April 6, 1965 T. R. BAKER ETAL 3,176,978

BLANK FEEDERS FOR BOX FORMING MACHINES

Filed Sept. 7, 1962 7 Sheets-Sheet 1

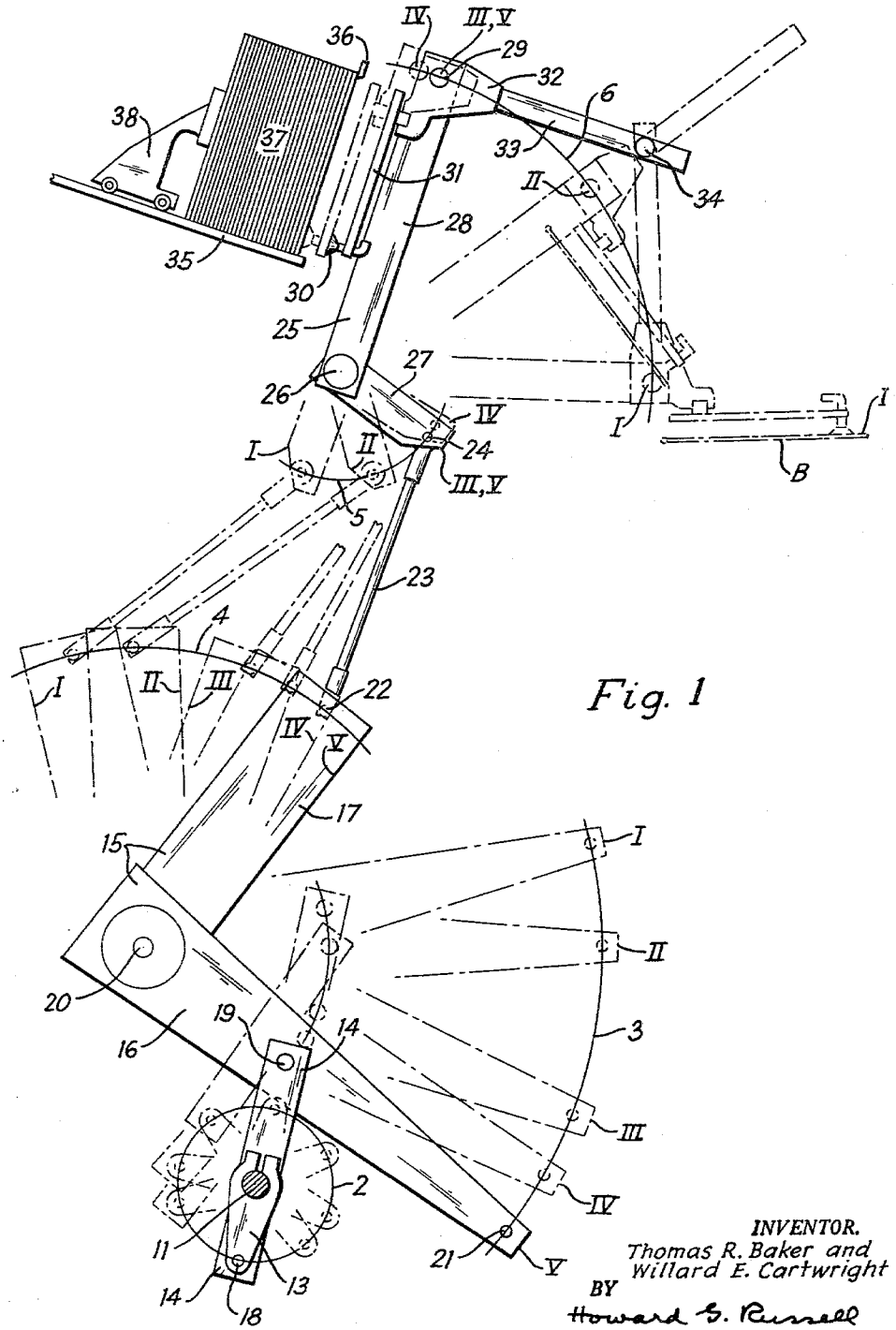


Fig. 1

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Filed Sept. 7, 1962 7 Sheets-Sheet 2

