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(71) Applicant: **GRETAG Aktiengesellschaft**
Althardstrasse 70
CH-8105 Regensdorf (CH)

(72) Inventor: **Fleckenstein, Allen Eugene**
13212 S.E. 51st Place
Bellevue, WA 98006 (US)

(74) Representative: **Pirner, Wilhelm et al**
Patentabteilung der CIBA-GEIGY AG Postfach
CH-4002 Basel (CH)

(54) Envelope feeder.

(57) An envelope feeder for use in a photographic order finishing station includes a suction member that attaches itself to the topmost sheet of a stack of envelopes and moves in an arcuate path curling the topmost envelope away from the remainder of the stack. Hold-down fingers are provided that are operable to engage the remainder of the envelopes in the stack while the topmost envelope is being removed in order to overcome any mechanical attachment between the topmost envelope and the remainder of the stack. An adjustable envelope holding tray is provided that is moved by an elevator motor to change the height of the stack in order to allow contact of the topmost envelope with the pickup member. The stack height is monitored and the elevator motor is controlled in relation to stack height to maintain the stack at a predetermined level at all times as envelopes are removed. A feed roller assembly is mounted on the envelope feeder base in a position to receive the leading edge of the topmost envelope as it is curled away from the rest of the envelope by the pickup member. The suction on the pickup member is released as the leading edge is received by the feed rollers to allow the envelope to be fed through to an operator while the pickup member returns to its initial position to pick up the next envelope in the stack.

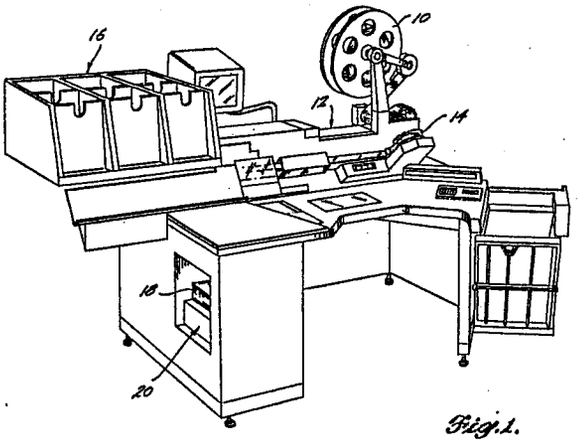

Fig.1.

EP 0 259 261 A2

Description

ENVELOPE FEEDER

Background of the Invention

This invention relates to an apparatus for separating the topmost sheet of material from a stack of such sheets and feeding it to a desired location and, more particularly, relates to an apparatus for successively peeling the topmost envelope from a stack of envelopes and feeding it into a conveyor system for delivery to a desired location.

While the invention will be described in the context of an envelope feeder in a photofinishing operation, it should be understood that the feeder can be used for other sheet materials and in other environments. The following description as it is limited to envelopes is meant to be exemplary only and not limiting. In the commercial photofinishing industry a customer's film is delivered to the processing lab in an envelope which contains customer identification. After the film has been processed the film is reunited with the original envelope so that the finished order can be returned to the customer in accordance with the information contained on the envelope. Typically, the process is carried out so that a sequence of the films proceeding through the processing operation is maintained as is the sequence of envelopes from which those films were taken. It is then up to an operator at the end of the processing to remove an envelope from the collection of envelopes and place the finished order into the envelope prior to its delivery to the customer. It is advantageous if the operator can remain in a single location and have the envelopes fed to her from a stack while at the same time the prints and developed film which make up the rest of the order are also delivered to her at the same location. While feeders for sheets of material have been developed which slide the topmost sheet away from the rest of the sheets the sliding procedure does not work as well in the case of photographic customer envelopes, since the envelopes have already been used and therefore are wrinkled so that they have a tendency to interfere with one another. Some of the envelopes may have an adhesive or staple thereon which tends to make them stick to the next envelope in the stack when an attempt is made to slide the top envelope over the next one.

Therefore, it is an object of the present invention to provide an envelope feeder that feeds the topmost envelope from a stack of envelopes even when the envelopes are wrinkled or contain an adhesive on their surface which tends to make the envelopes stick together.

It is a further object of the invention to provide an envelope feeder that peels the envelope from the top of the stack and curls it away from the remaining envelopes rather than sliding it laterally across the other envelopes.

It is a further object of this invention to provide an envelope feeder that can feed envelopes at a rate consistent with the processing rate for orders which allows the photofinishing operation to economically function without suffering mechanical breakdown or rapid wear of parts.

Summary of the Invention

In accordance with the above-stated objects, an envelope feeder is provided that includes a stack holding means for holding a stack of envelopes. An envelope removal means is also provided that is operable to attach itself to the topmost envelope in the stack. The removal means is rotatable to carry with it the edge of the envelope in an arcuate motion to curl the envelope and peel the topmost envelope from the remainder of the envelopes in the stack. A control means is provided that is associated with the envelope removal means that controls the attachment of the envelope removal means to the envelope and the detachment of the envelope removal means from the envelope. Feed roller means are also included which are operable in association with the envelope removal means to accept an envelope from the envelope removal means and carry the envelope to the desired end locaton.

The envelope feeder preferably also includes an envelope hold-down means operable in timed relationship with the envelope removal means to hold the remaining envelopes in the stack as the envelope removal means peels the topmost envelope from the stack. In a preferred embodiment of the invention, a stack height adjustment means is included, and stack height control means are associated with the stack height adjustment means for maintaining the height of the envelope stack at a predetermined level as envelopes are removed therefrom.

Preferably, the stack removal means includes a suction cup connected to a vacuum source by means of a valve which controls the vacuum that acts on the suction cup to permit the suction cup to attach itself to an envelope and detach itself from an envelope as determined by the control means.

