US00RE36301E

United States Patent [19]

Kai et al.

[11] E **Patent Number: Re. 36,301**

[45] **Reissued Date of Patent: Sep. 14, 1999**

[54] **IMAGE FORMING APPARATUS HAVING ROTATABLE ELECTROPHOTOGRAPHIC PROCESS UNIT**

[75] Inventors: **Tsukuru Kai**, Fujisawa; **Masayuki Ohtani**, Yokohama; **Takaaki Yanagisawa**, Yokohama; **Hisashi Ishijima**, Yokohama; **Masaaki Nagano**, Nishisonogi-gun, all of Japan

[73] Assignee: **Ricoh Company, Ltd.**, Tokyo, Japan

[21] Appl. No.: **08/754,520**

[22] Filed: **Nov. 21, 1996**

Related U.S. Patent Documents

Reissue of:

[64] Patent No.: **5,367,363**
Issued: **Nov. 22, 1994**
Appl. No.: **07/800,240**
Filed: **Nov. 29, 1991**

[30] **Foreign Application Priority Data**

Nov. 30, 1990	[JP]	Japan	2-330686
Nov. 30, 1990	[JP]	Japan	2-330688
Nov. 30, 1990	[JP]	Japan	2-330689
Nov. 30, 1990	[JP]	Japan	2-330698
Apr. 30, 1991	[JP]	Japan	3-124553
May 21, 1991	[JP]	Japan	3-144247
May 23, 1991	[JP]	Japan	3-146495

[51] **Int. Cl.**[6] **G03G 21/18**
[52] **U.S. Cl.** **399/113**; 399/12; 399/21
[58] **Field of Search** 399/110, 111, 399/119, 123, 113, 163, 158, 258, 88, 12, 21

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,809,916	5/1974	Crane	399/88 X
4,540,268	9/1985	Toyono et al.	399/111 X
4,757,344	7/1988	Idenawa et al.	399/113
5,051,778	9/1991	Watanabe et al.	399/111 X
5,061,959	10/1991	Kinoshita et al.	399/113
5,119,133	6/1992	Swain	399/163
5,172,164	12/1992	Fujiwara et al.	399/158 X
5,182,601	1/1993	Hodoshima et al.	399/258
5,196,884	3/1993	Sugiyama et al.	399/110
5,258,819	11/1993	Kimura et al.	399/119

FOREIGN PATENT DOCUMENTS

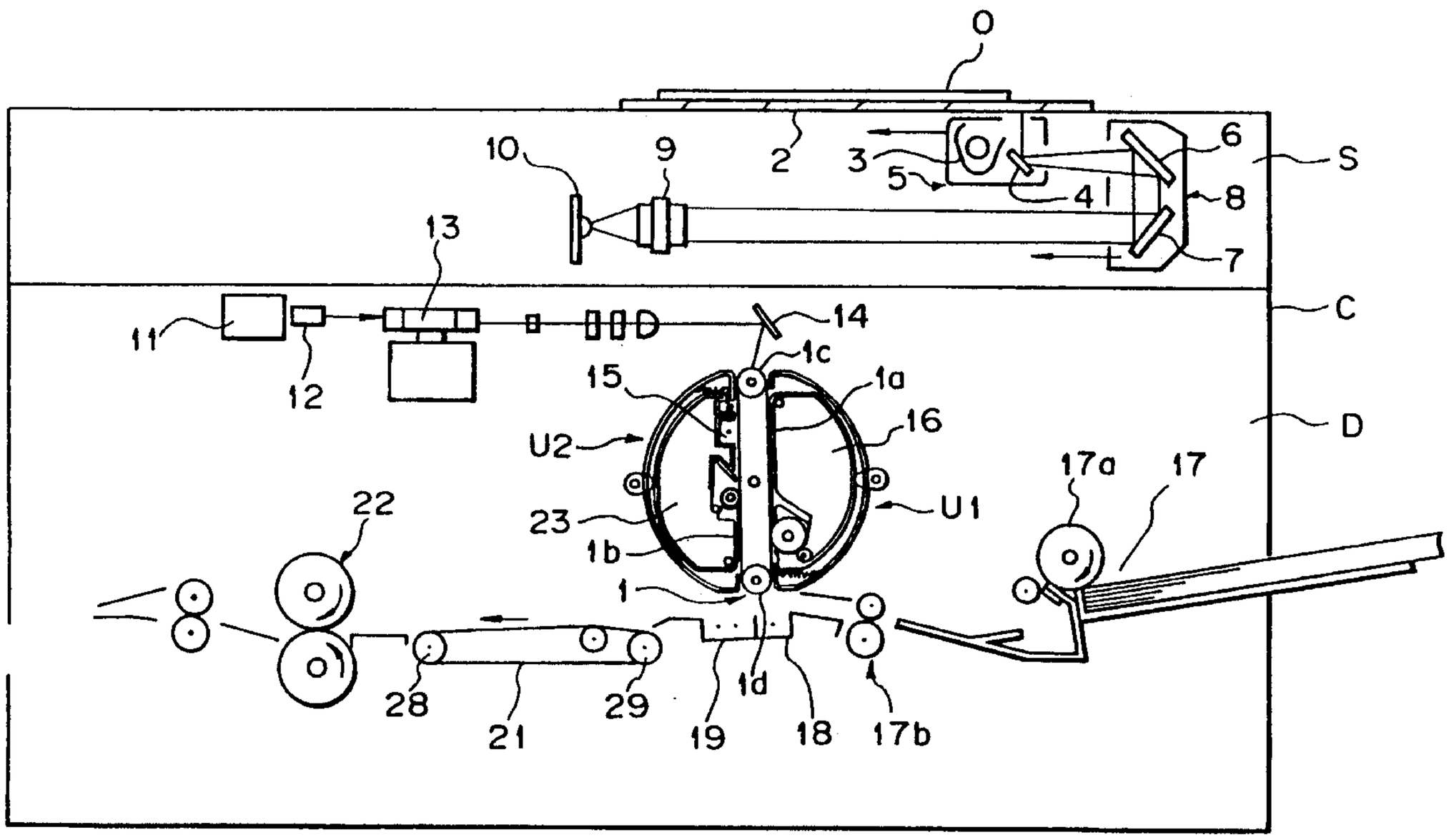
3941506	6/1990	Germany .
2-250066	10/1990	Japan .

Primary Examiner—S. Lee
Attorney, Agent, or Firm—Oblon, Spivak, McClelland, Maier & Neustadt, P.C.

[57] **ABSTRACT**

An image forming apparatus has two units which are engageable with a photoconductive element and provided with a substantially identical configuration. Various electrophotographic process devices including a developing device and a cleaning device and to be arranged around the photoconductive element are selectively arranged in the two units. The photoconductive element is passed over two rollers such that part of the element forms parallel flat portions. The two units and the photoconductive element are rotatable integrally with each other.

