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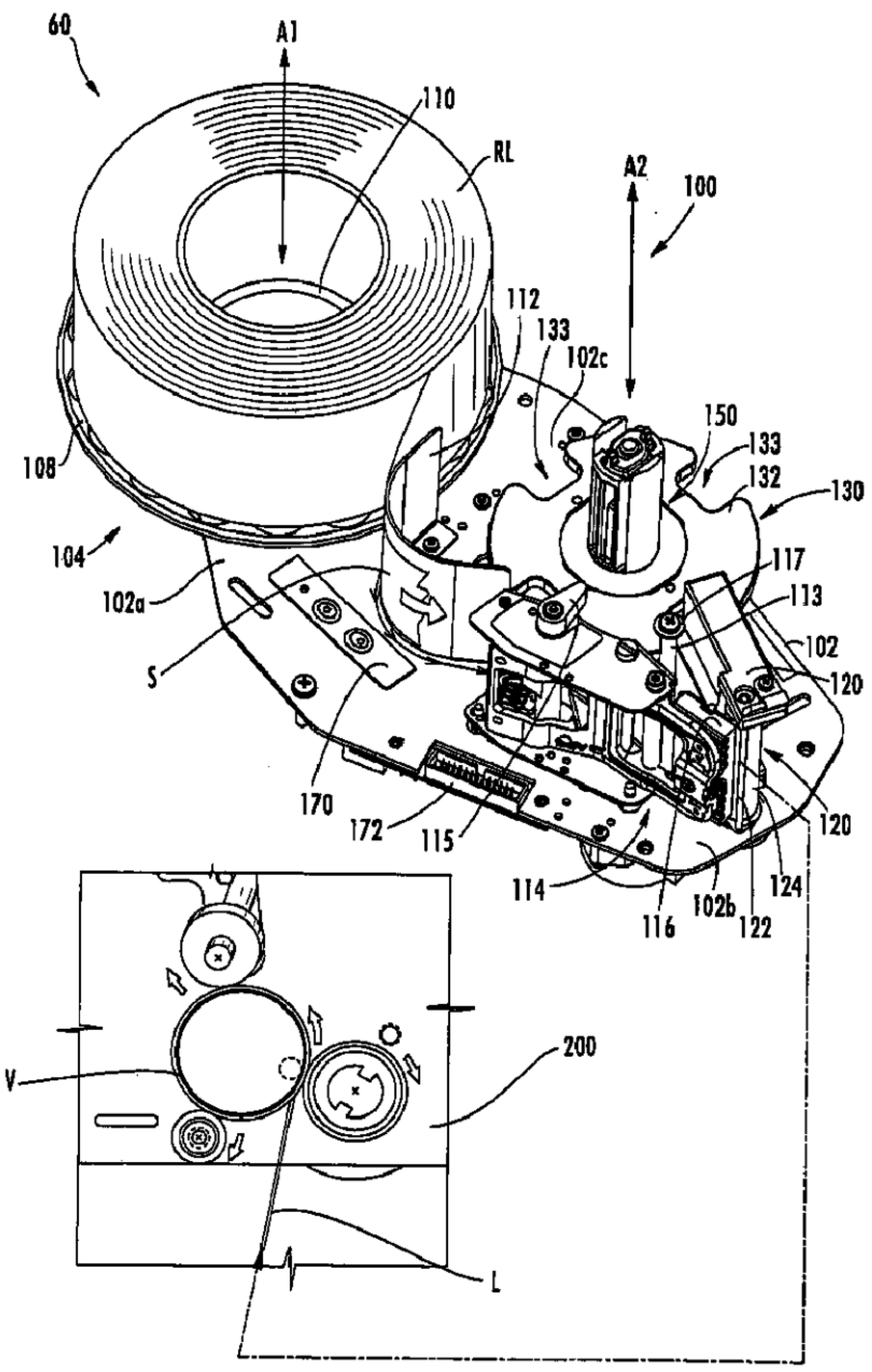

(57) Abrégé/Abstract:
A label printing station includes: a base (102); a label supply wheel (104) rotatably mounted to the base (102) for rotation about a first vertical axis (A1) of rotation; a label backing take-up wheel (130) rotatably mounted to the base for rotation about a second

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(57) Abrégé(suite)/Abstract(continued):
vertical axis (A2) of rotation; and a label print-head assembly mounted to the base, the label print-head assembly (100) being configured to print on a label (L) as the label is vertically oriented. The supply wheel, the print-head assembly and the take-up wheel serially define a paper path along which a substantially continuous label backing sheet (S) travels. The backing sheet may be supported from underneath at multiple locations along the paper path. With the printed label being vertically oriented, the label can be attached to an object, such as a vertically oriented pharmaceutical vial (V), which can simplify the labeling process.

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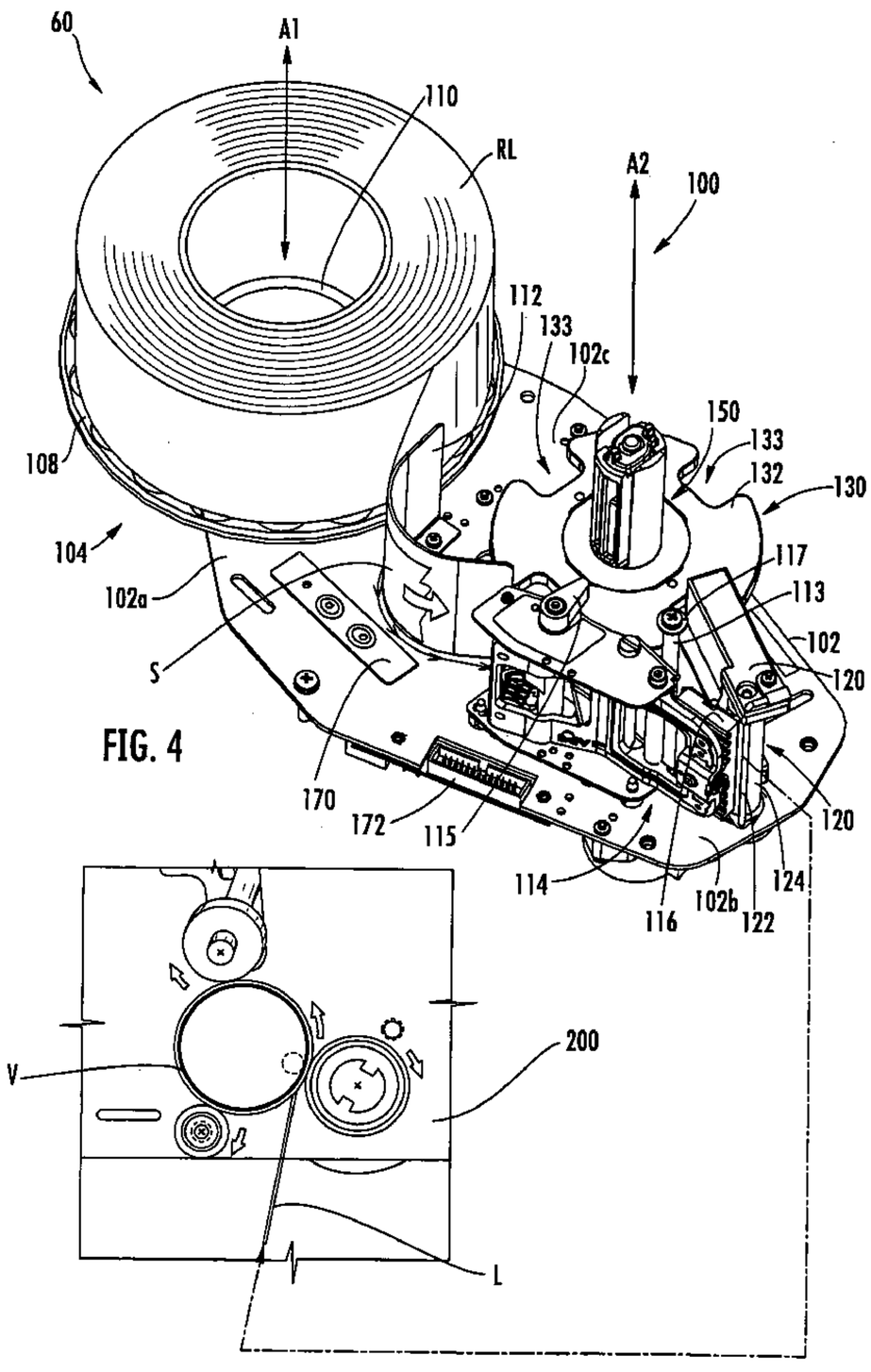

FIG. 4

(57) Abstract: A label printing station includes: a base (102); a label supply wheel (104) rotatably mounted to the base (102) for rotation about a first vertical axis (A1) of rotation; a label backing take-up wheel (130) rotatably mounted to the base for rotation about a second vertical axis (A2) of rotation; and a label print-head assembly mounted to the base, the label print-head assembly (100) being configured to print on a label (L) as the label is vertically oriented. The supply wheel, the print-head assembly and the take-up wheel serially define a paper path along which a substantially continuous label backing sheet (S) travels. The backing sheet may be supported from underneath at multiple locations along the paper path. With the printed label being vertically oriented, the label can be attached to an object, such as a vertically oriented pharmaceutical vial (V), which can simplify the labeling process.

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DEVICE AND METHOD FOR PRINTING LABELS

Field of the Invention

The present invention is directed generally to the dispensing of prescriptions of pharmaceuticals, and more specifically is directed to the automated dispensing of pharmaceuticals.

Background of the Invention

Pharmacy generally began with the compounding of medicines, which entailed the actual mixing and preparing of medications. Heretofore, pharmacy has been, to a great extent, a profession of dispensing, that is, the pouring, counting, and labeling of a prescription, and subsequently transferring the dispensed medication to the patient. Because of the repetitiveness of many of the pharmacist's tasks, automation of these tasks has been desirable.

Some attempts have been made to automate the pharmacy environment. Different exemplary approaches are shown in U.S. Patent Nos. 5,337,919 to Spaulding et al. and U.S Patent Nos. 6,006,946; 6,036,812 and 6,176,392 to Williams et al. The Williams system conveys a bin with tablets to a counter and a vial to the counter. The counter dispenses tablets to the vial. Once the tablets have been dispensed, the system returns the bin to its original location and conveys the vial to an output device. Tablets may be counted and

dispensed with any number of counting devices. Drawbacks to these systems typically include the relatively low speed at which prescriptions are filled and the absence in these systems of securing a closure (i.e., a lid) on the container after it is filled.

One additional automated system for dispensing pharmaceuticals is described in some detail in U.S. Patent No. 6,971,541 to Williams et al. This system has the capacity to select an appropriate vial, label the vial, fill the vial with a desired quantity of a selected pharmaceutical tablet, apply a cap to the filled vial, and convey the labeled, filled, capped vial to an offloading station for retrieval.

Although this particular system can provide automated pharmaceutical dispensing, certain of the operations may be improved. For example, the Williams system includes a first robotic carrier that receives a vial from a vial dispenser and conveys the vial to a label printer. The robotic carrier is configured to orient the vial to a horizontal disposition and to rotate the vial (via fingers inserted into the cavity of the vial) as the label printer presents the label. The robotic carrier then "hands off" the labeled vial to a second robotic carrier that conveys the labeled vial to tablet dispensing bins, a capping station, and an offload station. It may be desirable to simplify the system by reducing the number of robotic carriers.

Summary of the Invention

As a first aspect, embodiments of the present invention are directed to a label printing station for an object. The label printing station comprises: a base; a label supply wheel rotatably mounted to the base for rotation about a first vertical axis of rotation; a label backing take-up wheel rotatably mounted to the base for rotation about a second vertical axis of rotation; and a label print-head assembly mounted to the base, the label print-head assembly being configured to print on a label as the label is vertically oriented. The supply wheel, the print-head assembly and the take-up wheel serially define a paper path along which a substantially continuous label backing sheet travels. The label printing station further comprises a labeling station configured to apply a label to an object, the labeling station being positioned to receive a printed label from the print-head assembly and apply it to the object. With the printed label being vertically oriented, the label can be attached to a vertically oriented object, such as a pharmaceutical vial, which can simplify the labeling process.

As a second aspect, embodiments of the present invention are directed to a method of presenting a printed label for an object. The method comprises: conveying a label adhered to a substantially continuous label backing sheet past a print head assembly, the label and backing sheet being vertically oriented; printing pharmaceutical information on the label with the print head assembly as the label is vertically oriented; removing the vertically oriented printed label from the backing sheet for presentation to an object; and adhering the vertically oriented printed label to the object. Again, the vertical orientation of the label can facilitate the attachment to a vertically oriented object, such as a pharmaceutical vial.

As a third aspect, embodiments of the present invention are directed to a peel block for use with a label print-head assembly. The peel block comprises: a body section with opposed first and second side walls; at least one foot having an upper surface that defines a lower edge of a paper path followed by a backing sheet with labels adhered thereto, the foot extending from the first side wall; and at least one foot having an upper surface that defines a lower edge of the paper path, the foot extending from the second side wall. A peel block of this configuration can help to maintain a vertically-oriented label backing sheet in vertical alignment.