Brief Description of the Drawings

The advantages and workings of the present invention will be better understood by those of ordinary skill in the art and others upon reading the ensuing specification when taken in conjunction with the appended drawings wherein:

FIGURE 1 is an isometric view of an order finishing station for handling photographic processing orders and which contains an envelope feeder made in accordance with the principles of the present invention;

FIGURE 2 is an isometric view of one embodiment of an envelope feeder made in accordance with the principles of the present invention;

FIGURE 3 is a side elevational view of a portion of the envelope feeder shown in FIGURE 2 demonstrating the movement of an envelope as it is removed from the stack;

FIGURE 4 is a side elevational view of a portion of the envelope feeder shown in FIGURE 2 showing the drive train for the envelope removal means;

FIGURE 5 is a side elevational view of the envelope feeder of FIGURE 2;

FIGURE 6 is a side elevational view of a portion of the envelope feeder of FIGURE 2 with parts removed showing the envelope pickup means and the hold-down means; and

FIGURE 7 is a front elevational view in partial section of an envelope stack elevator made in accordance with the principles of the present invention for use with the envelope feeder of FIGURE 2.

Detailed Description of the Preferred Embodiment

FIGURE 1 is an illustration of an order finishing station for use in a commercial film processing lab. The order finishing station is the location where developed film, prints made from that film, and the original customer envelopes in which the film was received by the lab all come together for collection into finished film processing orders ready to be priced and returned to the customer. At the order finishing station a reel of prints 10 is mounted for delivery to a print cutter 12 which separates the prints into individual pictures. At the same time a roll 14 of developed film or negatives is also mounted on the order finishing station for separation into individual customer groupings to match the prints being cut by the print cutter. The prints and negatives, after being collected in the proper grouping, are placed into wallets which are delivered from a wallet feeder 16 which is also part of the order finishing station.

Typically, the only information that the processing lab has concerning the identity of the customer whose order is being processed is on the original envelope containing the film as it was received from the customer. Therefore, the customer envelopes are maintained in control of the processing lab in a sequence to match the sequence of the film as it is developed and printed in the lab. When the developed film and prints are delivered to the order finishing station, a stack of customer envelopes 18 is also typically delivered so that the developed film and prints can be placed into the original envelope for return to the customer. An envelope feeder 20 is provided as a part of the order finishing station and operates to deliver the envelopes 18, one by one, to the operator for use in connection with gathering the order together and preparing it for return to the customer.

FIGURE 2 illustrates one embodiment of an envelope feeder 20 made in accordance with the principles of the present invention for use in the order finishing station shown in FIGURE 1. The stack of envelopes 18 is placed into the feeder 20 on top of an elevator platform 22 which keeps the stack height at a predetermined level so that the topmost envelope can be picked up by the feeding mechanism and delivered to the operator. The feeding mechanism includes a suction block 30 which has a flexible suction cup 32 fixed to it. The suction block 30 and suction cup 32 are shown in their envelope pickup position in solid lines in FIGURE 2. The suction block is fixed to a shaft 34 which is carried by a first sprocket 36 fixed to the first end of the shaft and a second sprocket 38 fixed to a second opposing end of the shaft 34. Each of the sprockets 36 and 38 rides on a rack 40 or 42 mounted respectively on first and second side panels 44 and 46 of the envelope feeder 20. The shaft 34 passes through slots formed in the first and second side panels 44 and 46 of the envelope feeder. The slots allow rotation and linear translation of the shaft 34. The first and second sprockets 36 and 38 are moved by a reciprocating arm 48 which is rotatably affixed at its first end to the sprocket 36 and rotatably attached at its second end to a crank arm 50 which, in turn, is fixed to a timing gear 52 rotatably mounted on the envelope feeder first side panel 44. The timing gear 52 is driven by a timing belt 54 which, in turn, is drivingly coupled to a pulley 56 fixed to the shaft of a motor 58. As the motor 58 turns, the timing gear 52 rotates causing the reciprocating arm 48 to move the sprocket 36 back and forth across the rack 40 carrying with it the shaft 34 and the second sprocket 38. As the sprockets 36 and 38 rotate and carry with them the shaft 34, the suction block 30 rotates approximately 180° with the shaft 34 from its envelope pickup position shown in solid lines to its envelope release position shown in the phantom lines of FIGURE 2.

A vacuum line 60 from a vacuum source (not shown) is connected to a mechanically synchronous vacuum valve 64 mounted on the first side panel 44 directly adjacent the timing gear 52 and operated by the timing gear 52 as will be described in greater detail below. The output of the vacuum valve 64 is connected to a second vacuum line 66 which, in turn, is connected to a manifold block 68 at the first end of the shaft 34. The manifold block is fixed to the sprocket 36 and communicates with a bore formed through the shaft 34 which, in turn, communicates with another bore formed in the vacuum block 30 to allow a suction to be applied to the rubber suction cup 32 to assist the suction cup 32 in attaching itself to the topmost envelope 18 when it comes in contact with the envelope and in lifting the envelope as the vacuum block 30 rotates in response to rotation of the shaft 34.

A second timing gear 70 is mounted in register with the first timing gear 52 and moves in unison with it. The second timing gear 70 is engaged by a drive belt 72 which, in turn, is drivingly engaged with a conveyor drive pulley 74 mounted to a first end of a shaft 76 which is rotatably journaled in the side panels 44 and 46 of the envelope feeder 20. The conveyor drive pulley 74 causes a rotation of the shaft 76 which has a second drive pulley 78 fixed to it. The second drive pulley 78 is engaged by a belt 80 which connects the second drive pulley 78 to a series of feed roller pairs 82 and 84, each of which forms a nip into which the envelope 18 is inserted by the feed mechanism for passage out of the feeder 20 and into the operator's reach as can best be seen in FIGURE 3.