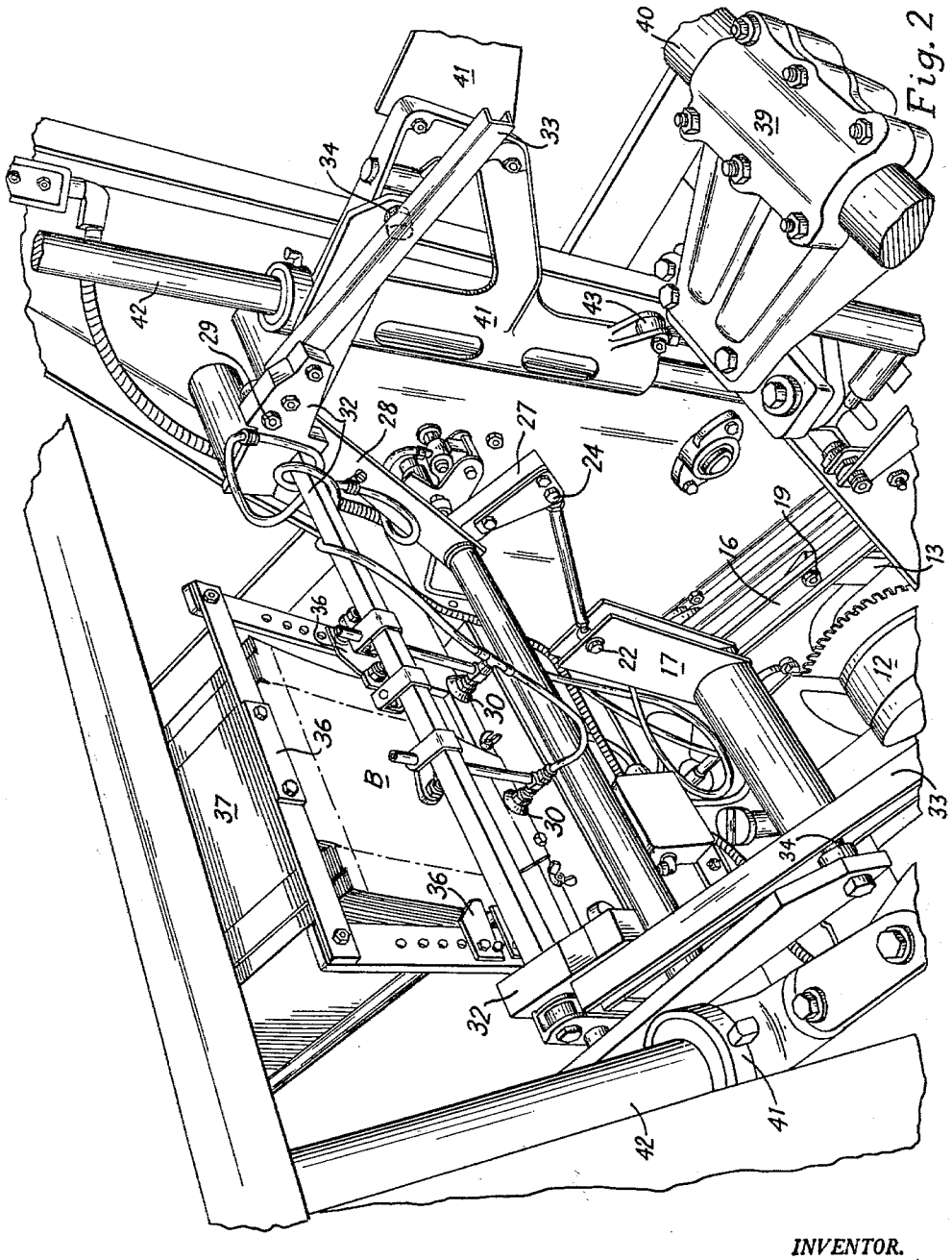


Fig. 2

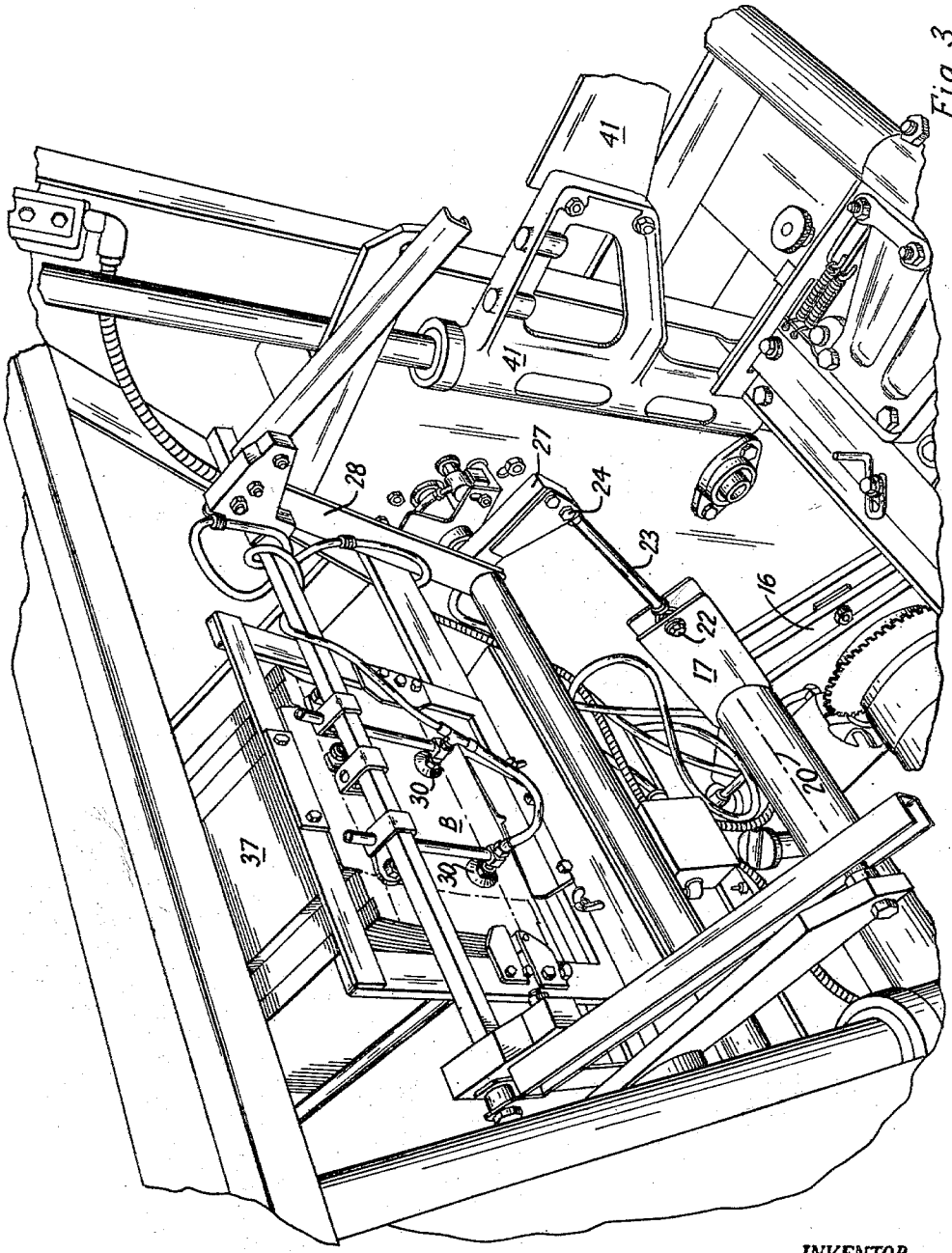
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BLANK FEEDERS FOR BOX FORMING MACHINES