51 Claims, 35 Drawing Sheets



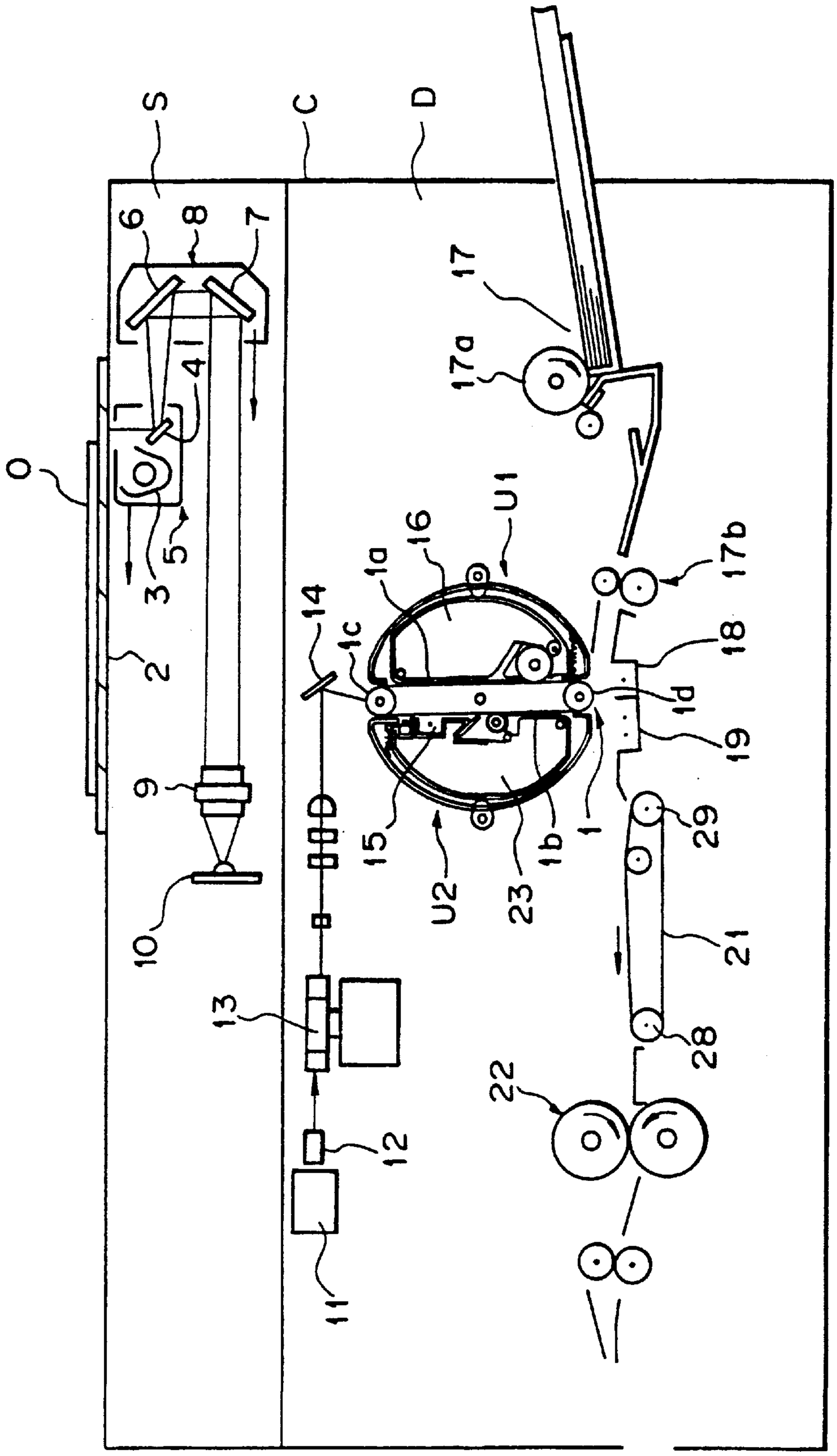

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Fig. 1

Fig. 2

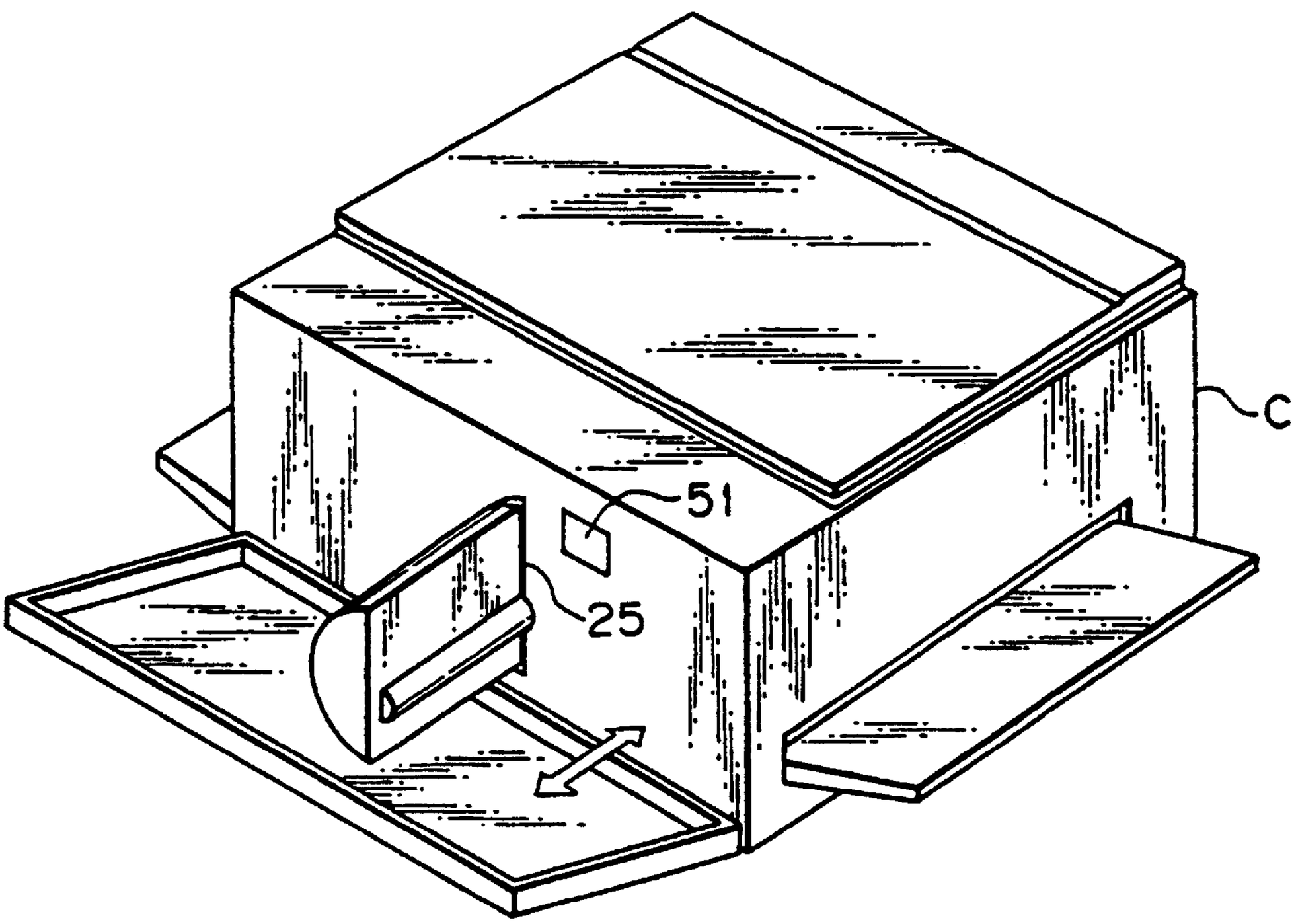
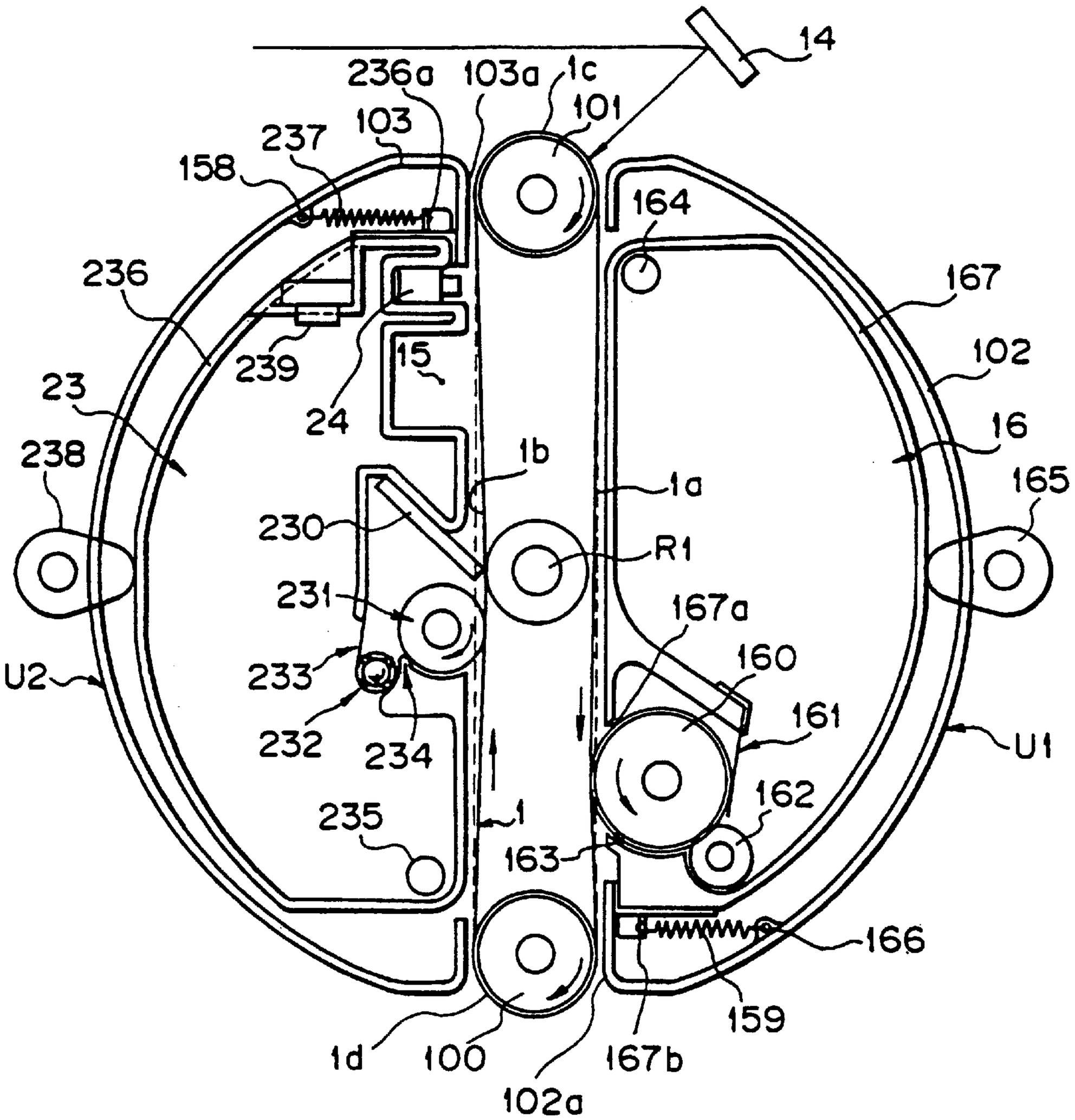