The operation of the suction block 30 and suction

cup 32 can best be seen with reference to FIGURES 2 and 3. As mentioned earlier, the solid lines of FIGURE 2 show the suction block 30 and suction cup 32 in their envelope pickup position.When the sprocket 36 is in its forwardmost position on the rack 40, the suction cup 32 engages a forward end of the topmost envelope 18a in the stack. The vacuum valve 64 is designed so that when the timing gear 52 is in position to allow the sprocket 36 to be in the forwardmost location on the rack 40, as shown in FIGURE 5, the vacuum valve 64 is open so that a suction is created at the suction cup 32 attaching it to the envelope 18a. As the timing gear 52 continues to turn, the crank arm 50 and reciprocating arm 48 move the sprocket 36 in a direction toward the timing gear 52 rotating the sprocket 36 and, hence, the suction block 30 to an intermediate position as shown in phantom line in FIGURE 3. The envelope 18a is carried by the suction cup 32 and is curled in a clockwise direction as viewed in FIGURE 3 bringing the edge of the envelope 18a toward the nip of the closest feed roller pairs 82 and 84. As the sprocket 36 continues to move toward the timing gear 52 under the control of the reciprocating arm 48 and crank arm 50, the envelope 18a continues to move toward the feed roller pairs until the edge of the envelope is inserted into the nip of the feed roller pairs and drawn to the right by the feed roller pairs as viewed in solid line in FIGURE 3. The valve 64 is then designed to close during this portion of travel of the suction block 30 and envelope 18a so that the suction cup 32 is released from the envelope 18a. The length of the reciprocating arm 48 is such that there is a slight overtravel of the block 30 beyond 180°, as shown in phantom lines in FIGURE 3, to ensure release of the suction cup 32 from the envelope 18a so that the envelope 18a can be moved through the feed roller pairs to the operator's station. The reciprocating arm 48 then follows travel of the crank arm 50 moving the sprocket 36 back in a direction away from the timing gear 52 and moving the suction cup 32 back to its initial envelope pickup position for pickup of the next envelope that is now topmost in the stack.

The envelopes that are being peeled off of the stack are envelopes that have already been used to carry the customer's order to the processing lab. Many times there will be coupons stapled or adhesively secured to the envelope having to do with special pricing of the order. Also, the envelopes are typically not perfectly flat but are wrinkled because of use. Therefore, because of either a mechanical or adhesive attachment of one envelope to the next, sometimes the second envelope in the stack will follow the topmost envelope as it is being peeled from the stack by the suction cup 32 and suction block 30. It is therefore desirable to provide hold-down fingers 86 and 88 to engage the second envelope in the stack to prevent it from following the first envelope as it is being peeled back by the envelope removal means. The fingers 86 and 88 shown in FIGURE 2 serve this purpose. Fingers 86 and 88 extend toward the envelope stack and are respectively affixed to mounting blocks 90 and 92. The mounting blocks 90 and 92 are fixed to a shaft 94 which is journaled for rotational movement in the side panels 44 and 46 of the envelope feeder. A first end of the shaft 94 has a cam member 96 fixed to it for rotation with the shaft 94. A coil spring 98 is affixed at a first end to the cam member 96 and at a second end to a pin 100 projecting from the first side panel 44 of the envelope feeder. The spring 98 acts to bias the cam member 96 in a clockwise direction thereby holding the fingers 86 and 88 against the envelope stack. The position of the fingers 86 and 88 as they engage the stack is seen in FIGURE 3. It is necessary, however, to move the fingers 86 and 88 out of the way so that the topmost envelope can be peeled back from the stack and then to reinsert the fingers onto the stack to hold the next envelope down as the topmost envelope is being removed. To accomplish this, a control block 102 is mounted on the shaft 34 and rides on the rack 40 to move linearly back and forth with the shaft 34. A control pin 104 extends from the control block 102 and, as the control block 102 moves forward with the shaft 34 and sprocket 36, the control pin 104 engages the cam member 96 to push the cam member counterclockwise, thereby also pushing the fingers 86 and 88 in counterclockwise direction away from the stack. The action of the control pin 104 on the cam member 91 and the position of the fingers 86 and 88 corresponding to that action is shown in FIGURES 5 and 6. As can be seen in FIGURE 6, the finger 86 is spaced from the topmost envelope in the stack to allow the envelope to be peeled back by the suction cup 32. When the sprocket 36 has moved toward the timing gear 52 a sufficient distance to curl the envelope 18a, the control pin 104 on the control block 102 will disengage from the cam member 96 allowing the coil spring 98 to draw the cam member 36 clockwise into the position shown in FIGURE 4 bringing the fingers 86 and 88 into contact with the envelope stack, again thereby holding the next envelope down while the topmost envelope is being peeled away.

In order for the suction cup 32 to properly attach itself to the topmost envelope in the stack, the stack height must be kept at a level sufficiently high to contact the suction cup 32. The stack height is changed by means of the structure shown in FIGURE 7 which includes a pair of cross-arms 106 and 108 which are diagonally placed inside the elevator portion at the foward end of the envelope feeder 20 and attached at their upper ends to the envelope tray 22. A motor 110 has a threaded shaft 112 passing through it. The motor 110 acts as a nut on the threaded shaft 112 so that as the motor 110 rotates, the length of the portion of the shaft 112 below the motor 110 increases and the length of the portion of the shaft 112 above the motor 110 decreases. The lengthening of the portion of the shaft 112 below the motor 110 forces the motor 110 upwardly and simultaneously moves the cross-arms 106 and 108 to a greater angle forcing the envelope tray 22 upwardly as shown by the arrow 114 in FIGURE 7.