As a fourth aspect, embodiments of the present invention are directed to a method of presenting a printed label for an object, comprising: conveying a label adhered to a substantially continuous label backing sheet past a print head assembly, the label and backing sheet being vertically oriented; printing information on the label with the print head assembly as the label is vertically oriented; and removing the vertically oriented printed label from the backing sheet for presentation to an object. During the conveying step, the backing sheet is supported from underneath at multiple locations. This technique can facilitate proper application of a vertically oriented printed label to the object.

As a fifth aspect, embodiments of the present invention are directed to a label printing station for printing labels, comprising: a base; a label supply wheel rotatably mounted to the base for rotation about a first vertical axis of rotation; a label backing take-up wheel rotatably mounted to the base for rotation about a second vertical axis of rotation; and a label print-head assembly mounted to the base, the label print-head assembly being configured to print on a label as the label is vertically oriented. The supply wheel, the print-head assembly and the take-up wheel serially define a paper path along which a substantially continuous label

backing sheet travels. The paper path includes multiple locations positioned to support the label backing sheet from underneath.

As a sixth aspect, embodiments of the present invention are directed to a label printing station for applying labels to an object, comprising: a base; a label supply wheel rotatably mounted to the base for rotation about a first vertical axis of rotation, the label supply wheel including a friction-inducing component configured to resist rotation of the supply wheel if torque applied to the label supply wheel is below a predetermined level; a label backing take-up wheel rotatably mounted to the base for rotation about a second vertical axis of rotation; a drive motor connected to the take-up wheel; a rotation-permitting component associated with the drive motor and the take-up wheel; a label print-head assembly mounted to the base, the label print-head assembly being configured to print on a label as the label is vertically oriented; wherein the supply wheel, the print-head assembly and the take-up wheel serially define a paper path along which a substantially continuous label backing sheet travels; and a labeling station configured to apply a label to an object, the labeling station being positioned to receive a printed label from the print-head assembly and apply it to the object; wherein the rotation-permitting component is configured such that, during operation of the drive motor, when tension in the backing sheet exceeds a predetermined level, the take-up wheel rotates at a lower speed than when tension in the sheet is below the predetermined level.

Brief Description of the Figures

Figure 1 is a flow chart depicting operations that can be carried out by an automated pharmacy machine according to embodiments of the present invention.

Figure 2 is a front perspective view of an automated pharmacy machine according to embodiments of the present invention.

Figure 3 is an opposite side front perspective view of the automated pharmacy machine of **Figure 2** with the outer skin removed to permit visual access to components housed therein.

Figure 4 is a top, front perspective view of the label printing station employed by the automated pharmacy machine of **Figure 2** along with a top view of a label application station.

Figure 5 is a top view of the label printing station of **Figure 4**.

Figure 6 is an exploded view of the supply wheel of the label printing station of **Figure 4**.

Figure 7 is a partial, top, front perspective view of the print-head assembly platen and peel block of the printing station of **Figure 4** showing the peeling of a printed label from the label backing sheet.

Figure 7a is a partial bottom front perspective view of the printing section of the base plate of the label printing station in **Figure 4** showing the motor that drives the backing roll.

Figure 8 is a front perspective view of the peel block of the label printing station of **Figure 4**.

Figure 9 is an opposite front perspective view of the peel block of **Figure 8**.

Figure 10 is a section view of the peel block taken along lines **10—10** of **Figure 12** showing the loading of a label backing sheet.

Figure 11 is a section view of the peel block as in **Figure 10** showing how the label backing sheet is vertically aligned thereby.

Figure 12 is an enlarged, top, rear perspective view of the take-up wheel and peel block of the label printing station of **Figure 4**.

Figure 13 is a bottom perspective view of the spindle unit and the clutch mechanism of the label printing station of **Figure 4**.

Figure 14 is a section view of the spindle unit and clutch mechanism of **Figure 13**.

Figure 15 is a bottom perspective view of the motor and clutch mechanism of the label printing station of **Figure 4**.

Figure 16 is an enlarged top perspective view of the upper end of the spindle of **Figure 13**.

Detailed Description of Embodiments of the Invention

The present invention will now be described more fully hereinafter, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. In the drawings, like numbers refer to like elements throughout. Thicknesses and dimensions of some components may be exaggerated for clarity.

Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof. As used herein the expression "and/or" includes any and all combinations of one or more of the associated listed items.

In addition, spatially relative terms, such as "under", "below", "lower", "over", "upper" and the like, may be used herein for ease of description to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the figures. It will be understood that the spatially relative terms are intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. For example, if the device in the figures is turned over, elements described as "under" or "beneath" other elements or features would then be oriented "over" the other elements or features. Thus, the exemplary term "under" can encompass both an orientation of over and under. The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors used herein interpreted accordingly.

Also, as used herein, the terms "downstream" and "upstream," which are often used in manufacturing environments to indicate that certain material being acted upon is farther along in the manufacturing process than other material, are intended to indicate relative positions of components along a path following by a substantially continuous paper sheet that travels along and through the components. A component that is "downstream" from another component means that the first component is positioned farther along the paper path, and a component that is "upstream" from another component means that the first component is nearer the origin of the paper path. It should be noted that, relative to an absolute x-y-z coordinate axis system, these directions shift as the paper is conveyed between different operations. When they occur, these shifts in absolute direction are noted hereinbelow, and the downstream direction is redefined with reference to structures illustrated in the drawings.

Well-known functions or constructions may not be described in detail for brevity and/or clarity.

As described above, the invention relates generally to a system and process for dispensing pharmaceuticals. An exemplary process is described generally with reference to **Figure 1**. The process begins with the identification of the proper container, tablets or capsules and closure to be dispensed based on a patient's prescription information (**Box 20**). A container of the proper size is dispensed at a container dispensing station (**Box 22**), then moved to a labeling station (**Box 24**). A printing station prints a label (**Box 25**) that is applied at the labeling station (**Box 26**), after which the container is transferred to a tablet dispensing station (**Box 28**), from which the designated tablets are dispensed in the designated amount into the container (**Box 30**). The filled container is then moved to a closure dispensing station (**Box 32**), where a

closure of the proper size has been dispensed (**Box 34**). The filled container is secured with a closure (**Box 36**), then transported to an offload station and offloaded (**Box 38**).

A system that can carry out this process is illustrated in **Figures 2** and **3** and designated broadly therein at **40**. The system **40** includes a support frame **44** for the mounting of its various components. The system **40** generally includes as operative stations a controller (represented herein by a graphics user interface monitor **42**), a container dispensing station **58**, a labeling station **60**, a tablet dispensing station **62**, a closure station **64**, and an offloading station **66**. In the illustrated embodiment, containers, tablets and closures are moved between these stations with a single carrier **68**; however, in some embodiments only a single carrier may be employed, or one or more additional carriers may be employed. The operation of the container dispensing station **58**, the tablet dispensing station **62**, and the closure station **64**, and the offloading station **66** are described in, for example, U.S. Patent Application Publication nos. 2008-0110921A1; 2008-0110555A1; 2008-0168751A1; and 2006-0241807A1.

Turning now to **Figure 4**, the labeling station **60** includes a label printing station **100** and a label application station **200**. The label application station **200**, which receives a label **L** from the label printing station **100** and applies the label **L** to a vial **V**, is described in some detail in co-pending U.S. Patent Application Publication no. 2008-0110555A1, listed *supra*, and need not be described in detail herein.

The label printing station **100** includes a flat base plate **102** that can be divided into a supply section **102a**, a printing section **102b**, and a take-up section **102c**. A supply wheel **104** is rotatably mounted on the supply section **102a**, a label print-head assembly **114** and a peel block **120** are mounted on the printing section **102b**, and a take-up wheel **130** is mounted on the take-up section **102b**. These components are described in detail below.

Referring to **Figures 4-6**, the supply wheel **104** includes an axle **106** that is inserted into the base **102** and extends substantially vertically therefrom. The axle **106** defines an axis of rotation **A1**. A bearing plate **109** is fixed to the base **102**. A turntable **108** is mounted on the axle **106** and is free to rotate relative to the axle **106** about the axis of rotation **A1**. The underside of the turntable **108** engages the bearing plate **109** such that friction therebetween resists rotation of the turntable **108** about the axis **A1**. In some embodiments, the underside of the turntable **108** may have a rib that contacts the bearing plate **109** to provide friction and resist

rotation. The turntable **108** includes a mounting ring **110** that is configured to fit within the central core of a reel of adhesive labels mounted on a label backing sheet.

Those skilled in this art will recognize that other configurations for a supply wheel may also be employed. For example, the turntable may be a solid piece, a foraminated piece as shown, or even a "spoked" piece. The turntable and mounting ring may be a single piece or separate pieces. The mounting ring may be replaced with upstanding prongs, projections or fingers that can engage the core of a reel of adhesive labels. The mounting ring may be formed of different materials, including polymeric materials or sheet metal; with embodiments formed of sheet metal, upstanding prongs and downwardly-extending ribs or projections may be formed in a stamping process. Also, the supply wheel may rely on a clutch or other friction-inducing mechanism that acts on either the turntable or the axle to induce rotational friction, such that the bearing plate may be omitted. Moreover, the supply wheel may lack a turntable altogether. Other embodiments may be apparent to those skilled in this art.

Turning now to **Figures 4** and **5**, a guide **112** is mounted to the base **102** between the supply wheel **104** and the print-head assembly **114**. The guide **112** is undulated and projects away from the take-up wheel **130**. A guide post **113** is mounted in the base **102** near the upstream end of the print-head assembly **114** and extends generally upwardly (*see also* **Figure 12**). A static discharge brush **118** is mounted such that its bristles confront the guide post **113** (**Figure 12**). The brush **118** is attached to a mounting guard **117**. The mounting guard **117** is attached to the upper ends of both the guide post **113** and the print-head assembly **114**, and its lower end engages a hole in the base plate **102**. The brush **118** is mounted such that its bristles confront the guide post **113** (**Figure 12**).

Turning now to **Figures 4, 5,** and **7**, the print-head assembly **114** is mounted to the printer section **102b** of the base **102** such that the printer head platen **116** is oriented to print on a vertical sheet. A release lever **115** is mounted on the upper surface of the print-head assembly **114** to enable a label sheet to be inserted and removed from the print-head assembly **114**. An exemplary print-head assembly **114** is the Printing Assembly Part No. 91600104, available from APS Industrial (Milan, Italy).

Referring now to **Figures 8, 9** and **12**, the peel block **120** is mounted to the printer section **102b** of the base **102** such that it confronts the print-head assembly **114**. The peel block **120** includes feet **121a, 121b** that extend toward the print-head assembly **114** from a side wall **128**; the foot **121a** is positioned adjacent the guide post **113** (*see* **Figure 13**), and the foot **121b**

is positioned just upstream of the printer head platen **116**. The side wall **128** includes a recessed area **128a** positioned above the feet **121a, 121b** that has an arcuate surface **128b**. A vertically oriented backing roll **124 (Figure 12)** is mounted in the peel block **120** adjacent the print-head assembly head **114** such that a nip **123 (Figure 5)** is formed therebetween. Also, a small diameter (0.040-0.150 inch) peel pin **122** (*see* **Figure 4**) is vertically mounted to the peel block **120** just downstream of the printer head platen **116**. On the opposite side wall **129** of the peel block **120**, feet **125a, 125b** extend away from the print-head assembly **114**, as does a ledge **127**, such that a pocket **126** is formed between the feet **125a, 125b** and the ledge **127 (Figures 8** and **9)**.

Referring now to **Figure 7a**, the backing roll **124** is attached via an axle (not shown) to a gear **161** that engages a motor **160** mounted to the underside of the base plate **102**. The backing roll **124** is rotatable about a generally vertical axis of rotation **A3**.

Those skilled in this art will appreciate that the peel block **120** may take different configurations with more or fewer feet, additional or fewer ledges and/or recessed areas, and the like. Also, the peel block **122** may be divided into upper and lower segments, which can be configured such that the distance between the feet **125a, 125b** and the ledge **127** can be varied. As another alternative, the ledge **127** itself may be an insert that can be attached to the remainder of the peel block **120**, such that changing the insert can adjust the vertical position of the ledge **127**. Whether formed as a unitary or multi-component part, the peel block **120** may include features that receive the backing roll **124** and/or the peel pin **122**, as well as the feet **121a, 121b, 125a, 125b**, ledge **127**, recessed area **128a** and the like.

Turning now to **Figures 4, 5** and **12**, the take-up wheel **130** includes a turntable **132** rotatably mounted on a spindle unit **150**. The turntable **132** is generally flat and includes four notches **133** that are generally circumferentially equidistant from each other. An access aperture **133a** is positioned on an interior portion of the take-up section **102c** of the base plate **102**. As is the case with the turntable **108** of the supply wheel **104**, the turntable **132** may take any number of configurations; in some embodiments, the turntable may be formed of a sheet metal, with structure for engaging the spindle unit **150** and the like being stamped into the turntable.

The turntable **132** is mounted to the spindle unit **150** via a base **152 (Figures 12-14)**. An axle **153** extends vertically through the base **152** to define an axis of rotation **A2**. On the underside of the base **102**, a clutch mechanism **134** is attached to the axle **153 (Figures 13-15)**. The clutch mechanism **134** includes a pair of friction washers **140, 141** that are keyed to and

rotate with the axle **153**. A spring **136** applies upward pressure to the lower friction washer **140**. The friction washers **140, 141** sandwich two bearing components **142, 143** that are keyed to and rotate with a gear **138** that receives, but is not restricted to rotate with, the axle **153**. The gear **138** engages a gear reduction train **146** that in turn engages a motor **144** that is mounted to the underside of the base **102** (**Figure 15**).