Fig. 3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R1
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167a
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1d
100
167b
102a

Fig. 4

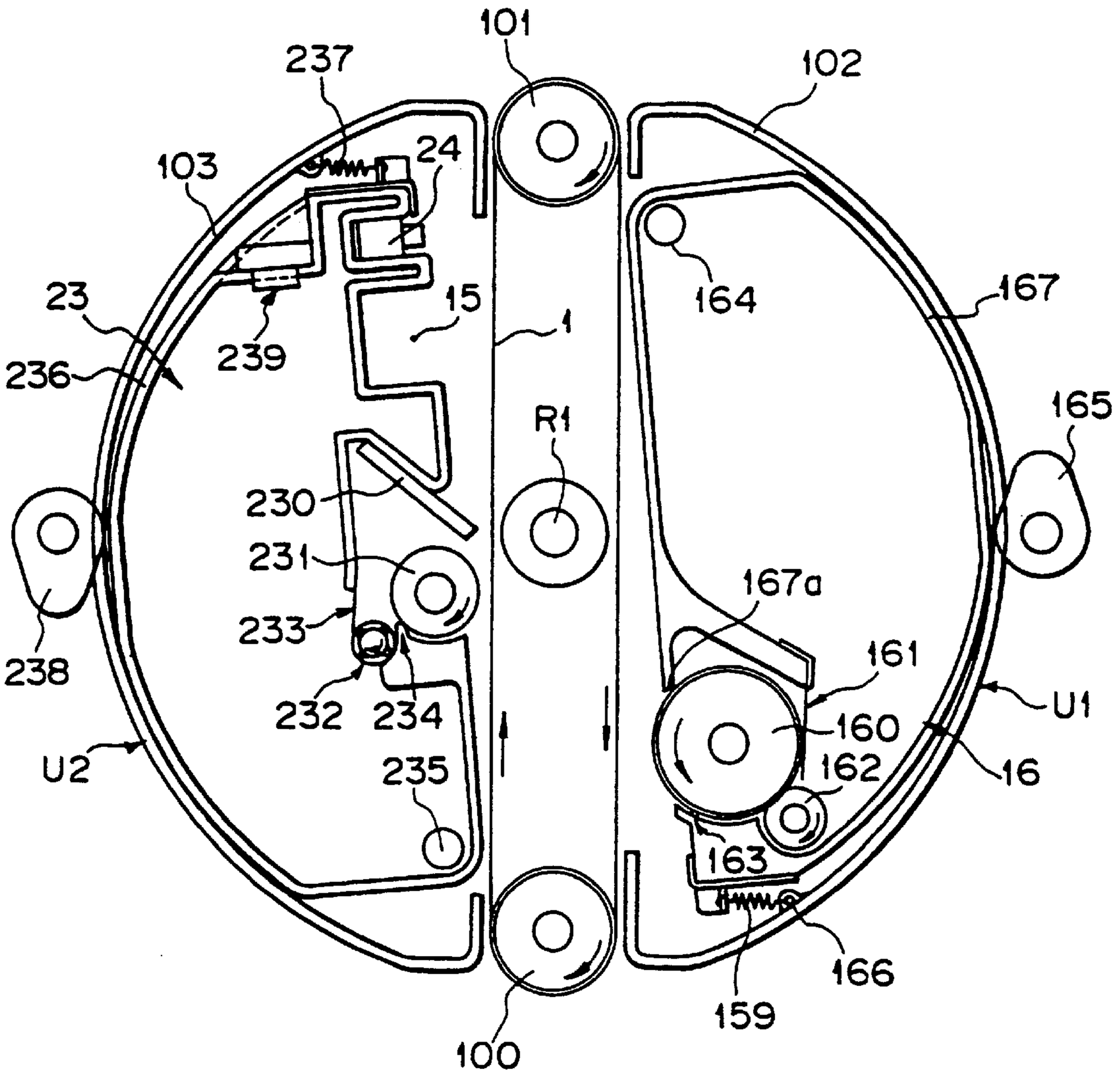
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Fig. 5A