The operation of the motor 110 is controlled by a switch 116 mounted on the side panel 44 of the envelope feeder 20. The switch 116 has a button 118

extending from it closely adjacent to a control finger 120a on a control arm 120 pivotally mounted on the panel 44. A spring 121 has a first end attached to the side panel 44 and a second end attached to the control arm 120 to bias the control arm 120 in a clockwise direction as viewed in FIGURE 5 to bring the control finger 120a into contact with the button 118 thereby closing the switch 116 and operating the motor 110. The control arm 120 is fixed to one end of a shaft 124 which is rotatably journaled in the side panels 44 and 46 of the envelope feeder and which has affixed to it a height-sensing member 126. The height-sensing member 126 has a finger portion 126a which overlies an edge of the envelope stack 18 so that when the stack height is such that it engages the finger 126a, the stack will lift the finger 126a and the height-sensing member will rotate in a counter-clockwise direction, as viewed in FIGURE 6, carrying with it the shaft 124 which, in turn, rotates the control member 120 to overcome the biasing force of the spring 121 and bring the control finger 120a out of contact with the button 118, thereby opening the switch 116 and stopping the motor 110. A pair of interlock blocks 130 and 132 are also fixed to the shaft 124 and rotate with it. As can be seen in FIGURE 3, when the hold-down fingers 86 and 88 are in their hold-down position contacting the envelope stack as shown in FIGURE 3 or 4, the mounting blocks 90 and 92 of the hold-down fingers contact the interlock blocks 130 and 132 holding them in a position that prevents rotation of the height-sensor member 126. The strength of the spring 98 attached to the cam member 96 is greater than the strength of the spring 121 attached to the control arm 120. In this way the hold-down fingers 86 and 88 lock the height-sensor 126 into position preventing operation of the elevator motor 110. It is not until the hold-down fingers 86 and 88 are moved away from the stack by engagement of the control pin 104 with the cam member 96 that the finger portion 126a is allowed to move under the force of the spring 121 to close the switch 116 and operate the elevator motor 110.

In summary, an envelope feeder is provided that peels the topmost envelope from a stack of envelopes avoiding substantially all sliding motion between the topmost envelope and the next one in the stack during the removal process. The feeder provides a pickup member which attaches itself to the topmost envelope and rotates the edge of the envelope away from the rest of the stack to present the edge of the envelope to a pair of feed rollers which then engage the edge of the envelope and feed the envelope through to an operator's station. Hold-down members are provided that disengage from the stack during the initial pickup procedure and then reengage themselves to hold down the second envelope in the stack while the topmost envelope is being removed so as to break any mechanical bonds between the topmost envelope and the remainder of the stack caused by staples or adhesives that may inadvertently be present. The stack height is automatically adjusted by elevator means to maintain the topmost envelope at a predetermined height cooperably designed to allow engagement of the pickup means with the topmost envelope. The preferred embodiment of the pickup means includes a suction member which is connected to a source of vacuum and operated through a valve which controls the application and termination of suction in cooperation with movement of the pickup member to allow attachment of the pickup member to the envelope and release of the pickup member from the envelope at the time the envelope is grabbed by the feed rollers.

As explained above, it should be understood that while the feeder of the present invention has been described and illustrated in relation to the feeding of customer envelopes in a commercial photo finishing lab, it is possible to use the feeder of the present invention with any sheet material such as sheets of paper, sheets of plastic or new or used envelopes. The description of the invention with regard to photofinishing should not be considered a limitation but rather simply exemplary of one environment in which the feeder can be used. It should be noted that several changes can be made to the described and illustrated embodiment of the invention without exceeding the scope of the invention. For example, other than vacuum means can be used as the pickup means. Also, while a mechanical height-sensor is described and illustrated, it would be also possible to use an electrically-activated sensor such as an electric eye to monitor stack height and control operation of the elevator motor to adjust stack height automatically. Since such changes can be made to the illustrated embodiment, the invention should be described solely with reference to the appended claims.

Claims

1. An apparatus for removing the topmost sheet from a stack of sheets comprising:
a base;
a stack-holding tray movably mounted on said base;
a pickup means mounted on said base and operable to be detachably attached to said topmost sheet; and
control means for moving said pickup means in an arcuate path to curl said topmost sheet away from the remainder of said stack.

2. The apparatus of Claim 1 further including hold-down means operable to engage the remainder of said stack during removal of said topmost sheet by said pickup means.

3. The apparatus of Claim 1 further including elevator means associated with said stack-holding tray and operable to move said stack-holding tray with relation to said base.

4. The apparatus of Claim 3 further including:
stack height monitoring means for producing a first signal related to stack height; and,
stack elevator control means associated with said elevator means and operable in response to said first signal to actuate said elevator means.

5. The apparatus of Claim 4 further including stop means associated with said stack height monitoring means and operable in response to said first signal to deactivate said elevator means when said stack reaches a predetermined height.

6. The apparatus of Claim 1 further including:
feed conveyor means associated with said base and operable to receive said topmost sheet as it is released by said pickup means.

7. The apparatus of Claim 1 wherein said pickup means includes:
a suction member adapted to contact said topmost sheet;
vacuum means connected to said suction member;
valve means associated with said vacuum means and said suction member for controlling application of vacuum to said suction member; and
control means associated with said valve means for operating said valve means in relation to the position of said pickup means.

8. In an order finishing station at which photographic prints and developed film are brought together for placement into a customer envelope, an envelope feeder for presenting the envelopes one at a time to an operator, comprising:
a stack holding tray mounted in said order finishing station and adapted to receive a stack of customer envelopes;
a pickup member mounted adjacent said tray and operable for releaseable attachment to a topmost one of said envelopes in said stack;
first control means associated with said pickup means for controlling the movement of said pickup means in an arcuate path to curl said topmost envelope away from said stack; and
second control means for controlling the attachment and release of said pickup member to said topmost envelope as a function of the position of said pickup member.

