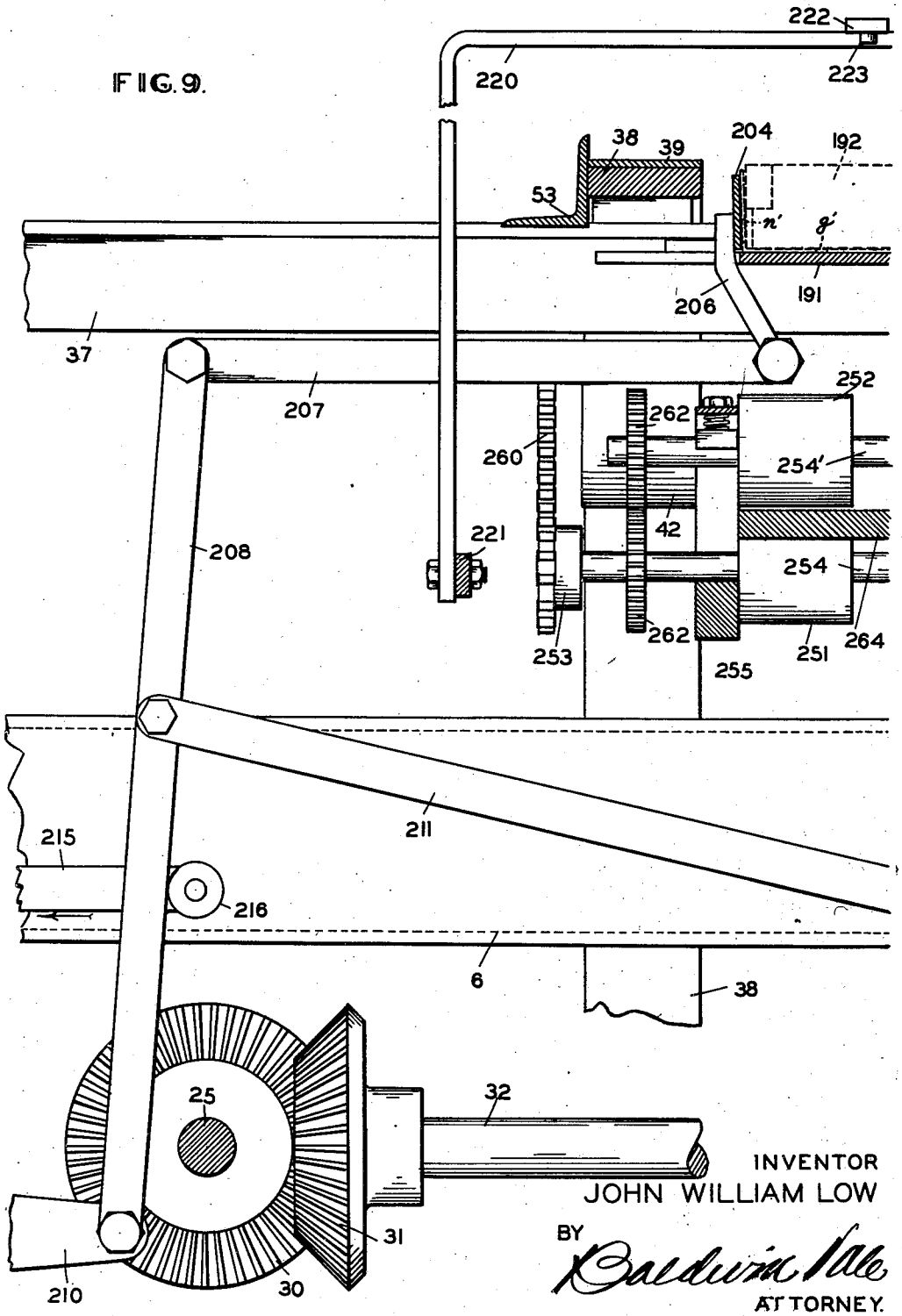
ATTORNEY

Nov. 28, 1933. J. W. LOW 1,937,027

BOX FOLDING MACHINE

Filed Nov. 23, 1931 16 Sheets-Sheet 9

FIG. 9.



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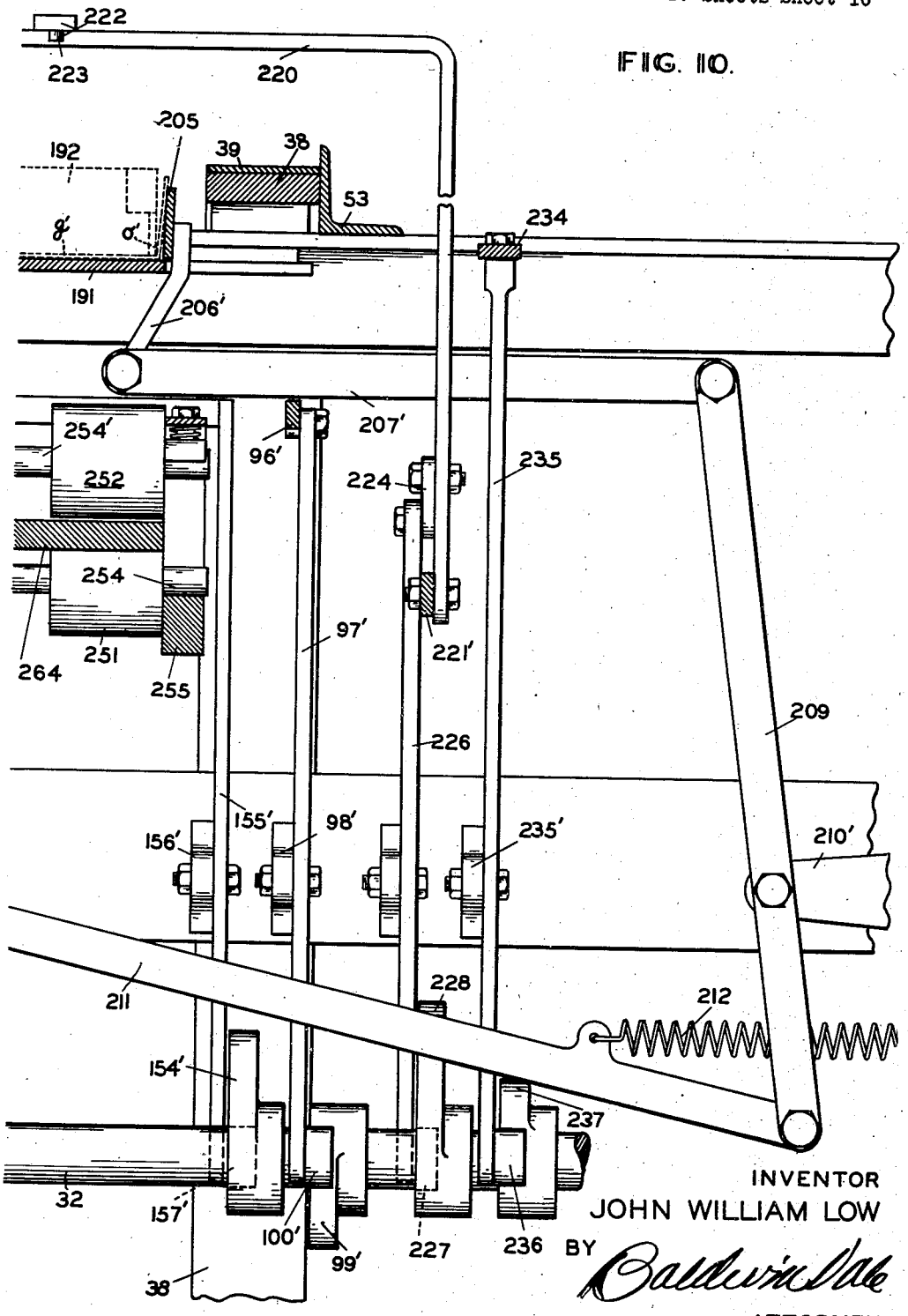
Nov. 28, 1933. J. W. LOW 1,937,027

BOX FOLDING MACHINE

Filed Nov. 23, 1931 16 Sheets-Sheet 10

FIG. 10.



