Jan. 6, 1953 T. R. BAKER ET AL 2,624,249

BLANK FEEDING MECHANISM FOR FOLDING BOX MACHINES

Filed Dec. 28, 1948

4 Sheets-Sheet 1

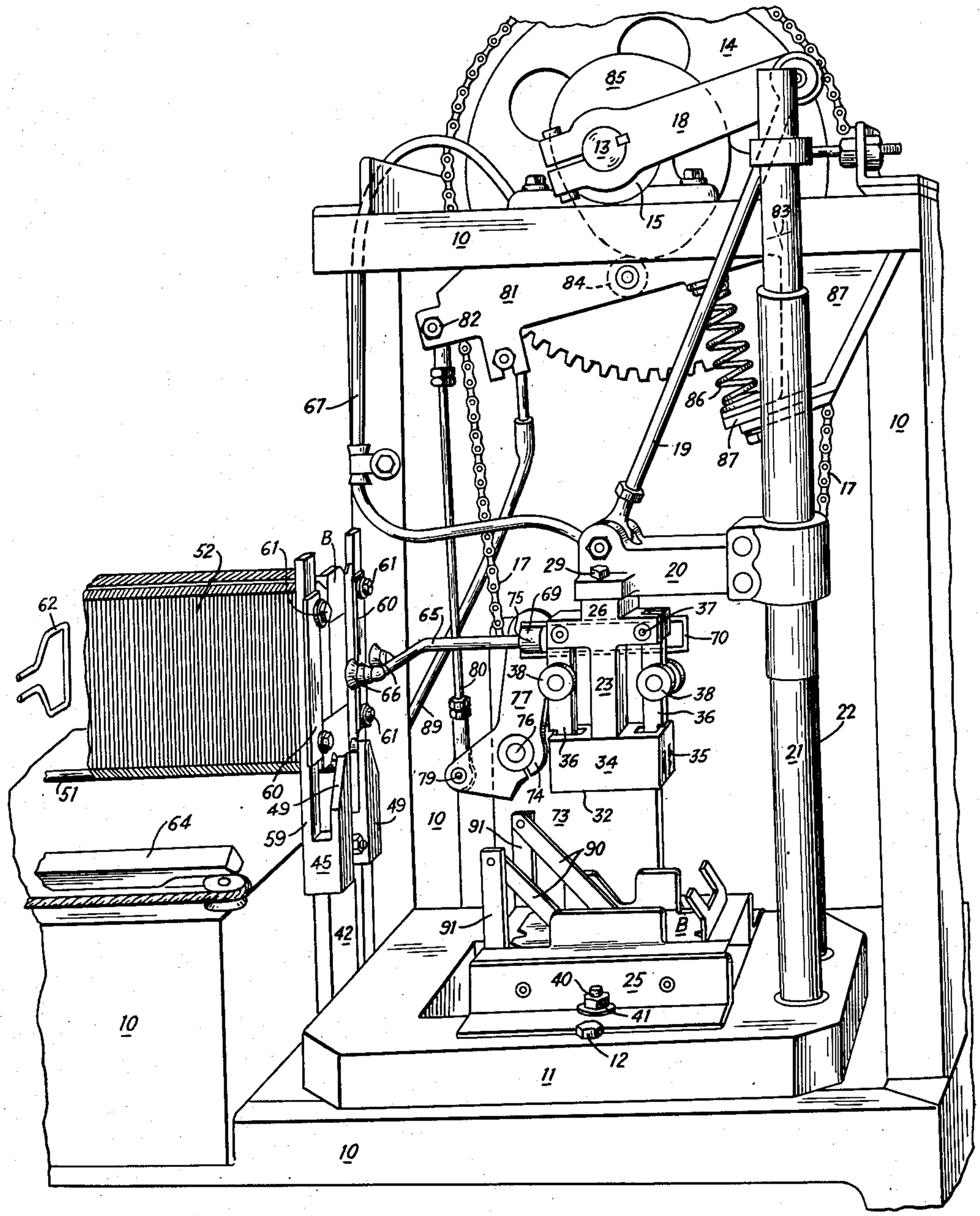

Fig. 1

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Filed Dec. 28, 1948 4 Sheets-Sheet 2