9. The envelope feeder of Claim 8, further including:
conveyor means adapted to receive said topmost envelope from said pickup member and convey it to said operator, said control means releasing said pickup member from said envelope as it is received by said conveyor means.

10. The envelope feeder of Claim 9, further including:
hold-down means mounted on said finishing station and operable to engage said stack of envelopes;
hold-down control means for controlling said hold-down means as a function of pickup member position so as to engage said stack after said pickup member has initially been attached to said topmost envelope and to disengage during said initial attachment.

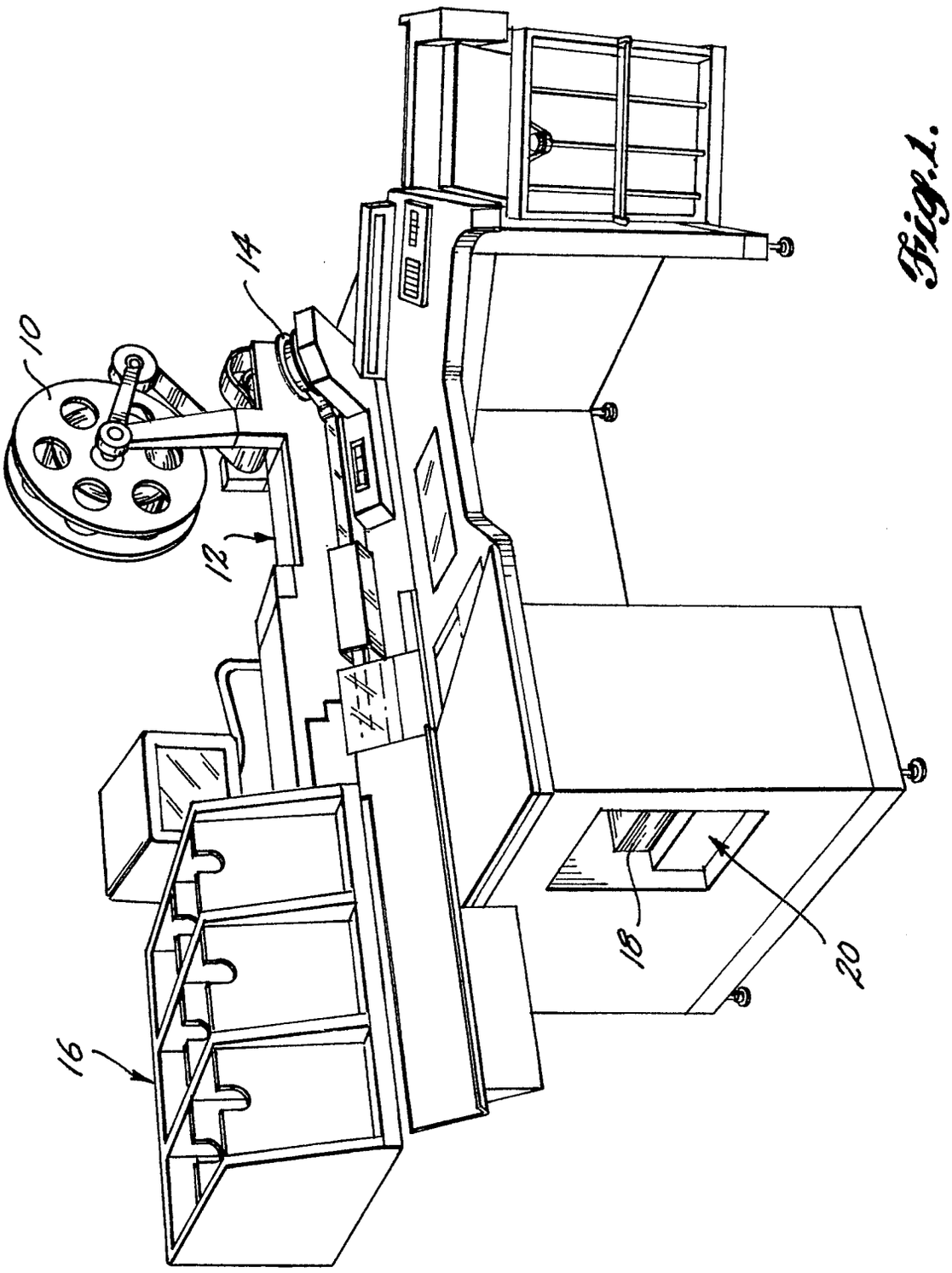

Fig.1.