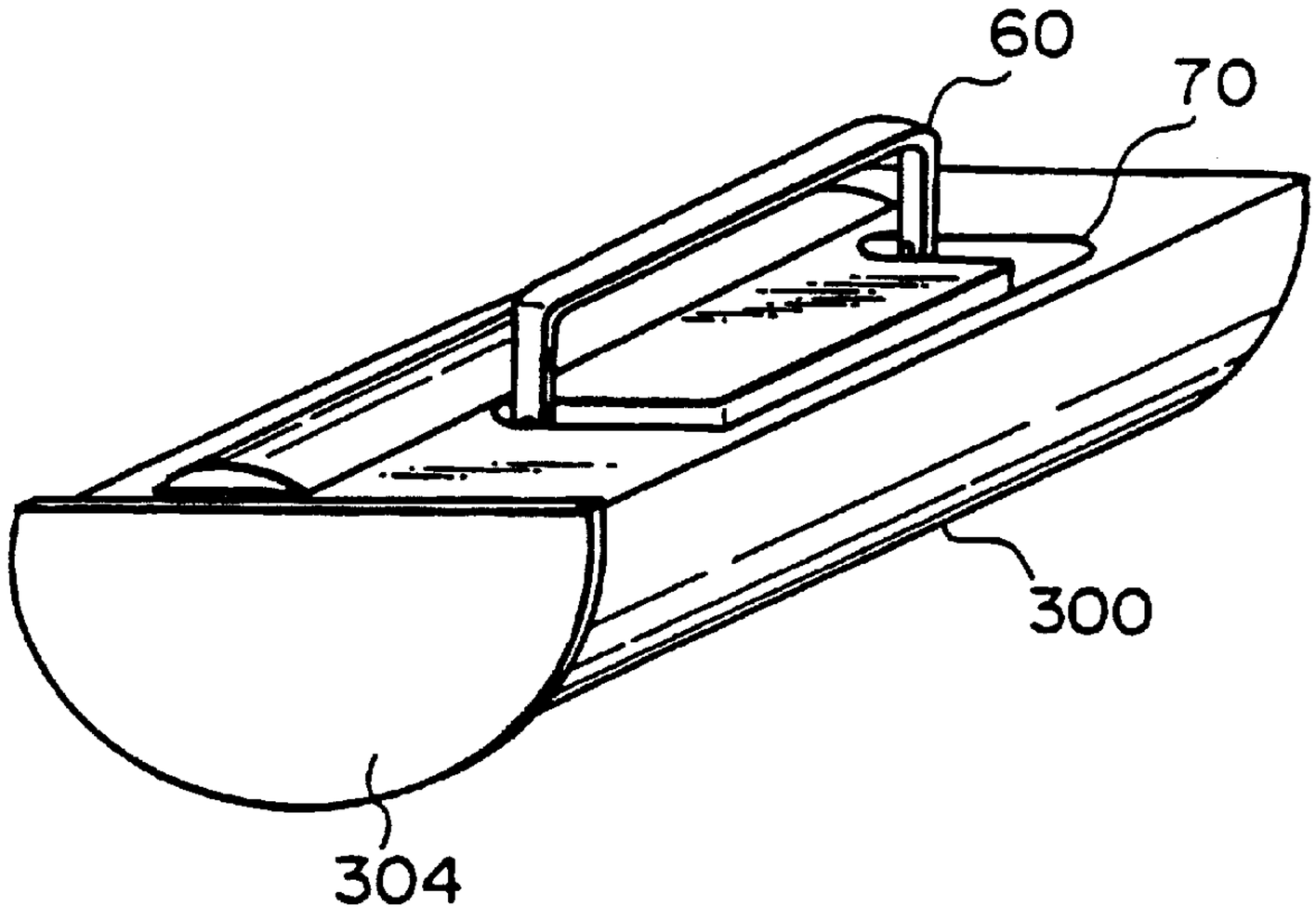


Fig. 5B

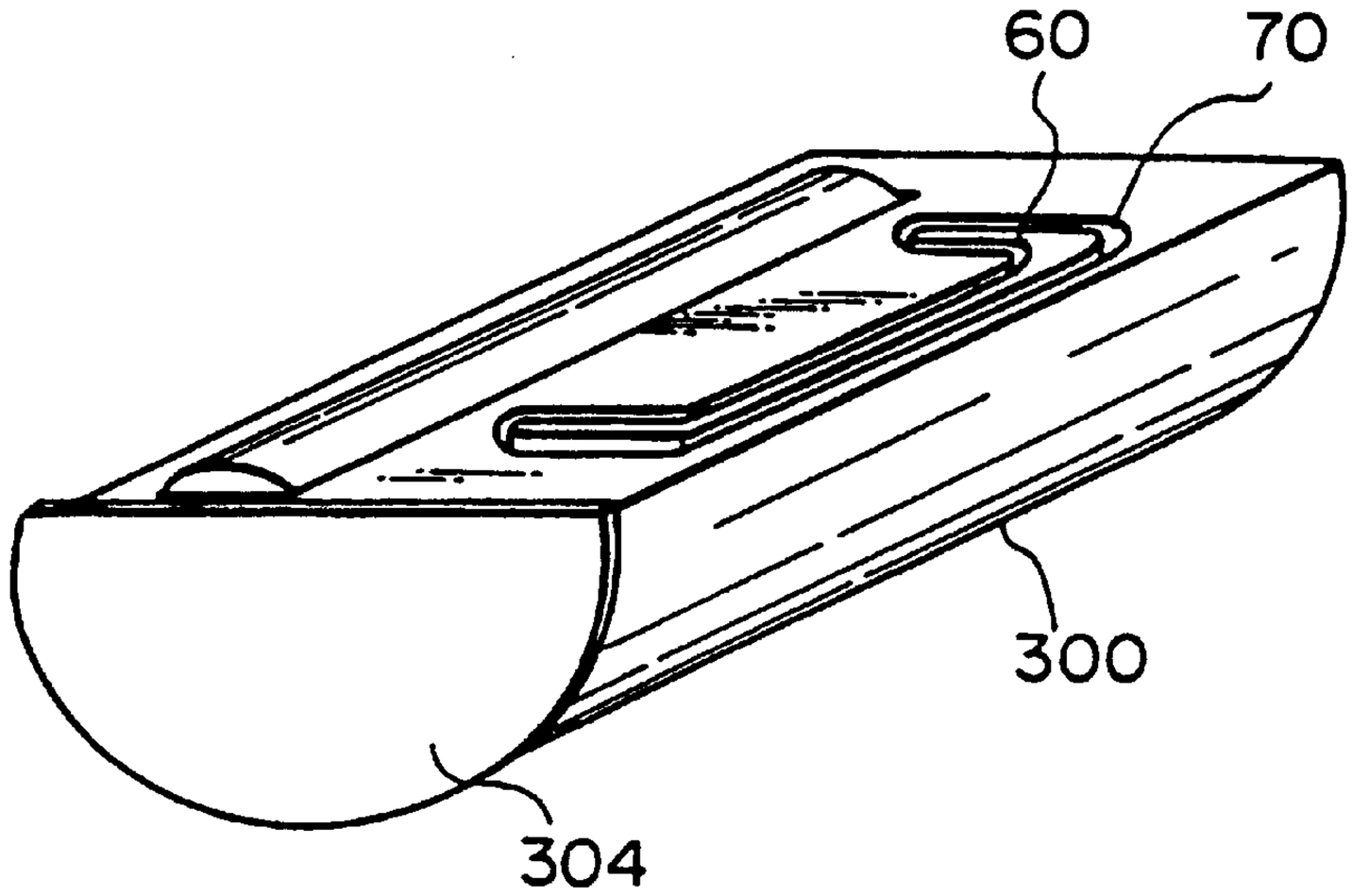
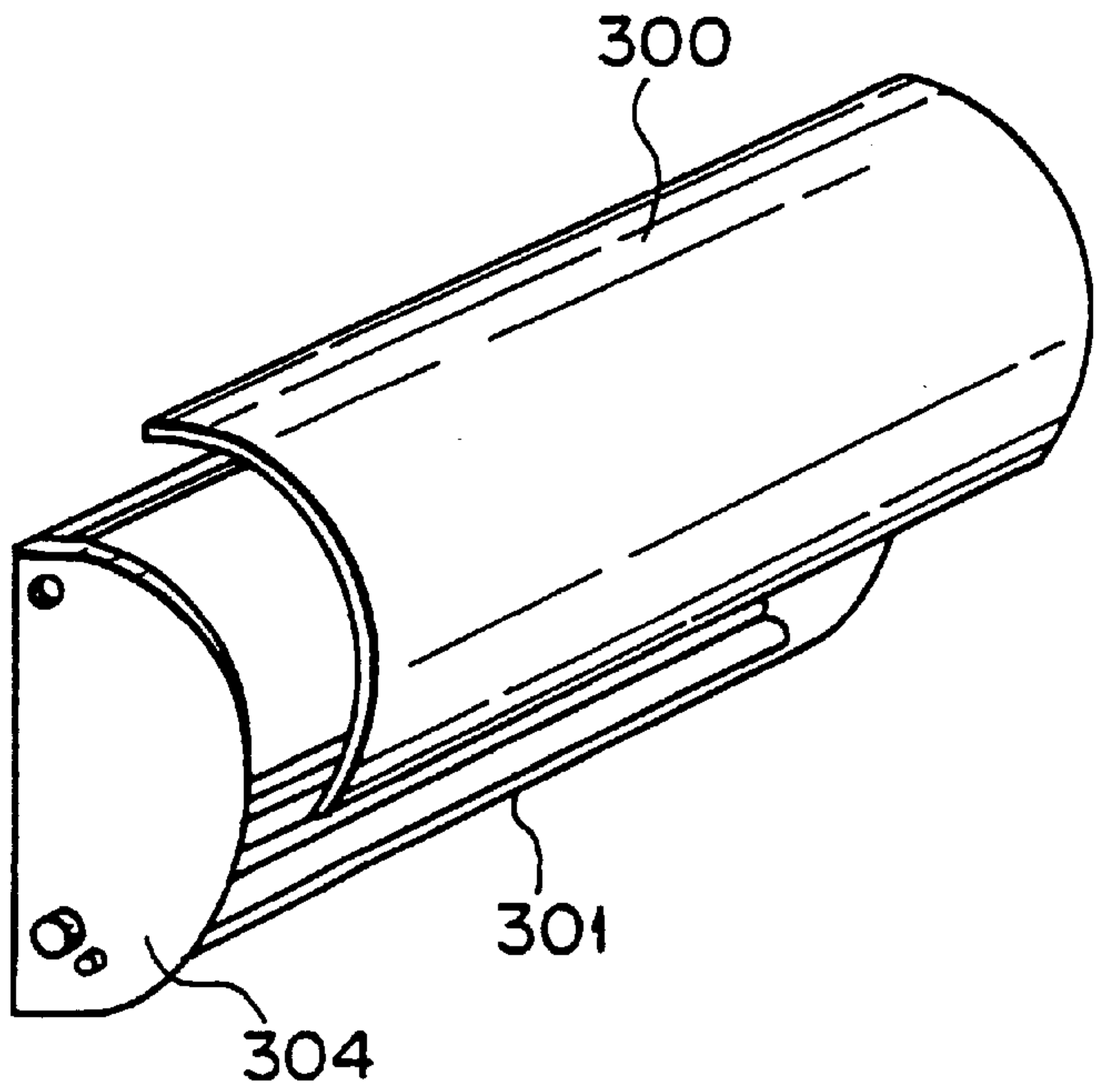


