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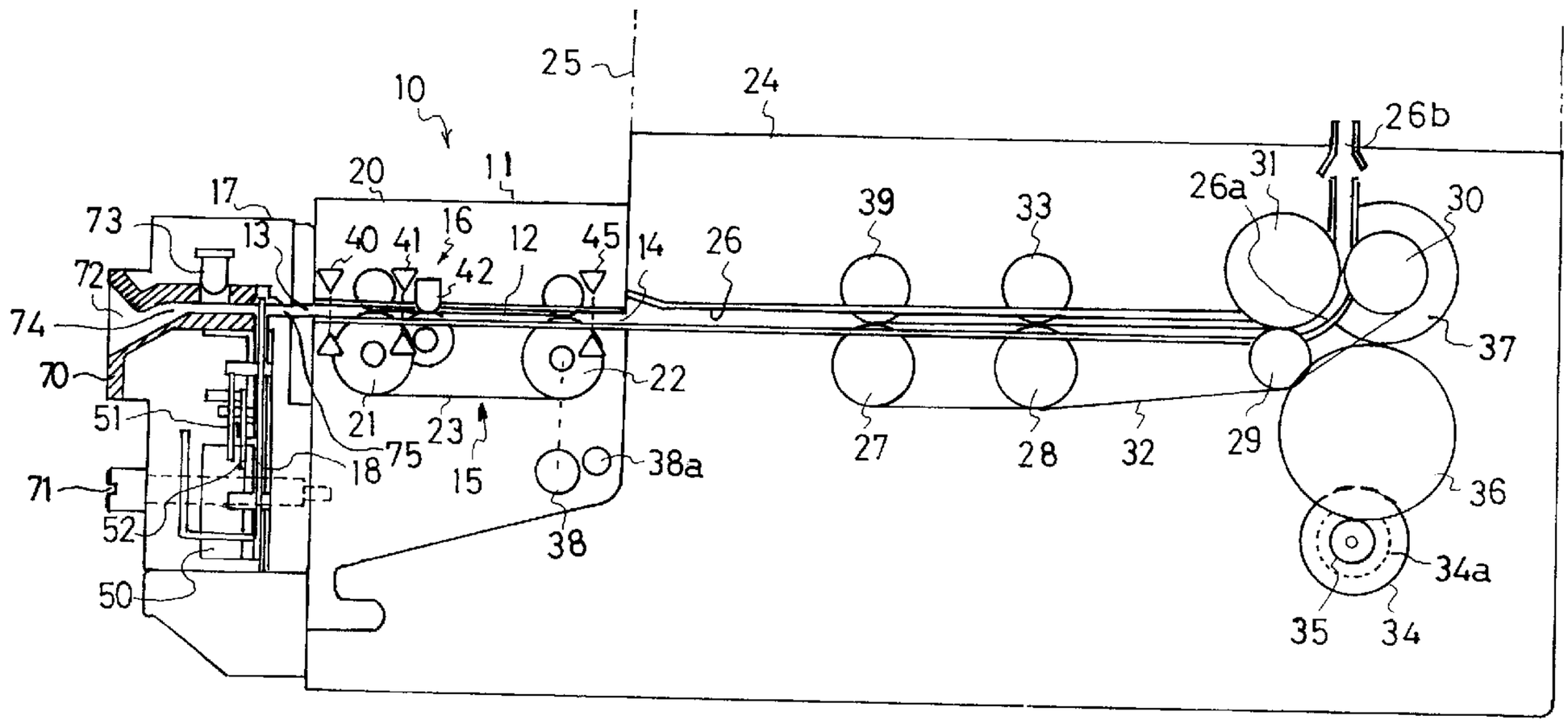
(54) **APPAREIL DE VALIDATION DE BILLET MUNI D'UN OBTURATEUR**

(54) **A BILL VALIDATOR WITH A SHUTTER UNIT**



(57) A shutter unit 17 of a bill validator comprises a blocking member 18 movable between an interceptive position for closing the through hole 74 of the shutter unit 17 and a release position away from the through hole 74 for allowing passage of the bill through the through hole 74 into a slot 13 of the validating unit 20; a control unit 48 movable between an inactive position for barring movement of the blocking member 18 to the release position and an operative position for allowing movement of the blocking member 18 to the release position; and an actuator 50 for shifting the control unit 48 between the inactive and operative positions. When the blocking member 18 is forcibly moved to the release position in an unauthorized manner, the control unit 48 in the inactive position effectively inhibits and resists movement of the blocking member 18 to the release position.

ABSTRACT

A shutter unit 17 of a bill validator comprises a blocking member 18 movable between an interceptive position for closing the through hole 74 of the shutter unit 17 and a release position away from the through hole 74 for allowing passage of the bill through the through hole 74 into a slot 13 of the validating unit 20; a control unit 48 movable between an inactive position for barring movement of the blocking member 18 to the release position and an operative position for allowing movement of the blocking member 18 to the release position; and an actuator 50 for shifting the control unit 48 between the inactive and operative positions. When the blocking member 18 is forcibly moved to the release position in an unauthorized manner, the control unit 48 in the inactive position effectively inhibits and resists movement of the blocking member 18 to the release position.

A BILL VALIDATOR WITH A SHUTTER UNIT

FIELD OF THE INVENTION

This invention relates to a bill validator capable of preventing unauthorized extraction of a bill from inside to outside of the bill validator by pulling out a string or tape connected with the bill.

PRIOR ART

For example, Japanese Patent Disclosure No. 7-175957 discloses a bill validator provided with a shutter device to prevent unauthorized extraction of a bill transported into the bill validator to outside thereof. The shutter device is provided with a blocking member disposed adjacent to pulleys and belts of a conveyor for transporting the bill along a passageway in the bill validator. The blocking member is movable between an interceptive position for inhibiting passage of the bill through a passageway formed in the bill validator and a release position away from the passageway for allowing passage of the bill through the passageway. In addition, the blocking member is urged toward the interceptive position by its gravity and resilient force of a spring, and is moved from the interceptive to the release position by a solenoid against the gravity of the blocking member and resilient force of the spring when a bill is inserted into an inlet of the bill validator. Therefore, the shutter device is defective in that the blocking member can forcibly be moved from the interceptive to the release position in an unauthorized manner by a tool inserted into the inlet against the gravity of the blocking member and resilient force of the spring. In addition, in case of some trouble or breakdown of the prior art shutter device, the bill

validator must thoroughly be disassembled from the pulleys and belts of the conveyor with time-consuming and troublesome dismantling operation for repair or maintenance.

Therefore, an object of the present invention is to provide a bill validator sufficiently resistible against the unauthorized movement of the blocking member to the release position.

Another object of the present invention is to provide a bill validator having a shutter unit wherein a blocking member is movable between the interceptive and release positions, but firmly retained in the interceptive position after once moved to the interceptive position.

Still another object of the present invention is to provide a bill validator with a shutter unit detachably attached thereto.

A further object of the invention is to provide a bill validator capable of inhibiting entry of cold air into the bill validator.

SUMMARY OF THE INVENTION

A bill validator of this invention includes a validating unit and a shutter unit attached to a front side of the validating unit. The shutter unit includes a through hole formed with an inlet at one end of the through hole to insert a bill into the inlet and an outlet at the other end of the through hole. The shutter unit comprises a blocking member movable between an interceptive position for closing the through hole of the shutter unit and a release position away from the through hole for allowing passage of the bill through the through hole into a slot of the validating unit. A control unit comprising a clasp is movable between an inactive position

for barring movement of the blocking member to the release position and an operative position for allowing movement of the blocking member to the release position. An actuator is provided for shifting the clasp between the inactive and operative positions. When the blocking member is forcibly moved to the release position in an unauthorized manner, the clasp in the inactive position effectively inhibits and resists movement of the blocking member to the release position, thereby preventing unauthorized extraction of the bill from inside of the bill validator by pulling out string or tape connected with the bill.

In one embodiment of the present invention, the clasp is rotatably mounted on a shutter frame around a shaft between the inactive and operative positions upon operation of the actuator to prevent and allow movement of the blocking member to the release position. In another embodiment of the invention, the clasp is slidable along a guide recess between the inactive and operative positions by the actuator. Otherwise, the control unit may include a link drivingly connected with the actuator and the clasp is movably mounted on a shutter frame between the inactive position for barring movement of the blocking member to the release position and the operative position for allowing movement of the blocking member to the release position. The clasp is rotatable around a shaft between the inactive and operative positions upon operation of the actuator to prevent and allow movement of the blocking member to the release position when the clasp is moved respectively to the inactive position and the operative position. The clasp is drivingly connected with the link which is also operatively connected with the blocking member with a

gap to permit the clasp to rotate from the inactive to the operative position by the link before the blocking member starts moving from the interceptive to the release position. A protrusion is provided in one of the blocking member and link, and a notch is formed in the other of the blocking member and link to receive the protrusion with a gap. For example, the protrusion provided in the blocking member is positioned in the notch formed in the link with the gap.

The validating unit comprises a case, a passageway formed in the case and having a slot and an outlet at the opposite ends thereof, a conveying device for transporting the bill from the slot through the passageway to the outlet; and a bill sensor disposed adjacent to the passageway for detecting an optical or magnetic feature of the bill. The link is rotatably mounted by a shaft on a shutter frame and drivingly connected with the actuator which comprises a solenoid with a plunger connected with the link.

The clasp is formed with a blocking edge in contact with the blocking member to bar movement of the blocking member toward the release position when the control unit is in the inactive position. The blocking edge can be vertically aligned with the shaft and an abutment of the blocking member so that the blocking edge is in contact with the abutment at a dead point to prevent movement of the clasp from the inactive to operative position, and thereby to bar movement of the blocking member toward the release position. The actuator comprises a solenoid with a movable plunger connected with the clasp to move the clasp between the inactive and operative positions. The shaft produces a resisting force against the vertical movement of the blocking member when the abutment of the

blocking member is forcibly urged toward the blocking edge of the clasp at the dead point. The shutter unit comprises a shutter frame for covering the link and clasp and a bolt for removably attaching the shutter frame to the case of the validating unit. Mounted in the vicinity of the inlet of the shutter unit is an inlet sensor which produces a detection signal when a bill is inserted into the inlet. A slot sensor mounted in the vicinity of the slot produces a detection signal when the bill is inserted into the slot. The actuator, inlet sensor and slot sensor are electrically connected with a validating control circuit which activates the actuator when received the detection signal from the inlet sensor to move the blocking member to the release position, and when received the detection signal from the slot sensor, the validating control circuit deactivates the actuator to return the blocking member to the interceptive position. The blocking member is resiliently urged by a spring toward the interceptive position, and drivingly connected with the clasp with a gap. A small gap is formed between the abutment and clasp to rotate the clasp while the blocking member is retained in the static condition.