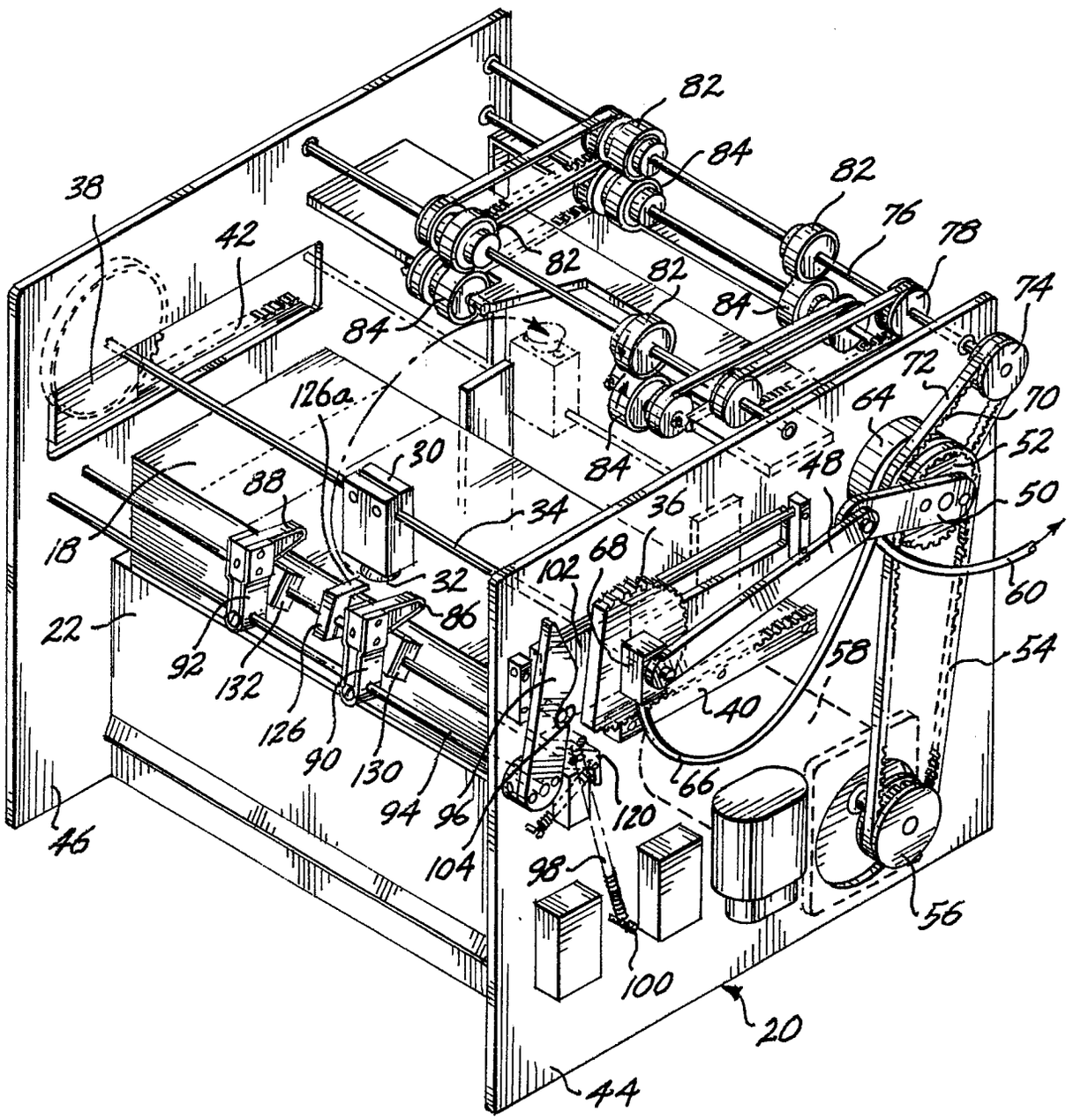
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Fig. 2.

Fig. 3.