Fig. 6A



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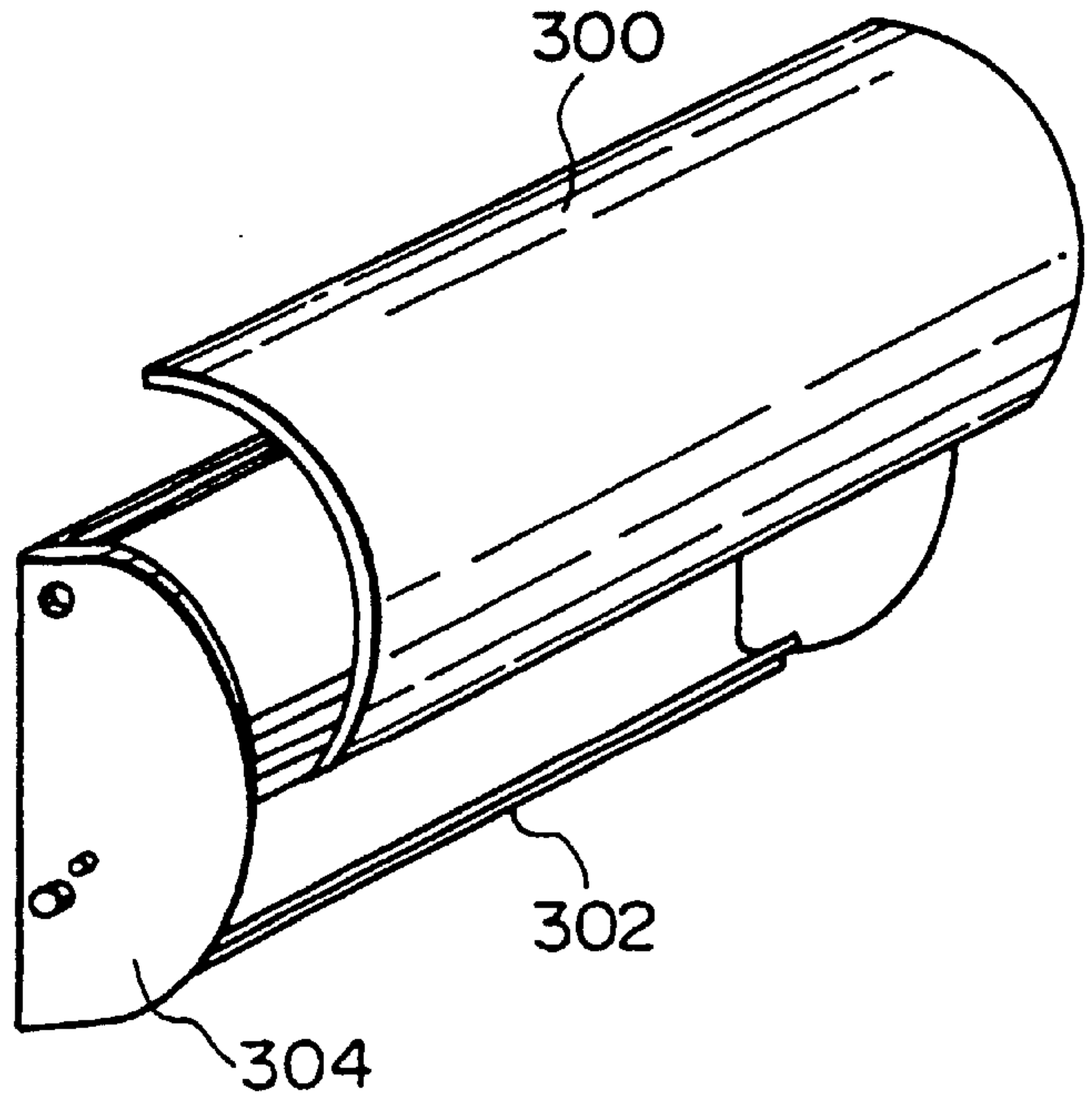

Fig. 7

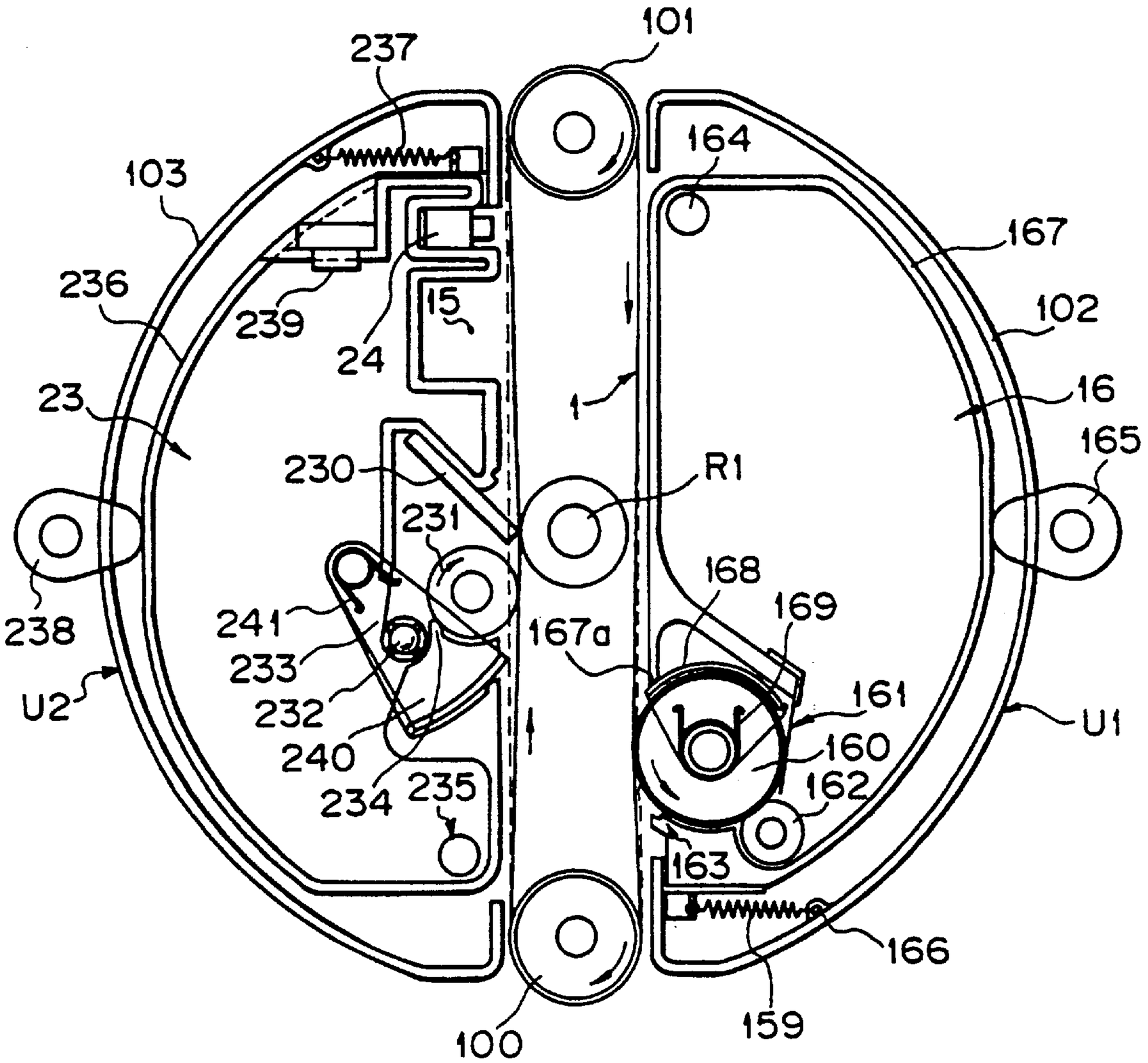
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Fig. 8