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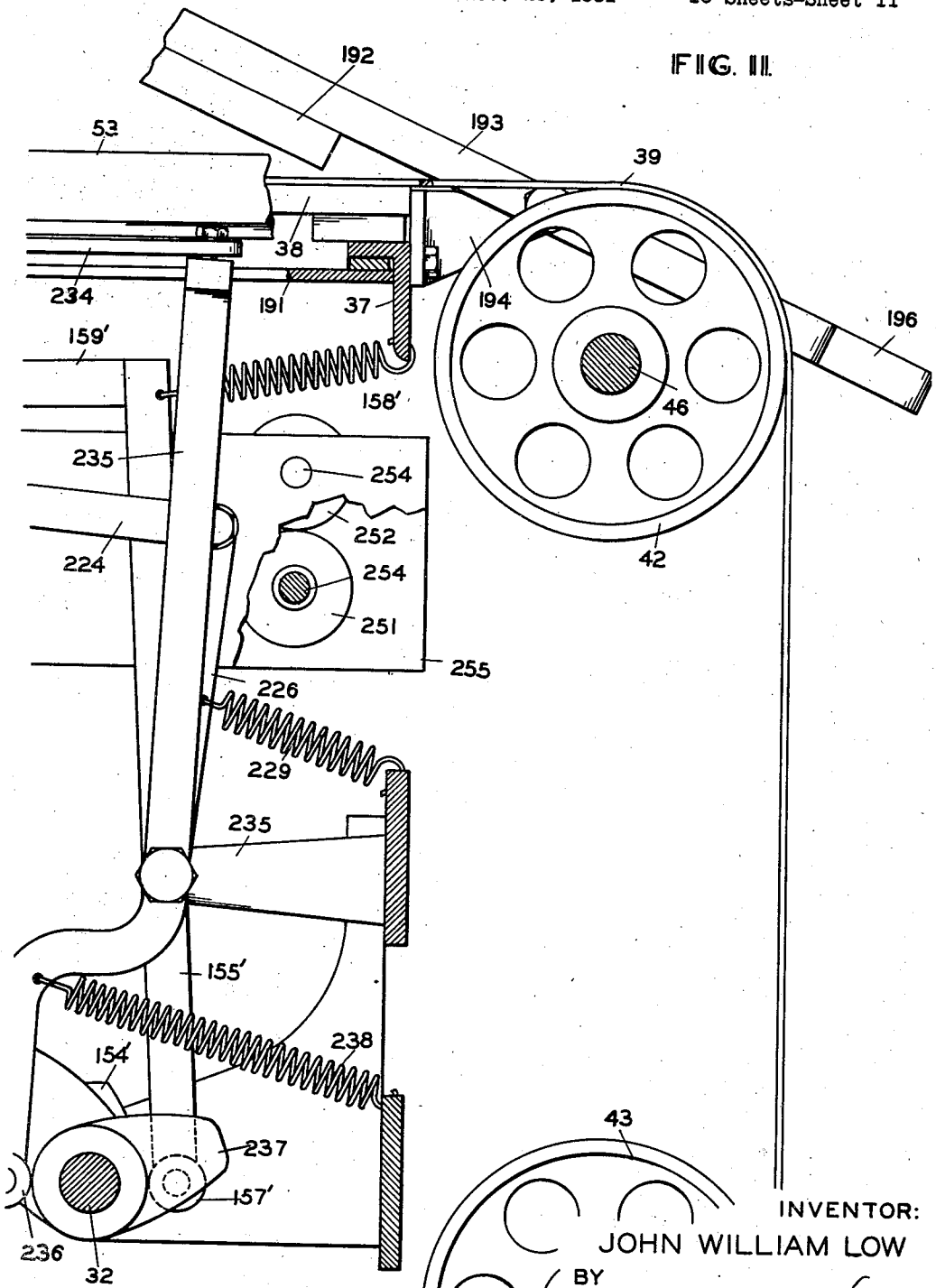
Nov. 28, 1933. J. W. LOW 1,937,027

BOX FOLDING MACHINE

Filed Nov. 23, 1931 16 Sheets-Sheet 11

FIG. 11.



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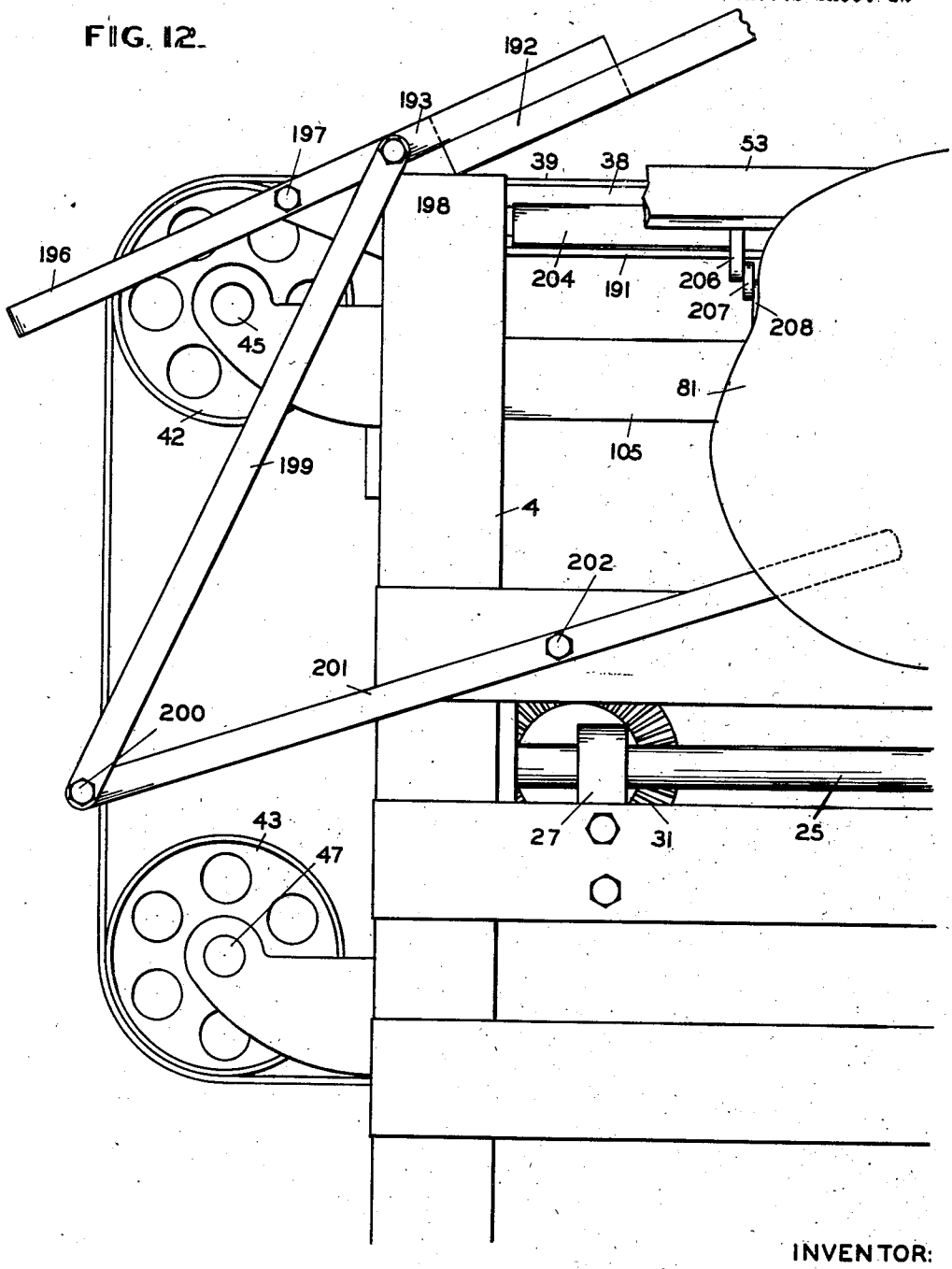
Nov. 28, 1933. J. W. LOW 1,937,027

BOX FOLDING MACHINE

Filed Nov. 23, 1931 16 Sheets-Sheet 12

FIG. 12.



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Nov. 28, 1933. J. W. LOW 1,937,027