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Fig. 3



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BLANK FEEDERS FOR BOX FORMING MACHINES

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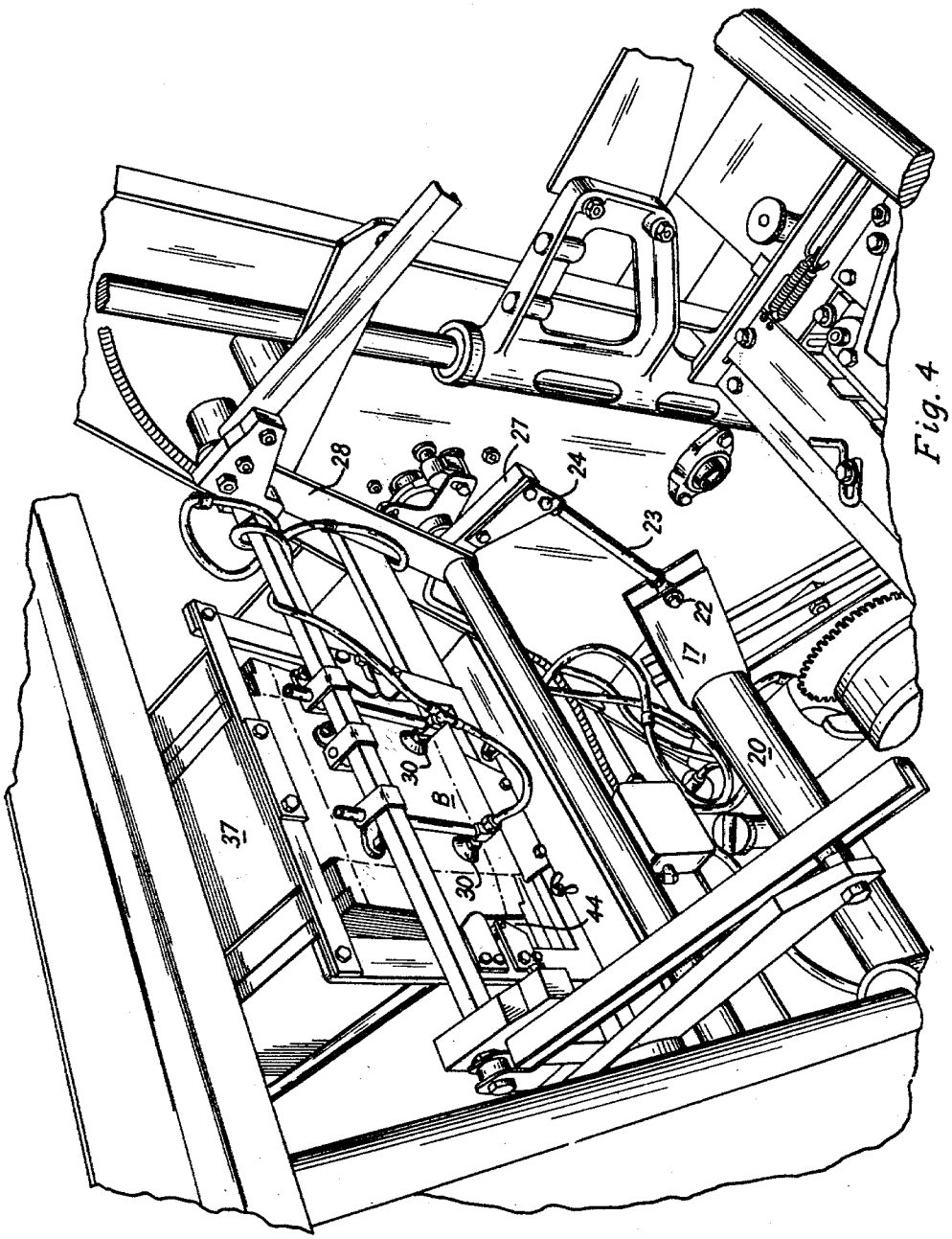