The above-mentioned as well as other objects of the present invention will become apparent during the course of the following detailed description and appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the present invention will be described

with reference to the accompanying drawings in which:

Fig. 1 is a partial cross-sectional view of a prior bill validator.

Fig. 2 is a front view of Fig. 1.

Fig. 3 is a plan view of Fig. 1.

Fig. 4 is a cross-sectional view showing an embodiment of a bill validator according to this invention.

Fig. 5 is a cross-sectional view of a shutter unit used in a bill validator according to this invention.

Fig. 6 is a perspective view of the shutter unit

Fig. 7 is a front view of the shutter unit having a blocking member in an interceptive position.

Fig. 8 is a front view of the shutter unit with the blocking member in a release position.

Fig. 9 is a block diagram of an electronic circuit used in the bill validator according to this invention.

Fig. 10 is a flow chart showing an operational sequence of the bill validator.

Fig. 11 is a perspective view of another embodiment form of this invention

Fig. 12 is a front view of a still another embodiment of the present invention with a guide cam.

DETAL DESCRIPTION OF THE INVENTION

As shown in Figs. 1 to 3, a prior art bill validator includes a passageway 7 which has an inlet 6 formed at an outer end of the passageway 7 to insert a bill therein. Mounted on the passageway 7 is a blocking member 1 movable between an interceptive position in the passageway 7 for

preventing passage of the bill through the passageway 7 and a release position away from the passageway 7 for allowing passage of the bill through the passageway 7. A spring 4 is provided to resiliently urge the blocking member 1 toward the interceptive position. A solenoid 2 is designed to shift the blocking member 1 from the interceptive to the release position against resilient force of the spring 4. A photoelectric sensor 3 is provided to detect the blocking member 1 in the release position.

Not shown but, the bill validator also is provided with an inlet sensor for detecting insertion of the bill into the inlet 6 to activate the solenoid 2. The blocking member 1 includes a plurality of nail portions 1a positioned along two lateral rows in a staggered arrangement so that these nail portions 1a are put in and interrupt the passageway 7 when the blocking member 1 is in the interceptive position.

The inlet sensor detects a bill inserted into the inlet 6 to produce a detection signal which is utilized to activate the solenoid 2 so that the blocking member 1 is upwardly moved from the interceptive to the release position. When the bill is transported along the passageway 7 by a conveyor not shown to a predetermined inner position, the solenoid 2 is deactivated, and therefore, the blocking member 1 is urged toward the interceptive position by resilient force of the spring 4. At the moment, the nail portions 1a contact the bill and the blocking member 1 cannot return to the interceptive position because the bill is on the way of the passageway 7 beneath the nail portions 1a, and the whole of the bill has not yet fully passed over the blocking member 1. Consequently, the photoelectric sensor 3 detects the blocking member 1 absent in the interceptive position and the bill is further successively moved inwardly by the conveyor. When a rear

end of the bill has completely passed over the blocking member 1, the nail portions 1a is free from engagement with the bill to allow the blocking member 1 to go to the interceptive position by elastic force of the spring 4. When the blocking member 1 returns to the interceptive position, the photoelectric sensor 3 produces a detection signal to the validator. However, if a tape or string is connected with the bill, it is positioned in the passageway 7 and contacts the blocking member 1 which is therefore prevented from returning to the interceptive position, and the photoelectric sensor 3 cannot produce the detection signal. In this case, the validator decides that the bill is too long and therefore invalid due to existence of the attached tape or string, and the validator drives the conveyor in the reverse direction to return it to the inlet 6.

However, such a prior art shutter device is defective in that the blocking member 1 can forcibly be moved from the interceptive to the release position by a tool because the blocking member 1 is simply urged by only its gravity and resilient force of the spring 4. Specifically, the blocking member 1 can easily be moved from the interceptive to the release position in an unauthorized manner by the tool inserted into the inlet 6 against the gravity of the blocking member 1 and the resilient force of the spring 4. Thus, such prior art shutter device is disadvantageous because it is not resistible against the unauthorized movement of the blocking member 1 to the release position. In addition, when there is some trouble or breakdown of the prior art shutter device, the bill validator must thoroughly be disassembled from the pulleys and belts of the conveyor for repair or maintenance, and the disassembling operation is time-consuming and troublesome.

As shown in Fig. 4, a bill validator 10 according to this invention

comprises a validating unit 20 and a shutter unit 17 attached to a front side of the validating unit 20. Fig. 5 indicates the shutter unit 17 including a through hole 74 which has an inlet 72 provided at one end of the through hole 74 to insert a bill into the through hole 74, and an outlet 75 provided at the other end of the through hole 74 to discharge the bill. The shutter unit 17 comprises a shutter frame 70 for covering the link 51 and a control unit 48 including a clasp 52; and a bolt 71 which removably secures the shutter frame 70 to the case 11 of the validating unit 20. Mounted in the vicinity of the inlet 72 of the shutter unit 17 is an inlet sensor 73 (Fig. 5) which produces a detection signal when a bill is inserted into the inlet 72.

As understood from Fig. 4, the validating unit 20 comprises a case 11, a passageway 12 formed in the case 11 to pass a bill therethrough and having a slot 13 and an outlet 14 at the opposite ends thereof, a conveying device 15 for transporting the bill from the slot 13 through the passageway 12 to the outlet 14; and bill sensors 16 disposed adjacent to the passageway 12 for detecting an optical or magnetic feature of the bill. A slot sensor 40 mounted in the vicinity of the slot 13 produces a detection signal when the bill is inserted into the slot 13. The shutter unit 17 also comprises a blocking member 18 movable between an interceptive position shown by dotted line in Fig. 5 and by Fig. 7 for closing the through hole 74 of the shutter unit 17 and a release position shown by solid line in Fig. 5 and Fig. 8 away from the through hole 74 for allowing passage of the bill through the through hole 74 into a slot 13 of the validating unit 20. As shown in Fig. 8, provided in the shutter unit 17 is a control unit 48 which includes a link 51 drivingly connected with an actuator 50; and a clasp 52 rotatable around a shaft 61 between the inactive and operative positions shown in Figs. 7 and 8

upon operation of the actuator 50 to prevent and allow movement of the blocking member 18 to the release position when the clasp 52 is moved respectively to the inactive position shown in Fig. 7 and the operative position shown in Fig. 8. The blocking member 18 is resiliently urged by a spring 92 toward the interceptive position.

The link 51 is rotatably mounted by a shaft 53 on a shutter frame 70 and drivingly connected at a pivotal portion 55 by a pin 54 with a movable plunger 50b provided in the actuator 50 which includes a solenoid 50a and a return spring (not shown) to resiliently push the link 51 to the upper position when the solenoid 50a is deenergized. Accordingly, activation of the solenoid 50a causes rotation of the link 51 around the shaft 53 in the clockwise direction to move the control unit 48 to the operative position. The return spring provided in the solenoid 50a serves to rotate the link 51 in the counterclockwise direction when the solenoid 50a is deactivated, thus causing the control unit 48 to move to the inactive position. In this way, the actuator 50 can shift the control unit 48 between the inactive and operative positions. Otherwise, the actuator 50b may be of the bidirectional operation type without the return spring so that the validating control circuit 80 may produce an output to operate the solenoid 50a in the reverse direction in order to move the plunger 50b to the retracted position.

The clasp 52 of the control unit 48 is rotatably mounted on the shutter frame 70 around a shaft 61 between the inactive and operative positions upon operation of the actuator 50 to prevent and allow movement of the blocking member 18 to the release position. One end of an arm 58 is secured to the clasp 52 and the other end of the arm 58 passes through a notch 59 formed in the link 51 to drivingly connect the clasp 52 with the link

51 by a link mechanism. A protrusion 56 has an intermediate portion 56a secured to the blocking member 18, a front end 56b which passes through an opening 57 formed in the link 51, and a rear end 56d which extends from the rear surface of the blocking member 18 to form an abutment 56c. Accordingly, the link 51 is drivingly connected with the blocking member 18 with a gap 57a as shown in Fig. 7 to rotate the clasp 52 from the inactive to operative position of Fig. 8 by the link 51 before the blocking member 18 starts moving from the interceptive to release position. A vertical length of the opening 57 is larger than the diameter of the protrusion 56 as shown in Fig. 7 to form a gap 57a between the front end 56b of the protrusion 56 and an upper edge 57b of the opening 57.

The clasp 52 is formed with a blocking edge 52a spaced by a small gap 52b from the abutment 56c of the blocking member 18, however the blocking edge 52a can be in contact with the blocking member 18 if moved downwardly to bar movement of the blocking member 18 toward the release position when the control unit 48 is in the inactive position because the blocking edge 52a is vertically aligned at a dead point with the shaft 61 and the abutment 56c of the blocking member 18. In other words, if the blocking member 18 is moved downwardly when the clasp 52 is in the inactive position, the blocking edge 52a at the dead point receives the lowered abutment 56c of the protrusion 56 to prevent movement of the blocking member 18 toward the release position. In this case, the shaft 61 produces a resisting force against the vertical movement of the blocking member 18 when the abutment 56c is forcibly urged toward the blocking edge 52a of the clasp 52 at the dead point. A fixed stopper 90 is positioned in an elongated hole 63 formed in the blocking member 18 to determine a

given vertical stroke of the blocking member 18 resiliently and upwardly urged by a spring 92. The blocking member 18 has a protrusion 64 which may pass through a photoelectric sensor 91 to produce electric signals upon vertical movement of the blocking member 18.

As shown in Fig. 4, a conveying device 15 comprises a pair of pulleys 21, 22; and a belt 23 wound around the pulleys 21, 22. The pulley 22 is operatively connected to a pull motor 38 to drive the belt 23 so that a bill is transported by the belt 23 from the slot 13 to the outlet 14. The pull motor 38 is provided with a rotary encoder 38a which calculates rotation of the pull motor 38 to detect the transported position and rate of the bill. The passageway 12 formed by the conveying device 15 is aligned with a carrier passage 26 formed in a transport apparatus 24 which comprises pulleys 27, 28, 29, 30 and 31 provided adjacent to the carrier passage 26, and a belt 32 wound around the transporting pulleys 27 to 31 so that the bill discharged from the outlet 14 of the bill validator 10 is continuously carried by the transport apparatus 24. The pulleys 27, 28 and 29 are rotatably mounted so that their upper surfaces are positioned nearly on a same plane toward push rollers 39, 33 and the pulley 31. A motor 34 has an output shaft to which a pinion 35 is mounted in engagement with an intermediate gear 36. An output gear 37 is meshed with the intermediate gear 36 for rotation together with a drive pulley 30 disposed outside an upwardly bent area 26a of the carrier passage 26 to smoothly drive the belt 32 along the bent area 26a of the carrier passage 26 to travel the bill through the bent area 26a and exit 26b into a stacker 25.