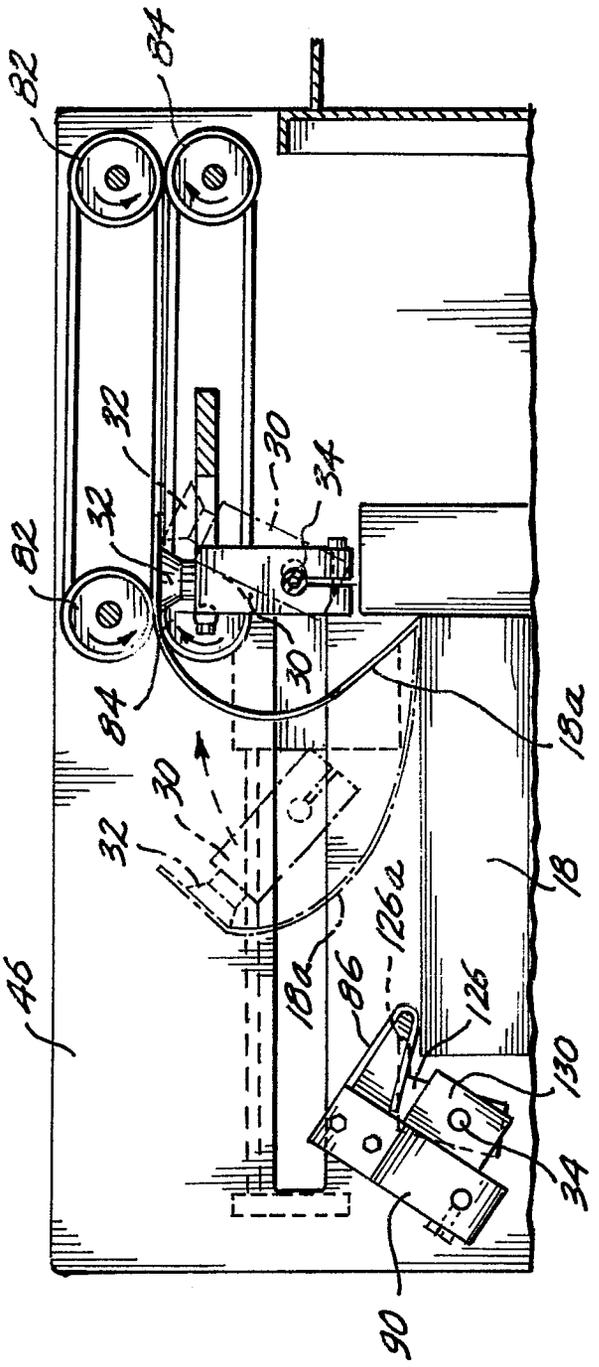
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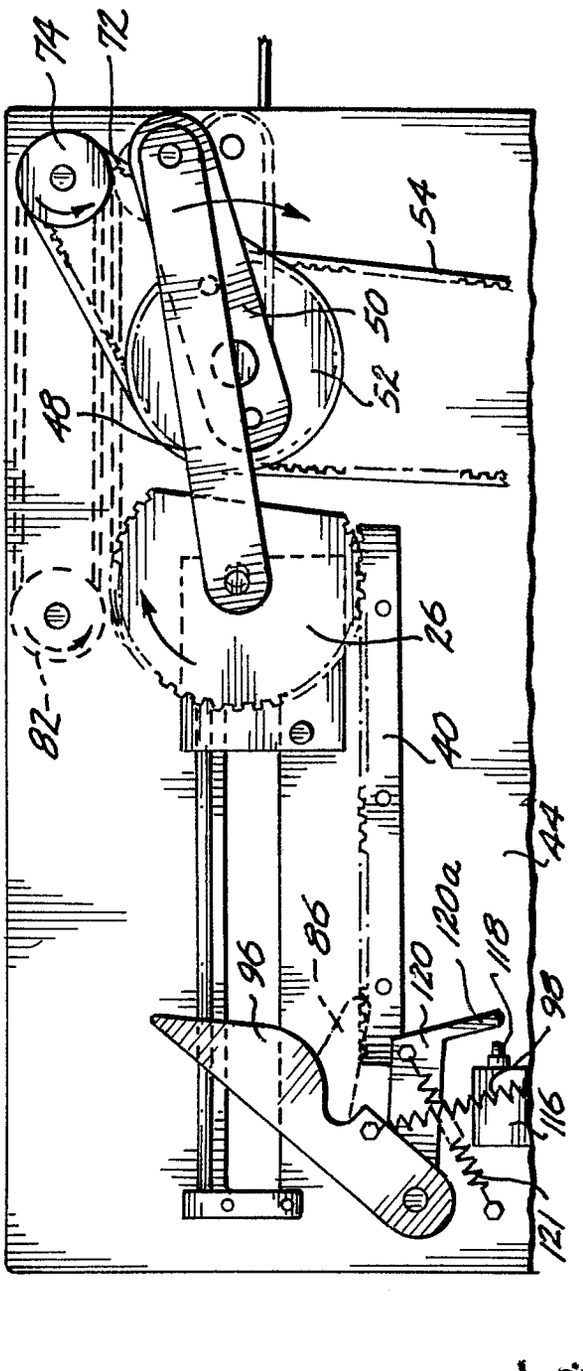
Fig. 4.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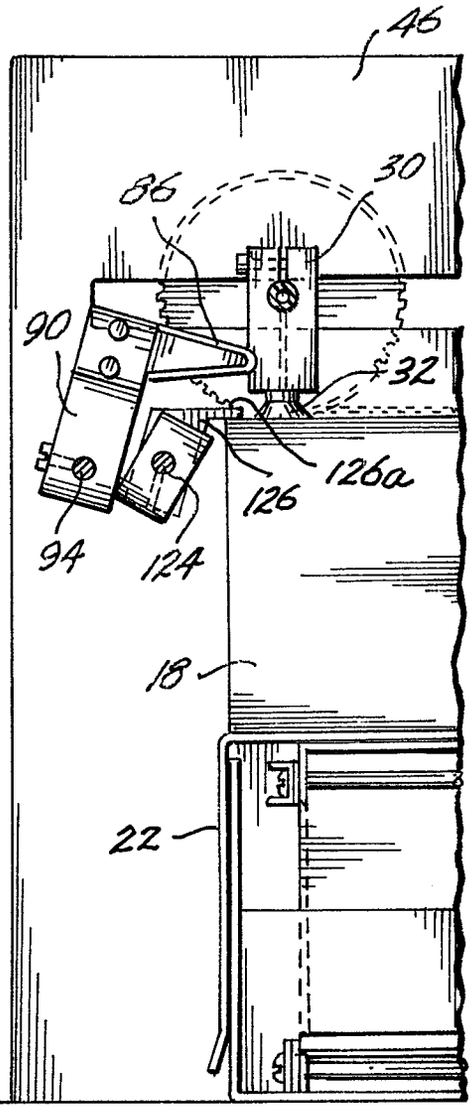

Fig. 6.