Fig. 4

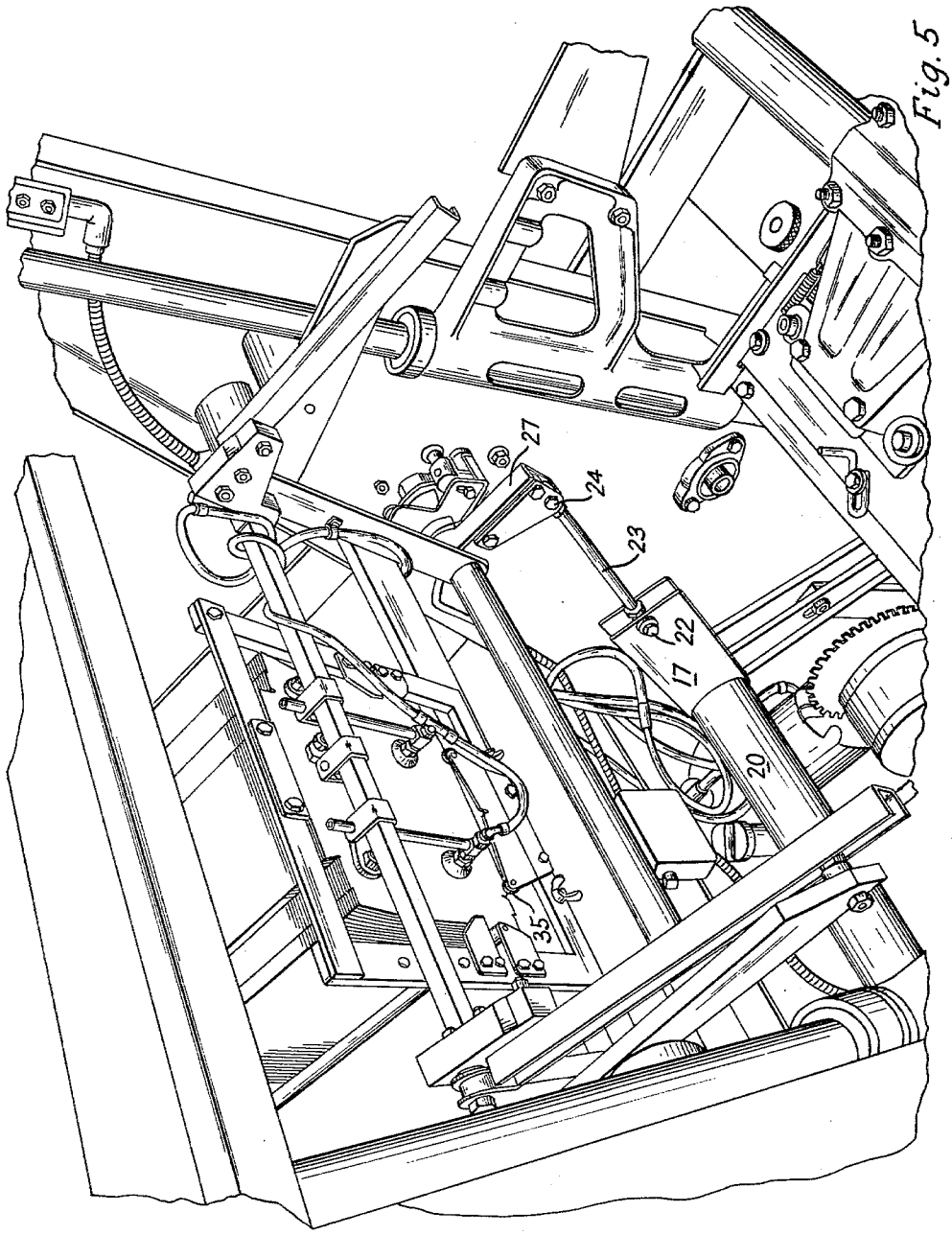
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BLANK FEEDERS FOR BOX FORMING MACHINES

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Fig. 5



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BLANK FEEDERS FOR BOX FORMING MACHINES