As shown in Fig. 9, the actuator 50, inlet sensor 73 and slot sensor 40 are electrically connected with a validating control circuit 80 which activates

the solenoid 50a of the actuator 50 when received the detection signal from the inlet sensor 73 to move the blocking member 18 to the release position. The validating control circuit 80 deactivates the solenoid 50a when received the detection signal from the slot sensor 40 to return the blocking member 18 to the interceptive position.

The validating control circuit 80 has its input terminals each connected with the slot sensor 40, inlet sensor 73, outlet sensor 45, photoelectric sensor 91 and rotary encoders 38a and 34a. The optical sensor 41 and magnetic sensor 42 are also connected with remaining input terminals of the validating control circuit 80 through an amplifier 81. Output terminals of the validating control circuit 80 are connected with a pull motor 38 via a motor control circuit 32, the actuator 50 via a solenoid control circuit 83, an indicator 85 and the transport motor 34 via a motor control circuit 86. Not shown but the validating control circuit 80 comprises a timer circuit formed therein by programmed control therein to decide whether a considerable first fixed time has elapsed after the inlet sensor 73 produces the output signal upon insertion of a bill into the inlet 72 until the bill is inserted through the slot sensor 40. The timer circuit is also utilized to decide whether a considerable second fixed time has elapsed after the outlet sensor 45 ceases the output signal upon completion of passage of the bill in order to confirm that the blocking member 18 is returned to the interceptive position by resilient force of the spring 92.

The bill validator of the present invention is worked in accordance with an operational sequence shown in flow chart of Fig. 10.

When the processing moves from START in Step 100 to Step 101, the validating control circuit 80 decides whether the inlet sensor 73 produces an

output by detecting a bill inserted into the inlet 72. If no bill is inserted into the inlet 72, the blocking member 18 is in the interceptive position as shown in Figs. 4 and 7 and also indicated by dotted line in Fig. 5, and the blocking edge 52a is disposed in the upper position vertically aligned with the shaft 61 and abutment 56c of the protrusion 56. In this case, the blocking member 18 can forcibly be moved downward through the only small gap 52b by any tool in an unjust manner against the resilient force of the spring 92 until the abutment 56c is brought into contact with the blocking edge 52a at the dead point. However, after the abutment 56c comes into contact with the blocking edge 52a, the blocking member 18 can never be moved downwardly because the clasp 52 and shaft 61 firmly resist and prevent further downward movement of the blocking member 18 without application of any rotating force to the clasp 52 at the dead point. Accordingly, so far as the clasp 52 is not rotated from the inactive to the operative position to move the blocking edge 52a away from the dead point in vertical alignment with the shaft 61 and abutment 56c, it is impossible to move the blocking member 18 to the release position.

In this way, when the blocking member 18 is forcibly moved to the release position in an unauthorized manner, the control unit 48 in the inactive position effectively inhibits and resists movement of the blocking member 18 to the release position, thereby certainly preventing unauthorized extraction of the bill from inside of the bill validator by pulling out string or tape connected with the bill.

When a bill is inserted into the inlet 72 in Step 101, the inlet sensor 73 detects insertion of the bill and produces a detection signal to the validating control circuit 80 which forwards a drive signal to the actuator 50

through the solenoid control circuit 83, and at the same time, the validating control circuit 80 turns the timer circuit ON. By activation of the actuator 50, the solenoid 50a electromagnetically retracts the plunger 50b to rotate the link 51 around the shaft 53 in the clockwise direction. The rotation of the link 51 causes rotation of the shaft 58 and clasp 52 around the shaft 61 in the counterclockwise direction so that the blocking edge 52a is moved away from the dead point and free of the vertical alignment with the shaft 61. However, during the initial rotation of the link 51, the blocking member 18 is kept in the static condition due to the gap 57a until the upper edge 57b of the gap 57a comes into contact with the protrusion 56. After the blocking edge 52a is perfectly deviated from the vertical alignment with the shaft 61, the upper edge 57b of the opening 57 is brought into contact with the protrusion 56 and forcibly moves the blocking member 18 against the resilient force of the spring 92. Thus, the blocking member 18 is rotated from the interceptive position shown by Fig. 7 to the release position shown by Fig. 8 with subsequent rotation of the link 51. When the blocking member 18 reaches the release position, the photoelectric sensor 91 forwards an output to the validating control circuit 80. In Step 103, the validating control circuit 80 decides whether the blocking member 18 is in the release position, and when the validating control circuit 80 receives the output from the photoelectric sensor 91 as mentioned above, the processing moves to Step 104. In Step 103, if the validating control circuit 80 does not receive an output from the photoelectric sensor 91, it produces drive signals to the solenoid 50a several times in Step 119. If a given number of the drive signals is not repeatedly supplied to the solenoid 50a, the sequence is returned to Step 102. When the photoelectric sensor 91 does not generate

its output to the validating control circuit 80 although it furnishes the solenoid 50a with the drive signals several times, the validating control circuit 80 generates an output representative of "ERROR" to the indicator 85 in Step 120.

In Steps 104 and 105, the validating control circuit 80 drives the pull motor 38 and transport motor 34 through the motor control circuits 82 and 86. Then, the validating control circuit 80 determines in Step 106 whether the timer circuit counts a predetermined period of time (a first fixed time) since it is turned ON in Step 102 to confirm that the slot sensor 40 detects existence of the bill in the predetermined period of time after passage of the bill through the inlet sensor 73. As the pull motor 38 is driven, the inserted bill is pulled into the validating unit 20 and transported by the conveying device 15 toward the outlet 14 during which the bill sensors 16 detect optical and magnetic features of the travelling bill, convert them into electric signals and forward these signals to the validating control circuit 80. In case the time is not over in Step 106, the validating control circuit 80 decides whether the slot sensor 40 detects the bill, and if this is "Yes", the circuit 80 ceases to produce the output to the solenoid 50a in Step 108. When the solenoid 50a is deactivated, the link 51 is returned from the operative to the inactive position by the return spring provided in the solenoid 50a. Accordingly, the blocking member 18 is returned to the upper interceptive position by virtue of the spring 92, and the clasp 52 is rotated in the adverse direction to the inactive position together with the arm 58 received in the notch 59 of the link 51. In the present invention, it is very important to return the blocking member 18 to the interceptive position before the whole bill passes through an upper end of the blocking member 18 in order to inhibit entry of cold air

into the bill validator 10 and to thereby prevent breakdown of the bill validator 10 because of cold air. In addition, a plurality of longitudinal creases can be formed on surfaces of the bill by forcibly sandwiching the bill between a plurality of lugs 65 formed at the upper edge of the blocking member 18 and a plurality of dents 72b formed on an upper wall 72a of the passageway 12 to strengthen buckling resistance of the bill against bending force by the formed longitudinal creases and to thereby prevent jamming of the bill during transportation.

Subsequently, receiving the electric signals from the bill sensors 16, the validating control circuit 80 compares these signals with optical and magnetic patterns stored in a memory of the validating control circuit 80 and judges in step 109 whether the bill is genuine or not. If the signals supplied from the bill sensors 16 are corresponding to the stored optical and magnetic patterns, the validating control circuit 80 regards the bill as genuine, and the treatment goes to Step 110 wherein the validating control circuit 80 observes whether the outlet sensor 45 is turned OFF by thorough passage of the bill. Upon the switching action of the outlet sensor 45 to OFF, the circuit 80 ceases to supply the pull motor 38 with the drive signal, and therefore rotation of the pull motor 38 is stopped (Step 111). Then, in Step 112, the circuit 80 decides whether the timer circuit counts a predetermined time elapse (a second fixed time) after the switching action of the outlet sensor 45 to OFF. If the predetermined time is over, the circuit 80 judges in Step 113 whether the blocking member 18 is returned to the interceptive position in view of the output from the photoelectric sensor 91. If this is negative, the circuit 80 activates the indicator 85 to display "ERROR" in Step 126. Adversely, if receiving the output from the photoelectric sensor 91 indicative

of the blocking member 18 being in the interceptive position, the circuit 80 ceases to generate the drive signal to the transport motor 34 which is therefore deactivated (Step 114).

Thereafter, the circuit 80 forwards a drive signal to the transport motor 38 to rotate it in the reverse direction so that a stacking mechanism (not shown) is operated to accumulate in the stacker 25 the bill carried from the transport apparatus 24 utilizing the drive power of the transport motor 38 in the reverse direction. To this end, the circuit 80 counts pulses generated in the rotary encoder 34a, and decides completion of the stacking operation of the bill when it counts up a predetermined number of the pulses from the rotary encoder 34a (Step 116). Next, the circuit 80 stops the operation of the transport motor 38 in Step 117, advancing to "END" in Step 118.

When the circuit 80 cannot decide in Step 109 that the bill is genuine, it ceases operation of the transport motor 38 in Step 127, and also operation of the pull motor 34 in Step 128. Successively, the circuit 80 provides the solenoid 50a with a drive signal to thereby activate it and move the blocking member 18 to the release position in order to return the bill to the inlet 72 (Step 129). When the blocking member 18 reaches the release position, the photoelectric sensor 91 gives rise to the electric signal to the circuit 80 which therefore can detect the blocking member 18 in the release position in Step 130. Following procedures are in Steps 131 and 132 where the transport motor 34 and pull motor 38 are driven in the adverse direction by outputs from the circuit 80 which then makes a decision whether the optical sensor 41 is switched to ON upon backward passage of the bill in Step 133. When a predetermined period of time has elapsed after the optical sensor 41 does

not detect the bill, in other words when the bill is discharged from the belt 23 of the conveying device 15, the circuit 80 deenergizes the solenoid 50a and pull motor 38 in Step 134 so that the rear end of the returned bill comes out of the inlet 72. Specifically, the bill is kept on the way of the passageway 12 in the sandwiched condition between the lugs 65 formed at the upper edge of the blocking member 18 and the dents 72b formed on the upper wall 72a of the passageway 12. In this case, although the bill is sandwiched between the lugs 65 and the dents 72b by resilient force of the spring 92, an operator can manually grip the rear end of the bill, and easily pull same out of the shutter unit 17to remove the bill. After that, as the circuit 80 makes a judgment that the bill is pulled by the operator and is completely passed the inlet sensor 73 in Step 135, it ceases the operations of the transport motor 38 and pull motor 34, then coming into Step 136.

Returning to Step 106, when the time is over, the circuit 80 stops operation of the transport motor 38 and pull motor 34 in Steps 121 and 122, and also ceases operation of the solenoid 50a in Step 123 so that the bill is retained with its rear end of the bill extending out of the inlet 72. In this case, although the bill is sandwiched between the lugs 65 and the dents 72b by resilient force of the spring 92, an operator can manually grip the rear end of the bill, and pull same out of the shutter unit 17. Subsequently, the circuit 80 decides whether the inlet sensor 73 is turned OFF by pulling the bill out of the shutter unit 17 by operator. If this is affirmative and the bill is completely passed the inlet sensor 73, the stage goes to Step 125.