BOX FOLDING MACHINE

Filed Nov. 23, 1931 16 Sheets-Sheet 13

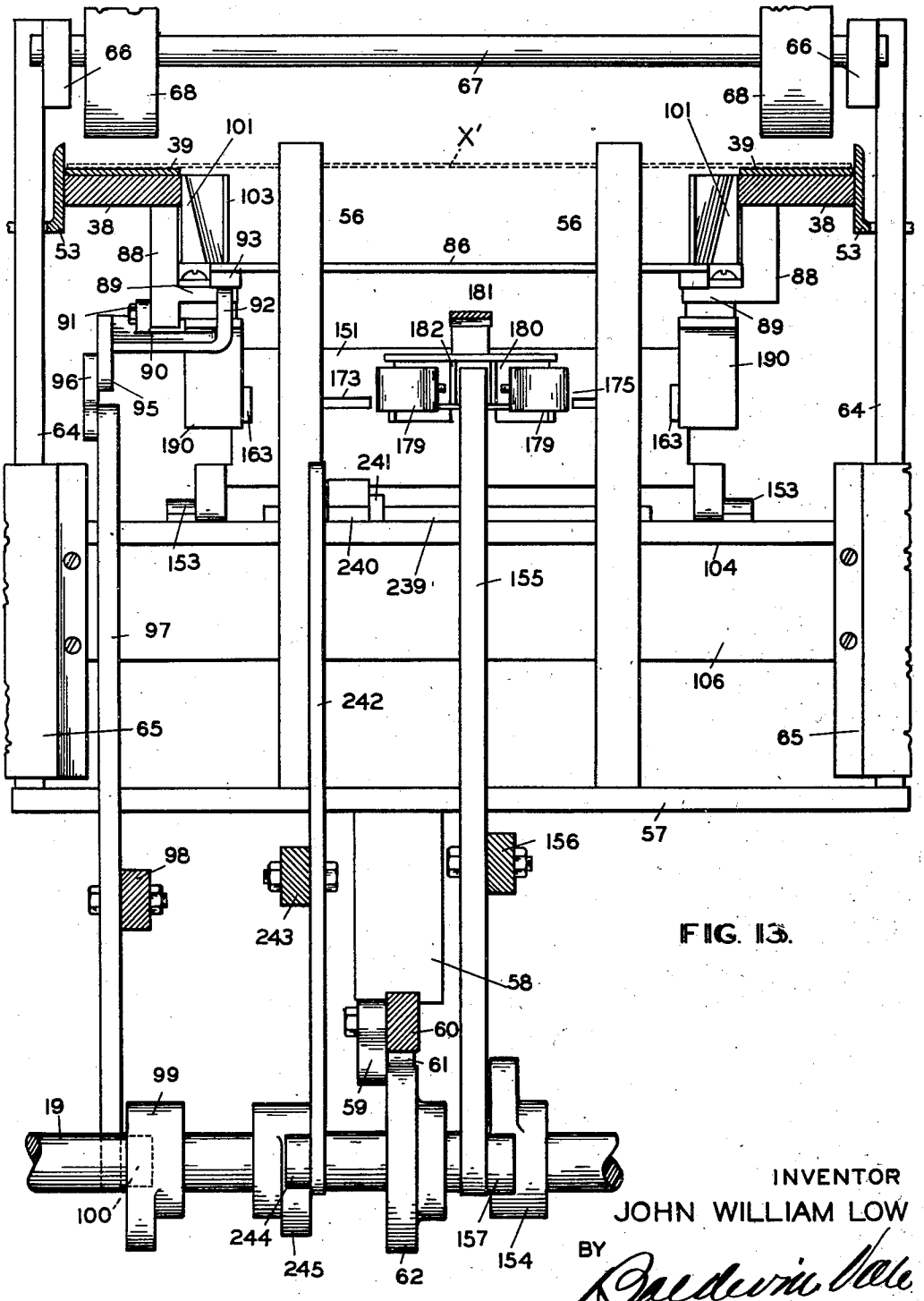

FIG. 13.

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Nov. 28, 1933. J. W. LOW 1,937,027

BOX FOLDING MACHINE

Filed Nov. 23, 1931 16 Sheets-Sheet 14

FIG. 15.

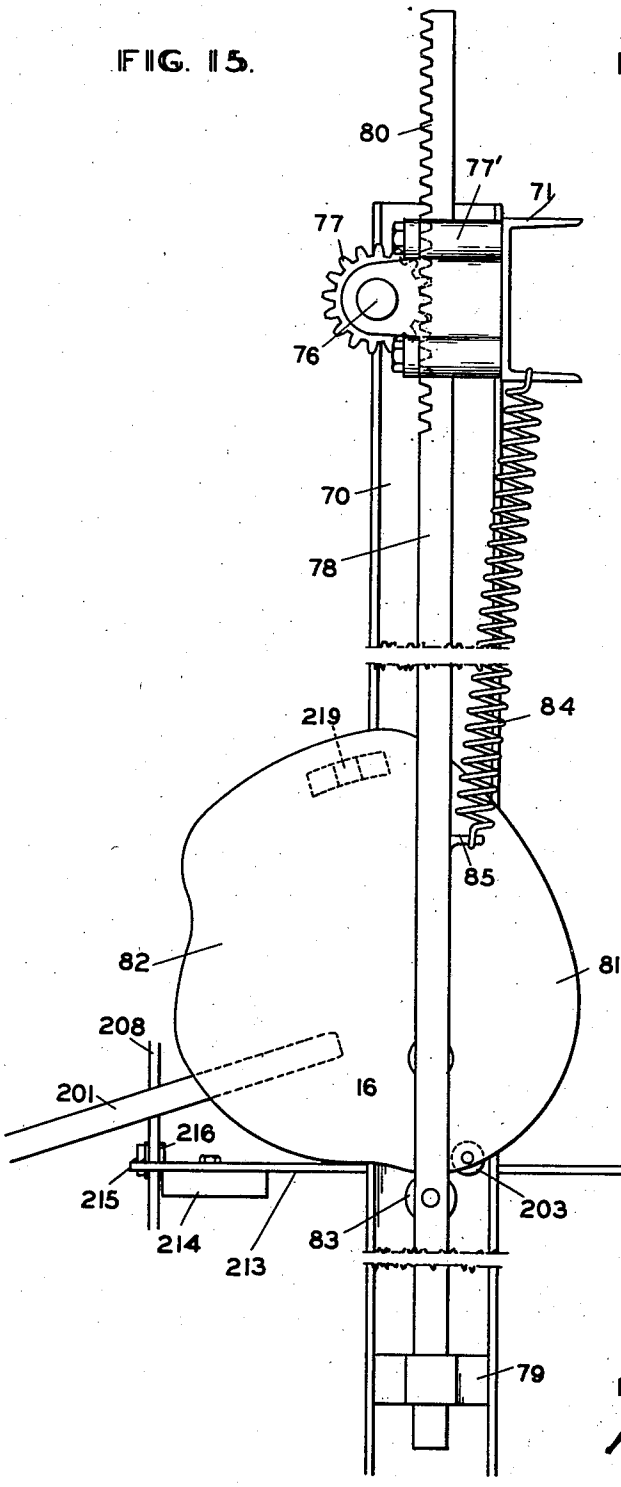
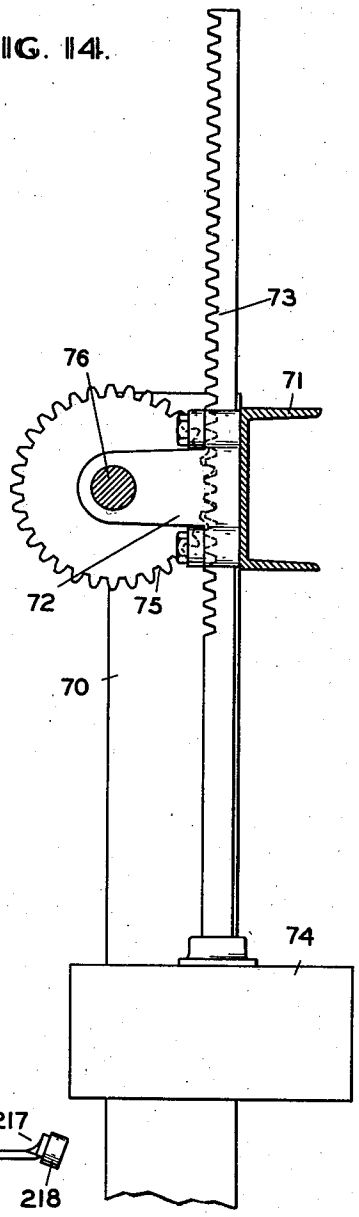


FIG. 14.



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ATTORNEY

Nov. 28, 1933. J. W. LOW 1,937,027

BOX FOLDING MACHINE

Filed Nov. 23, 1931 16 Sheets-Sheet 15

FIG. 16.