Filed Sept. 7, 1962 7 Sheets-Sheet 6

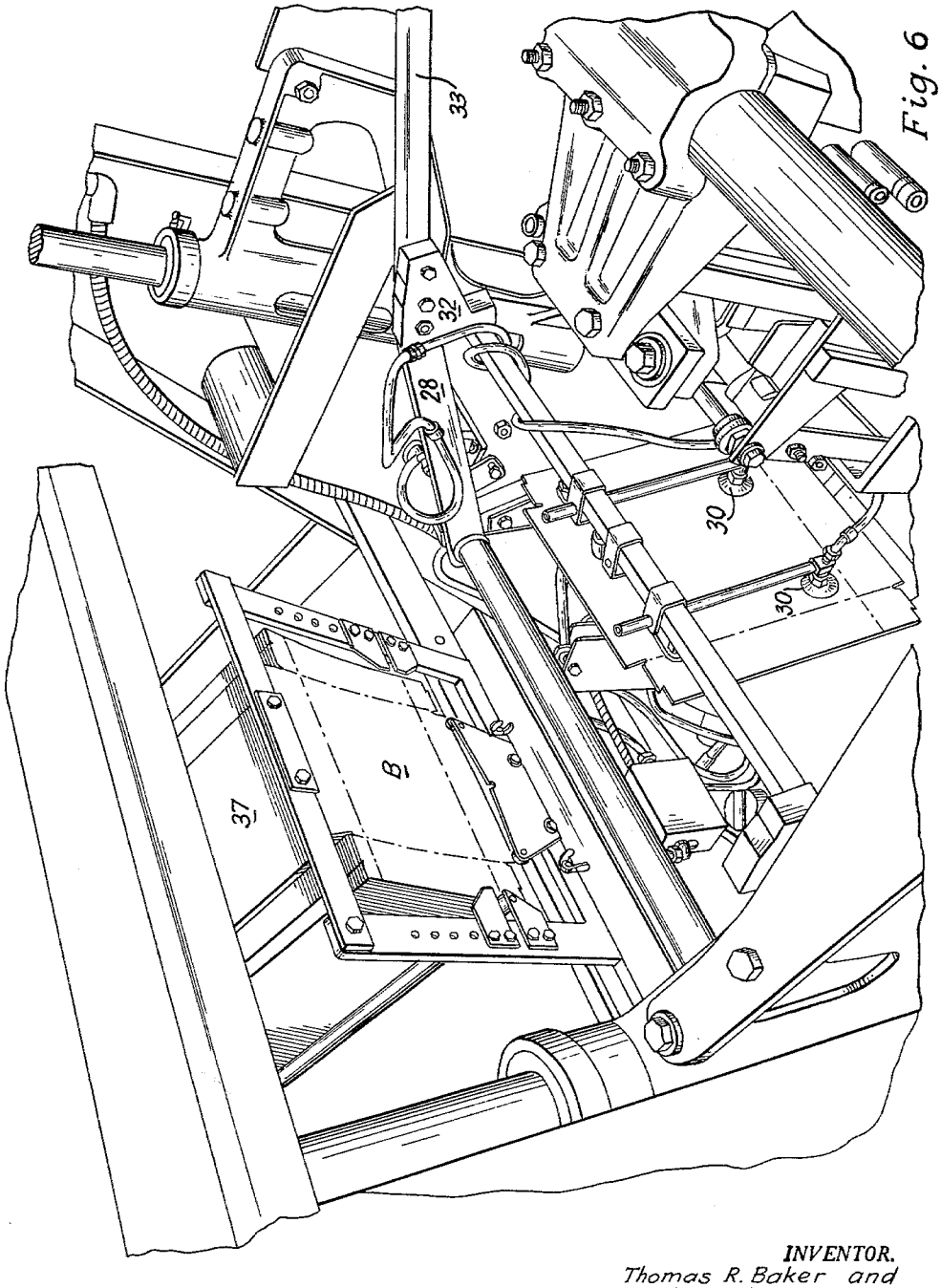


Fig. 6

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BLANK FEEDERS FOR BOX FORMING MACHINES