While the shutter unit 17 comprises the shutter frame 70 which accommodates the solenoid 50a, link 51, clasp 52 and bolt 71, it is easy to attach and detach and exchange for repair the shutter unit 17 as an

integrated assembly to the case 11 by tightening and loosing the bolt 71.

The worked mode of the present invention may be varied. For example, as illustrated in Fig. 11, the clasp 52 may directly be operated by the actuator 50 without the link 51. In this embodiment, the blocking member 18 is in the interceptive position to prevent it from moving downwardly because the blocking edge 52a of the clasp 52 at the dead point in vertical alignment with the shaft 61 and abutment 56c. The clasp 52 is formed integrally with an arm 52b which extends through a slit 66 formed in the blocking member 18 with a gap 57a. When the solenoid 50a is activated, the clasp 52 is rotated around the shaft 61, however, the blocking member 18 is retained in the static condition during the initial rotation of the clasp 52 due to existence of the gap 57a. Specifically, during the initial rotation of the clasp 52, the blocking edge 52a is moved away from the dead point. By further rotation of the clasp 52, the arm 52b is brought into contact with the lower edge of the slit 66 and forcibly moves the blocking member 18 downwardly toward the release position against the resilient force of the spring 92.

Alternatively, the blocking member 18 may have an arm which extends through an opening formed in the clasp 52 in lieu of the arm 52b as shown in Fig. 11 provided in the clasp 52 and positioned in the slit 66 of the blocking member 18.

In still another embodiment of the instant invention shown in Fig. 12, the blocking member 18 may be formed with a guide cam 67 which comprises a slant cam 68 and a horizontal cam 69 connected with a lower end of the slant cam 68. A clasp 52 is positioned in the horizontal cam 69 to prevent downward movement of the blocking member 18 in the interceptive position.

When the actuator 50 is activated, it retracts a plunger 53 to move leftward the clasp 52 which is brought into contact with the slant cam 68 to forcibly move downwardly the blocking member 18 toward the release position against resilient force of the spring 92. Adversely, when the actuator 50 extends the plunger 53, the blocking member 18 is returned to the interceptive position. In this way, the clasp 52 is effective to prevent downward movement of the blocking member 18 in the interceptive position. In addition, the opening 57 may be formed by a notch. The link 51 may be formed with a protrusion 56 which is received in an opening 57 formed in the blocking member 18.

In this way, the present invention can realize to firmly prevent unauthorized movement of the blocking member 18 from the interceptive to the release position. Accordingly, the present invention is very effective to inhibit unjust extraction of a bill from inside of the bill validator by pulling out string or tape connected with the bill. In addition, as the shutter unit can detachably be attached to the bill validator, it is very easy to exchange the shutter unit for repair, and also to attach the shutter unit to the bill validator as required.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A bill validator including a validating unit and a shutter unit attached to a front side of said validating unit, said shutter unit including a through hole formed with an inlet at one end of said through hole to insert a bill into said inlet, and an outlet at the other end of said through hole;

said shutter unit comprising a blocking member movable between an interceptive position for closing said through hole of the shutter unit and a release position away from said through hole for allowing passage of the bill through said through hole into a slot of said validating unit;

a control unit comprising a clasp movable between an inactive position for barring movement of said blocking member to the release position and an operative position for allowing movement of the blocking member to the release position; and

an actuator for shifting said clasp between the inactive and operative positions.

2. The bill validator of claim 1, wherein said clasp is rotatably mounted on a shutter frame around a shaft between the inactive and operative positions upon operation of said actuator to prevent and allow movement of said blocking member to the release position.

3. The bill validator of claim 1, wherein said clasp is slidable along a guide recess between the inactive and operative positions by said actuator.

4. The bill validator of claim 1, wherein said control unit includes a link drivingly connected with said actuator;

said clasp is movably mounted on a shutter frame between the inactive and operative positions by the operation of said link

5. The bill validator of claim 4, wherein said clasp is rotatable around a shaft between the inactive and operative positions upon operation of said actuator to prevent and allow movement of said blocking member to the release position when said clasp is moved respectively to the inactive position and the operative position.

6. The bill validator of claim 4, wherein said clasp is drivingly connected with said link which is also operatively connected with the blocking member with a gap to rotate said clasp from the inactive to operative position by said link before the blocking member starts moving from the interceptive to release position.

7. The bill validator of claim 5, wherein a protrusion is provided in one of said blocking member and link;

a notch is formed in the other of said blocking member and link to receive said protrusion with a gap.

8. The bill validator of claim 7, wherein said protrusion is provided in said blocking member and is positioned in said notch formed in said link with said gap.

9. The bill validator of claim 1, wherein said shutter unit comprises a shutter frame for covering said control unit which includes said clasp;

said validating unit comprises a case, a passageway formed in said case and having a slot and an outlet at the

opposite ends thereof, a conveying device for transporting the bill from the slot through the passageway to the outlet; and a bill sensor disposed adjacent to the passageway for detecting an optical or magnetic feature of the bill,

said shutter frame is detachably attached to said case.

10. The bill validator of claim 4, wherein said link is rotatably mounted by a shaft on a shutter frame and drivingly connected with said actuator.

11. The bill validator of claim 4, wherein said actuator comprises a solenoid with a plunger connected with said link.

12. The bill validator of claim 1, wherein said clasp is formed with a blocking edge in contact with said blocking member to bar movement of said blocking member toward the release position when said control unit is in the inactive position.

13. The bill validator of claim 12, wherein said clasp is formed with a blocking edge which can be vertically aligned with a shaft and an abutment of said blocking member so that said blocking edge is in contact with said abutment at a dead point to prevent movement of said clasp from the inactive to operative position, and thereby to bar movement of said blocking member toward the release position.

14. The bill validator of claim 1, wherein said actuator comprises a solenoid with a movable plunger connected with said control unit to move said clasp between the inactive and operative positions.

15. The bill validator of claim 13, wherein said shaft produces a resisting force against the vertical movement of said

blocking member when said abutment of the blocking member is forcibly urged toward said blocking edge of the clasp at the dead point.

16. The bill validator of claim 1, wherein said shutter unit comprises a shutter frame for covering said clasp; and

a bolt for removably attaching said shutter frame to a case of said validating unit.

17. The bill validator of claim 1, further comprising an inlet sensor mounted in the vicinity of the inlet of the shutter unit for producing a detection signal when a bill is inserted into the inlet; a slot sensor mounted in the vicinity of the slot for producing a detection signal when the bill is inserted into the slot; and a validating control circuit electrically connected with said actuator, inlet sensor and slot sensor,

whereby upon receiving the detection signal from said inlet sensor, said validating control circuit activates said actuator to move said clasp from the inactive to operative position and move the blocking member from the interceptive to release position,

and upon receiving the detection signal from said slot sensor, said validating control circuit deactivates said said actuator to return the blocking member from the release position to the interceptive position and move said clasp from the operative to inactive position.

18. The bill validator of claim 1, wherein said blocking member is resiliently urged by a spring toward the interceptive position.

19. The bill validator of claim 1, wherein said blocking member is drivingly connected with said clasp with a gap.

20. The bill validator of the claim 13, wherein a small gap is formed between said abutment and clasp to permit rotation of said clasp while said blocking member is retained in the interceptive condition.