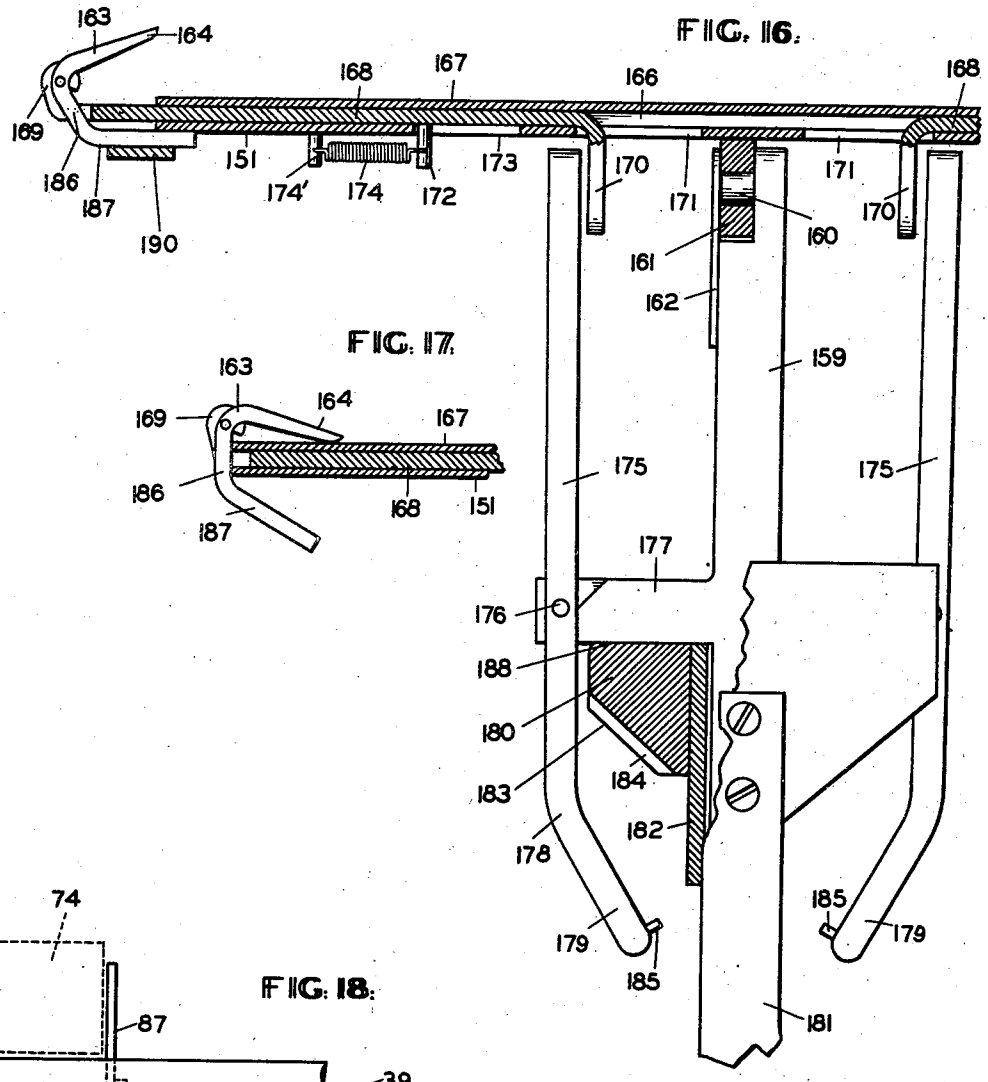
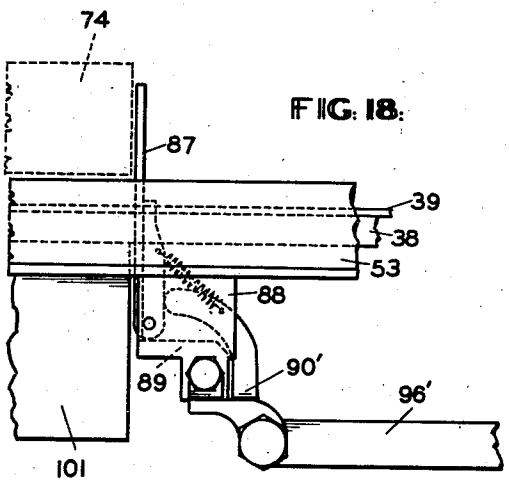


FIG. 17.

FIG. 18.



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Nov. 28, 1933. J. W. LOW 1,937,027

BOX FOLDING MACHINE

Filed Nov. 23, 1931 16 Sheets-Sheet 16

FIG. 19.

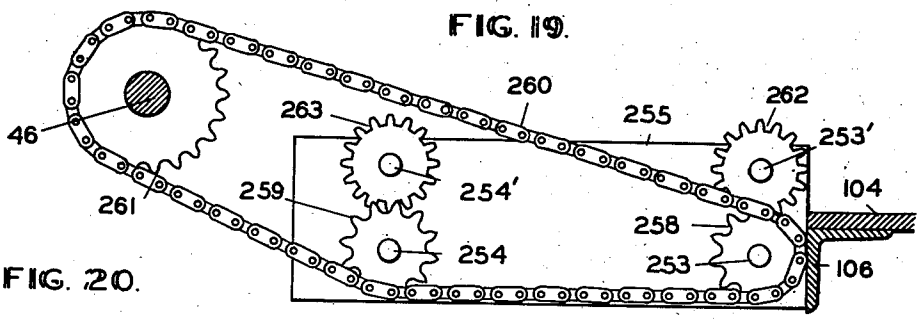


FIG. 20.

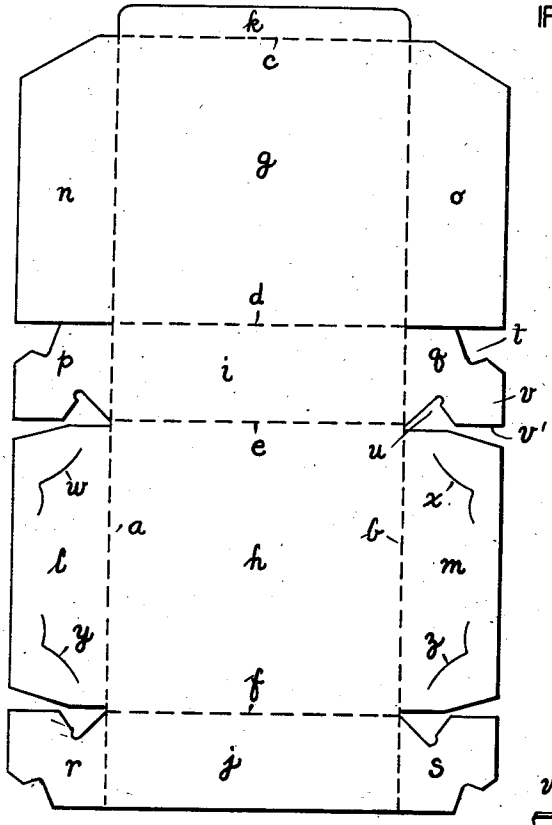


FIG. 21.

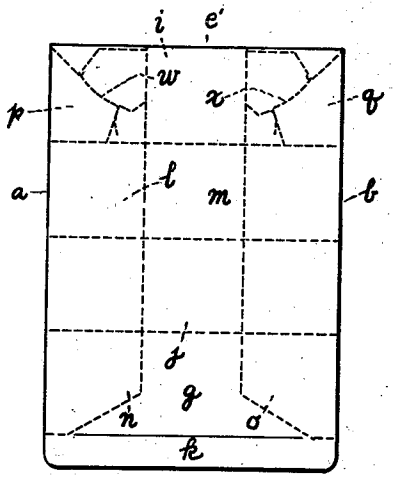
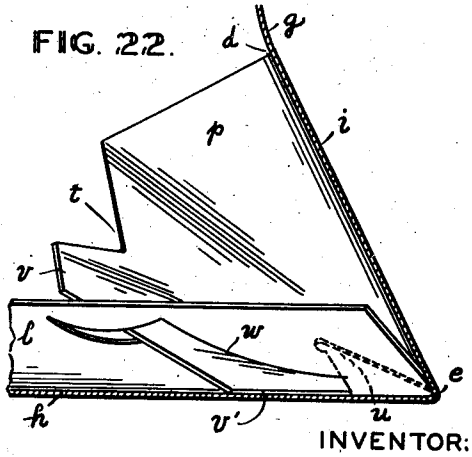


FIG. 22.



INVENTOR:
JOHN WILLIAM LOW
BY Baldwin Hale
ATTORNEY

Patented Nov. 28, 1933

1,937,027

UNITED STATES PATENT OFFICE

1,937,027

BOX FOLDING MACHINE

John William Low, Mill Valley, Calif., assignor, by mesne assignments, of one-half to Edgar L. Stern and one-half to Raoul J. Gruenberg, both of San Francisco, Calif.

Application November 23, 1931
Serial No. 576,643

12 Claims. (Cl. 93—49)

This invention relates to improvements in box folding machines and more particularly to a machine for folding boxes of the class shown in the patent to Edgar L. Stern, Number 1,463,448, dated July 31, 1923, entitled Folding box.

Among the objects of the invention is to provide a machine that will automatically feed and fold box blanks seriatim and interlock the tabs and slots to form fully assembled collapsed boxes ready for immediate use when opened.

Another object is to reduce the cost of product and improve the quality of folding boxes.

Another object is to increase the speed of production of such boxes.

Another object is to design the machine to insure against scarring and crumpling the boxes during production.

A further object is to produce a machine requiring but the minimum of attention of the operators.

In the accompanying drawings and the following description the invention is disclosed in its preferred form. It is to be understood, however, that it is not limited to this form because it may be embodied in other forms within the purview of the claims following the description.

In the sixteen sheets of drawings:

Fig. 1 is a plan view of a paper box folding machine constructed in accordance with this invention.

Fig. 2 is a side elevation of the same showing the driving mechanism for the several operating shafts.

Fig. 3 is a fragmentary plan view partly in horizontal section taken below the line III—III, Fig. 2 showing the box folding mechanism with a box blank set up in position therein prior to the folding operation.

Fig. 4 is a similar view showing the positions of the folding mechanism while the folding operation is in progress.

Fig. 5 is a transverse vertical section of the folding mechanism taken on the line V, Fig. 1, and showing the plates for folding the sides of the box blank and the blades for inserting the tongues of the blank into the sides.

Fig. 6 is a similar view taken on the line VI, Fig. 1, and showing an extension of Fig. 5 to be read in conjunction therewith.

Fig. 7 is a longitudinal vertical section taken on the line VII, Fig. 1, and showing the plates for folding the ends of the box blank and the bell cranks for bending the tabs of the box into position to be inserted in the slots in the sides of the box.

Fig. 8 is a similar view taken on the line VIII and showing an extension of Fig. 7 to be read in conjunction therewith.