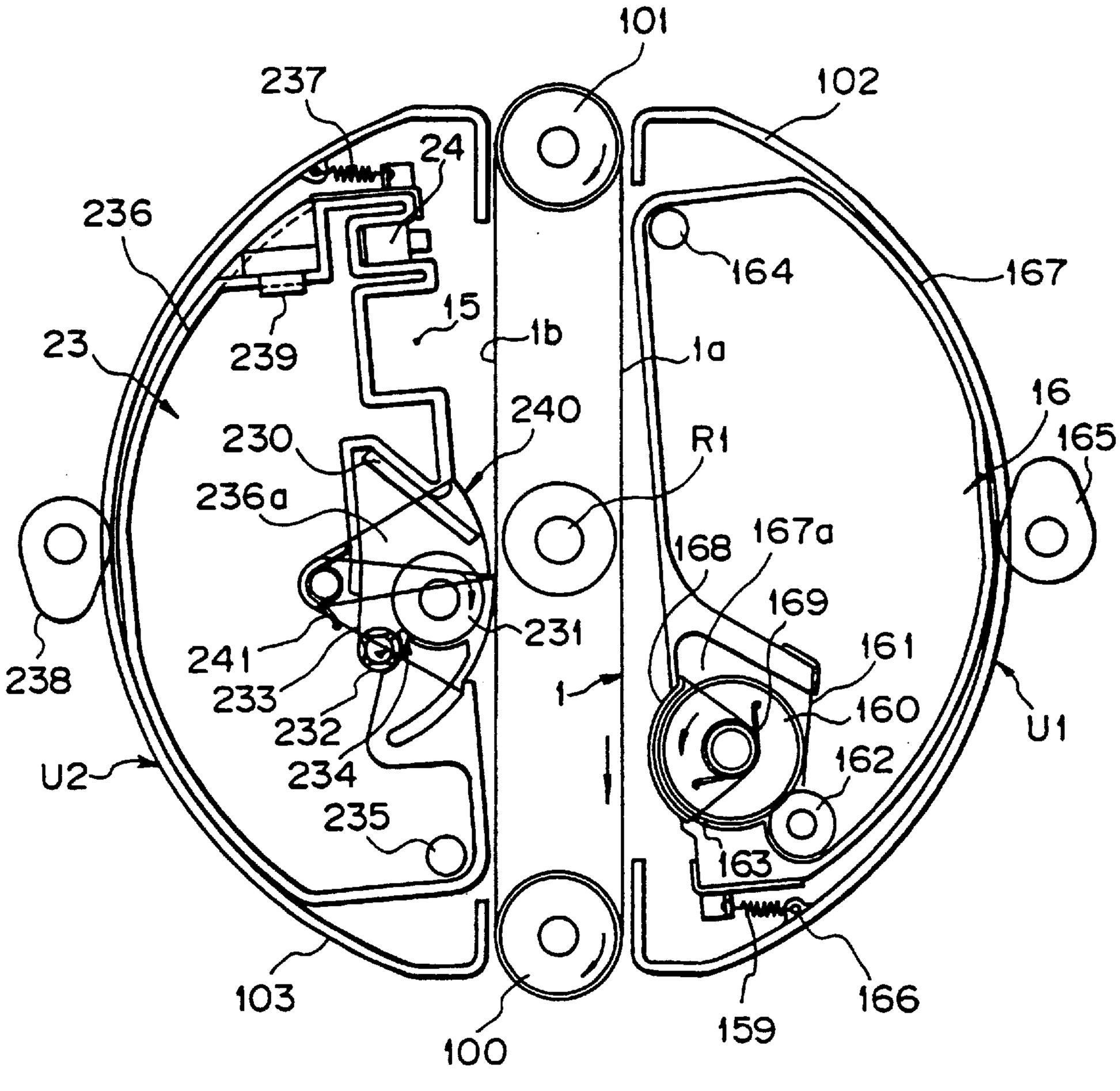
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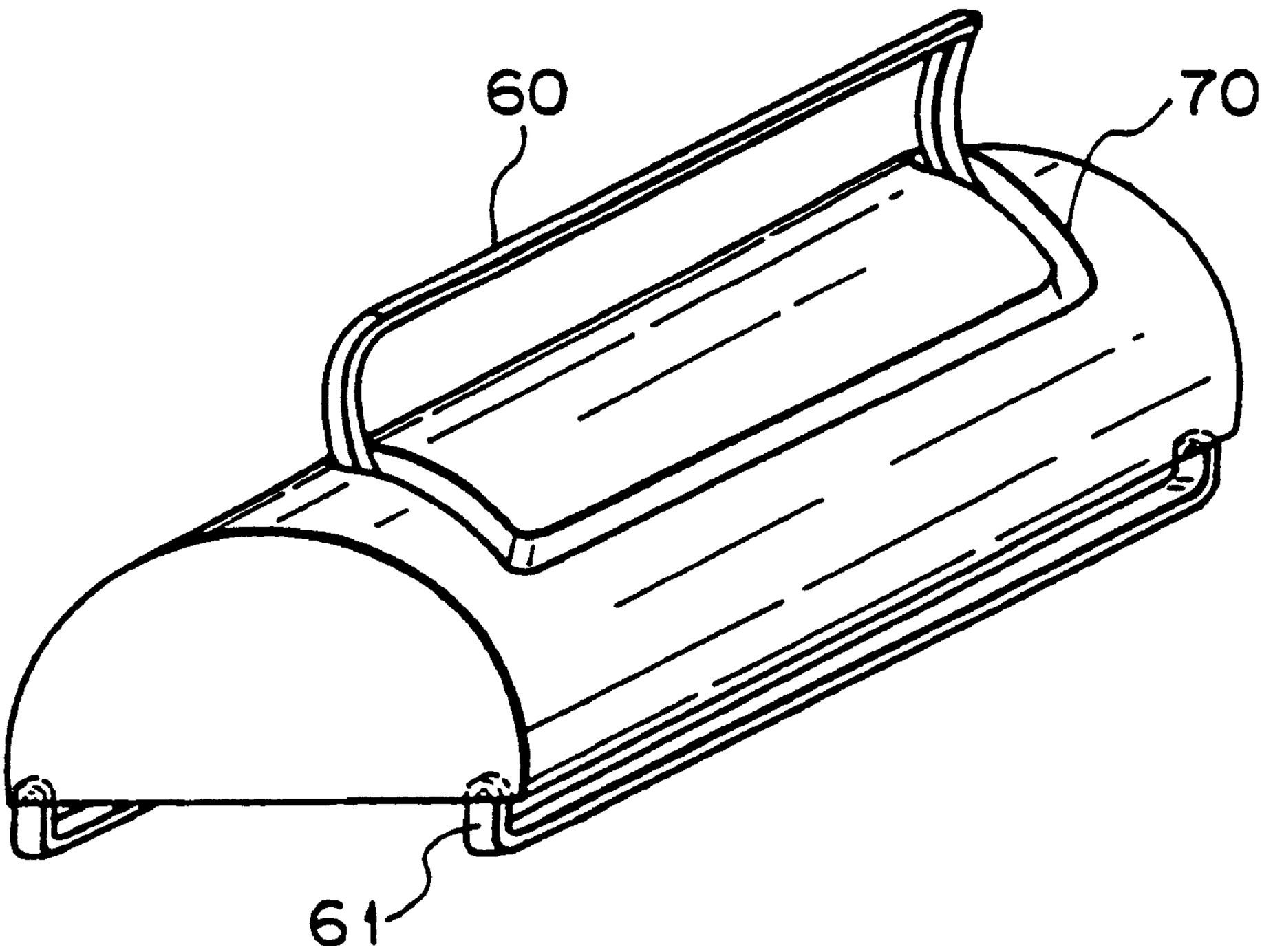
Fig. 9



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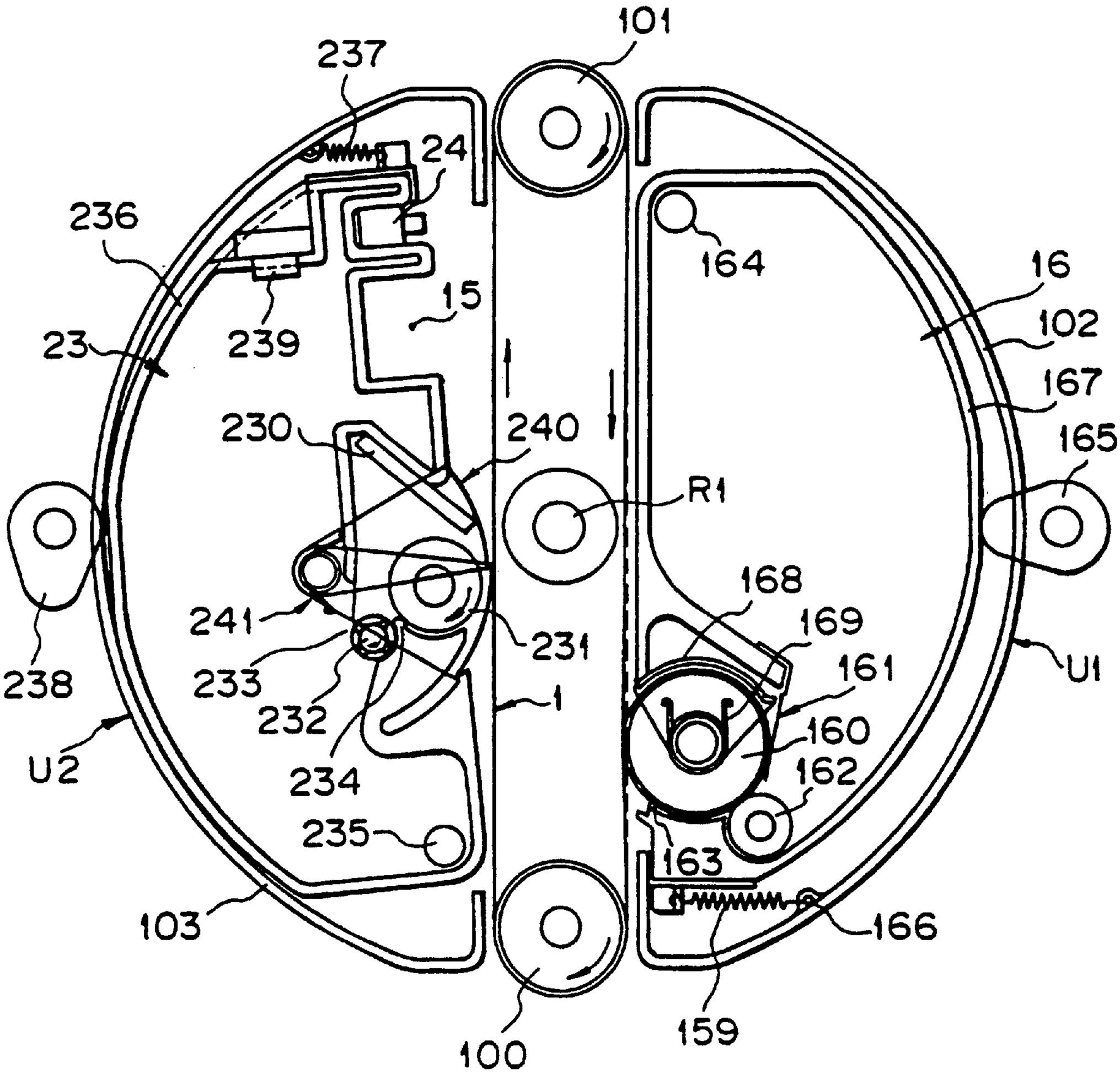
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Fig. 11