FIG. 1 PRIOR ART

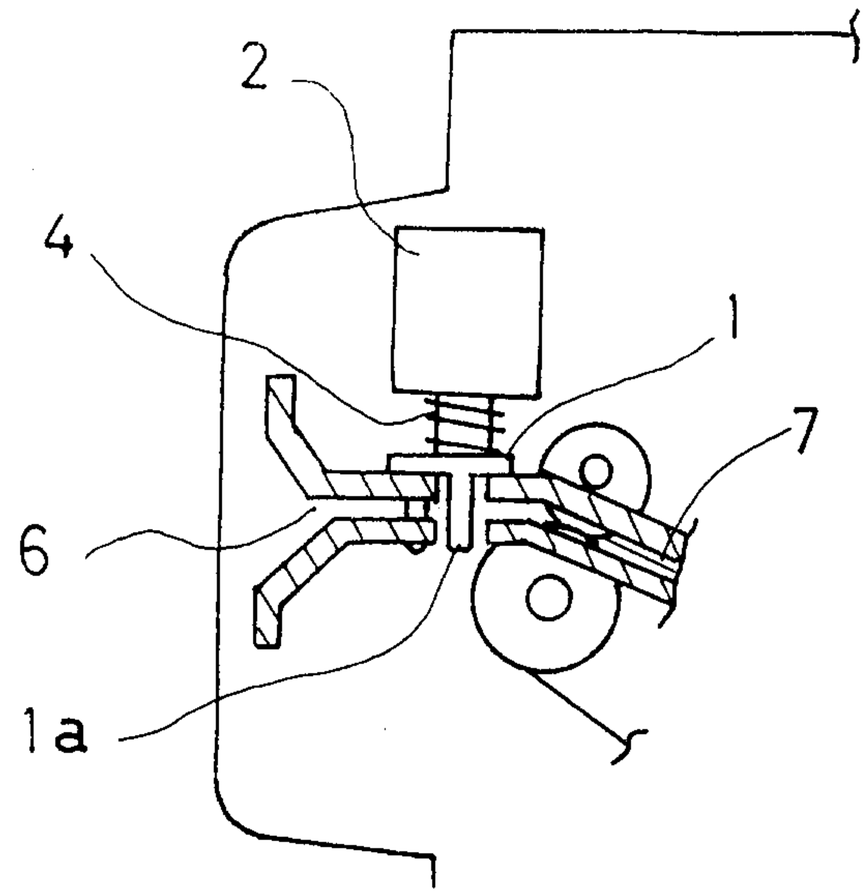


FIG. 2 PRIOR ART

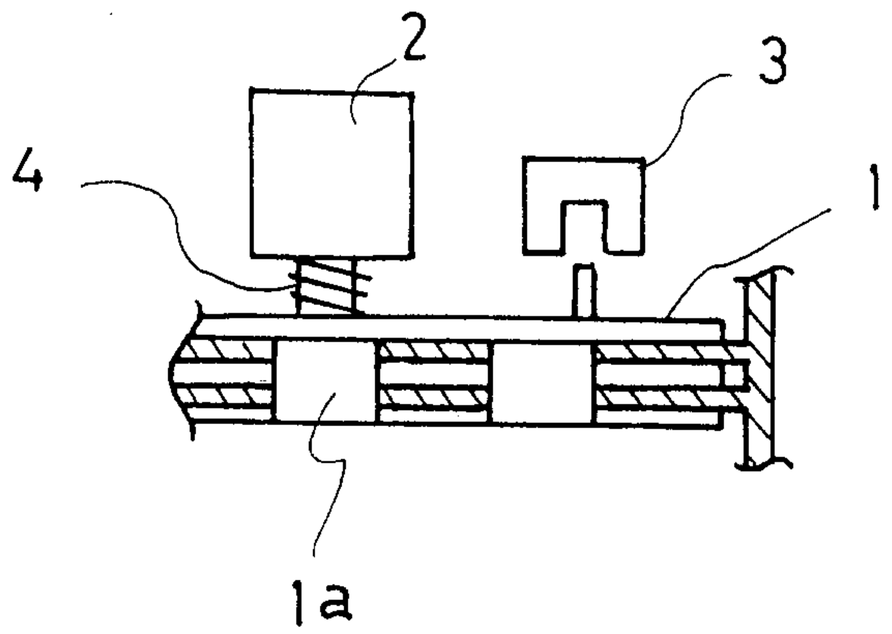
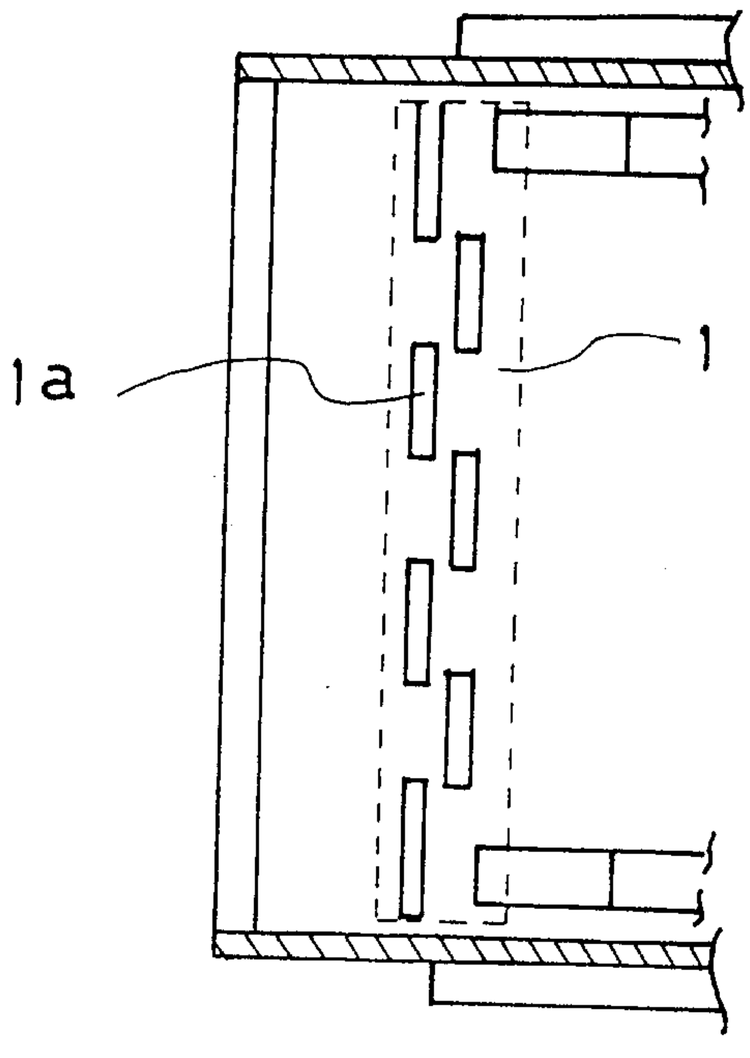
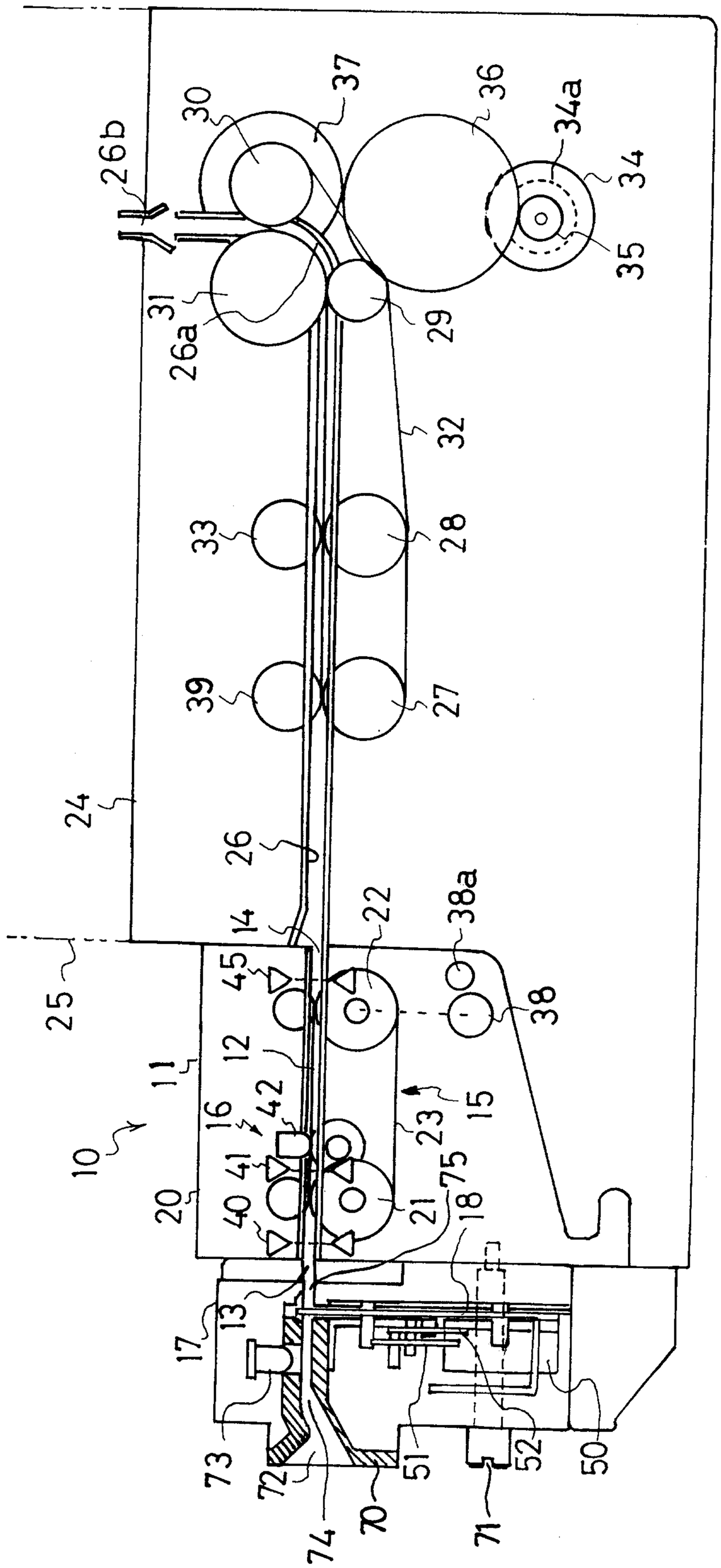


FIG. 3 PRIOR ART

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16
17
18
20
21
22
23
24
25
26
26a
26b
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28
29
30
31
32
33
34
34a
35
36
37
38
38a
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42
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74
75