Fig. 9 is a transverse vertical section taken on the line IX, Fig. 1, and showing the mechanism for folding one of the sides of the box lid.

Fig. 10 is a similar view taken on the line X, Fig. 1, and showing an extension of Fig. 9 to be read in conjunction therewith.

Fig. 11 is a longitudinal vertical section taken on the line XI—XI, Fig. 1, and showing the pivoted plunger for folding the box lid.

Fig. 12 is a fragmentary rear elevation view showing the cam driven levers for operating the lid folding plunger.

Fig. 13 is a transverse vertical section taken on the line XIII—XIII, Fig. 1, and showing the mechanism for timing the feeding of the box blanks into the folding mechanism.

Fig. 14 is a fragmentary vertical section of the plunger for placing the box blank in the folding mechanism.

Fig. 15 is a fragmentary rear elevation of the cam and rack for driving the plunger shown in Fig. 14.

Fig. 16 is an enlarged horizontal section of one of the plates for folding the ends of the box and showing the mounting of the bell cranks which fold the tabs of the box.

Fig. 17 is a fragmentary detail in horizontal section showing one of the tab folding bell cranks in tripped position.

Fig. 18 is a fragmentary detail view in side elevation showing the means for operating one of the wipers which coact with the descending box blank plunger.

Fig. 19 is a fragmentary vertical section of the driving means for the rollers for ejecting the folded boxes.

Fig. 20 is a plan view of a box blank adapted to be folded by the present machine.

Fig. 21 is a plan view from above of a box folded by the present machine.

Fig. 22 is a vertical section of one of the corners of the box during the folding operation.

The present machine is designed to fold the type of folding box illustrated in Figs. 20, 21 and 22. It is obvious, however, that the machine may be modified by those skilled in the art to fold other forms and sizes of folding boxes.

The blank shown in Fig. 20 is formed of foldable box board and is longitudinally scored at *a—b* and transversely scored at *c—d—e—f*. These score lines divide the blank respectively into the lid and bottom *g—h*, the ends *i—j*, and

the locking flap *k*, in longitudinal alinement. The body of the box has the sides *l*—*m* extending transversely therefrom on opposite sides, while the lid *g* has the transverse slides *n*—*o*. The locking tabs *p*—*q*—*r*—*s* extend transversely from the ends *i*—*j* and are cut away at *t*—*u* to form the obliquely extending tongues *v*.

The sides *l*—*m* are pierced to form the obliquely disposed biarcuate slots *w*—*x*—*y*—*z* which are adapted to be engaged by the tongues of the locking tabs *p*—*q*—*r*—*s*, respectively.

The box is assembled by folding the sides *l*—*m* on the score lines *a*—*b* to overlie the bottom *h*. The ends *i*—*j* are then folded on the lines *e*—*f* perpendicular to the bottom *h*. The tabs *p* to *s* are bent inward on the lines *a*—*b* and then obliquely curled as shown in Fig. 22 to enter the tongues *v* in the slots *w* to *z*. The ends *i*—*j* are then folded completely over to overlie the ends of the sides *l*—*m* and the bottom *h*. This forces the tongues *v* completely through the slots *w* to *z* to lock the ends *i*—*j* and the sides *l*—*m* together.

The sides *n*—*o* of the box lid are folded over on the lines *a*—*b* to overlie the body of the lid. The lid *g* then follows the end *i* as it is folded over on the score line *e* and assumes the position shown in Fig. 21, overlying the body of the box.

In detail, the construction of the machine illustrated in the drawings, referring more particularly to Figs. 1 and 2 comprises: The main frame having the pillars 1—1, 2—2, 3—3, and 4—4 on each side of the machine. These pillars are fixed together by the horizontal side rails 5—6—7—8 to form a rigid structure. Additional reinforcing bars such as 9—10—11 are fixed to the pillars 1 to 4 to increase the rigidity and stability of the frame.

The large pulley 12 is mounted on the shaft 13 which is supported between the out bearing 14 and the pillar 3. The pulley is engaged by the belt 15 and driven from any suitable prime mover such as an electric motor.

The shaft 16 extends between the pillars 3—3 and is driven at about 35 R. P. M. by the pulley 12 through the reduction gearing 17—18. The cam shaft 19 is mounted in the journal brackets 20—21 which are fixed on the side rail 7. This shaft is driven by the shaft 16 through the sprockets 22—23 and the chain 24 at the same speed ratio.

The longitudinal cam shaft 25 is mounted in the journals 26—27 at right angles to the shaft 19 and is driven thereby through the miter gears 28—29 mounted on the shafts 19 and 25 respectively. The miter gear 30 is mounted on the opposite end of the shaft 25 and meshes with the gear 31 to drive the shaft 32 upon which it is mounted. This cam shaft 32 extends parallel with the shaft 19 and is mounted in the brackets 33—34 fixed to the side rail 6. The three cam shafts 19, 25, 32 are thus driven by the shaft 16 at the same ratio of speed, 35 R. P. M.

The tops of the pillars 1—1, 2—2, and 4—4 are joined by the transverse angle supports 35—36—37 upon which are mounted the longitudinal pair of rails 38—38. The conveyor belts 39—39 overlie the rails 40 and each encircles a set of pulleys 41—42—43—44 mounted on the shafts 45—46—47—48, respectively.

The sprocket 49 is mounted on one end of the shaft 46 and engages within the chain 50. The sprocket 51 is mounted on the power driven shaft 32 and drives the chain 50 and sprocket 49. Thus the pulleys 42—42 are rotated, moving the conveyor belts 39—39 in the direction of the arrows in Fig. 1.

The inclined table 52 is mounted at the side of the pillars 1—1 and terminates adjacent the ends of the rails 38. The pile of blanks X is placed on the table 52 and are fed manually seriatim onto the conveyor belts 39—39.

The angle guides 53—53 extend alongside the belts 39 throughout the length of the rails 38 to maintain the blanks in perfect alinement on the belts 39.

The rollers 54—54 are fixed on the shaft 55 which is rotatably mounted in suitable brackets on the angles 53 adjacent the end of the table 52. The lower circumference of the rollers impinge on the belts 39. Thus, a box blank placed on the conveyor belts 39 is pressed down upon the belts by the rollers 54 to insure against possible slipping due to the inertia of the blank.

The two vertical stops 56—56 (see Fig. 13) are located between the rails 38—38 and their upper ends project slightly above the plane of the blank X' lying on the conveyor belts 39. Thus the blanks are halted in their travel on the conveyor belts 39 upon contacting the stops 56 (see Figs. 1 and 13). The blanks are then fed in timed relation into the folding mechanism as follows:

The lower ends of the stops 56—56 are fixed to the cross bar 57 which has the depending block 58 resting on the end of the cam follower lever 59 (see Figs. 7 and 13). The lever 59 is pivoted on the bracket 60 and has the roller 61 riding on the "kidney" cam 62. This cam is mounted on the power driven shaft 19 and maintains the lever 59 and the stops 56 in raised position except when the depression 63 on the cam comes under the roller 61. The stops 56 then fall of their own weight and permit the blank X' to continue its travel on the conveyors 39.

The uprights 64—64 are fixed at each end of the cross bar 57 and are slidable in the guides 65—65 which are fixed to the frame of the machine. Thus, the guides 65 direct the movement of both the stop 56 and the cross bar 57 and the other members of this feeding mechanism. The laterally extending brackets 66—66 are fixed to the upper ends of the uprights 64 and mount the ends of the shaft 67.

The pair of rollers 68—68 are rotatably mounted on the shaft 67 above the conveyor belts 39. When the stops 56 are depressed by the operation of the cam 62, the rollers 68 are also lowered to contact the blank X'. The blank is thus pressed down upon the moving belts 39 to insure its being carried away into position over the folding mechanism. When the blank reaches its proper position over the folding mechanism, its front edge contacts against the angle stop 69 to prevent further movement (see Fig. 1).

The pillars 3—3 of the frame of the machine have the upward extensions 70—70 which are cross connected at their upper ends by the channel beam 71. The guide bracket 72 is bolted to the center of the channel and slidably mounts the rack 73. The plunger 74 is mounted at the lower end of the rack 73 and is adapted to be lowered to press the blank X'' into position between the folding members of the machine, as shown in Fig. 3.

The gear 75 (see Fig. 15) is mounted on the shaft 76 in the bracket 72 and meshes with the rack 73 to govern the movements of the plunger. The opposite end of the shaft 76 is mounted in the bracket 77' and has the pinion 77 fixed thereon. The reciprocating rod 78 is slidably mount-

ed in the bracket 77' and the guide 79 and has the rack teeth 80 enmeshed with the pinion 77.

The cam 81 is mounted on the power driven shaft 16 and has the irregular contour 82 impinging on the roller 83 on the rod 78. The spring 84 contracts between the channel 71 and the lug 85 on the rod 78 to hold the roller 83 in engagement with the contour of the cam. Thus, movement of the cam 81 reciprocates the rod 78 and rotates the shaft 76 and the gear 75 to raise or lower the plunger 74.