Referring now to **Figures 13, 14** and **16**, on the upper side of the base **102**, the base **152** of the spindle unit **150** includes a mounting panel **152a** and a tower **152b**. The tower **152b** has two vertical wings **154** on either side of a central shaft **156**. The wings **154** and shaft **156** form two slots **155**. The axle **153** extends upwardly through a bore in the tower **152b**. A spreader **157** with radially-extending projections **158** is mounted to the upper end of the axle **153** (**Figure 16**). Each of the projections **158** includes an upwardly-extending nub **159**. The projections **158** reside in pockets **152c** in the top surface of the tower **152b**; each of the pockets **152c** is bordered on one end by a finger **152d**.

Further construction and operation of the spindle unit **150** is described at www.aps-printers.com, the disclosure of which is hereby incorporated herein by reference. An exemplary spindle unit is Part No. 91600103, available from APS Industrial (Milan, Italy). Those skilled in this art will appreciate that other rotary units suitable for driving the take-up wheel may also be employed.

Turning back to **Figures 4, 5** and **15**, the printing station **100** also includes a keypad **170** that is visible and accessible from the upper surface of the base **102** (in the illustrated embodiment, the keypad **170** is positioned near the guide **112**, although those skilled in this art will appreciate that the keypad may be positioned in other locations on the base **102**). A printed circuit board **172** that controls the operation of the printer station **100** is mounted below and in electrical communication with the keypad **170**. The printed circuit board **172** controls the operation of the print-head assembly **114** and the motor **144** that drives the take-up wheel **130** and the motor **160** that drives the backing roll **124**. The printed circuit board **172** is also in communication with the controller **42** of the overall system **40**.

To prepare the printing station **100** for operation, a reel **RL** of labels **L** adhered to a rolled label backing sheet **S** is installed on the supply wheel **104**, with the core of the reel **RL** fitting over the mounting ring **110** and the lower edge of the reel **RL** resting on the upper surface of the turntable **108**. The labels **L** and label backing sheet **S** are well-known to those of skill in this art and need not be described in detail herein.

The label backing sheet **S** is threaded through the components of the printing station **100** along a paper path **P** that is defined by the supply wheel **104**, the label print-head assembly **114**, and the take-up wheel **130**. Best seen in **Figure 5**, the paper path **P** begins as the label backing sheet **S** extends from the supply wheel **104** around the convex surface of the guide **112** to form an undulation that extends away from the take-up wheel **130**. The paper path **P** then travels to the brush **118**, where static electricity can be dissipated from the label backing sheet **S** (the static electricity can be bled from the brush **118** by the mounting guard **117** – *see* **Figure 12**). The label backing sheet **S** is then routed around the guide post **113** (passing between the guide post **113** and the peeler block **120**, as the mounting guard **117** prevents incorrect insertion between the guidepost **113** and the print-head assembly **114**), then along the side wall **128** of the peeler block **120** to the nip **123** (insertion of the label backing sheet **S** between the side wall **128** and the print-head assembly **114** is facilitated by the presence of the recessed area **128a** and the arcuate surface **128b** – *see* **Figures 10** and **11**). On this portion of the paper path **P**, the lower edge of the label backing sheet **S** is supported by the upper surfaces of the feet **121a, 121b**, and the position of the upper edge of the label backing sheet **S** is maintained by the lower surface of the mounting guard **117**. After passing through the nip **123** between the backing roll **124** and the print-head assembly **114**, the paper path **P** veers around the peel pin **122** (*see* **Figure 7**) and the back side of the backing roll **124** to pass into the pocket **126** (wherein the label backing sheet **S** is supported by the feet **125a, 125b** and maintained in vertical position by the lower surface of the ledge **127** as shown in **Figure 12**). A take-up segment of the paper path **P** then leads to the take-up wheel **130**, where the label backing sheet **S** can be inserted into one of the slots **155** in the tower **152b** and wound around the wings **154** and the outer surface of the tower **152b**. Once the label backing sheet **S** is threaded onto the paper path **P**, the printing station **100** is ready for operation to form a substantially continuous component. As used herein, the term "substantially continuous" with respect to the label backing sheet indicates that it forms a continuous traveling sheet along the paper path **P**.

Because the paper path **P** doubles back on itself (*i.e.*, the supply segment follows generally a first direction and the take-up segment follows generally a second, opposite direction – *see* **Figure 5**), the printing station **100** can be relatively compact. Those skilled in this art will recognize that other paper paths are possible, and that the positions of the guides (*e.g.*, the guide **112**, the guide post **113**, and the peel pin **122**) may vary.

It should also be noted that the lower edge of the label backing sheet **S** is supported at several points along the entire paper path **P** in order to ensure correct feed of the label backing sheet **S**. Support of the label backing sheet **S** can prevent sagging of the label backing sheet **S**, which could disrupt its conveyance along the paper path **P**. In the illustrated embodiment, the specific surfaces which provide this support are: the top suface of the turntable **108**, and the top surfaces of the feet **121a**, **121b**, **125a**, and **125b**, and the top surface of the turntable **132**. These surfaces are all substantially coplanar, which allows them to provide support for the label backing sheet **S** from underneath at substantially the same elevation.

In operation, the controller **42** signals the printed circuit board **172** to actuate the take-up wheel **130** and the print-head assembly **114**. The motor **144** drives the gear reduction train **146**, which in turn rotates the gear **138** about the axis **A2** (the rotation is clockwise from the vantage point of **Figures 13** and **15**). As the gear **138** rotates, the bearing components **142, 143** rotate also. Friction between the bearing components **142, 143** and their contacting friction washers **140, 141** causes the axle **153** to rotate (this rotation is counterclockwise from the vantage point of **Figures 4** and **5**). The spreader **157** rotates with the axle **153**. As the projections **158** on the spreader **157** contact the wings **155**, the upper ends of the wings **155** deflect outwardly, such that any label backing sheet **S** that is wrapped around the tower **152b** is maintained in a cylindrical form. When the projections **158** contact the fingers **152d** of the pockets **152c** of the tower **152b**, the tower **152b** and, in turn, the entire base **152** and turntable **132**, begin to rotate.

Rotation of the backing roll **124** (driven by the motor **160**) draws the label backing sheet **S** from the supply reel **RL** along the paper path **P** to the peel pin **122**. As the label backing sheet **S**, with its adhered labels **L**, passes through the nip **123**, the print-head assembly **114** prints the desired information on a label **L** as it is vertically oriented. When the label backing sheet **S** veers along the paper path **P** around the peel pin **122** (*see* **Figure 12**), the label **L** has enough rigidity to remain planar and peel away from the label backing sheet **S**. The label travels away from the nip **123** and adheres to a vertically-oriented pharmaceutical vial **V** that is presented by the label application station **200** (**Figure 4**). In this embodiment, the forward edge of the label **L** adheres to the vial **V** before the rear edge of the label **L** is removed from the label backing sheet **S**.

The presence of the small diameter peel pin **122** can facilitate peeling of label **L**. In typical label printers, a sharp edge is employed in the peeling process; however, sharp edges have at least two inherent problems. Due to the sharp edge, a very high tension is required to

keep the label backing tightly conformed against the edge as the label backing advances. If high tension is not maintained, or if the label backing catches on the sharp edge, a momentary condition may occur in which the label backing is continued to be pushed ahead by the backing roll **124**, but is not immediately taken up by the spindle unit **152**. This condition typically causes an instantaneous bulge of the label backing in the immediate vicinity of the sharp peeling edge, rendering the label peeling function of the edge momentarily ineffective. If the leading edge of a label is present when this condition occurs, the label will not peel as intended, but will instead remain attached to the label backing where it will be conveyed to, and wrapped around, the spindle unit **152**, thus preventing the label from being presented, as desired, to the label application mechanism. A round peeler pin **122**, of sufficiently small diameter, can permit a lower label backing tension and eliminates the sharp edge which can snag the label backing.

A second advantage of the round peel pin **122** relates to the precision of location required of this feature. In order to reliably apply labels to vials, the label should be presented very consistently over many repetitions. This requires that the peeling edge be controlled very consistently from machine to machine. Sharp edges are most economically produced from formed sheet metal, typically attached with screws or other mounting hardware. The location of the peeling edge is typically affected by a number of tolerances: precision of the stamping and forming processes, hole locations in the peeler part and its mounting base, etc. By employing a round peel pin **122**, which can be directly positioned by its diameter, the locating tolerances of the peeling surface can be significantly reduced over typical sharp-edged parts. More precise control of the location of the peeling surface can produce a direct improvement in the consistency of label presentation accuracy, which is desirable for successful label application on a vial.

Although rotation of the base **152** and turntable **132** are driven by the motor **144** as described, rotation of the base **152** and turntable **132** are restricted by tautness in the label backing sheet **S** extending from the print-head assembly **114**. In some embodiments, the motor **144** causes the take-up wheel **130** to rotate at a speed that would cause the label backing sheet **S** to wind about the tower **152b** faster than the speed at which the label backing sheet **S** exits the print-head assembly **114** (as controlled by the backing roll **124** driven by the motor **160**); as a result, the friction washers **140, 141** slip on bearing components **142, 143** to reduce the

rotational speed of the turntable **132** and tower **152b**. Under these conditions, the label backing sheet **S** can remain substantially taut.

The supply wheel **104** can also assist in keeping the label backing sheet **S** taut upstream from the print-head assembly **114**. The turntable **108** is free to rotate about the axis **A1**; however, friction between the turntable **108** and the bearing plate **109** resists this rotation sufficiently that, when the label backing sheet **S** and adhered labels **L** are not being drawn from the reel **RL** by the print-head assembly **114**, the turntable **108** does not rotate. As a result, the supply segment of the label backing sheet **S** that extends from the roll to the print-head assembly **114** remains taut.

Once a reel **RL** of label backing sheet **S** is exhausted of labels **L**, the rolled label backing sheet that has collected on the take-up wheel **130** can be removed. Removal can be facilitated by the presence of the notches **133**, which provide room for an operator's finger to fit beneath the rolled sheet, and the aperture **133a**, which also provides access to the underside of the rolled sheet.

Those skilled in this art will recognize that, although the printing station **100** is illustrated and described herein with respect to an automated pharmaceutical machine, the printing station may be employed in other environments in which it may be desirable to present a vertically oriented label. Examples may include the labeling of jars, cans, barrels, and other cylindrical objects.

The foregoing is illustrative of the present invention and is not to be construed as limiting thereof. Although exemplary embodiments of this invention have been described, those skilled in the art will readily appreciate that many modifications are possible in the exemplary embodiments without materially departing from the novel teachings and advantages of this invention. Accordingly, all such modifications are intended to be included within the scope of this invention as defined in the claims. The invention is defined by the following claims, with equivalents of the claims to be included therein.

77203-150

CLAIMS:

1. A label printing station for applying labels to an object, comprising:

a base;

a label supply wheel rotatably mounted to the base for rotation about a first vertical axis of rotation, the label supply wheel including a friction-inducing component configured to resist rotation of the supply wheel if torque applied to the label supply wheel is below a predetermined level;

a label backing take-up wheel rotatably mounted to the base for rotation about a second vertical axis of rotation;

a drive motor connected to the take-up wheel;

a rotation-permitting component associated with the drive motor and the take-up wheel;

a label print-head assembly mounted to the base, the label print-head assembly being configured to print on a label as the label is vertically oriented;

wherein the supply wheel, the print-head assembly and the take-up wheel serially define a paper path along which a substantially continuous label backing sheet travels; and

a labeling station configured to apply a label to an object, the labeling station being positioned to receive a printed label from the print-head assembly and apply it to the object;

wherein the rotation-permitting component is configured such that, during operation of the drive motor, when tension in the backing sheet exceeds a predetermined level, the take-up wheel rotates at a lower speed than when tension in the sheet is below the predetermined level.

77203-150

2. The label printing station defined in Claim 1, wherein the paper path comprises a supply segment between the supply wheel and the label print-head assembly and a take-up segment between the label print-head assembly and the take-up wheel.

3. The label printing station defined in Claim 2, wherein the supply segment of the paper path follows a first direction and the take-up segment follows a second direction from the label print-head assembly to the take-up wheel, the second direction being generally opposite the first direction.

4. The label printing station defined in Claim 1, further comprising guides mounted to the base along the paper path configured and arranged to guide the continuous label backing.

5. The label printing station defined in Claim 4, wherein a first guide is positioned and configured to induce an undulation in the paper path that projects away from the take-up wheel.

6. The label printing station defined in Claim 1, wherein the supply wheel includes a turntable positioned to underlie a roll of label backing sheet and labels, the take-up wheel includes a turntable positioned to underlie a roll of label backing sheet, and the supply wheel turntable and the take-up wheel turntable are substantially coplanar.

7. The label printing station defined in Claim 1, wherein the labeling station is positioned such that a forward edge of a printed label adheres to an object in the labeling station as a rearward edge of the printed label remains adhered to the label backing sheet.