FIG. 4

FIG. 5

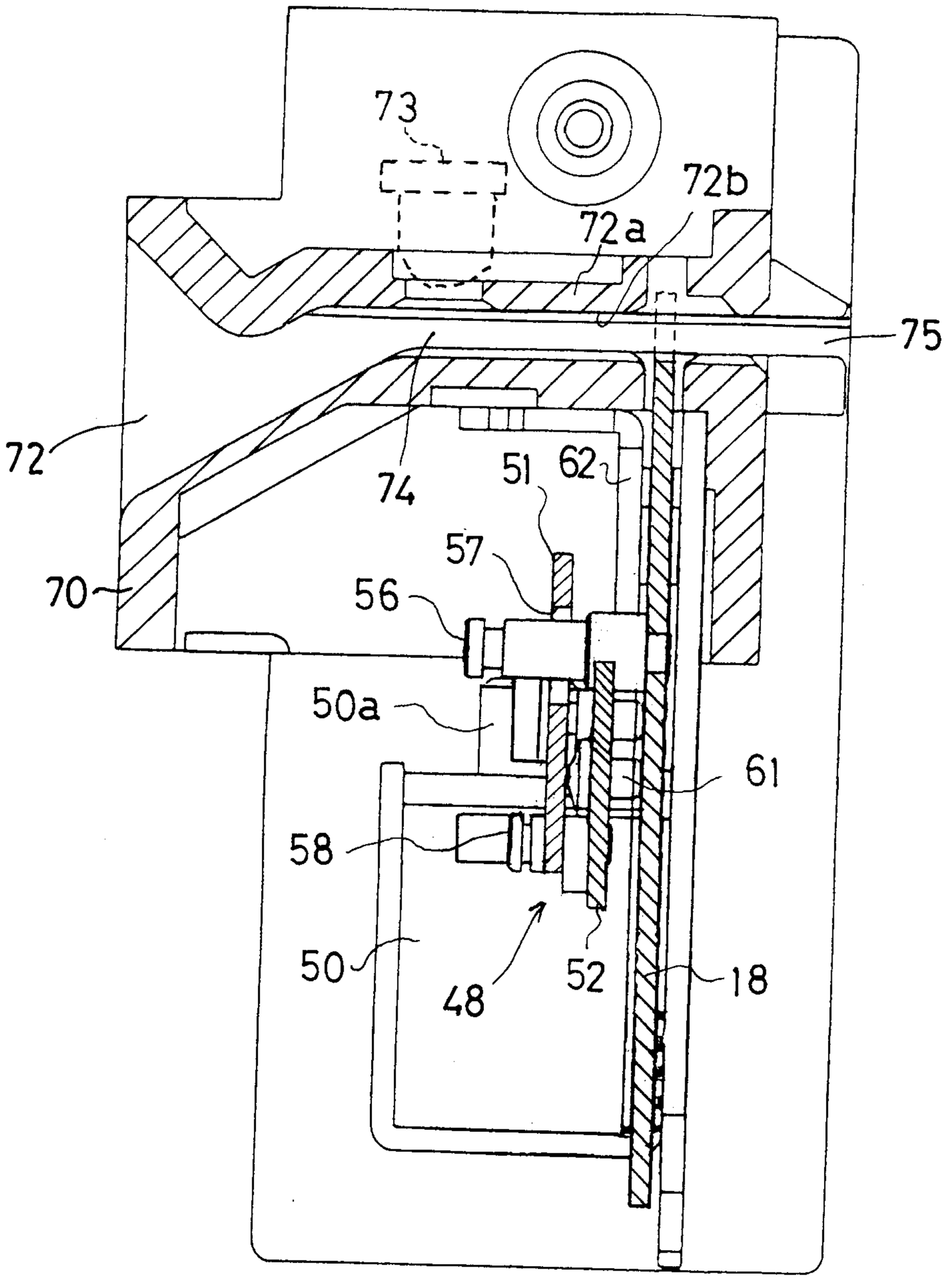


FIG. 6

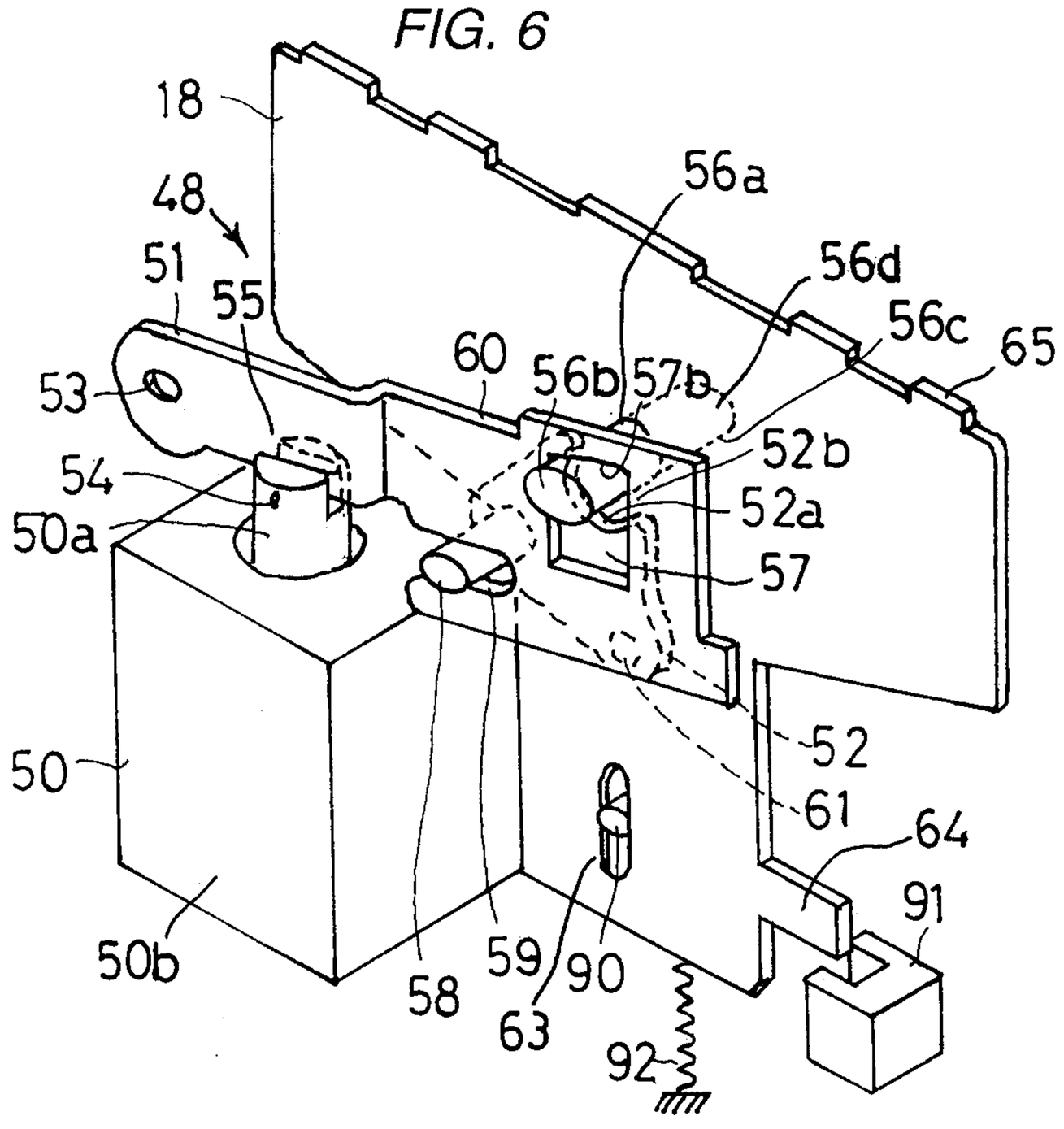

18
48
51
55
56a
56d
56c
65
60
56b
57b
53
52b
54
52a
50a
57
52
50
61
64
91
50b
58
59
90
63
92

FIG. 7

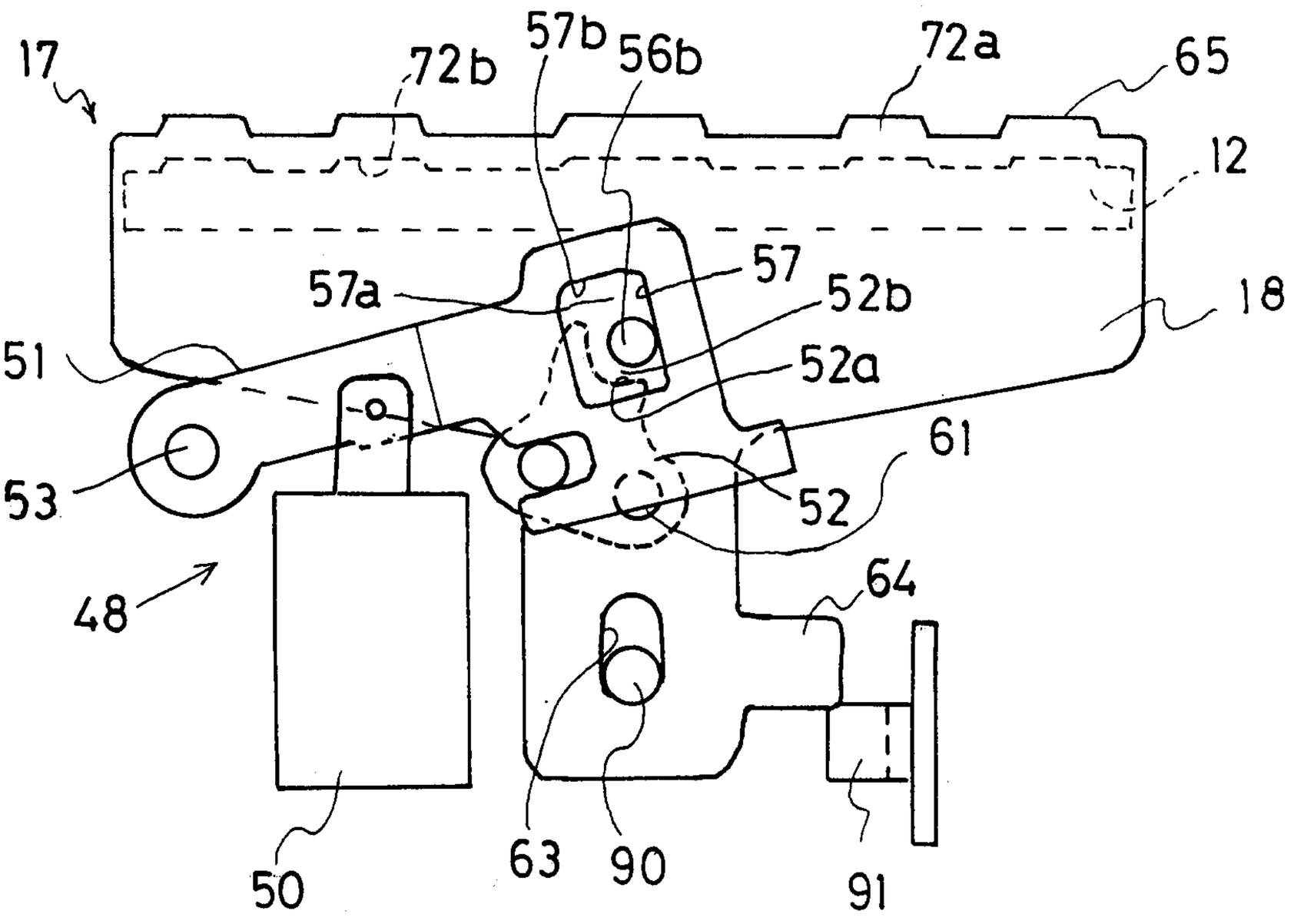
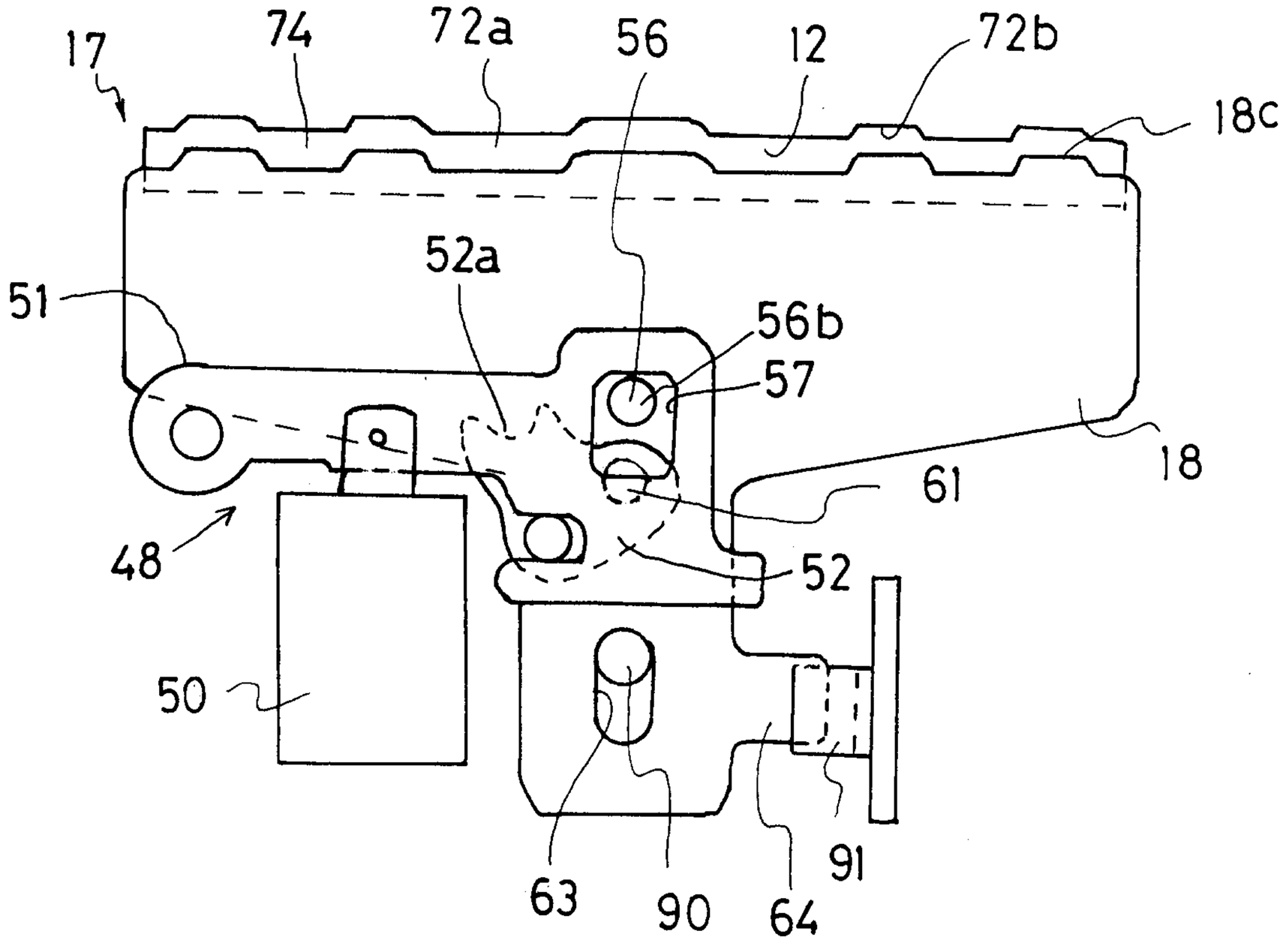