When the plunger descends to press the blank X'' downward into the folding mechanism, the ends *i—j* and the sides *l—m* of the box blank are wiped up against the sides of the plunger perpendicular to the bottom *h*.

The wiper plates 86—87 (see Figs. 1, 7, 8, 13 and 18) are pivoted transversely across the rails 38 on the brackets 88—88 depending from the rails on opposite sides of the plunger 74. The wiper plates normally rest in a horizontal plane supported by the lugs 89—89 extending transversely from the brackets 88.

The wiper 86 is adapted to be raised into vertical position by the plate 90 which is pivoted at 91 to the bracket 88 (see Figs. 7, 13 and 18). The arm 92 projects vertically from the plate 90 and impinges on the cam surface 93 provided at the end of the wiper 86. The spring 94 contracts between the cam 93 and the arm 92 to resiliently maintain the arm in engagement with the cam surface.

The lug 95 depends from the opposite side of the pivoted plate 90 and is connected to the link 96. The cam follower lever 97 is fulcrumed on the bracket 98 and is pivoted at its upper end to the link 96. The operating cam 99 is fixed on the rotating shaft 19 and engages the roller 100 provided at the lower end of the lever 97.

When the raised portion of the contour of the cam 99 strikes the roller 100, the link 96 is drawn rearward and swings the plate 90 on its pivot. The arm 92 is thus raised and causes the wiper 86 to assume a vertical position, thus folding the end *j* of the box blank upward between the wiper and the descending plunger 74.

The wiper 87 is operated similarly to the wiper 86 by the pivoted plate 90'. The link 96' connects the plate 90' to the lever 97' pivoted at 98'. The cam 99' is mounted on the power driven shaft 32 and engages the roller 100' to oscillate the lever 97'. The cams 99 and 99' are timed together to operate the wiper plates 86—87 synchronously as the plunger 74 descends. The wiper 87 folds the end *i* of the box blank upward on the line *e* to assume a vertical position perpendicular to the bottom *h* in a plane parallel with the opposite end *j*.

The blocks 101—101 (see Figs. 1, 5, 7 and 13) are fixed opposite each other on the rails 38 between the conveyor belts 39—39. The faces of the blocks 101 are cut away at each end to form inclined bevel surfaces as at 102. The thin plates 103—103 are mounted on the faces of the blocks 101 and extend laterally to overlie the inclined surfaces 102.

When the plunger 74 descends, the sides *l—m* of the box blank impinge on the plates 103 and are folded up vertically between the plates and the plunger, as the plunger continues its descent. This is accomplished immediately after the ends *i—j* are folded by the wiper plates 86—87.

The tabs *p—q—r—s* impinge upon the edge of the conveyor belt and are forced upward and inward toward each other thereby. The continuation of the movement of the plunger carries the tabs *p* to *s* downward between the inclined surfaces 102 of the blocks 101 and the plates 103 and bends the tabs into a vertical plane parallel with the sides *l—m*.

When the plunger passes below the plane of the blocks 101, the blank assumes the position shown in Fig. 3 in the folding mechanism with the tabs *p—q—r—s* lying on the outside of the sides *l—m*.

The bed plate 104 is rigidly mounted on the sills 105—105 (see Figs. 2, 5, 7 and 8) which extend between the pillars 2—4 and 2—4 on opposite sides of the machine. The transverse reinforcing angles 106—106 extend between the sills 105—105 under the edges of the bed plate to increase the rigidity of the structure.

The sides *l—m* of the box blank are folded inward and downward on the score lines *a—b* to overlie the bottom *h* by the plates 107—108 (see Figs. 3, 4, 5 and 7). These plates are pivoted on the brackets 109 fixed to the bed plate 104 and cut away as at 110 to clear the tabs *p—q—r—s*.

The plates 107—108 are operated by the cam 111 which is fixed on the rotating shaft 25. The lever 113, fulcrumed on the bracket 114, is provided at its lower end with the cam roller 115 and is connected to the cross link 116 at 117. The spring 118 contracts between the lug 119 on the cross link 116 and the frame of the machine and resiliently maintains the roller 115 impinging on the contour of the cam 111. The lever 120 on the opposite side of the machine is pivoted at 121 and is connected at its lower end to the end of the cross link 117. The links 122—122' join the upper ends of the levers 113, 117 to the lugs 123 fixed adjacent the upper edges of the plates 107—108.

When the roller 115 is displaced by the cam 111, the upper ends of the levers 113, 120 are swung together by the cross link 116. The links 122—122' thus tilt the plates 107—108 downward, folding the sides *l—m* of the blank to overlie the bottom *h*.

The plates 124—125 extend between the guides 126—126, 127—127 and are slidably mounted in the inclined grooves 128—129 therein (see Figs. 5, 6, 7 and 8). The blades 130—130, 131—131 extend from the lower ends of the inclined plates 124—125 opposite the slots *w—x—y—z* in the blank X''.

The ends of the blades 130, 131 are beveled as at 132 (Fig. 5) to form a thin edge adapted to enter the slots *w* to *z* in the blank. The edge 132 is cut away to form the inclined portions 133—134 at each side and leaving the central projecting portion 135.

The upwardly extending cam plates 136—136 are fixed at the intersection of the blades 130—131 and the plates 124—125. The cam plates have the inclined curved surface 137 which extends tangentially to the blades 130, 131 to cooperate with the tabs *p—q—r—s* of the blank as hereinafter set forth.

The plates 124—125 are operated by the cam 138 which is mounted on the power driven shaft 25. The lever 139 is pivoted on the bracket 140 and has the roller 141 mounted at its lower end to impinge on the contour of the cam 138. The lever 142 is pivoted at 143 on the opposite side of the machine.

The link 144 is pivoted at 145 to the lever 139 and is connected to the lower end of the lever 142 to cause the two levers to operate in unison. The

spring 146 contracts between the depending lug 147 on the link 144 and the frame of the machine to urge the roller 141 into engagement with the cam 139. The short links 148—148' connect the upper ends of the levers 139—142 to the lugs 149 fixed to the underside of the inclined plates 124—125.

When the rotation of the cam 138 displaces the roller 141, the upper ends of the levers 139—142 are swung together by the link 144. This slides the plates 124—125 in the inclined grooves 128—129 and carries the blades 130—130, 131—131 forward and downward to pass on each side of the cut away portions 110 of the pivoted plates 107—108. This is accomplished during the folding of the sides *l—m* of the box blank by the operative movement of the plates 107—108.

The projecting portions 135 of the edges of the blades 130—130, 131—131 enter the biarcuate slots *w—x—y—z* while the sides *l—m* are yet in an inclined position before the end of the movement of the folding plates 107—108. The continuation of the movement of the blades projects the inclined portions 133—134 into the slots of the box blank to open up the entire length of the slots.

The inclination of the grooves 128—129 causes the blades 130, 131 to descend obliquely to bring the edges 132 into proximity with the top surface of the bed plate 104. The blades thus press downward in the slots *w—x—y—z* to hold the sides *l—m* flat on the bottom *h* after the restoration of the folding plates 107—108 to vertical position. The ends of the blades 130—131 are longitudinally curved at 150 (see Figs. 3 and 7) to part the edges of the slots *w* to *z* into different planes to facilitate the insertion of the tabs *p—q—r—s* as hereinafter described.

The ends *i—j* of the box blank are folded down on top of the ends of the folded sides *l—m* by the plates 151—152 (see Figs. 3, 4, 7, 8, 16 and 17). These folding plates are pivoted on each side adjacent their lower edge on the small brackets 153.

The folding plates 151—152 are operated by the cams 154—154' fixed on the rotating shafts 19 and 32 respectively. The levers 155—155' are mounted opposite each other on the brackets 156—156' and are provided with the rollers 157—157' at their lower ends. The springs 158—158' contract between the upper ends of the levers and the frame of the machine to urge the rollers 157—157' into contact with the contours of the operating cams.

The upper ends of the levers 155—155' are bent over to form the horizontal arms 159—159' projecting toward each other. The ends of the arms 159—159' are provided with the pins 160—160' projecting through the vertically grooved lugs 161—161' on the rear sides of the folding plates 151—152. The strips 162 of thin metal are riveted to the ends of the arms 159 and impinge on the ends of the pins 160 to prevent the pins from slipping out of the grooved lugs 161.

Displacement of the rollers 157—157' by the cams 154—154' swings the arms 159 toward each other. This tilts the plates 151—152 forward and downward to fold over the ends *i—j* of the box on the lines *e—f*. The pin and slot connection 160—161 between the levers 155 and the folding plates, compensates for the incidental downward thrust incurred by the arcuate movements of the levers and pivoted plates.

The bell cranks 163—163 are pivoted at each end of the folding plates 151—152 as is best shown in Figs. 3, 4 and 13. The ends 164 of the bell cranks are tapered and have curved off edges which project in front of the planes of the folding plates (see Fig. 16) and engage the tabs *p—q—r—s* of the blank adjacent the score lines *a* and *b*.