8. The label printing station defined in Claim 1, wherein the rotation-permitting component is a clutch operatively connected with the drive motor and the take-up wheel that causes the take-up wheel to slip relative to the drive motor when the tension in the backing sheet exceeds the predetermined level.

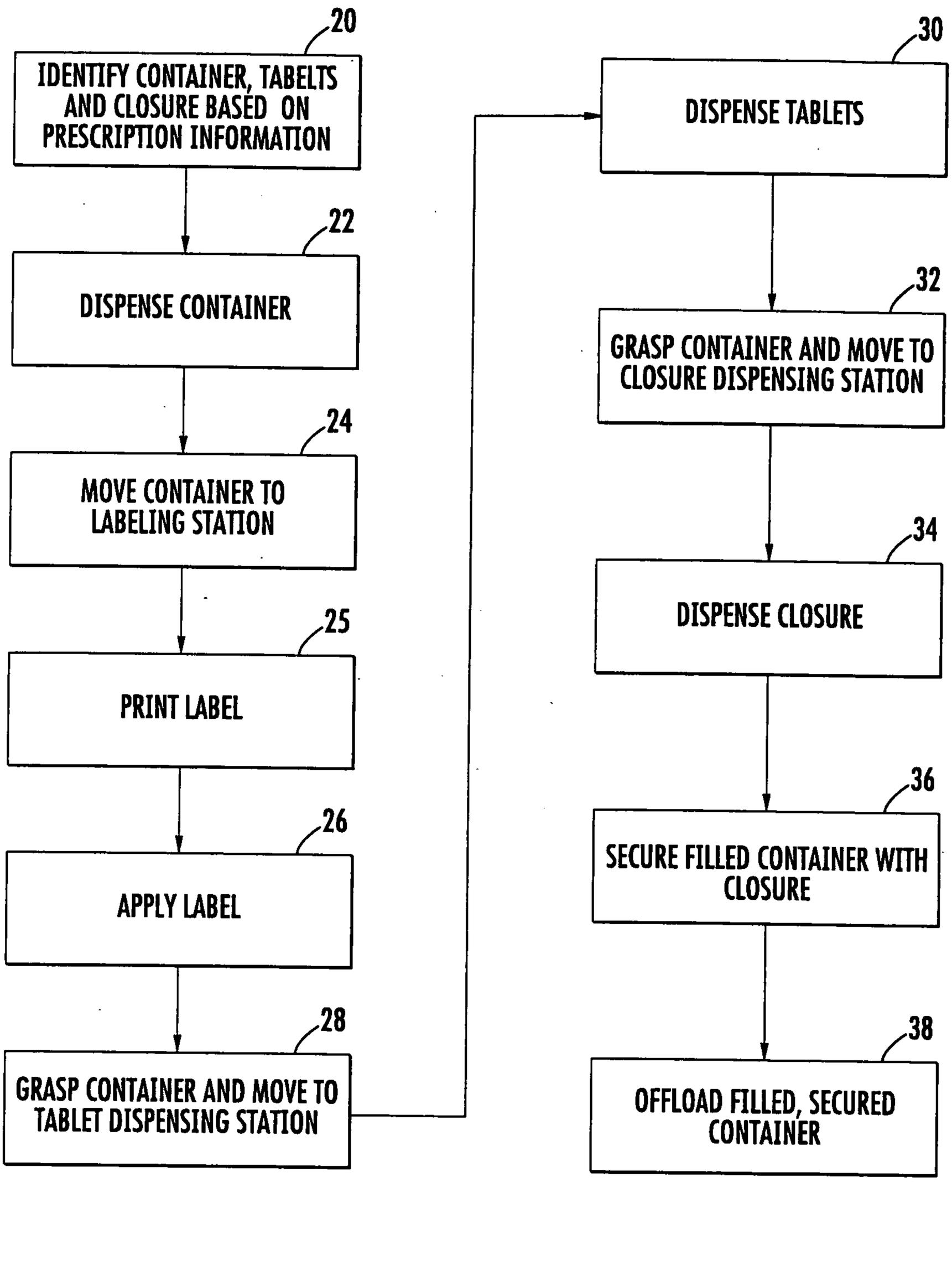

20
IDENTIFY CONTAINER, TABELTS AND CLOSURE BASED ON PRESCRIPTION INFORMATION
22
DISPENSE CONTAINER
24
MOVE CONTAINER TO LABELING STATION
25
PRINT LABEL
26
APPLY LABEL
28
GRASP CONTAINER AND MOVE TO TABLET DISPENSING STATION
30
DISPENSE TABLETS
32
GRASP CONTAINER AND MOVE TO CLOSURE DISPENSING STATION
34
DISPENSE CLOSURE
36
SECURE FILLED CONTAINER WITH CLOSURE
38
OFFLOAD FILLED, SECURED CONTAINER