17
72b
57b
56b
72a
65
12
57a
57
52b
18
51
52a
61
53
52
48
64
50
63
90
91

FIG. 8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74
72a
56
12
72b
18c
52a
51
56b
57
18
61
48
52
50
63
90
64
91

FIG. 9

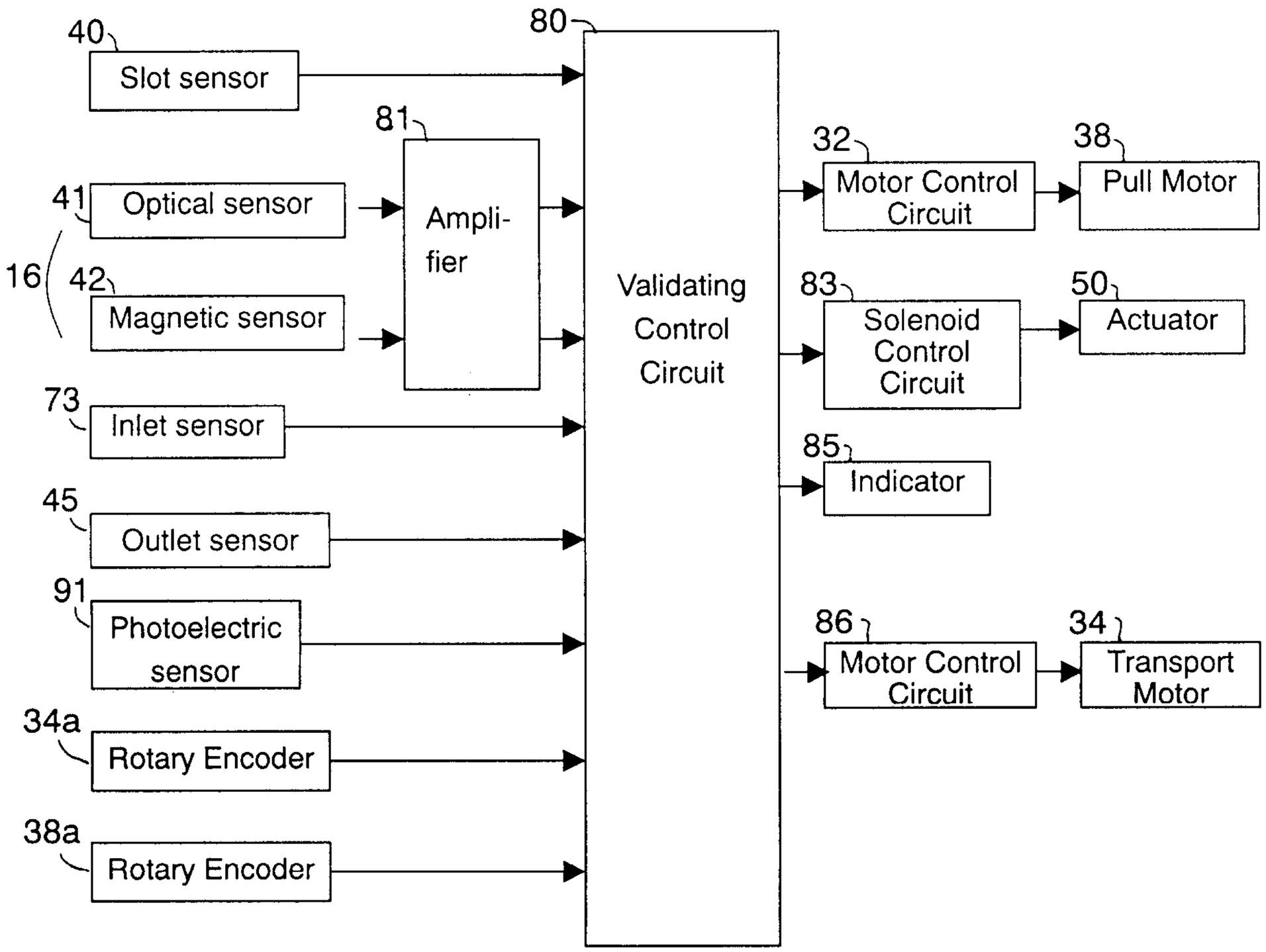

40
Slot sensor
80
81
41
Optical sensor
Ampli-
fier
16
42
Magnetic sensor
73
Inlet sensor
45
Outlet sensor
91
Photoelectric
sensor
34a
Rotary Encoder
38a
Rotary Encoder
Validating
Control
Circuit
32
Motor Control
Circuit
38
Pull Motor
83
Solenoid
Control
Circuit
50
Actuator
85
Indicator
86
Motor Control
Circuit
34
Transport
Motor

FIG. 10

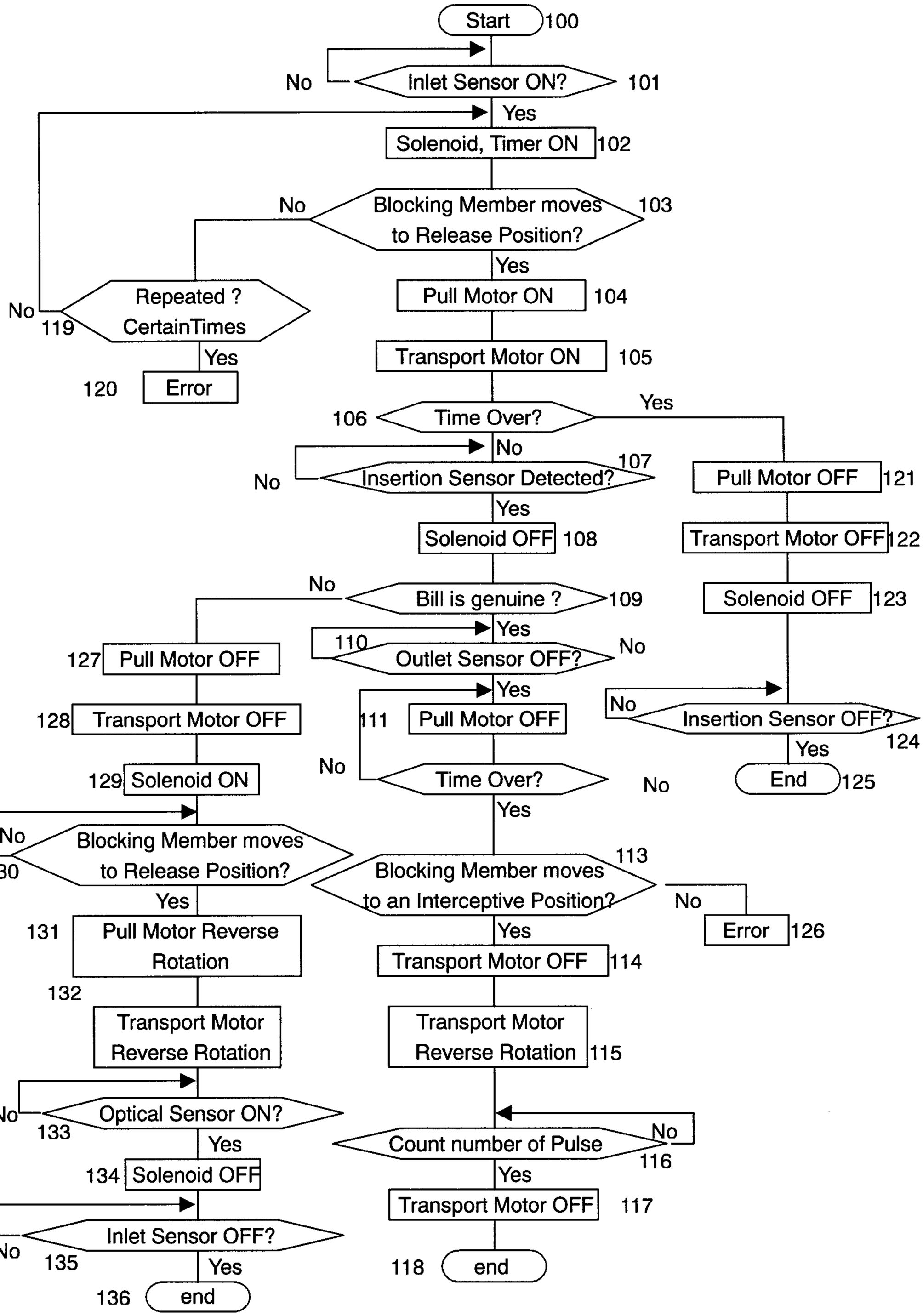
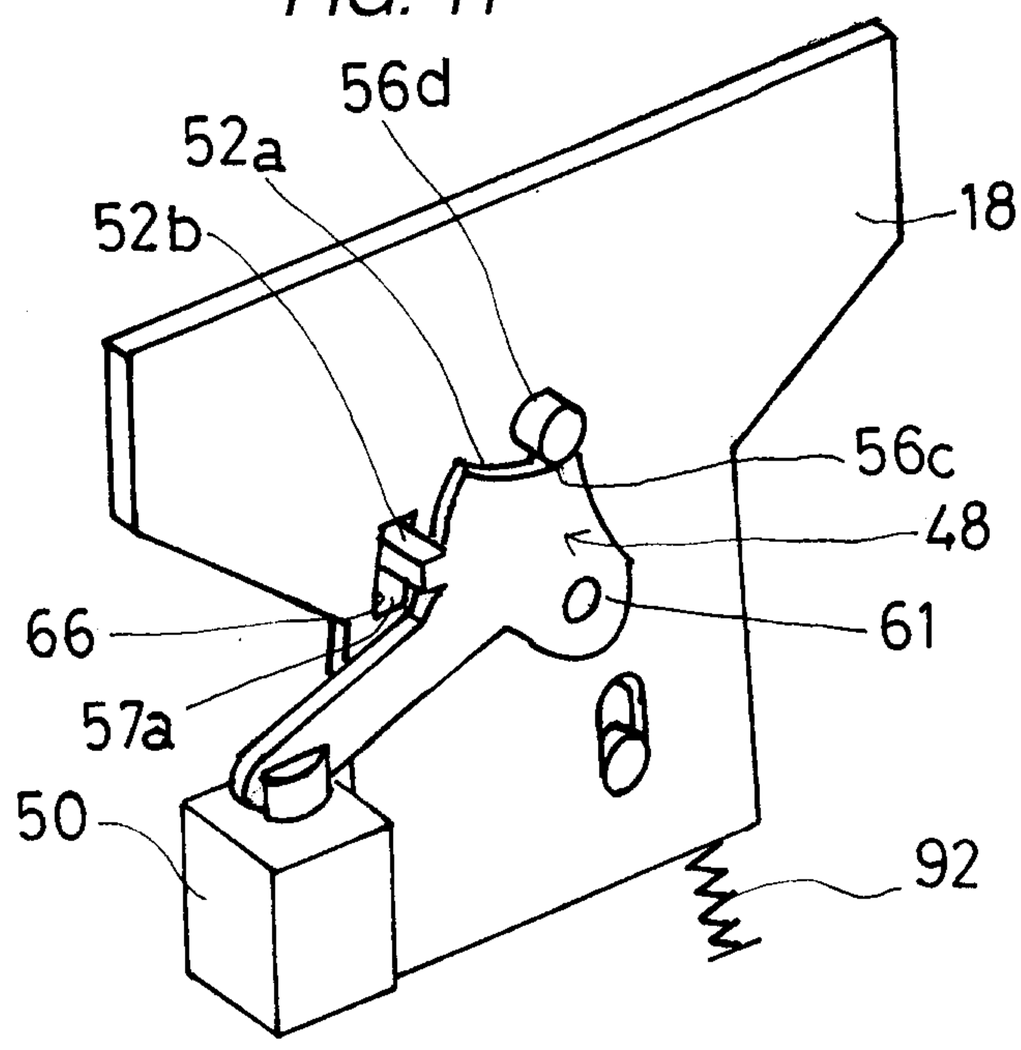