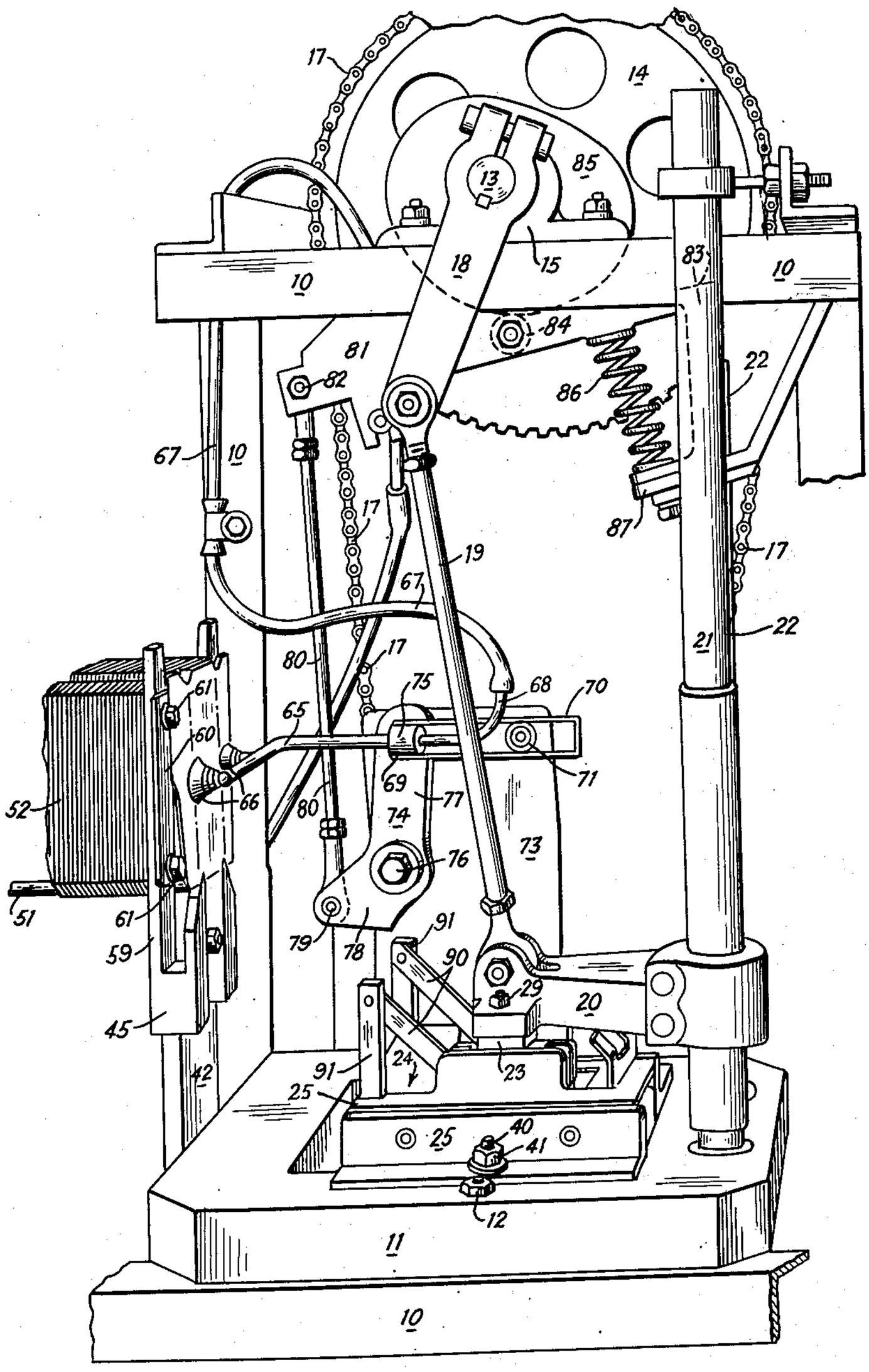

Fig. 2

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Jan. 6, 1953 T. R. BAKER ET AL 2,624,249