Filed Sept. 7, 1962 7 Sheets-Sheet 7

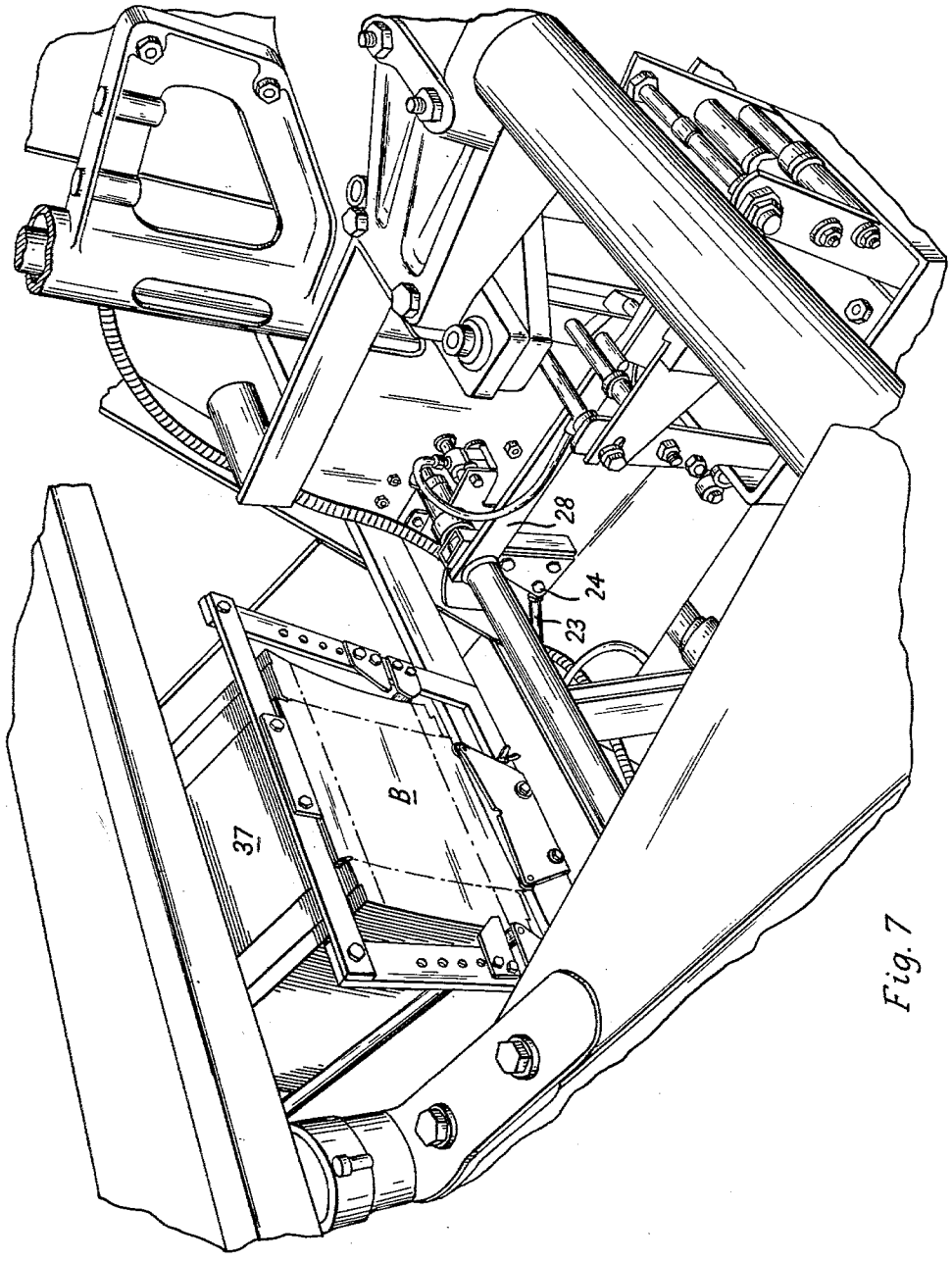


Fig. 7

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United States Patent Office 3,176,978 Patented Apr. 6, 1965

3,176,978

BLANK FEEDERS FOR BOX FORMING MACHINES

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Filed Sept. 7, 1962, Ser. No. 222,014
4 Claims. (Cl. 271—5)

This invention relates to improvements in feeding mechanisms for feeding individual blanks of flexible sheet material by vacuum means from a blank pick-up station to a blank deposit station, for example for feeding flat folding box blanks from the magazine of a box forming machine to the box forming device which may be a forming die and plunger.

In the operation of blank feeding mechanisms of the aforementioned kind several problems are encountered.

Blanks, especially those of large size, tend to cling together and resist separation at the magazine gate by failure of atmospheric air to flow quickly enough into the space between the foremost blank which is being removed and the next blank. Quick removal of the foremost blank in a direction substantially normal to its plane causes the creation of a temporary partial vacuum between the foremost blank and the next, as a result of which the two blanks tend to cling together. The problem is the greater the larger the blank and the greater the rate of removal.

Another problem is the continuous advance of the stacked blanks in the magazine forward towards the magazine gate, by the thickness of a blank, after the removal of each blank. This problem has been met by agitation, particularly oscillation, of the blank supporting rods on which the blanks rest on edge. The present invention offers a different and mechanically very simple solution involving agitation of the blanks proper, on the theory that although a stack of blanks may not move after removal of one or two blanks, it will move if several blanks are removed or the removal of several blanks is simulated.

A further problem is caused by the tendency of certain blanks, such as coated, lined, laminated or other blanks to warp. For practical reasons more than one vacuum element is used on the feeder for grasping the blanks. Thus, vacuum cups are arranged in pairs, threes, or fours. Failure of one cup to seat causes all other cups connected to the same vacuum line to lose vacuum with the result of failure to feed, or misfeeding, the latter comprising only partial removal of a blank from the magazine or loss of the blank during transport.

The present invention involves the superimposition on the major oscillating motion of the feed carrier, back and forth between the blank deposit station and the pick-up station, of a minor oscillating motion at the beginning of the feed stroke, i.e., at the magazine end. The suction cup means, after initial contact with the foremost blank, is withdrawn by only a fraction of the major stroke, then advanced a second time to press against the stack of blanks again, whereafter the major feed stroke is carried out.

The repeated contact with the stack agitates the blank and simulates removal of several blanks, causing the stack to advance. Partial separation of the blanks is made complete by a pumping action which distributes air which entered between the blanks at some point over the entire blank area. Finally, repeated pressing of the vacuum cups against the blank causes the cups to seat securely.

The art of mechanics provides various mechanical means for producing the required motion of the feed carrier. Among these are cams and non-circular gears. A particularly simple way of producing the required superimposed major and minor oscillations is the utilization of the well known over-center action of a lever system.

This form of feeder drive is preferred because of its simplicity, positive action and the fact that it is readily combined with other already existing lever drives of the folding box forming machine, particularly the oscillating plunger drive.

These and various objects, features and advantages of the 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 resides 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:

FIG. 1 is a diagrammatic representation of the construction and operation of a blank feeding mechanism embodying the present invention; and

FIGS. 2 to 7 are perspective illustrations of the feeding mechanism of FIG. 1 in various successive stages of 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 generic in their application. Corresponding reference characters refer to corresponding parts in the several figures of the drawings.

The drawings accompanying, and forming part of, this specification disclose certain specific details of construction for the purpose of explanation of broader aspects of the invention, but it is understood that structural details may be modified in various respects without departure from the principles of the invention and that the invention may be incorporated in other structural forms than specifically shown.

FIG. 1 is most readily explained and understood by following the flow of power from its source, a main drive shaft, to the feed carrier. The principal movable elements are shown in solid and broken lines in five different positions identified by Roman numeral indices I to V.