The plates 151—152 have the longitudinal internal grooves 166 which are covered by the face plates 167. The slides 168—168 are mounted in the grooves 166 and project therefrom at each end. The projecting ends of the slides are bent laterally at 169 to form pivoting brackets for the bell cranks 163. The inner ends of the slides are bent rearward to form the lugs 170 projecting through the slots 171 in the rear surface of the plates 151—152.

The pins 172—172 are set in the slides 168 and project through the slots 173 provided in the rear of the folding plates. The springs 174—174 contract between the projecting pins 172 and the pins 174'—174' fixed to the plates 151—152. The slides 168 are thus urged outwardly by the springs 174 to project the ends 169 to the fullest extent.

The levers 175—175' are pivoted at 176 adjacent the ends of the lugs 177—177' which extend laterally from the operating arms 159—159'. The ends of the levers 175 terminate alongside the lugs 170 and are adapted to engage the lugs to operate the slides 168. The opposite ends of the levers 175 are bent inward toward each other at 178 to form the angularly disposed ends 179—179 extending toward the arms 159.

The stationary cams 180—180' depend from the resilient brackets 181—181' which are fixed to the frame of the machine. The guide channels 182 integral with the cams 180 straddle the arms 159 to maintain the cams in lateral alinement.

The faces of the cams are beveled as at 183 to form inclined cam surfaces in the plane of the angularly offset lever ends 179 (see more particularly Figs. 7 and 16). The grooves 184 are cut in the cam faces 183 and are adapted to be engaged by the pins 185 fixed in the lever ends 179.

When the arms 159—159' are operated to tilt the plates 151—152 to fold the ends *i—j* of the box blank, the levers 175 are also moved longitudinally. This brings the angularly disposed ends 179 into engagement with the cam surfaces 183. The pins 185 engage the grooves 184, thus preventing the cams 180 from rising out of contact with the lever ends 179.

The continuation of the longitudinal movement of the levers 175 draws the lever ends 179 along the inclined cam surfaces 183, thus tilting the levers 175 on their pivots 176. The opposite ends of the levers then engage the lugs 170 and draw the slides 168—168 toward each other, as in Fig. 4. This presses the ends 164 of the bell cranks 163 against the tabs *p—q—r—s* of the blank and bends them inwardly on the score lines *a—b*.

As the folding of the ends *i—j* progresses, the tabs *p* to *s* are pressed against the curved faces 137 of the cam plates 136. This resiliently curls the tabs *p* to *s* and enters the lower edges *v'* of the tongues *v* between the parted edges of the slots *w—x—y—z* (see Figs. 4 and 22). The completion of the folding of the ends *i—j*, and the continuation of the bending of the tabs on the lines *a—b* by the bell cranks 163, forces the tongues *v* completely through the slots *w* to *z*. The edges of the cut away portion *u* of the tabs then lock within the edge of the slots as is shown in Fig. 21.

The bell cranks 163 are bent at their pivots to form the angularly disposed portions 186, the ends of which are bent again at 187 to lie against the rear surface of the end folding plates 151—152. When the slides 168 are withdrawn into the grooves 166 to the fullest exten by the operation

of the levers 175, the angularly disposed portions 186 of the bell cranks impinge on the square ends of the plates 151—152. This forces the bell cranks to assume the position shown in Fig. 17, thereby pinching the tabs *p*—*q*—*r*—*s* against the plates 151—152 and completely folding them on the score lines *a*—*b*.

The blades 130—131 are then withdrawn by the operation of the cam 138 (see Figs. 5 and 6) leaving the tabs *p*—*q*—*r*—*s* locked in the slots *w*—*x*—*y*—*z*.

A short additional movement of the arms 159 causes the lever ends 178 to pass beyond the ends 188 of the cams 180. The levers 175 are thus restored to normal position and release the slides 168 which are again projected outward under the tension of the springs 174. The bell cranks 163 are thus withdrawn from under the locked tabs of the box to beyond the folded score lines *a*—*b*. The plates 151—152 are then raised into vertical position by the operation of the synchronous cams 154—154'.

The undersides of the cams 180 are cut away to form the inclined surfaces 189. (See Fig. 7.) When the levers 175 are moved back into normal position, the inclined surfaces 189 impinge upon the lever ends 178 and the cams 180 are raised thereby riding over the lever ends against the tension of the resilient brackets 181. When the lever ends 178 pass from under the cams 180, the cams are urged downward by the resilient brackets 181 to abut the lugs 177, thus preventing overthrow of the levers 155 under the tension of the springs 158.

The angles 190—190 depend from the underside of the brackets 88 which are fixed to the conveyor rails 38 at each end of the plates 151—152. When the plates 151—152 are restored to normal vertical position, the ends 187 of the bell cranks 163 abut the depending angles 190 and swing the bell cranks on their pivots. This moves the tapered working ends 164 of the bell cranks outward to assume the inoperative position shown in Figs. 3 and 16.

In detail the construction of the mechanism for folding over the sides *n*—*o* to overlie the box lid *g*, and for bending the lid over to assume the position shown in Fig. 21, is as follows:

The flat plate 191 is fixed at one end to the angle brace 37 and to the rails 38 at each side (see Figs. 1, 2, 8, and 11). This plate is mounted at a higher level than the bed plate 104 and constitutes the base plate for the folding of the box lid *g*.

The plunger 192 has longitudinally extending arms 193—193 which are pivoted on the brackets 194—194 fixed to the angle 37. The brace 195 joins the ends of the arms 193 to form a rigid structure. The spring 195' (see Fig. 1) contracts between the brace 195 and the frame of the machine and urges the plunger into inoperative position. The laterally extending operating lever 196 (see also Fig. 12) is fixed to one of the arms 193 and extends to the side of the machine where it is pivoted at 197 in alinement with the brackets 194.

The end of the lever 196 extends slightly beyond the pivot 197 and is connected at 198 to the link 199. The opposite end of the link 199 is pivoted at 200 to the end of the lever 201. This lever is pivoted to the frame of the machine at 202 and extends into proximity with the side of the contour cam 81. The roller 203 (see Fig. 15) is mounted on the side of the cam 81 adjacent its periphery and is adapted to engage and operate the end of the lever 201.

The plates 204—205 (see Figs. 9 and 10) extend longitudinally along the sides of the plates 191 and are pivoted thereto adjacent their lower ends. The bell cranks 206—206' are fixed to the pivoted plates 204—205 and depend therefrom. The links 207—207' are pivoted to the bell cranks 206 and connect the bell cranks to the upper ends of the levers 208—209 which fulcrum on the brackets 210—210' on opposite sides of the machine. The link 211 cross connects the levers 208—209 to cause these levers to operate in unison. The spring 212 contracts between the link 211 and the frame of the machine and urges the levers 208—209 and the plates 204—205 into inoperative position.

The horizontal operating lever 213 is fulcrumed on the angle bracket 214 (see Figs. 9 and 15) and has the arm 215 extending at right angles to the remainder of the lever. The end of the extension is provided with the roller 216 which is adapted to impinge on the edge of the lever 208. The opposite end of the lever is bent angularly at 217 to the body of the lever and extends into proximity with the side of the cam 81. The roller 218 is mounted on the end of the angular extension 217 and is adapted to be contacted and operated by the wiper cam 219 fixed to the side of the contour cam 81.

As before described, the cam 81 has the roller 203 also mounted on its side. The wiper cam and the roller are so arranged on the cam 81 that each clears the roller 218 and the lever 201, respectively.

Rotation of the cam 81 brings the roller 203 into engagement with the end of the lever 201. This operates the lever 201 and swings the lever 196 to lower the plunger 192 into contact with the base plate 191.

The lid *g'* of the box blank is brought into position above the base plate 191 by the conveyor belts 39. Overcarry of the box blank beyond the desired position is prevented by the angle stop 69 mounted on the brace 37. The lowering of the plunger 192 presses the box lid down upon the plate 191 simultaneously with the descent of the body of the box blank under the pressure of the plunger 74. As the box lid descends, the sides *n'*—*o'* are wiped upward and bent into vertical position on the score lines *a*—*b* by contact with the plates 204—205 on either side. When the roller 203 moves out of engagement with the end of the lever 201, the plunger 192 is restored to inoperative position by the contraction of the spring 195', leaving the box lid *g'* resting on the base plate between the plates 204—205.

When the roller 218 is displaced by the operation of the wiper cam 219, the lever 213 is swung on its pivot, thus moving the roller 216 against the edge of the lever 208. This swings the lever 208 and also the lever 209 by reason of the connecting link 211. This tilts the pivoted folding plates 204—205 into a horizontal position to fold over the lid sides *n'*—*o'* on the lines *a*—*b* into a flat position overlying the body of the lid.

The yoke 220 is pivoted at its lower ends to the brackets 221—221' and extends above and across the conveyors 39 and the base plate 191 (see Figs. 1, 2, 8, 9 and 10). The two bail arms 222—222 are fixed near the center of the yoke and have the downwardly extending pins 223—223 mounted in their outer ends.