BLANK FEEDING MECHANISM FOR FOLDING BOX MACHINES

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4 Sheets-Sheet 3

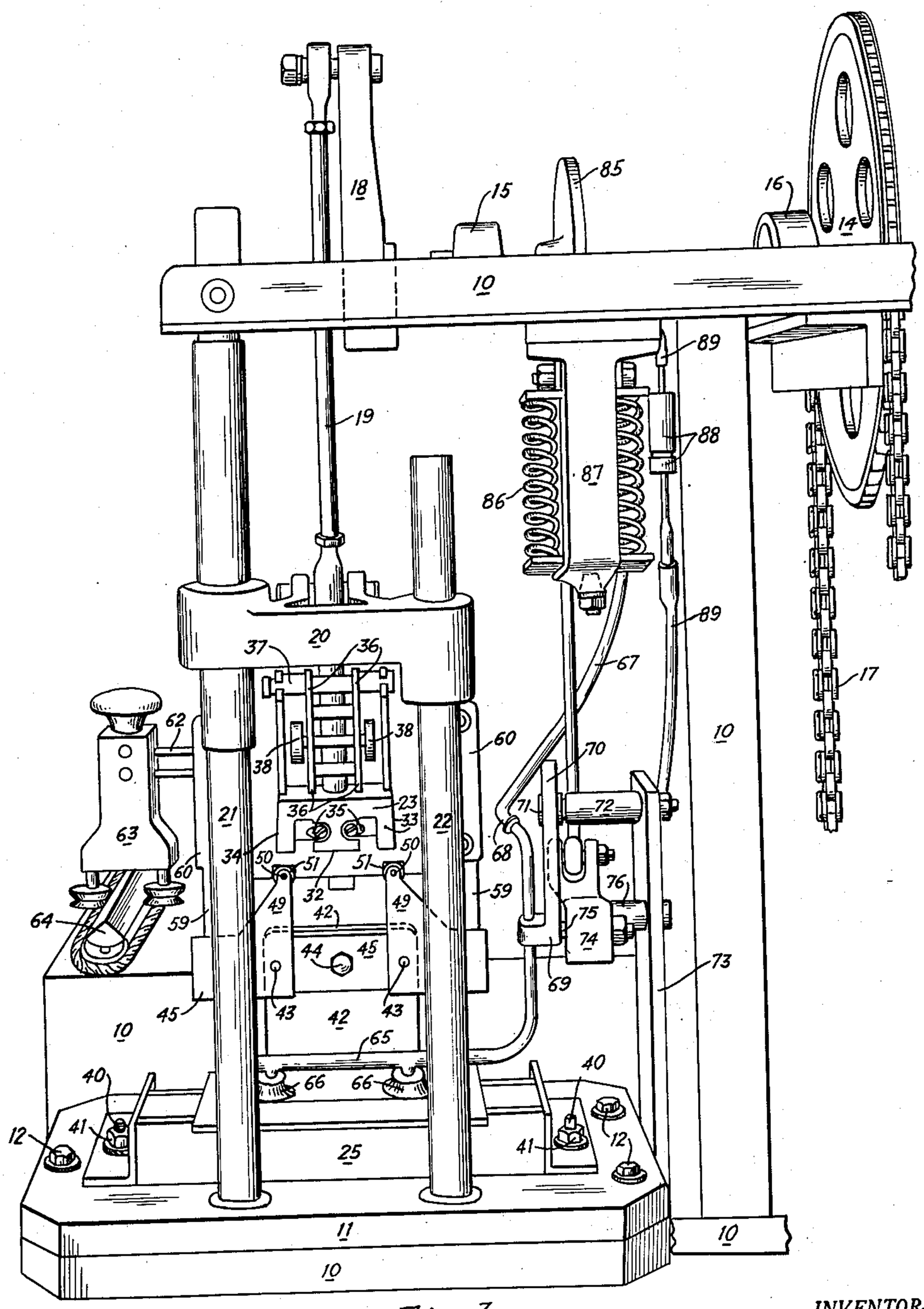

Fig. 3

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BLANK FEEDING MECHANISM FOR FOLDING BOX MACHINES

Filed Dec. 28, 1948 4 Sheets-Sheet 4

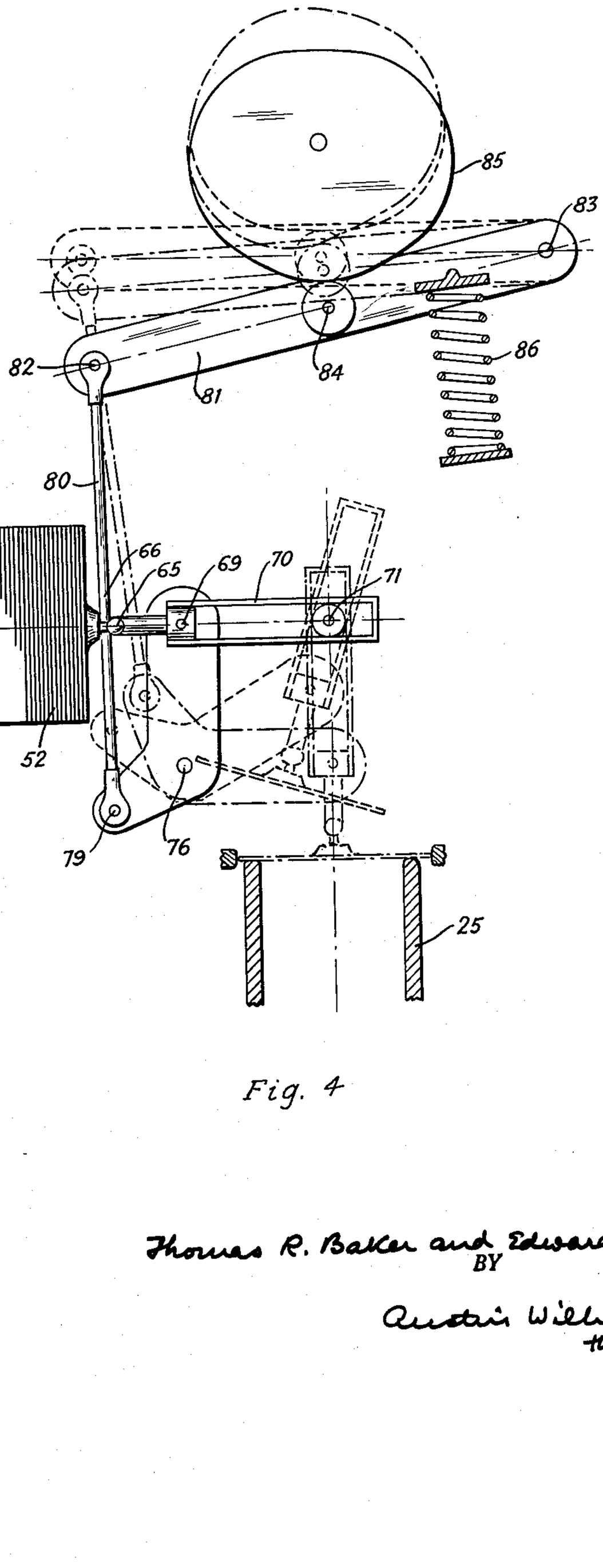

Fig. 4

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2,624,249

UNITED STATES PATENT OFFICE

2,624,249

BLANK FEEDING MECHANISM FOR FOLDING BOX MACHINES

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Application December 28, 1948, Serial No. 67,613

4 Claims. (Cl. 93—51)

1

This invention relates to improvements in blank feeding mechanisms for folding box machines of the type in which a flat, or nearly flat blank of foldable sheet material, for example paperboard, is forced through a folding die by a plunger, to fold the blank into hollow box form.

The invention offers particular advantages if applied to machines of the aforementioned general class which, in addition to folding the blank during its passage through the die, also perform a locking operation on the blank to lock certain blank portions, such as walls, panels, tabs, or flaps together, so that these blank portions thereafter remain in box forming position without extraneous connecting means such as adhesive, staples, rivets, or the like.

However, the invention is not limited in its application to machines for the glueless assembly of folding boxes, but offers many advantages if applied to die and plunger machines for making glued boxes.

The success of the folding operation of a blank between the plunger and the die depends in a large measure on the accuracy with which a box blank is deposited on the die. If the blank is slightly out of position at the moment the plunger engages it, the blank will not fold at the intended fold lines, and, if it is of the self-locking type, the locks will generally not engage. This means that the blank will have to be discarded as waste. In this connection it is well to remember that machines for the glueless assembly and interlocking of boxes are capable of extremely high production rates which are of the order of double to triple the rate of a comparable machine for setting up glued boxes. Production rates of between 150 to 200 boxes per minute are not uncommon for box forming machines of the glueless type. From these figures it is readily appreciated that extreme accuracy in the position and adjustment of the various elements of the machine is of utmost importance, since there is no time for the blank to settle between tapered guides at the mouth of the die, nor is there time for "jogging" the blank in the conventional manner by engaging one or several blank edges to push it into correct position.