A main shaft drive or power shaft 11, which may be the output shaft of a reduction gear 12 (FIG. 2), carries a crank 13 moving through a full 360 degree circle 2.

A drive link 14 extends from the crank 13 to an oscillating power arm 15, shown as having the form of an angle lever with arms 16 and 17. The pivotal connections of the link 14 with the crank 13 and with the power arm 15 are identified as pins 18 and 19.

The power arm is pivotally mounted for oscillation about an axis 20. Its arm 16 carries a connecting pin 21 for connection to a push rod for moving the plunger of the box forming machine up and down. This portion of the machine is not essential for an understanding of this invention and is for this reason not shown in detail. Suffice it to say that pin 21 oscillates on an arc 3 and assumes on its path the five positions I to V indicated on arc 3.

The arm 17 also carries a connecting pin 22 which sweeps an arc 4.

A connecting rod 23 extends from pin 22 to a pin 24 of a drive arm 25 pivotally mounted for oscillation about an axis 26. The drive arm 25 is also shown in the form of an angle lever with arms 27 and 28. Arm 27

may be referred to as an input arm, and arm 28 as an output arm provided with a pin 29.

As the pin 24 moves on an arc 5, the pin 29 sweeps an arc 6 at the lower end of which the blank deposit station is indicated as position I. From position I on arc 6 the pin 29 moves through its return stroke to the opposite end of the arc identified as position IV representing the pick-up station.

The prinicipal elements of the feed carrier are shown in the diagram and comprise vacuum cups 30, of which there are two, one lying behind the other in the elevational representation. The cups 30 are mounted on arms 31 secured to a feed carrier head 32 pivotally mounted on the output arm 28 at 29. The carrier head 32 has a control arm 33 connected to it extending to a control pivot 34. The control arm 33 has slidable as well as pivotal engagement with the control pivot and thus controls the attitude, i.e., the inclination, with respect to the horizontal or vertical, of the carrier head 32 and of the suctions cups 30 in particular, as pin 29 sweeps the arc 6. Such attitude control is known in the art.

Blanks B are supported on edge on rods 35 of a blank magazine provided with a retaining lip or lips 36 to prevent the foremost blank from falling out. The rods 35 are preferably inclined to facilitate forward sliding of the stack of blanks 37 under the influence of a gravity-urged or spring-urged follower or pusher 38.

Following now the motion of the illustrated mechanism, it is seen that in position I the output arm 28 is approximately horizontal. The mouths of the suction cups 30 are in a horizontal plane, and upon venting of the vacuum applied to the cups 30 the blank B transported into position I drops by gravity, or is removed by appropriate elements of the box forming mechanism. It will also be noted that the horizontal orientation of the blank B at position I is the result of the action of the control arm which is nearly vertical.

Position II on arc 6 shows the feeder head 32 in its halfway position of its return stroke. The blank indicated in position II is, of course, not present during the return stroke. It is shown however to illustrate the change of the attitude of the head, and also because position II is the halfway position of the feed stroke during which the feeder carries a blank.

In the halfway position the control arm 33 extends at approximately a 45 degree angle and feeder head 32 is nearest the control pivot 34.

The end of the return stroke is reached in position IV of arc 6. In this position vacuum is applied to the line or lines leading to the cups 30, the cups attach themselves to the foremost blank of the stack and push the stack back slightly.

Considering the corresponding positions on arcs 4 and 5 it is seen that pin 22 of arm 17 lies on the straight line connecting the axis 20 of the power arm 15 with the pin 24 of the input arm 27. At this moment arm 17 has not yet reached the end of its sweep of arc 4, but the pin 22 continues to move into the over-center position at the end of arc 4. This causes the drive arm 25 of the feed carrier 32 to execute a limited clockwise rotation about its axis, the extent of the motion being a fraction of the major feed stroke. As a result, the cups 30 move to the right and withdraw the foremost blank of the stack 37. Air enters into the space behind the foremost blank and the next blank of the stack.

As the drive crank 13 continues to rotate the angle lever 15 begin its counterclockwise sweep. The pin 22 on arm 17 moves to position IV and the drive arm 25 moves counterclockwisely through the second phase of its minor, or over-center oscillation.

The cups 30 press against the stack 37, and in doing so pumps or press the air which has accumulated behind the foremost blank over its entire back surface, thus establishing an air film behind the foremost blank for subsequent effortless separation from the stack.

When the pin 22 of arm 17 reaches the position III during the feed stroke, the cups 30 have the same distance from the end of the stack 37 as they did in the over-center position V. Arm 17 now continues its counterclockwise sweep towards position I, and the feeder head 32 executes its feed stroke.

The displacement of the blanks in the stack 37 caused by the minor oscillating motion from position V to IV amounts to several thicknesses of board and is sufficient to cause all blanks subsequently to slide forward into abutting position with lips 36.

FIG. 2 shows the feed mechanism during its return stroke. Pin 22 has not quite reached the position III (of arc 4 in FIG. 1) and the cups are still a short distance from the foremost blank B in the magazine. In FIG. 2 a portion of the plunger drive is visible. The plunger is mounted on a bracket 39 on a plunger drive bar 40 extending between crossheads 41. The crossheads are vertically slidable on rods 42. The upper end of the push rod which connects the far crosshead 41 with pin 21 of lever 15 (FIG. 1) is visible at 43.