The yoke 220 is operated by the link 224 which is connected to the yoke at 225 and pivoted to

the upper end of the lever 226 (see also Fig. 11). This lever is fulcrumed near its center on a suitable fixed bracket and is provided with the roller 227 at its lower end. The cam 228 is mounted on the power driven shaft 32 and is adapted to operate the lever 226. The spring 229 contracts between the upper end of the lever 226 and the frame of the machine and resiliently maintains the roller 227 in contact with the contour of the cam 228.

It is to be noted that the score line *d* of the blank is not bent or folded by the operation of this machine. Thus, when the end *i* of the box blank is folded upward by the operation of the plate 152, the lid *g* follows this movement describing an arc centering on the score line *e*.

At the conclusion of this movement the body of the box blank is seated on the bed plate 104 and the locking tab *k* impinges on the arms 222. The pins 223 engage the edge of the tab *k* and prevent further movement of the lid *g*. Throughout this movement the box lid is curled as shown at *g''* in Fig. 8, to retain the sides *n*—*o* in position overlying the body of the lid. This curling of the lid *g* is an important feature of the operation of the present invention. Unless the lid *g* is slightly curled during its upward movement, the sides *n*—*o* spring outward from the lid and are liable to be destroyed by contact with the working parts of the machine.

The cam 228 is timed to operate the lever 226 synchronously with the movement of the folding plate 152. Thus, the yoke 220 is swung forward to carry the lid *g* into the position shown in Fig. 20 simultaneously with the folding over of the end *i* of the box blank by the plate 152.

The lever 230 is pivoted at 231 to the angle 53 and is bent downward at 232 to clear the block 101 (see Figs. 3 and 6). The foot 233 depends from the lower end of the lever 230 and is arranged to clear the top of the folding plate 108.

The link 234 is pivoted to the end of the lever 230 and has its opposite end loosely mounted on the top of the lever 235 (see Figs. 6 and 11). The lever 235 fulcrums on the bracket 235' which is fixed to the frame of the machine. The roller 236 is mounted on the lower end of the lever 235 and cooperates with the contour of the cam 237 which is mounted on the rotating shaft 32. The spring 238 contracts between the lever 235 and the frame of the machine to urge the lever into an inoperative position.

When the roller 236 is displaced by the rotation of the cam, the lever 235 is tilted to draw the link 234 rearward. This swings the lever 230 on its pivot and brings the foot 233 into contact with the box lid *g* which is folded over the body of the box by the yoke 220 as hereinbefore described. The foot 233 remains in contact with the lid and retains the lid in folded over position while the pins 223 are disengaged from the edge of the locking tab *k* by the restoration of the yoke 220 into inoperative position.

The plunger 239 extends laterally underneath the folding plate 151 and has the arm 240 extending longitudinally therefrom and slidably mounted within the guide 241 (see Figs. 3, 7 and 13). The lever 242 is mounted on the fixed bracket 243 and has the roller 244 mounted at its lower end and cooperating with the cam 245. The spring 246 serves to resiliently maintain the cam roller in contact with the cam. The lever is slotted as at 247 at its upper end and engages the pin 248 mounted on the end of the plunger arm 240.

When the lever 242 is operated by the cam, the plunger 239 is thrust forward and ejects the folded up box from its position in the folding mechanism. This is accomplished by sliding the folded box upon the bed plate 104 underneath the lower edge of the folding plate 152. The edge *e'* of the box passes between the roller conveyors 249—250 (see Figs. 8, 9 and 10).

The rollers 249—250, 251—252 are mounted on the shafts 253—253' and 254—254' which are journaled in the side plates 255—255. The shafts 253'—254' carrying the upper series of rollers are preferably mounted in suitable bushings which are resiliently maintained in position by the compression springs 257. The sprockets 258—259 are fixed on the ends of the shafts 253—254 (see Fig. 19). These sprockets are driven by the chain 260 which is actuated by the sprocket 261 on the rotating shaft 46. The shafts 253—253' and 254—254' are geared together by the pinions 262—263 (see also Fig. 9) thus rotating all of the rollers 249—250, 251—252 in unison.

The folded up box after having its edge *e'* caught between the rollers 249—250 passes through these rollers and slides along the table 264 and is seized by the rollers 251—252. After passing through the rollers the completed box drops into a suitable hopper, not shown. The machine is then ready for the folding of the succeeding box.

Having thus described this invention, what is claimed and desired to secure by Letters Patent is:

1. A machine for folding paper boxes, including; means for feeding the box blanks singly; plates for folding the sides of the box over the bottom; plates for folding the ends of the box over the bottom subsequent to the folding of said sides; levers operated by said end folding plates for locking the box tabs in said sides synchronously with the folding of said front and rear ends.

2. A machine for folding paper boxes, including; means for feeding the box blanks singly; plates for folding the sides of the box over the bottom; blades for opening the slots in the box sides subsequent to their folding; plates for folding the ends of the box over the bottom subsequent to the folding of said sides; levers mounted on said end folding plates and adapted to engage the box tabs in slots in said sides; and cams for guiding said tabs into said slots during the folding of the box ends.

3. A machine for folding paper boxes, comprising; a frame; a base plate mounted on said frame; means for feeding the box blanks seriatim; a reciprocating plunger mounted on said frame and adapted to deposit the box blank onto said base plate; means for folding the sides and ends of the box vertically against said plunger; means for folding the box tabs to lie outside said sides, plates pivoted on said base and adapted to fold the box sides over the bottom subsequent to the depositing of said box blank on said base, plates pivoted on said base for folding the ends of the box over the bottom subsequent to the folding of said sides, means mounted on said end folding plates and adapted to enter the box tabs in slots in the sides, and means for ejecting the folded box from said base plate.

4. A machine for folding paper boxes, comprising; a frame; a base plate mounted in said frame; means for feeding box blanks seriatim onto said base; means for folding the sides and ends of the box over the bottom, means for

locking the box tabs in said sides; means for folding the box lid over the folded sides and ends, and means for ejecting the folded box from said base.

5. A machine for folding paper boxes, comprising; a frame; a base plate mounted in said frame; a conveyor mounted in said frame; detent stops synchronized with the operation of the machine for timing the feeding of the box blank on said conveyor; a reciprocating plunger mounted on said frame and adapted to press the box blank down from said conveyor to deposit it on said base; stationary blocks beneath said conveyor for wiping the sides of the box up against said plunger as the plunger descends; plates for folding up the ends of the box against the descending plunger, curved surfaces in said blocks for folding the box tabs outside the sides of the box; plates pivoted on said base adapted to fold the box sides after the box is deposited on said base; means for directing the box tabs into slots in said sides; plates for folding the ends of the box and thereby locking said tabs in said slots; and means for ejecting the folded box from said base.

6. In a machine for folding paper boxes; means for locking the tabs in the sides of the box, including; means for folding the sides of the box over the bottom; blades having sharpened edges adapted to enter slots in said sides subsequent to the folding of the sides; plates for folding the ends of the box; levers mounted on said plates and adapted to fold the tabs at their junction with the ends of the box; and cam surfaces mounted on said blades for guiding said tabs into said slots.

7. In a machine for folding paper boxes; means for locking the tabs in the sides of the box, including; means for folding the sides of the box over the bottom; blades adapted to enter slots in said sides subsequent to the folding of the sides, plates for folding the ends of the box; levers pivoted on movable slides mounted on said plates and adapted to engage the box tabs; means for moving said slides to cause said levers to fold said tabs at their junction with the ends of the box; and cams mounted on each of said blades for guiding said tabs into said slots during the folding of said tabs.

8. A machine for folding paper boxes, including means for holding a box blank; means for folding the sides of the box over the bottom; and means for locking the box tabs in said sides coincidentally with the folding of said sides.

9. A machine for folding paper boxes, including means for holding a box blank; plates for folding the sides of the box over the bottom; plates for folding the ends of said box over the bottom subsequent to the folding of said sides; and levers operated by said end folding plates for locking the box tabs in said sides synchronously with the folding of said ends.

10. A machine for folding paper boxes, comprising a base plate; a reciprocating plunger for depositing the box blank on said base; means for wiping the sides of the box against the plunger as the plunger descends, means for similarly folding the ends of the box against the plunger; means for subsequently folding the box tabs outside the sides of the box; means for retracting said plunger after the box blank is deposited on said base; means for folding the sides of the box over the bottom; means for subsequently folding the ends of the box over the bottom; and means for locking the box tabs in said sides synchronously with the folding of said ends.

11. A machine for folding paper boxes having sides with slots therein and ends with tabs thereon, including means for folding the sides of the box blank; means for folding the ends of the blank subsequent to the folding of said sides; and means to resiliently curl the box tabs synchronously with the folding of said ends to enter and lock the tabs in said slots.

12. A machine for folding paper boxes having flanged lids including means for folding the lid flanges over the body of the lid; means for folding the sides and ends of the box over the bottom; means for locking the box tabs in said sides synchronously with the folding of said ends; and a lever arranged to engage and curl the box lid and to swing the lid over the body of the box synchronously with the folding of the ends of the box.

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