The accuracy with which the feeding mechanism deposits blanks on the folding die after removing them from a magazine is therefore quite critical.

It is also of great importance to guard against the accidental feeding of two blanks adhering to each other, since the clearance between the folding die and the plunger is so selected as to permit

2

only material of a predetermined maximum thickness to pass therebetween. Accidental simultaneous feeding of two blanks, therefore, always results in destruction of the blanks and frequently in damage to the machine.

The present invention provides a feeding mechanism which reliably feeds blanks, one at a time, and deposits them with great accuracy in precisely the position which the blank should assume with respect to the die without the necessity to correct the position by special means.

The improved feeding mechanism handles blanks in a manner in which they can be moved at an extremely high speed. The improved device effectively eliminates air resistance against the blank surface and inertia effects; that is the tendency of the blank to rebound if stopped suddenly, factors which critically affect the accuracy of delivery of the blank.

The various objects, features, and advantages of this invention will appear more fully from the detailed description which follows accompanied by drawings showing, for the purpose of illustration, a preferred embodiment of the invention. The invention also consists in certain new and original features of construction and combination of elements hereinafter set forth and claimed.

Although the characteristic features of this invention which are believed to be novel will be particularly pointed out in the claims appended hereto, the invention itself, its objects and advantages, and the manner in which it may be carried out may be better understood by referring to the following description taken in connection with the accompanying drawings forming a part of it in which:

Figure 1 is a perspective side view of a box machine embodying the present invention, the machine being of the glueless interlocking type shown in a position shortly before the blank feeder picks up a flat blank at the magazine gate;

Figure 2 is a perspective side view of the box machine of Figure 1 at an advanced phase of its operation at the point of removal of a blank from the magazine by the feeder;

Figure 3 is a perspective end view of the machine at a further advanced phase of its operation at the point of deposit of the blank on the folding die by the feeder; and

Figure 4 is a diagrammatic and simplified illustration of the blank feeding mechanism, showing the mechanism at several phases of its operation.

In the following description and in the claims, various details will be identified by specific names

for convenience. The names, however, are intended to be as generic in their application as the art will permit. Corresponding reference characters refer to corresponding parts in the several figures of the drawings.

In the drawings accompanying, and forming part of, this specification, certain specific disclosure of the invention is made for the purpose of explanation of broader aspects of the invention, but it is understood that the details may be modified in various respects without departure from the broad principles of the invention and that the invention may be applied to other structures than the ones shown.

The folding box forming machine shown in Figures 1 to 3 produces boxes by folding a blank and interlocking the box corners in a manner to form a rigid self-sustaining box without gluing, stapling, or riveting. Gluelessly interlocked boxes are quite popular because of their low cost, the high rate at which they can be set up and because of the low cost and relatively small size of the machine required for setting them up. The glueless interlock of such boxes generally comprises flaps on the side or end walls which are partially inserted through cuts or apertures in the end or side walls of the box, respectively. The flaps generally engage the walls in edge-to-edge contact, whereby a strong interlock is produced comparable in strengh to a glued connection.

Because of the extensive use of gluelessly interlocked boxes a detailed description of a representative blank and box may be dispensed with. It may be stated, however, that the illustrated machine is particularly equipped to set up and lock boxes of the type disclosed in the patent to Meller No. 2,580,181 (application Serial No. 789,839 of December 4, 1947).

The machine comprises a supporting frame work 10 to which a base 11 is secured by bolts 12. A drive shaft 13 carrying a chain gear 14 is mounted in bearings 15 and 16. The drive shaft is driven through a chain 17 from a motor or other suitable source of power (not shown) and carries a crank 18. A connecting rod 19 connects the crank 18 with a cross head 20 vertically movable on posts 21 and 22 of the base 11.