FIG. 3 shows the elements in the centered position IV in which axis 20, pin 22 and pin 24 are in line. The suction cups are attached to the foremost blank.

FIG. 4 shows the elements in the over-center position V in which the foremost blank is separated from the next blank in the stack, a wedge shaped gap being clearly visible at 44.

In FIG. 5 the centered position is again reached, the blanks are pushed back to such an extent that the front portion of one of the supporting rods 35 is visible.

FIG. 6 shows the feeding mechanism at about its halfway position of the feed stroke near position II of the diagram FIG. 1.

FIG. 7 shows the feeding mechanism at the end of its feed stroke in position I in which arm 28 is substantially horizontal.

Obviously the invention may be practiced by employing other forms of mechanism for producing the required motion characteristics.

What is claimed is:

1. A blank feeding mechanism for transferring a blank from a pickup station of a folding box machine to a blank deposit station, the mechanism comprising, in combination,

a power operated crank;

a first angle lever having two arms;

a first link connecting said crank to one arm of said first lever;

a second angle lever having two arms;

a second link pivotally connected to the second arm of the first lever and to the first arm of the second lever, the points of pivotal connection moving on arcs when said first lever is oscillated by rotation of said crank,

a feed carrier pivotally mounted on the second arm of said second lever, said feed carrier comprising suction cup means for grasping a blank;

a fixed control pivot;

and a control arm fixed on said carrier and having slidable as well as pivotal engagement with said control pivot for varying the inclination of the feed carrier with respect to the horizontal during oscillation of the second angle lever;

the relative disposition of the axes of the angle levers and the pivot axes at which said second link is connected to said angle levers being such that, between the end positions of the movement of the pivot axis of the second link on the first angle lever, said last named pivot axis moves from one side of the hypothetical straight line connecting the axis of said first angle lever with the pivot axis of said second link

on said second angle lever, beyond said line, to the other side of said line.

2. A blank feeder, particularly for folding box forming machines for transferring a blank from a pickup station to a blank deposit station, the feeder comprising, in combination,

a drive arm mounted for oscillation about a substantially horizontal drive arm axis;

a feed carrier mounted on said drive arm, said carrier including suction means for grasping a blank;

and drive means for imparting an oscillating motion to said drive arm, said drive means comprising a prime mover and, between said prime mover and said drive arm, an over-center lever assembly comprising a driving lever mounted for oscillation about a first lever axis, a driven lever mounted for oscillation about a second lever axis spaced from and parallel to said first lever axis; and a connecting link hingedly connected to said driving lever and to said driven lever, respectively, at a first and a second hinge axis, respectively, the relative disposition of the lever axes and the hinge axes being such that the first hinge axis of the connecting link moves on its arcuate path about the first lever axis from one side of a center line to the other side of the center line, the center line being the hypothetical straight line connecting said first lever axis with said second hinge axis.

3. A blank feeder mechanism comprising, in combination,

a first lever mounted for oscillation about a first lever axis;

a feed carrier pivotally mounted on said lever about a pivot axis parallel to, and spaced from, said first axis;

suction cup means on said carrier for grasping a blank;

a control pivot;

control arm means fixedly connected to said feed carrier and having pivotal as well as sliding engagement with said control pivot;

a second lever mounted for oscillation about a second lever axis, spaced from and parallel to, said first and said pivot axes;

power means for oscillating said second lever;

and a connecting rod pivotally connected to said second lever and said first lever at a second hinge axis and a first hinge axis, respectively, said second and said first hinge axes being spaced from and parallel to said second and first lever axes, respectively, as a result of which said hinge axes move back and forth on arcs about the respective lever axes when said second lever is oscillated;

the relative disposition of said second lever axis and said hinge axes being such that between reaching its end positions on its arc the second hinge axis moves beyond the center position defined by the hypothetical straight line connecting the second lever axis and said first hinge axis.

4. A blank feeder mechanism comprising, in combination,

a first lever mounted for oscillation about a first lever axis;

a feed carrier pivotally mounted on said lever about a pivot axis parallel to, and spaced from, said first axis;

suction cup means on said carrier for grasping a blank;

a control pivot;

control arm means fixedly connected to said feed carrier and having pivotal as well as sliding engagement with said control pivot;

a second lever mounted for oscillation about a second lever axis, spaced from the parallel to, said first and said pivot axes;

power means for oscillating said second lever;

and a connecting rod pivotally connected to said second lever and said first lever at a second hinge axis and a first hinge axis, respectively, said second and said first hinge axes being spaced from and parallel to, said second and first lever axes, respectively, as a result of which said hinge axes move back and forth on arcs about the respective lever axes when said second lever is oscillated;

the relative disposition of said second lever axis and said hinge axes being such that during the terminal portion of its arcuate sweep and prior to reaching the end position on its arc corresponding to the pickup position of said feed carrier the second hinge axis moves from one side of the hypothetical center line connecting the second lever axis and the first hinge axis, beyond the center line, to the other side of the center line.

References Cited by the Examiner

UNITED STATES PATENTS

1,830,889	11/31	Sague	271—79 X
2,085,612	6/37	Spiess	271—27
2,624,249	1/53	Baker et al.	271—27 X
3,055,658	9/62	Kister	271—29

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