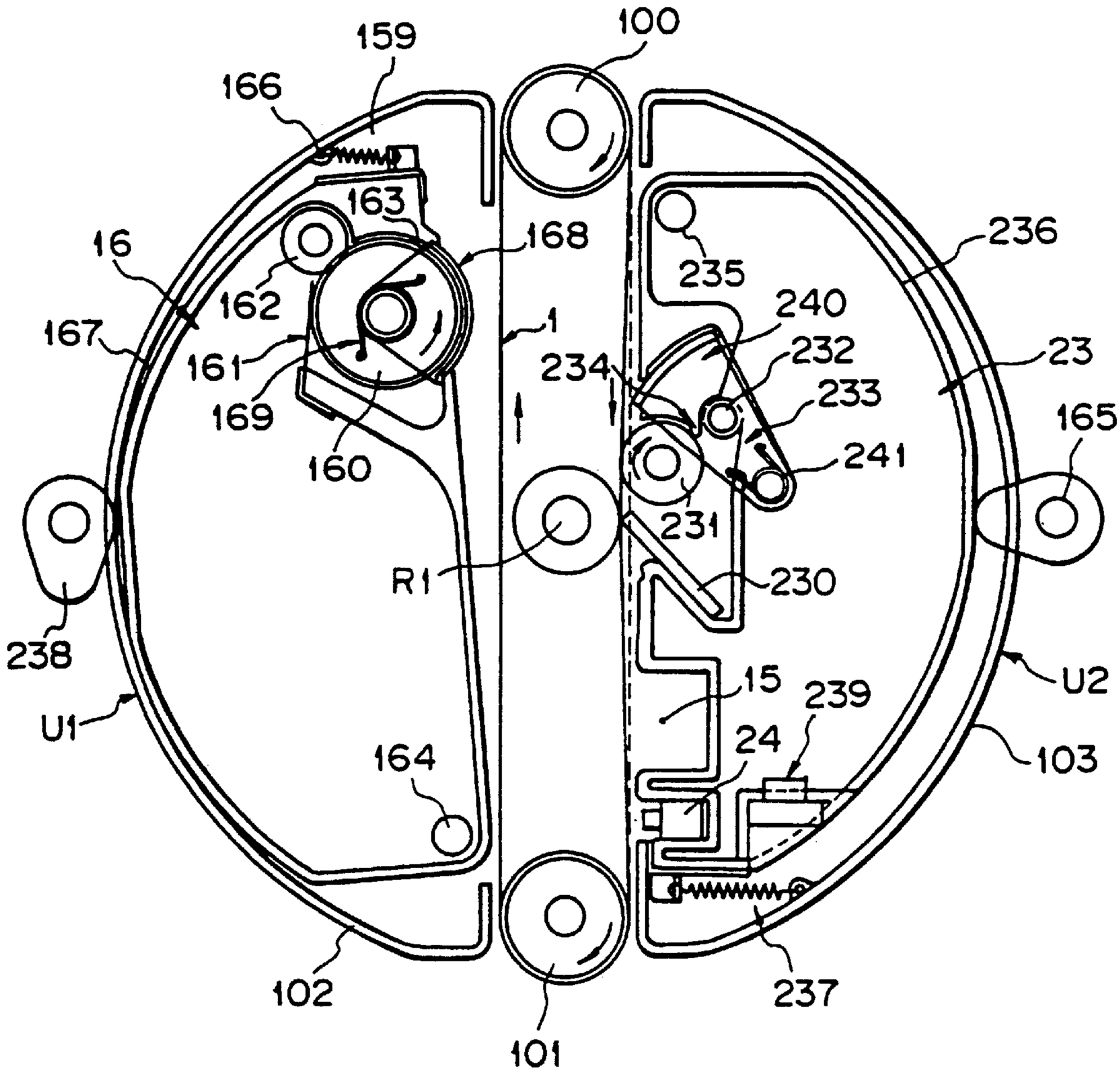
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Fig. 12

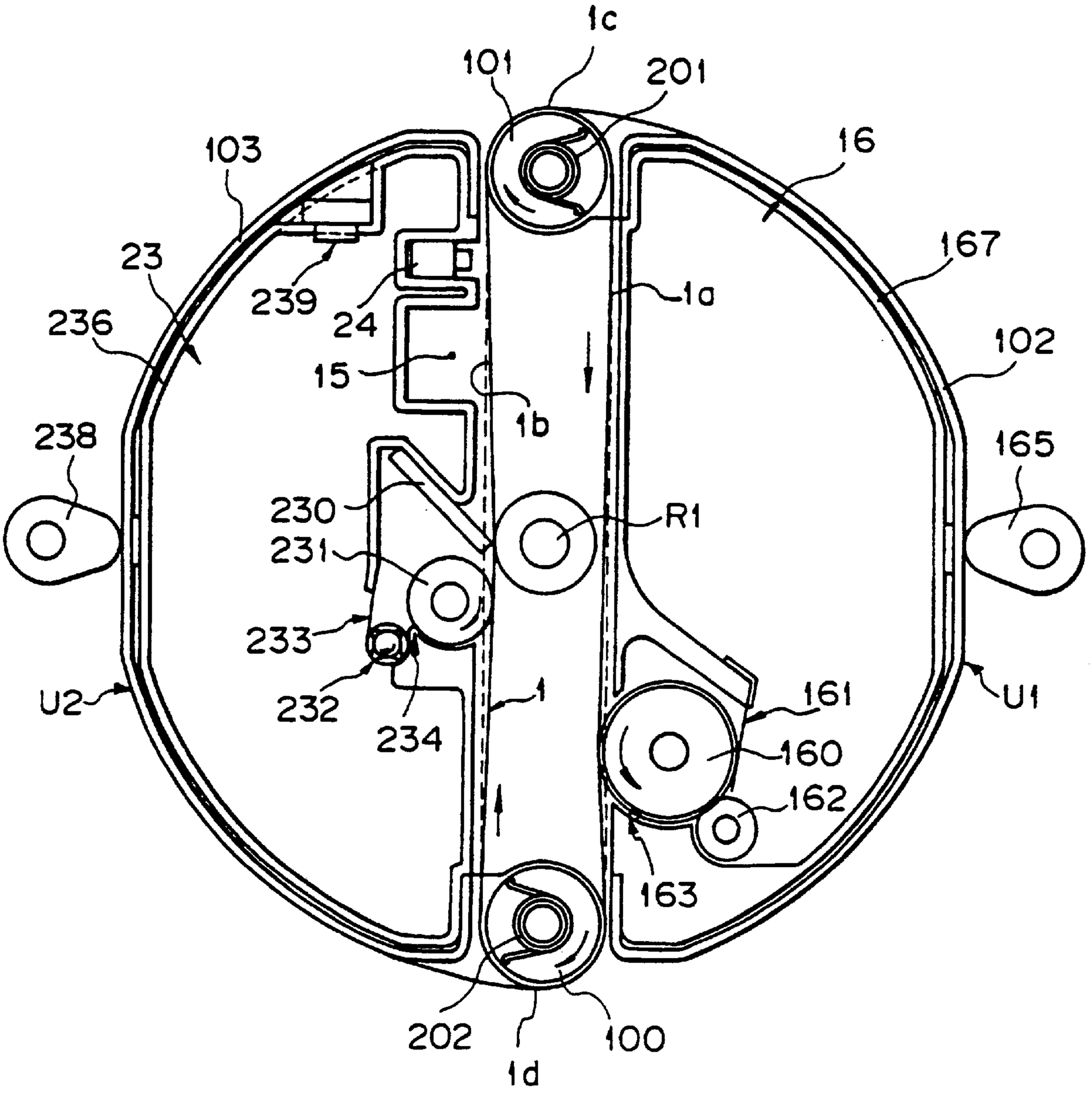
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Fig. 13