The cross head 20 has a plunger 23 attached to it, movable through the forming and folding aperture 24 of a die 25, the axis of the die and plunger being substantially vertical. The plunger 23 has a head portion 26 secured to the cross head by bolts 29. The bolts 29 extend through holes in the cross head 20 with close tolerances so that the plunger assumes a definite position with respect to the cross head when being secured thereto by the bolts. The bottom surface 32 of the plunger 23 is approximately equal in size to the bottom panel of the box to be formed. The bottom surface of the plunger engages a blank placed over the die aperture and forces it through the die while the inner side walls of the die fold the wall panels of the blank towards the outer wall surface 33 of the plunger. The plunger is equipped with projectable and retractable elements 35 on the lower ends of levers 36 pivoted in the plunger at 37. The levers 36 carry rollers 38 which cause the levers to swing inwardly when the rollers 38 strike projecting cam surfaces in the die (not shown). This causes the elements 36 to be pulled inwardly to perform a certain locking operation on the blank. A detailed description of these box assembly operations is not required for an understanding of the particular improvements provided by this invention. How-

ever, a detailed explanation may be found in the patent to Pagendarm No. 2,580,189 (application Serial No. 739,749 of April 7, 1947).

The folding die 25 proper fits with close tolerance on bolts 40 in the base. The bolts serve as dowels causing the die to assume a definite position with respect to the base 11 and also permit the die to be securely fastened to the base by nuts 41. The die thus assumes adjusted position in the machine in proper relation with respect to the path of the plunger. The described mounting causes the central axis of the plunger to coincide with the center axis of the die, the latter being the imaginary vertical line extending through the center of the die aperture.

The base 11 has a rigid gate supporting plate 42 attached to it which near its upper end carries two dowel pins 43 and a central tapped aperture into which a bolt 44 fits. A magazine gate 45 is attached to the supporting plate 42. Vertical spaced inner arms 49 of the gate carry dowel pins 50 at their upper ends over which blank supporting rods 51 fit. The rods, in turn, fit into cutout or recessed portions of a stack 52 of blanks B and align the blanks with respect to the magazine gate 45. The far ends of the rods 51 are supported in a similar manner as the front ends and support the magazine in a substantially horizontal direction. The magazine axis intersects the vertical plunger axis and lies in substantially the same vertical plane as the latter.

Vertical outer arms 59 of the magazine gate carry blank retaining plates 60. The blank retaining plates are secured to the arms 59 by bolts 61 and are spaced from each other slightly less than the width of the blanks B. Thus the retaining plates 60 prevent the blanks in the magazine from falling out under the pressure of a feeder arm 62 urging the blanks towards the gate. The feeder arm 62 is supported by a carriage 63 which runs on a prismatic track 64 and bears against the rearmost blank to feed the entire stack of blanks towards the magazine gate.

The spacing of the retaining plates 60 permits removal of the frontmost blank by a feeder which grasps the blank intermediate the retaining plates and pulls it away from the stack of blanks in the magazine. During the removal the frontmost blank flexes slightly and snaps with its side edges past the edges of the retaining plates 60.

The blank feeding mechanism comprises a feeder arm 65 carrying a pair of suction cups 66. The feeders arm 65 is hollow and serves as a suction duct to apply at proper intervals a partial vacuum to the suction cups. The feeder arm has a flexible duct 67 attached to its end at 68. The arm is rigidly mounted on a bracket 69 having an elongated guide-way 70 engaging the cylindrical outer surface of a ball bearing 71. The ball bearing 71 is mounted on a stud 72 on a supporting plate post 73 which, similar to the gate supporting plate 42, is rigidly and permanently attached to the base 11.

The bracket 69 of the feeder arm 65 is pivotally connected to one arm of a bell crank lever 74 at 75. The bell crank lever 74 is pivotally mounted on the supporting plate 73 at 76. Its pivotal axis is substantially normal to the vertical plane in which the plunger and magazine axes lie. The bell crank lever has two arms, the one arm 77 being represented by the distance between the pivotal axes 75 and 76, the other arm 78 being represented by the distance between the pivotal axis 76 and the axis of a pin 79 at which one

end of a connecting rod 80 is attached to the bell crank lever.

The other end of the connecting rod 80 is pivotally connected to a rocking lever 81 at 82. The rocking lever 81 is pivoted in the frame work 10 of the machine about an axis 83 and carries a cam follower 84 urged against the periphery of a cam 85 on the drive shaft 13. The rocking lever 81 is under the action of helical compressed springs 86 bearing with its one end against the rocking lever proper and with the other end against a bracket 87 secured to the framework 10.