FIG. 1

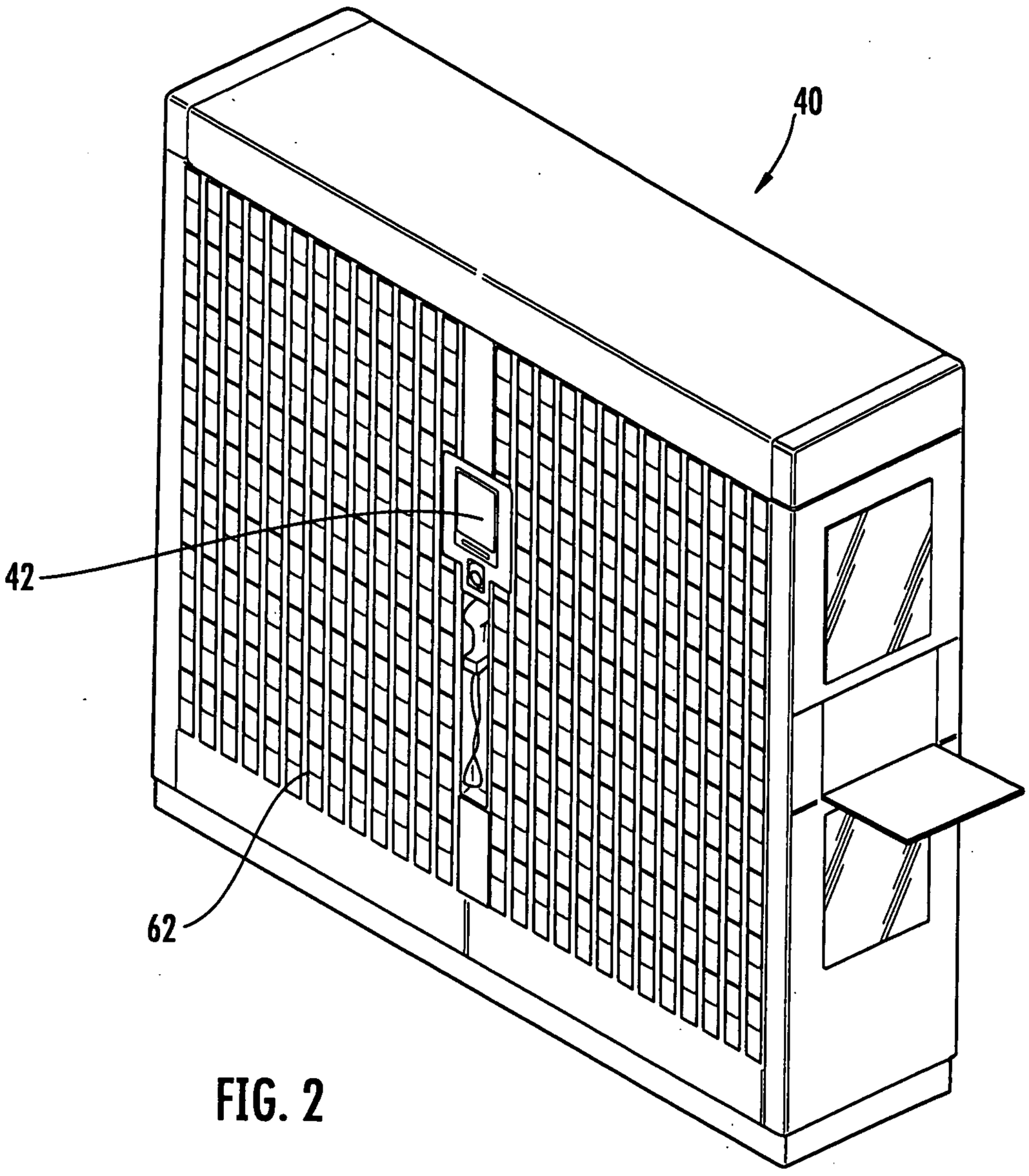


FIG. 2

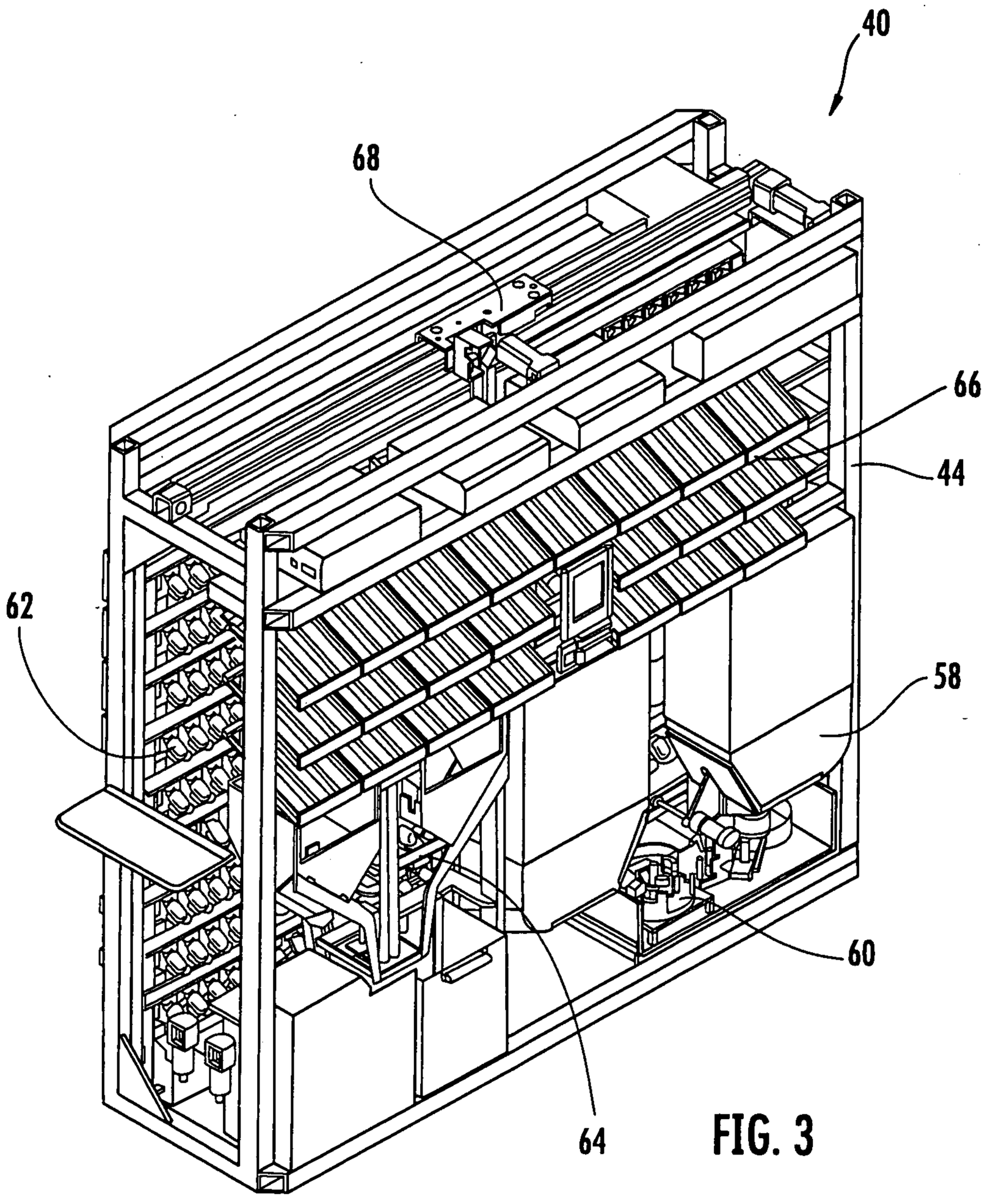


FIG. 3

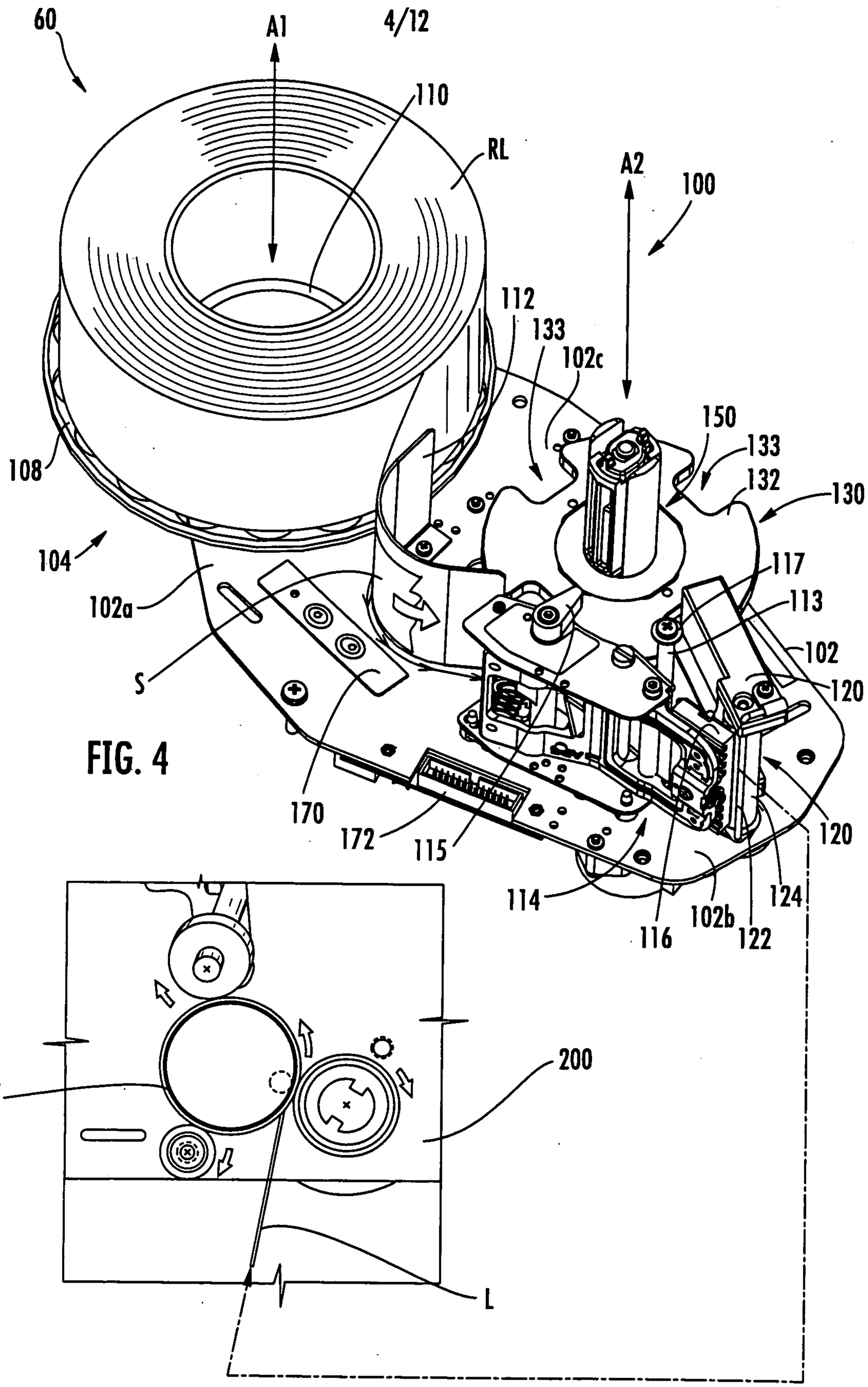

60
A1
4/12
110
RL
A2
100
112
133
102c
150
133
132
130
108
104
117
113
102a
102
S
120
170
172
115
114
116
102b
122
124
120
V
200
L