Start
100
No
Inlet Sensor ON?
101
Yes
Solenoid, Timer ON
102
No
Blocking Member moves to Release Position?
103
Yes
Pull Motor ON
104
Transport Motor ON
105
106
Time Over?
Yes
No
107
No
Insertion Sensor Detected?
Yes
Solenoid OFF
108
No
Bill is genuine ?
109
Yes
110
Outlet Sensor OFF?
No
Yes
111
Pull Motor OFF
No
Time Over?
Yes
No
Repeated ? CertainTimes
119
Yes
120
Error
Pull Motor OFF
121
Transport Motor OFF
122
Solenoid OFF
123
No
Insertion Sensor OFF?
124
Yes
End
125
113
Blocking Member moves to an Interceptive Position?
No
Error
126
Yes
Transport Motor OFF
114
Transport Motor Reverse Rotation
115
No
Count number of Pulse
116
Yes
Transport Motor OFF
117
118
end
127
Pull Motor OFF
128
Transport Motor OFF
129
Solenoid ON
No
130
Blocking Member moves to Release Position?
Yes
131
Pull Motor Reverse Rotation
132
Transport Motor Reverse Rotation
No
133
Optical Sensor ON?
Yes
134
Solenoid OFF
No
135
Inlet Sensor OFF?
Yes
136
end

FIG. 11


56d
52a
52b
18
56c
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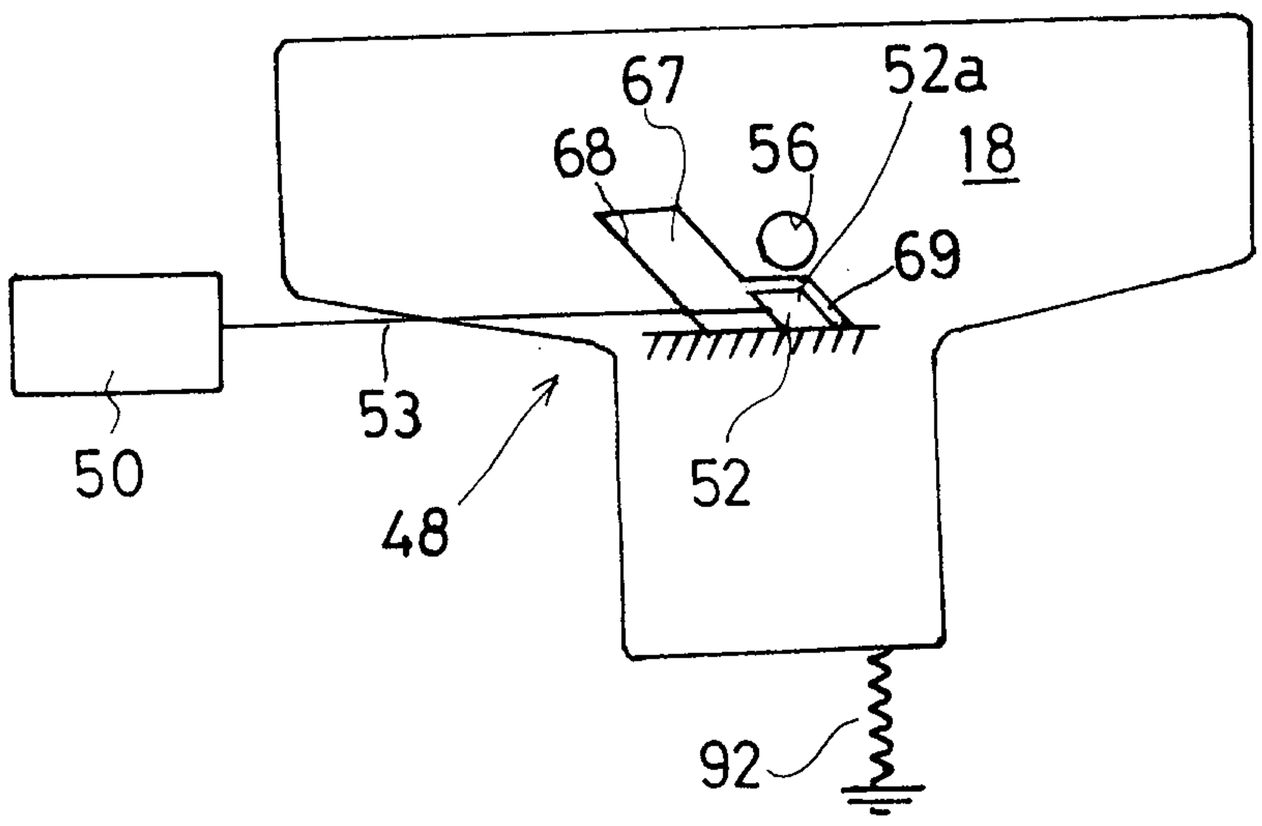
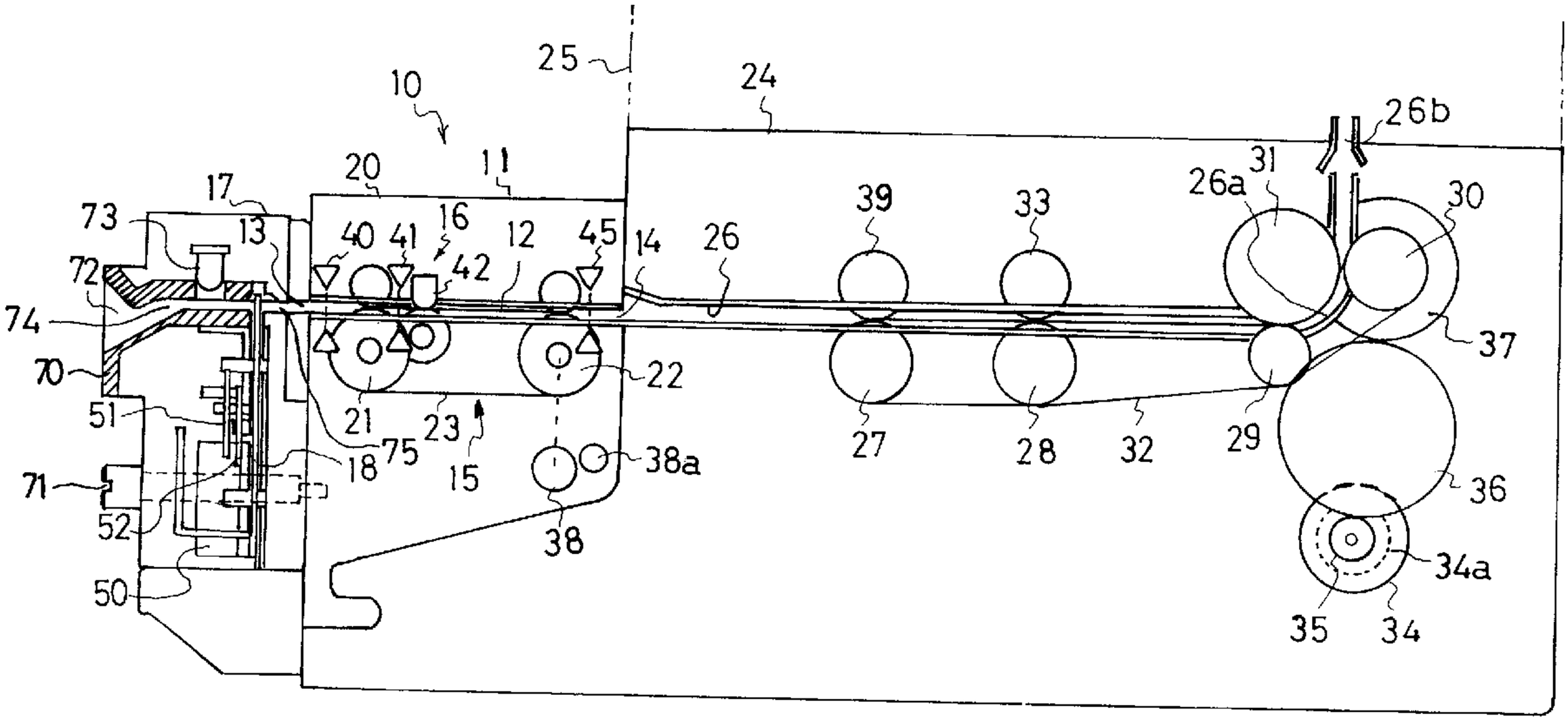
66
61
57a
50
92

FIG. 12


67
52a
68
56
18
69
53
50
52
48
92


25
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26b
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11
31
26a
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72
42
74
37
70
22
51
21
23
75
18
15
38a
27
28
32
29
36
71
52
38
34a
50
35
34