The cam 85 is fast on the drive shaft 13 and oscillates the rocking lever 81 about its axis 83. The lever 81 in turn causes the bell crank lever 74 to oscillate about its pivot 76 to move the feeder arm 65 in a manner presently to be described.

Beginning with the position of the elements of the machine, as shown in Figure 1, a blank B rests on the folding die 25, and the plunger 23 is on its downward stroke driven by the crank 13 moving in a clockwise sense. The rocking lever 81 is nearing its lowermost position as the cam follower 84 climbs onto portions of the cam of progressively increasing radius. The feeder arm 65 is in front of the magazine gate and the suction cups 66 are only a short distance from the frontmost blank, moving towards the blank in order to grip it. As the follower 84 of the rocking arm 81 continues to climb with respect to the cam, the rocking lever is depressed further causing the bell crank lever 74 to turn counterclockwisely. The bell crank lever arm 77 is nearly vertical. Its pivotal motion about the lever axis 76 therefore causes the feeder arm to make a translatory motion substantially horizontal towards the magazine gate. The feeder arm is guided in this motion by the guideway 70 which slides relatively to the outer surface of the ball bearing 71 (see Figures 2 and 4) until the suction cups make contact with the frontmost blank of the stack 52.

It will be observed that the approach of the feeder mechanism is relatively slow due to the very gradual change in curvature of the cam 85 at the point of contact with the follower 84. In distinction, the movement of the plunger 23 is relatively rapid as the plunger approaches the die 25.

Referring now to Figure 2 showing the machine at a phase of operation advanced approximately 120 degrees in terms of crank angle, it will be seen that the plunger has forced the blank previously resting on the die entirely through the die, performing the folding operation on the blank, and has begun to return towards its upper dead center position.

The cam follower 84 has just moved over the highest portion of the cam at which point the suction cups 66 make contact with the frontmost blank. As the cam follower then moves onto cam portions of progressively shorter radius, the rocking lever 81 moves upwardly under the action of the spring 86 and the bell crank lever 74 turns in a clockwise sense thereby moving the suction cups to the right. This motion, again, is rather slow and causes the frontmost blank to flex and separate from the next blank and to snap past the edges of the retaining plates 60. Figure 2 illustrates the instant at which the right side edge of the blank has cleared the retaining plate, whereas the upper portion of the left side edge of the blank is still in engagement with the respective retaining plate. The removal of the blank from the magazine thus takes place during a predominantly translatory motion of the feeder.

As the bell crank lever 74 continues to turn about its axis 76 the translatory component of motion of the feeder arm 65 gradually decreases while a rotary component of motion increases. As a result the suction cups with the blank attached to them swing towards the die as the feeder pivots relatively to the bell crank lever about the pivotal axis 76. During the latter phase of motion the rocking lever 81 approaches its uppermost position as the cam follower 84 gradually moves onto the portion of the cam having the shortest radial distance from the drive shaft axis.

It will be noted that the movement of the blank from the magazine to the die is most advantageous from the standpoint of air resistance since during its fast swinging movement towards the die the blank exposes substantially only an edge to the air but not its flat surface.

During the swinging motion of the blank towards the die the crank 13 which operates the plunger 23 moves towards its upper dead center position causing the plunger to clear the die so that the feeder arm can deposit the blank on the upper die surface underneath the plunger.

Figure 3 shows the machine with the crank 13 at the upper dead center position. At this phase the feeder arm 65 has reached a vertical position ready to deposit the blank on the die. The point of release is controlled by a valve 68 in the duct 67 which at the proper moment shuts off the duct from the vacuum line 69 (Figure 3) and vents it to the atmosphere. The blank now drops onto the receiving surface of the die.

During the approach of the blank the lever arm 77 is in substantially horizontal position and the guide way 70 is substantially vertical. As a result the motion of the blank is a predominantly translatory motion during which the blank moves slowly due to the very gradual change in curvature of the cam 85. At the moment of deposit of the blank the follower 84 passes the cam portion of shortest radius.

Removal of the blank from the suction cups is assisted by two strippers 90 of flat spring bronze, or spring mounted on posts 91 of the die. During the last portion of the feeding movement the blank moves past the lower ends of the strippers 90 which thereafter flex slightly inwardly to engage the upper surface of the blank and retain it on the die. The strippers thus prevent the blank from being disturbed as the suction cups return empty to the magazine.