FIG. 4

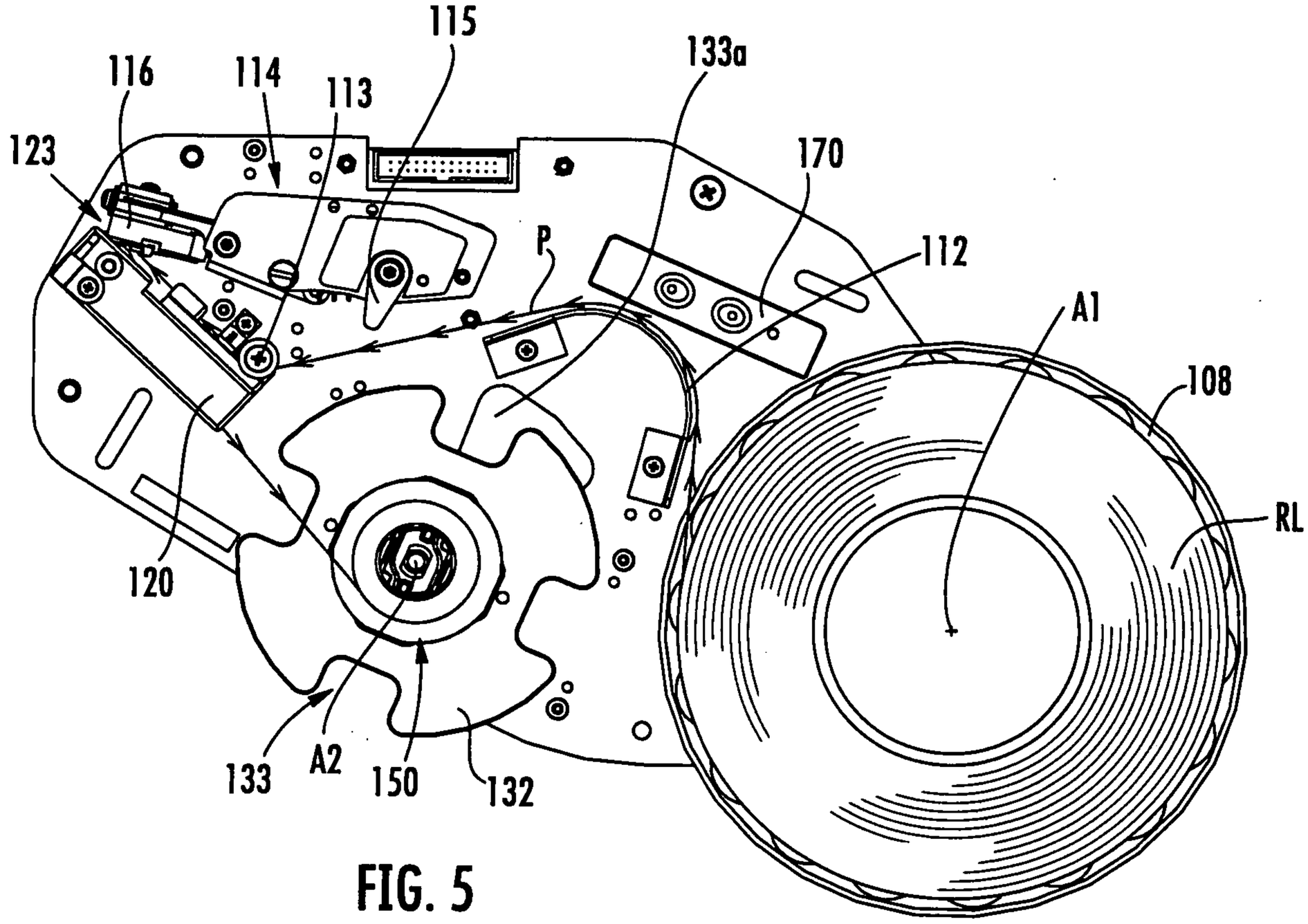


FIG. 5

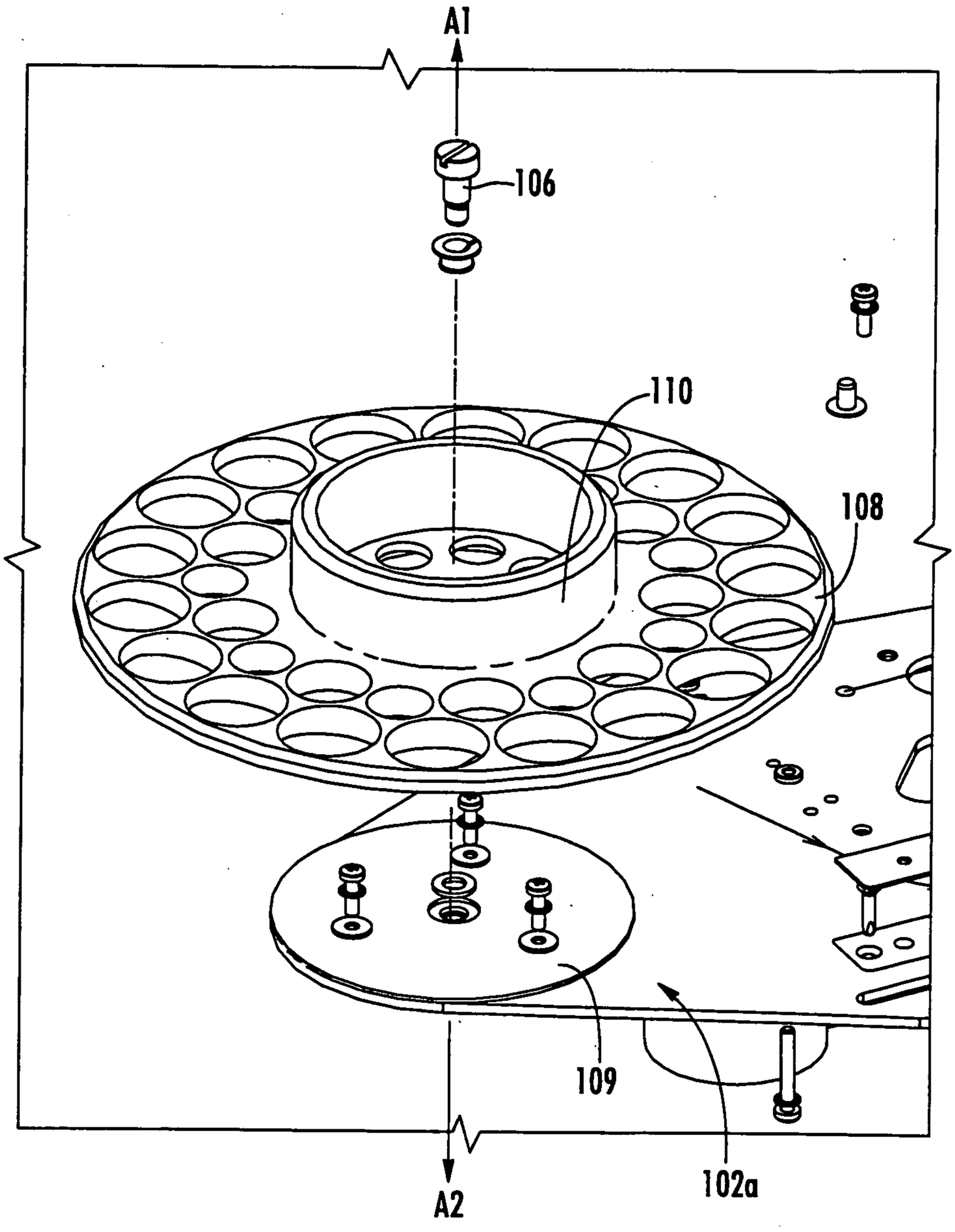


FIG. 6

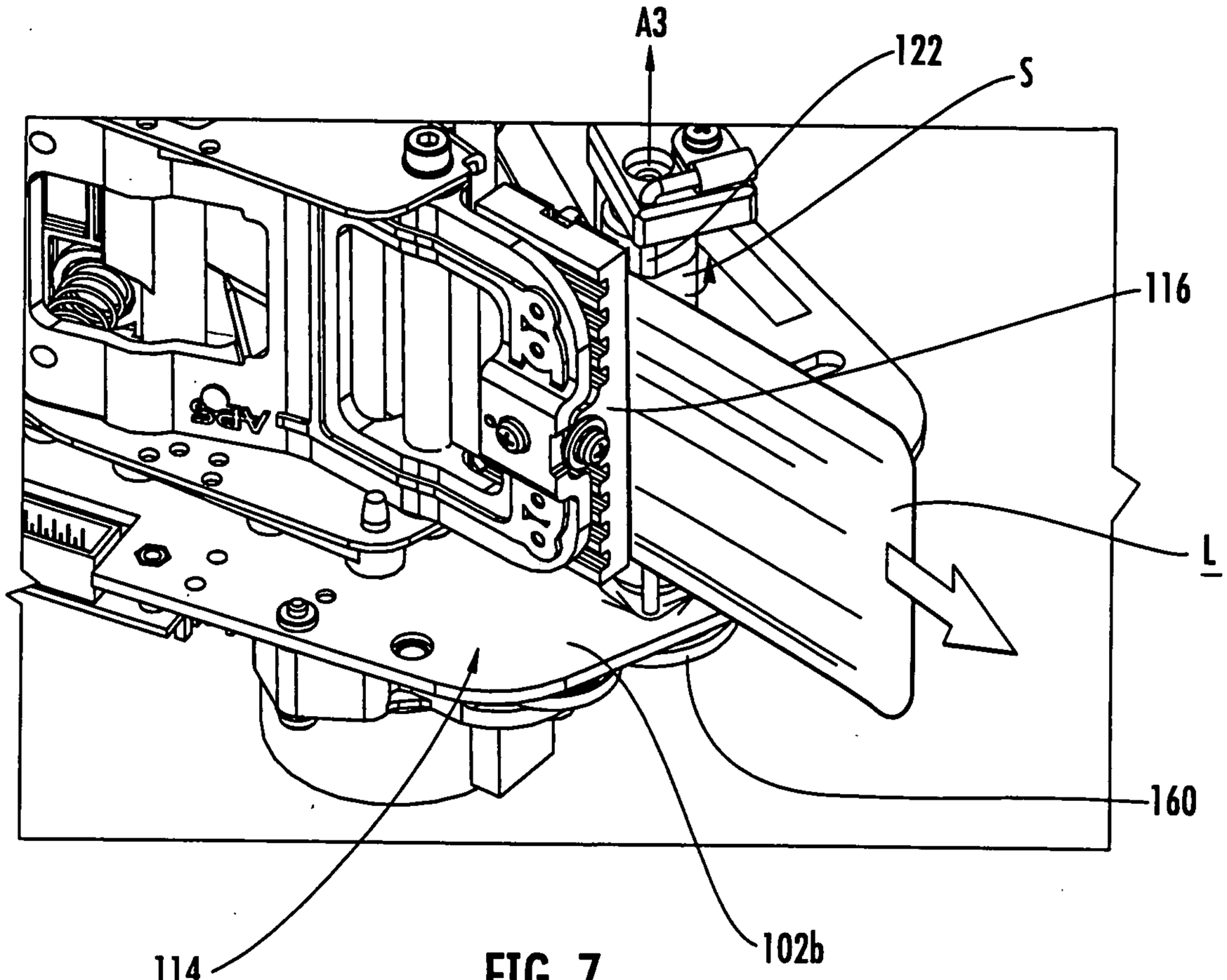


FIG. 7

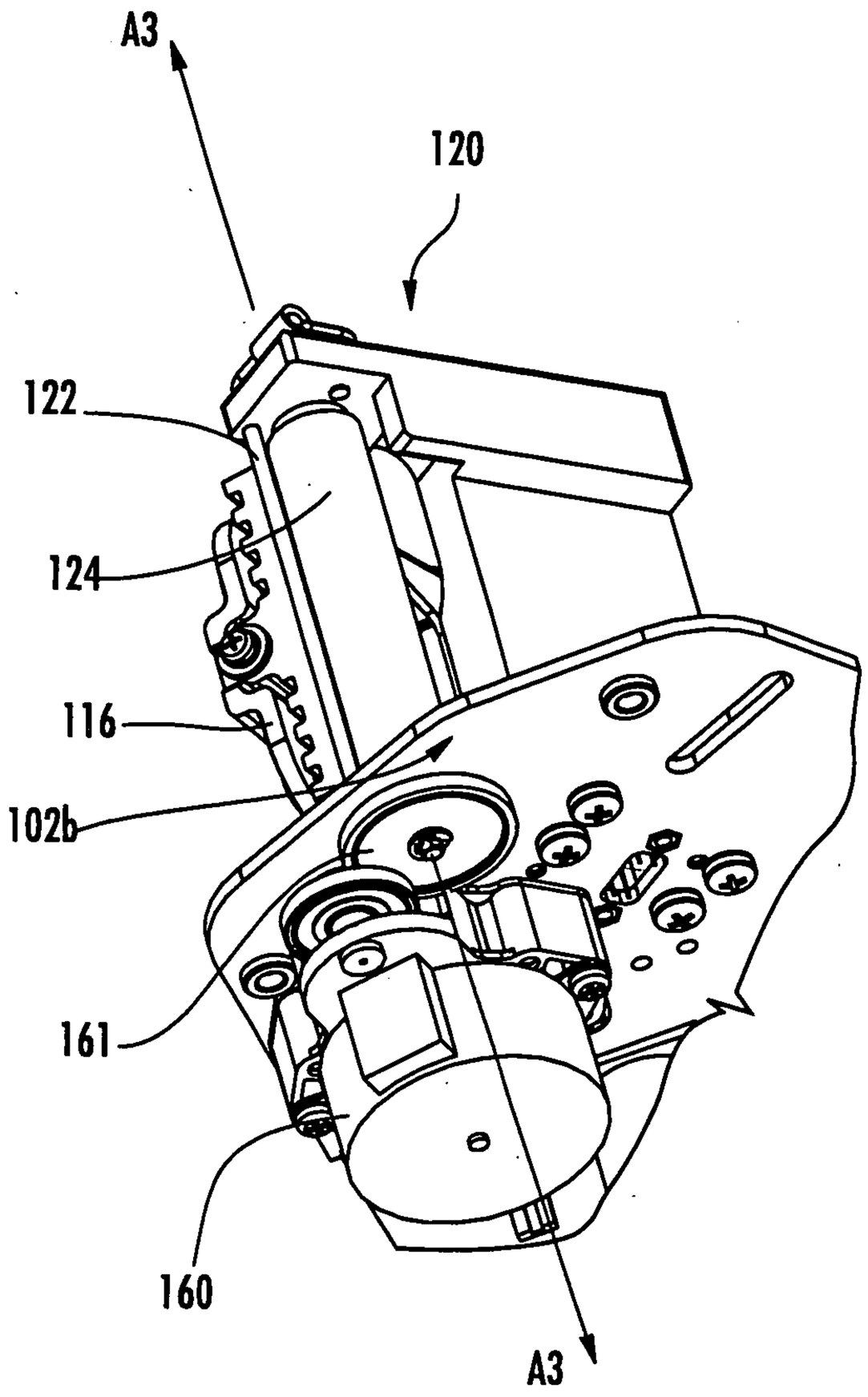


FIG. 7A

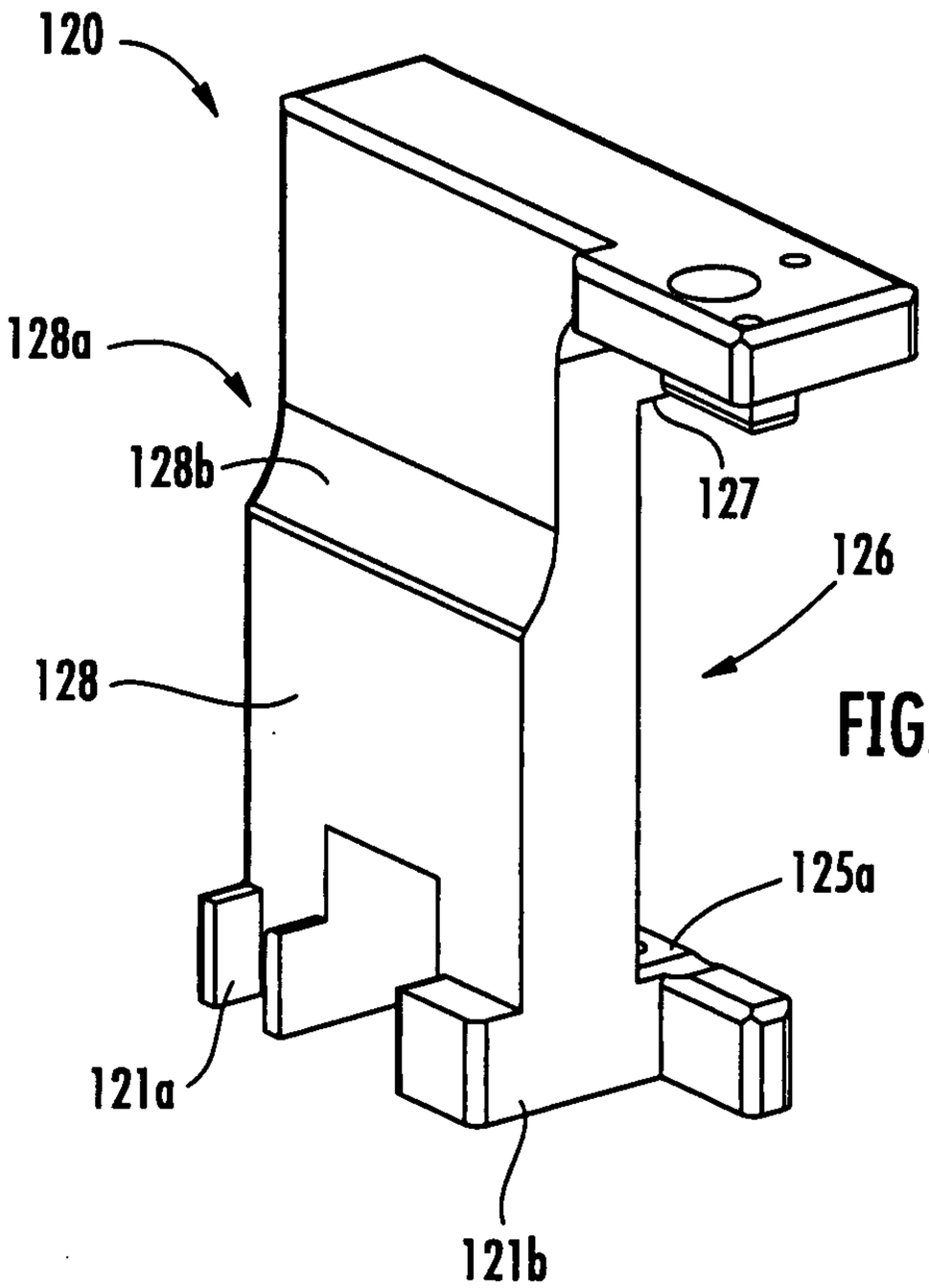

120
128a
128b
127
126
128
125a
121a
121b

FIG. 8

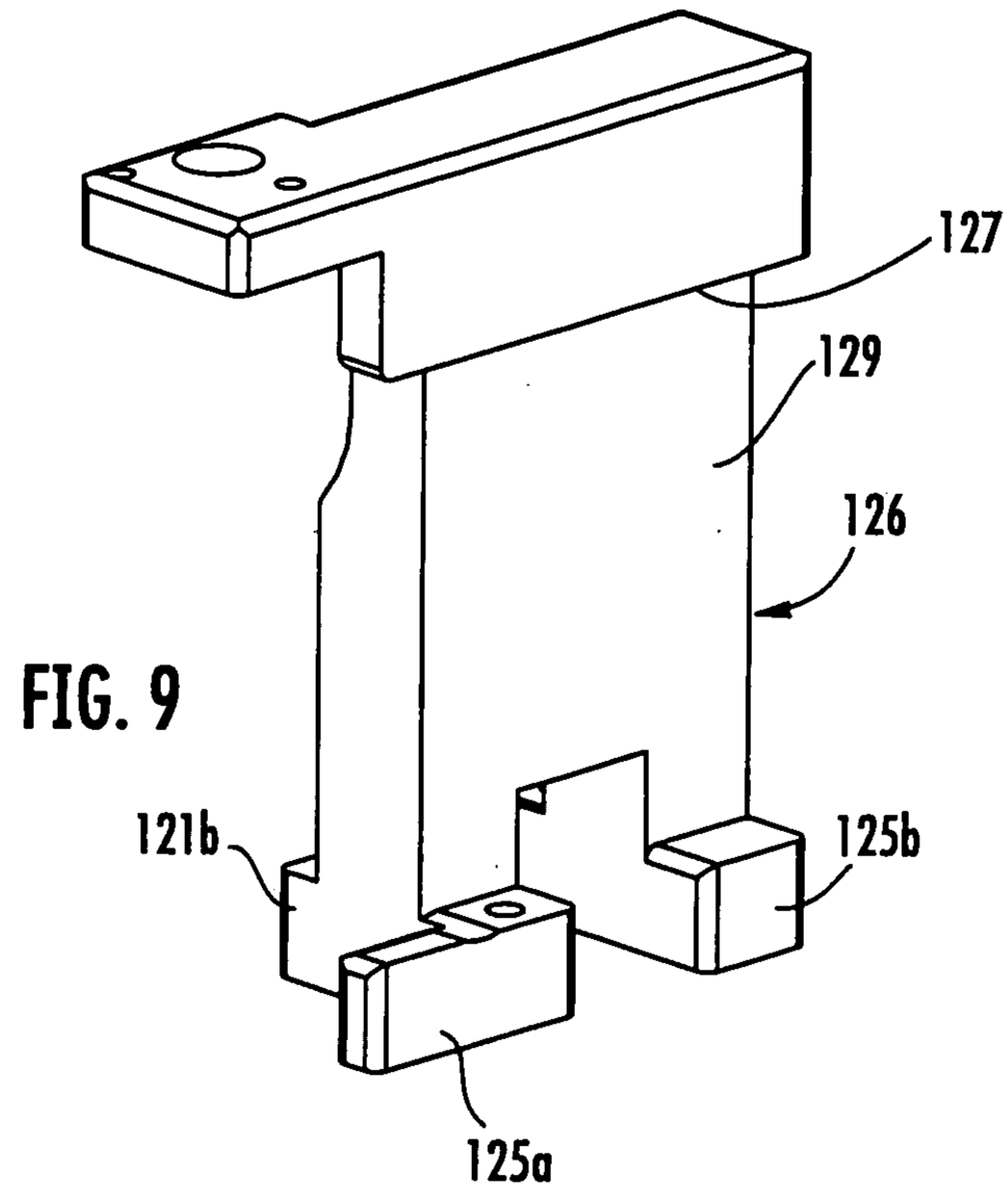

127
129
126
121b
125b