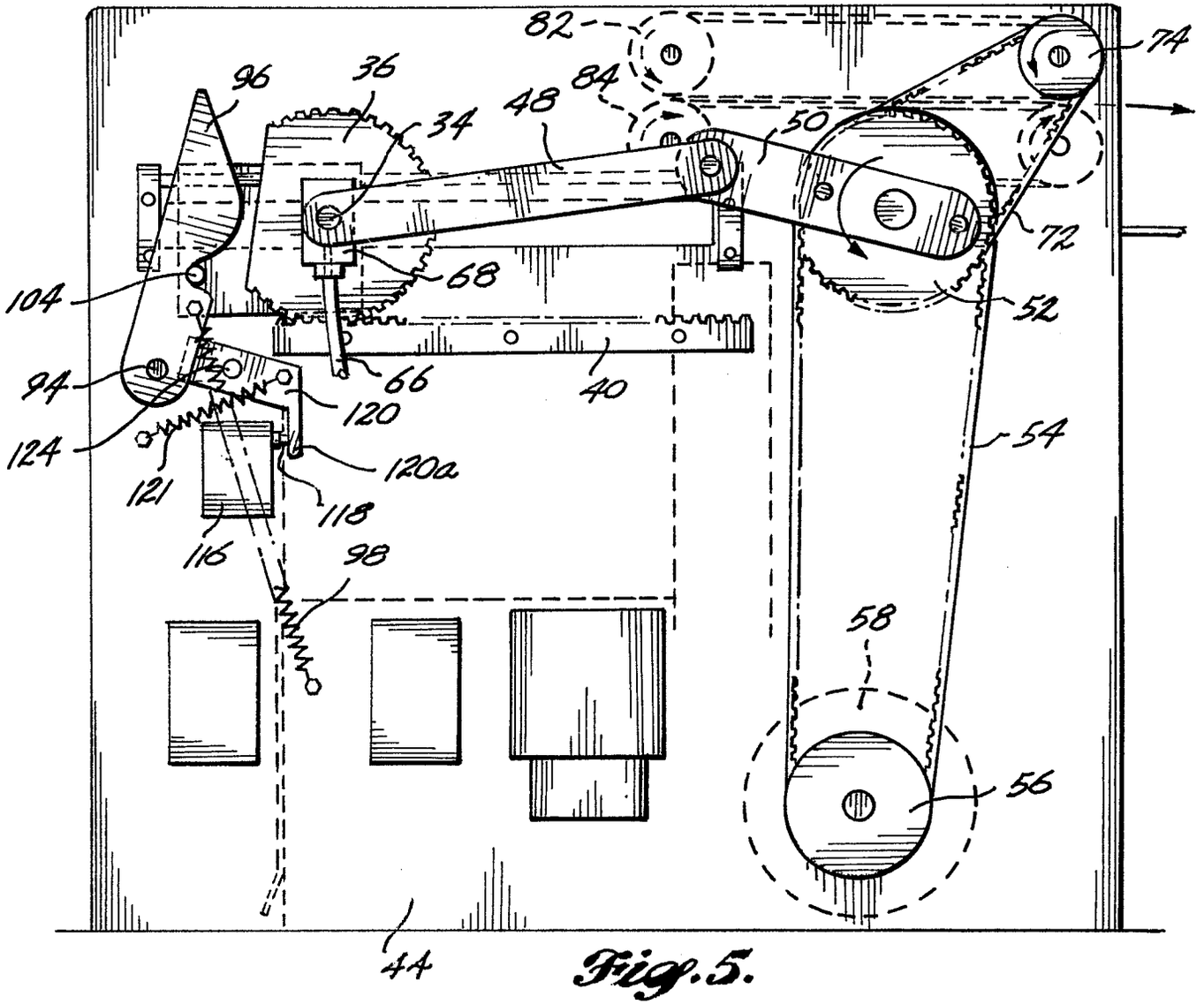

Fig. 5.

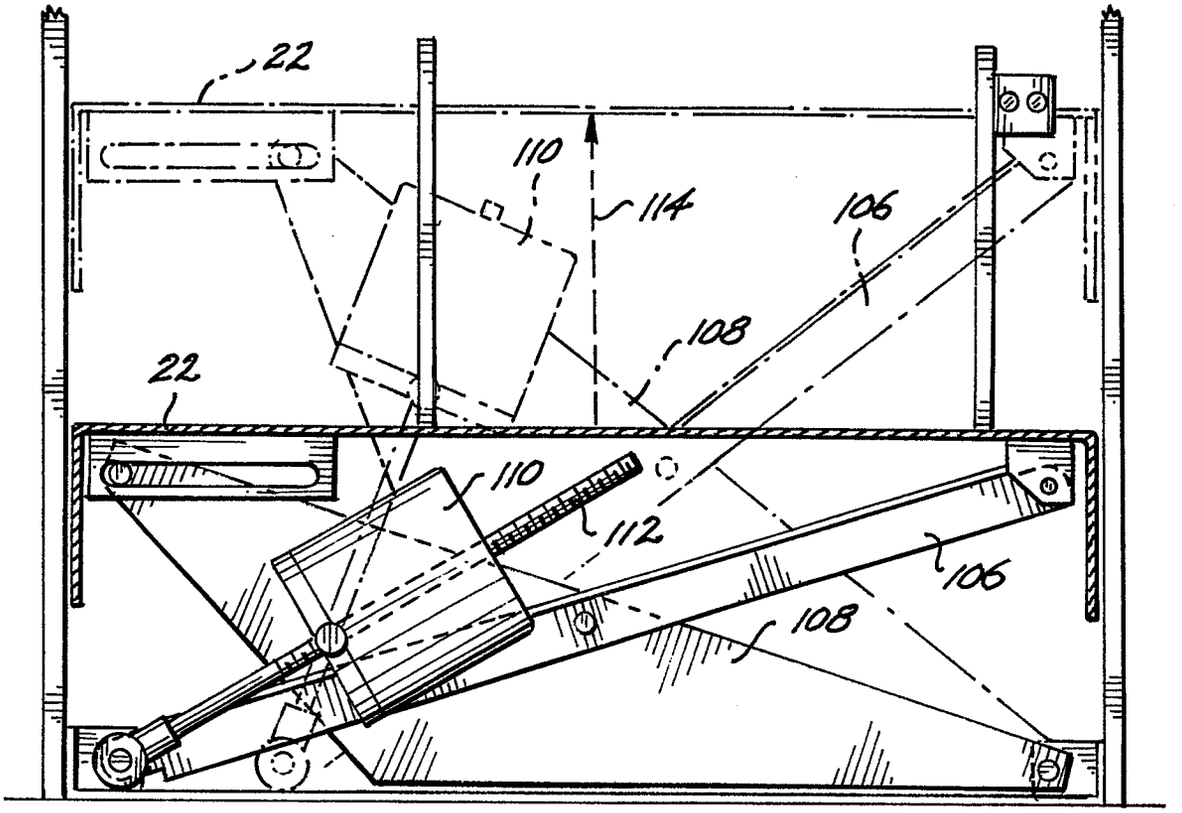

Fig. 7.