The principal phases of compound motion of the feeder arm are diagrammatically shown in Figure 4. In the position shown in full lines the feeder arm is fully extended and the suction cups 66 make contact with the frontmost blank of the stack 52. During the phase of predominantly rotative motion shown in dotted lines the suction cups have the shortest distance from the pivotal point 71 relatively to which the guideway 70 of the feeder slides. The other extreme position at which the feeder deposits the blanks on the die is shown in dash-dot lines. In this position the feeder arm is again fully extended.

The invention thus provides an improved feeding mechanism which slidably feeds blanks, one at a time, at an extremely rapid rate and deposits them accurately in the position in which the blanks are to be grasped by the blank folding mechanism. The blanks are so guided as to reduce the air resistance to a minimum during

the transport of the blank from the magazine to the die. However, air resistance is taken advantage of as the blank is being deposited at the die to decelerate the blank to prevent rebound. The rapidity with which the feeding mechanism is capable of operating makes it particularly suited for high speed glueless box forming and interlocking machines. However, the accuracy with which the device operates makes it a desirable feeding unit for slower machines employing adhesives where accuracy of blank delivery is of importance.

What is claimed is:

1. A feeding mechanism for removing single blanks of foldable sheet material from a withdrawal position and plane, for example from the end of a stack of blanks, and moving the withdrawn blank to, and deposit it in, a deposit position and plane, for example on a folding die through which a plunger is movable, said deposit position and plane lying at an angle with respect to the withdrawal plane, the feeding mechanism comprising, a support; a bell-crank lever pivotally mounted on said support; a bearing on said support, said bearing having a pivotal axis spaced from, and parallel with, the pivotal axis of the bell-crank lever; a double-armed gripper arm pivotally mounted to one arm of said bell-crank lever, one arm of the gripper arm having rotative and slidable engagement with said bearing; a suction gripper mounted on the other arm of said gripper arm; and means engaging the other arm of said bell-crank lever for oscillating the bell crank lever about its axis.

2. A feeding mechanism for removing single blanks of foldable sheet material from a withdrawal position and plane for example from the end of a stack of blanks, and moving the withdrawn blank to, and deposit it in, a deposit position and plane, for example on a folding die through which a plunger is movable, said deposit position and plane lying at an angle with respect to the withdrawal plane, the feeding mechanism comprising, a mounting plate substantially normal to said withdrawal plane and said deposit plane; a bell-crank lever pivotally mounted on said plate; a combination pivot and slide bearing mounted on said plate, its axis being spaced from, and parallel to the pivotal axis of said bell-crank lever; a double-armed gripper arm pivotally mounted to one arm of said bell-crank lever, one arm of the gripper arm having rotative and slidable engagement with said bearing; a suction gripper mounted on the other arm of said gripper

arm; and means engaging the other arm of said bell-crank lever for oscillating the bell-crank lever about its axis.

3. A feeding mechanism as set forth in the preceding claim 2 in which the imaginary line connecting the pivotal axis of said bearing with the bell-crank axis bisects the angle between the normal axes of said removal plane and said deposit plane said normal axes extending through said pivotal axis.

4. A feeding mechanism for removing single blanks of foldable sheet material from a withdrawal position and plane, for example from the end of a stack of blanks, and moving the withdrawn blank to, and deposit it in, a deposit position and plane, for example on a folding die through which a plunger is movable, said deposit position and plane lying at an angle with respect to the withdrawal plane, the feeding mechanism comprising, a mounting plate substantially normal to said withdrawal plane and said deposit plane; a bell-crank lever pivotally mounted on said plate; a combination pivot and slide bearing mounted on said plate, its axis being spaced from, and parallel to, the pivotal axis of said bell-crank lever; a double armed, substantially L-shaped gripper arm pivotally mounted on one arm of said bell-crank lever, one arm of the gripper arm having rotative and slidable engagement with said bearing, the other arm of the gripper arm having a portion bent at right angles to said one arm of the gripper arm, the right angular portion being parallel to said withdrawal plane and said deposit plane; a suction gripper mounted on said angular portion; a cam; a cam follower lever engaging said cam; and a link rod pivotally connecting said cam follower lever and the other arm of said bell-crank lever.

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