125a

FIG. 9

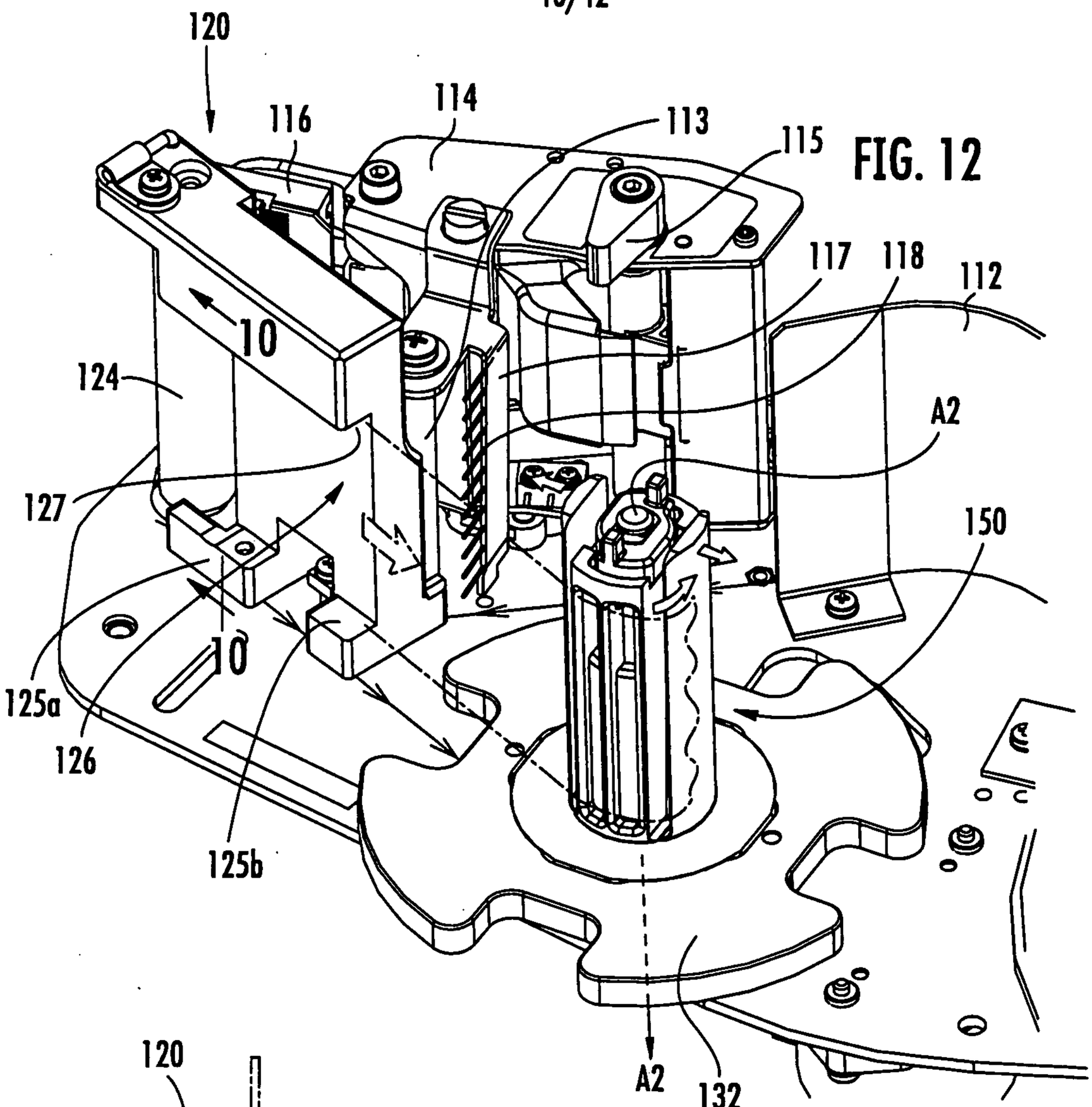


FIG. 12

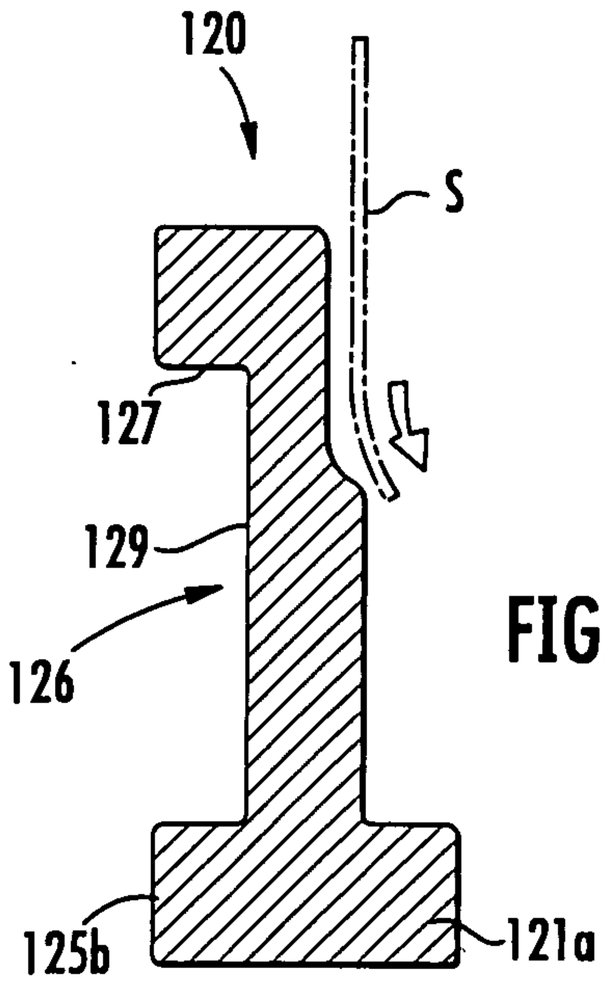


FIG. 10

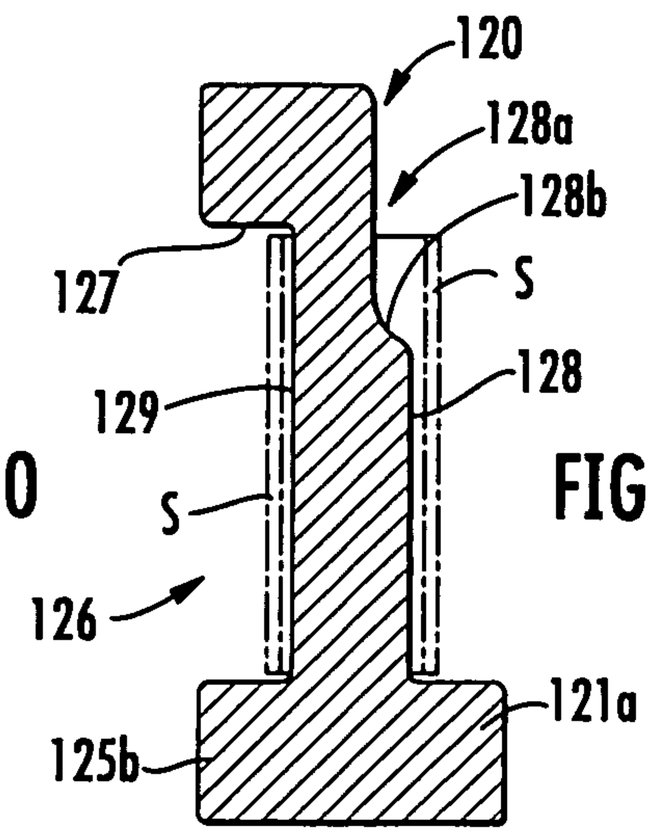


FIG. 11

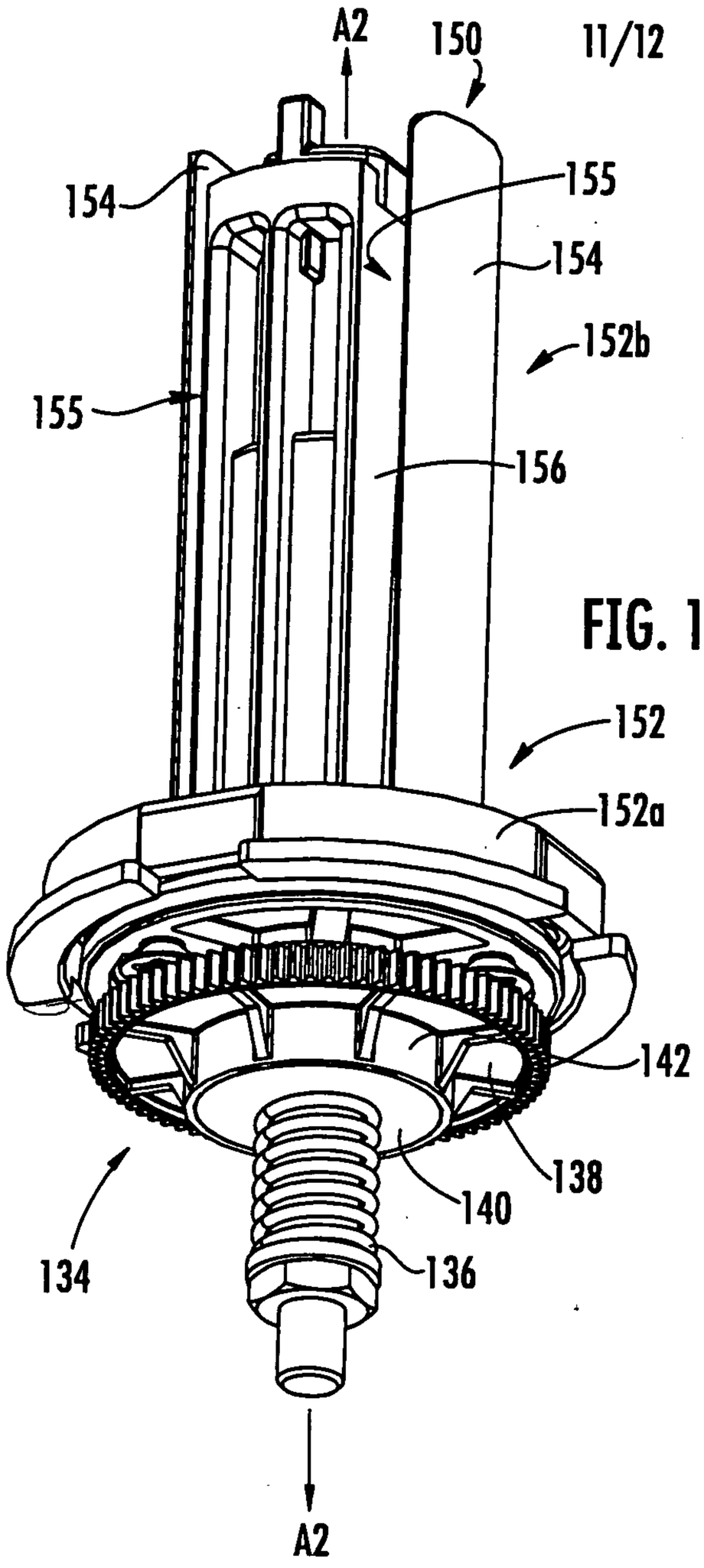

A2
150
11/12
154
155
154
152b
155
156
152
152a
142
138
140
134
136
A2

FIG. 13

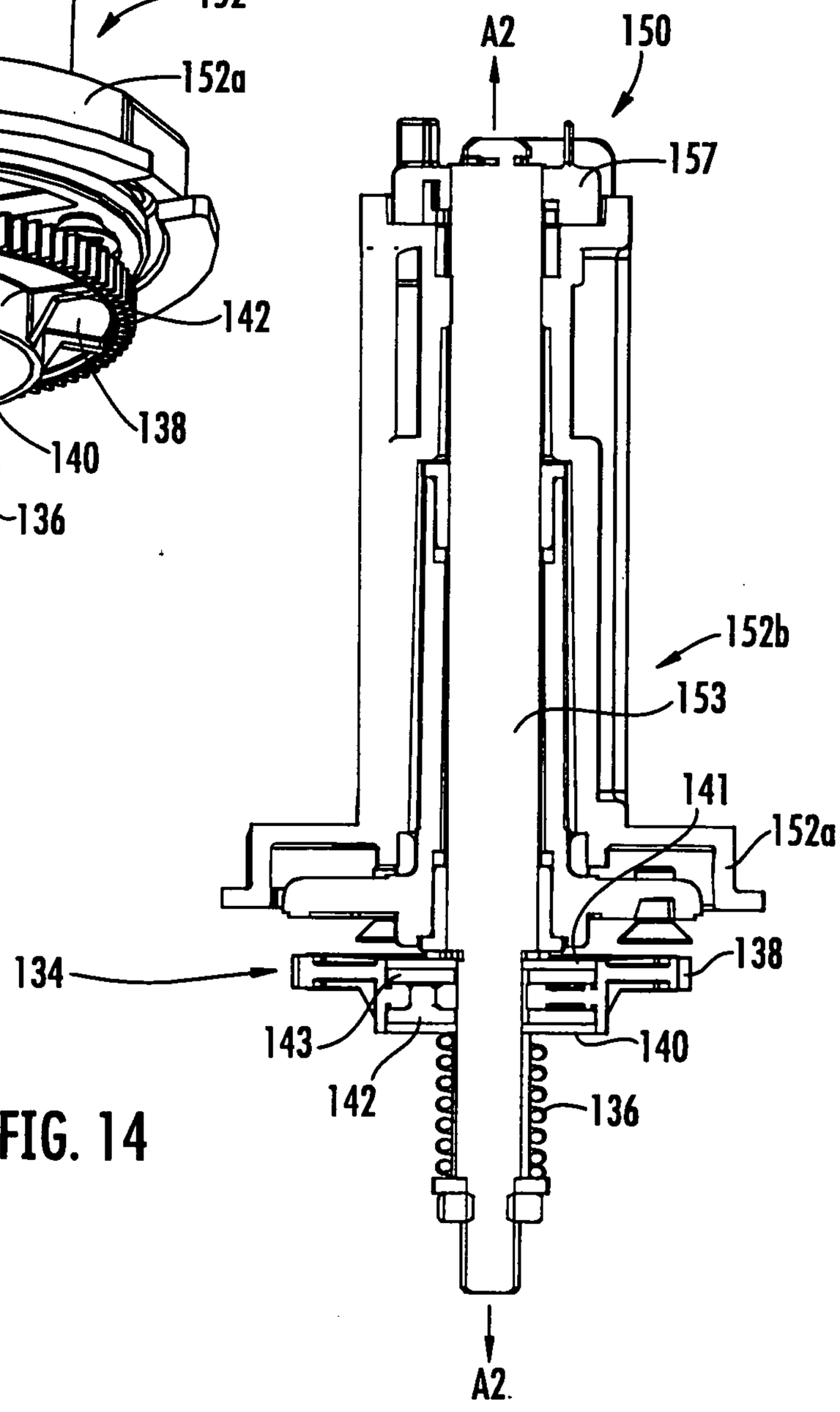

A2
150
157
152b
153
141
152a
138
134
140
143
142
136
A2

FIG. 14

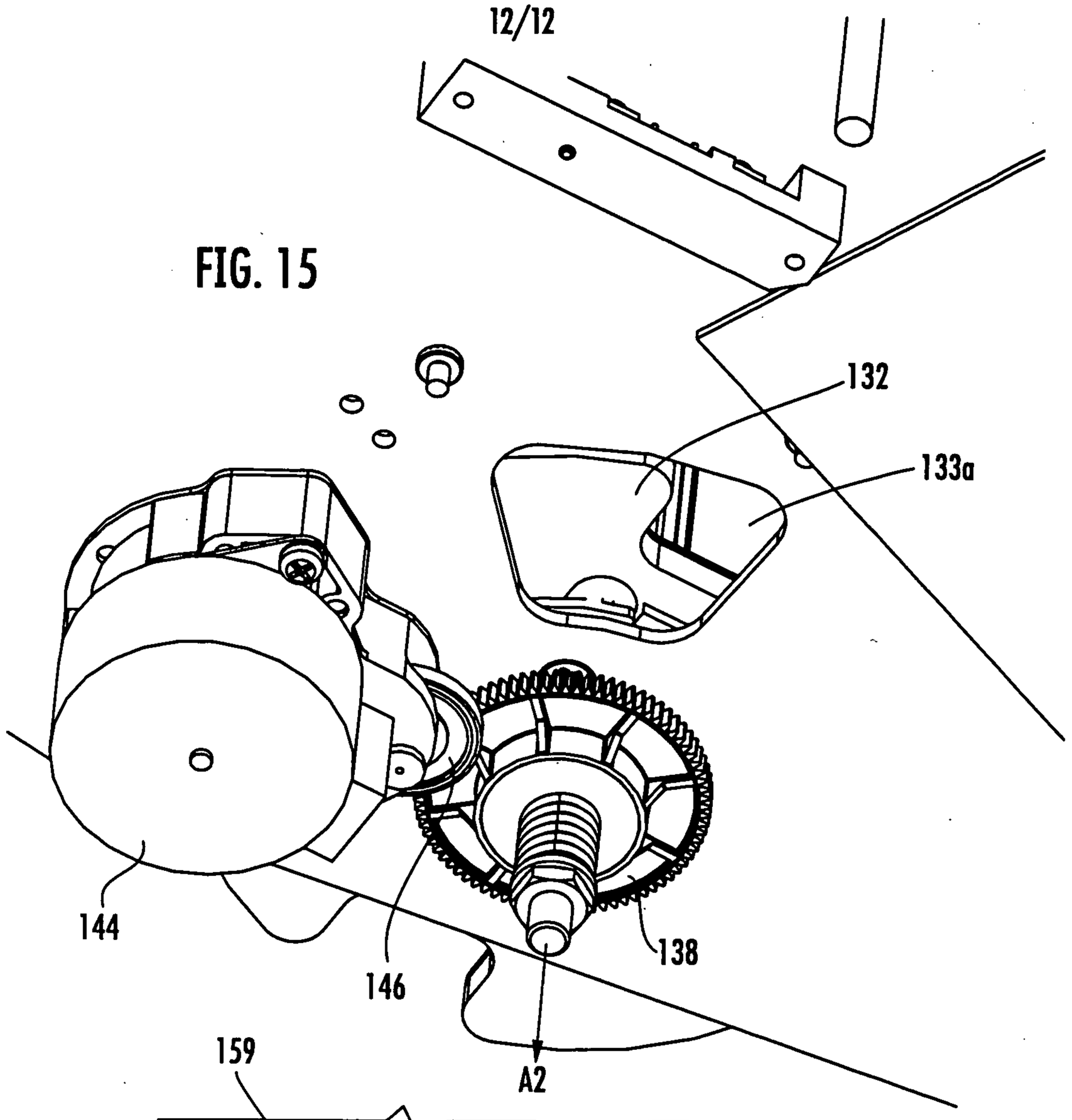

132
133a
144
146
138
A2

FIG. 15

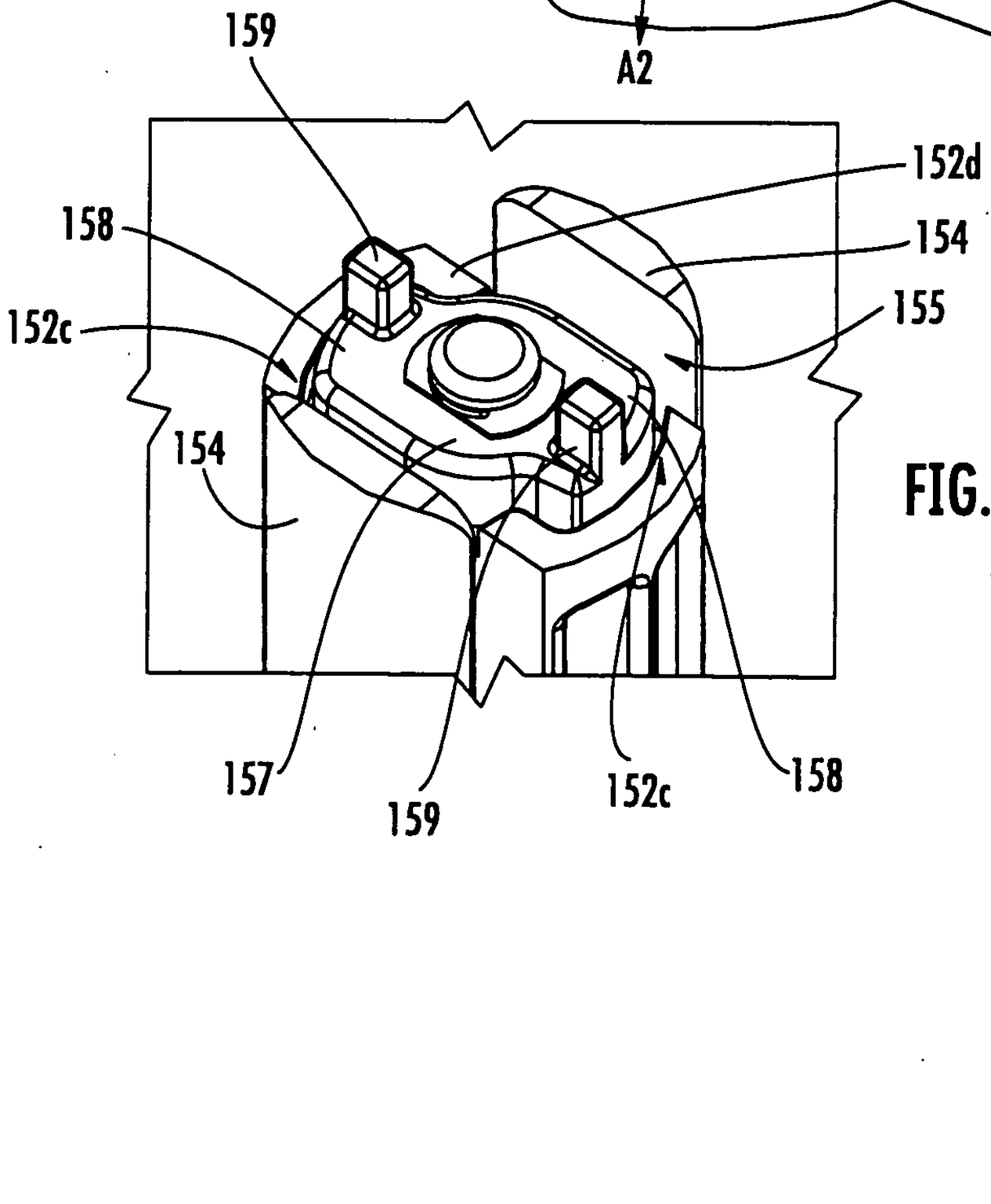
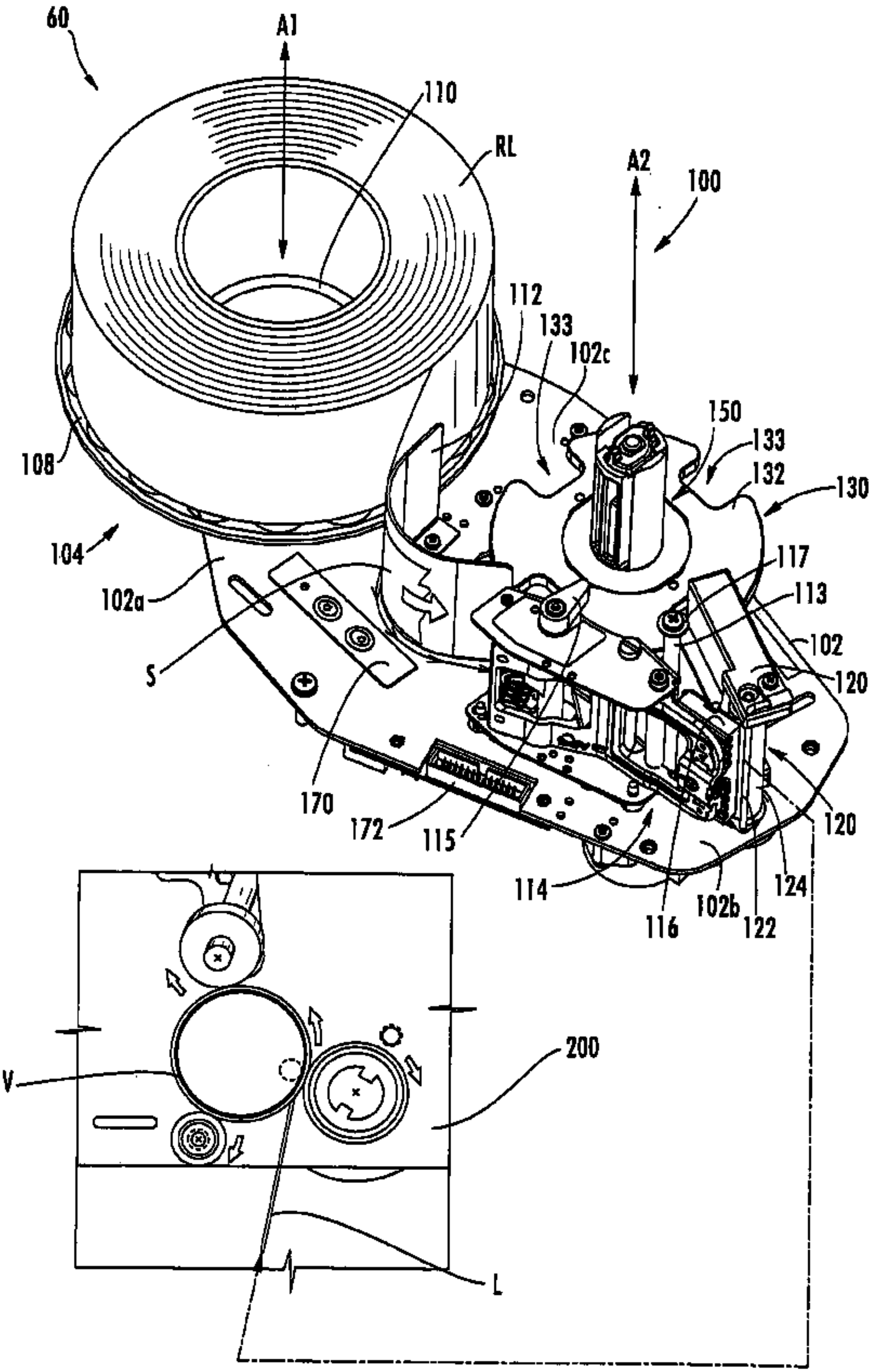

159
158
152c
154
152d
154
155
157
159
152c
158

FIG. 16


60
A1
110
RL
A2
100
112
133
102c
150
133
132
130
108
104
117
113
102a
102
S
120
170
172
115
120
114
116
102b
122
124
200
V
L