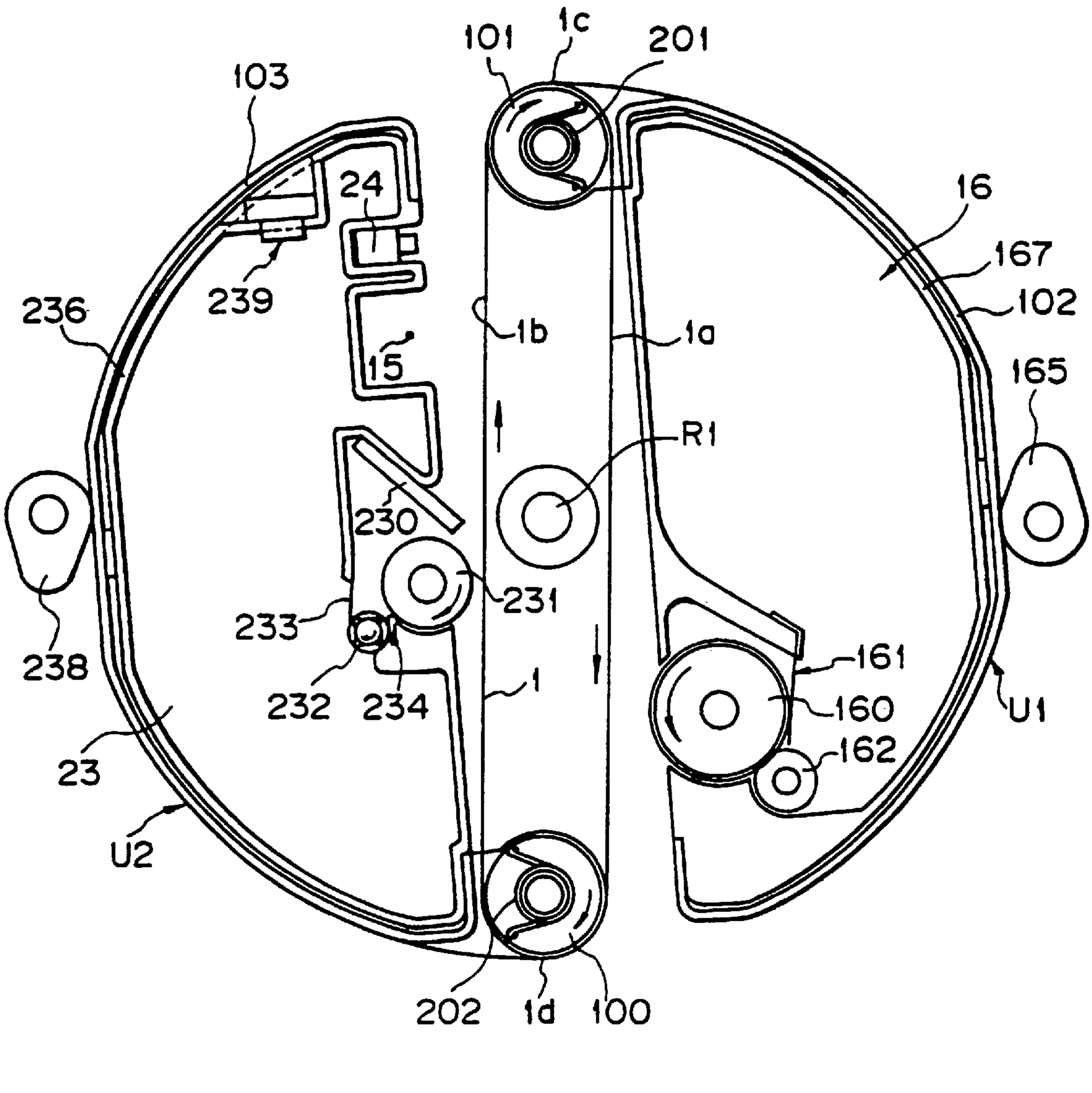
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Fig. 14

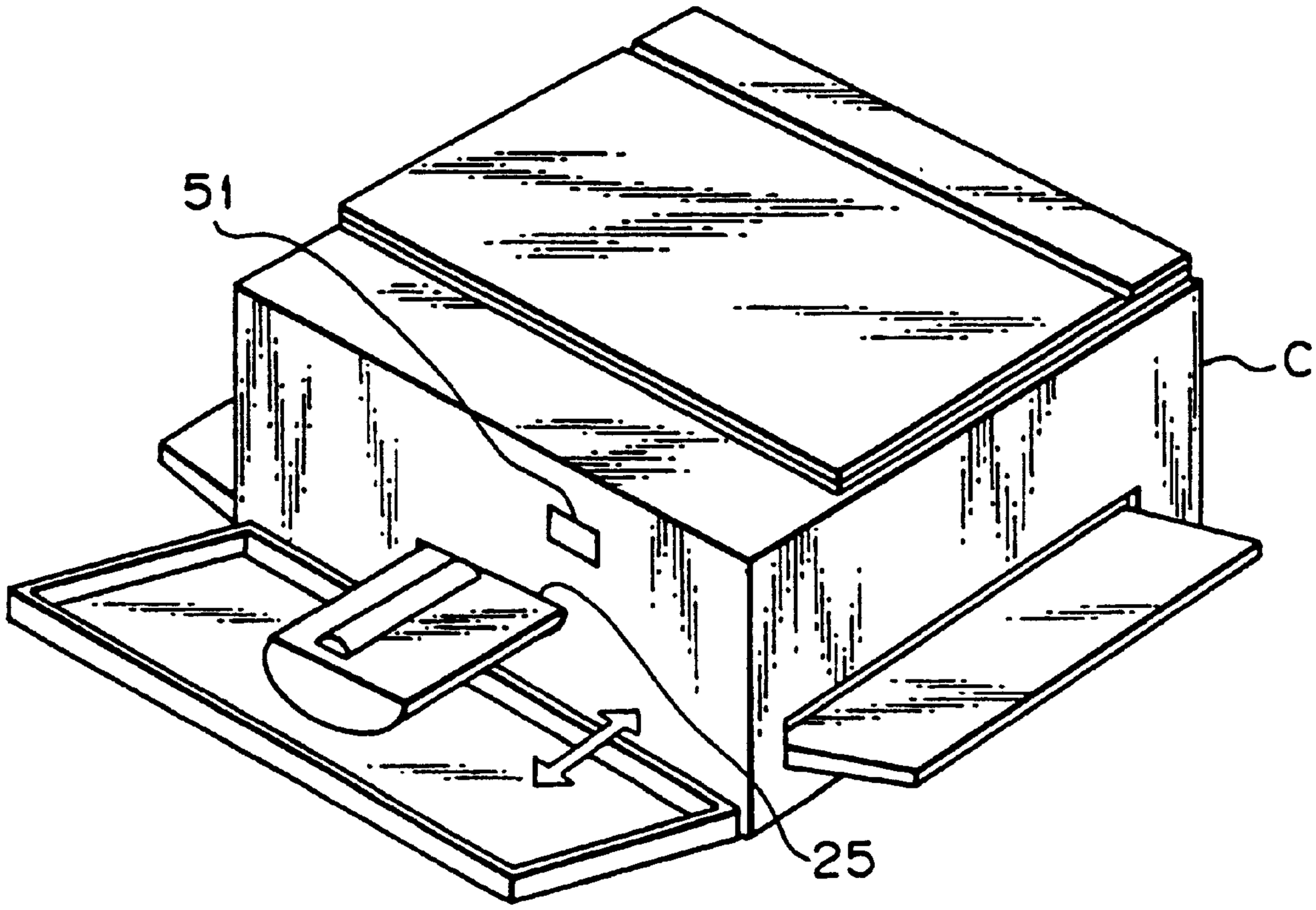


Fig. 15A

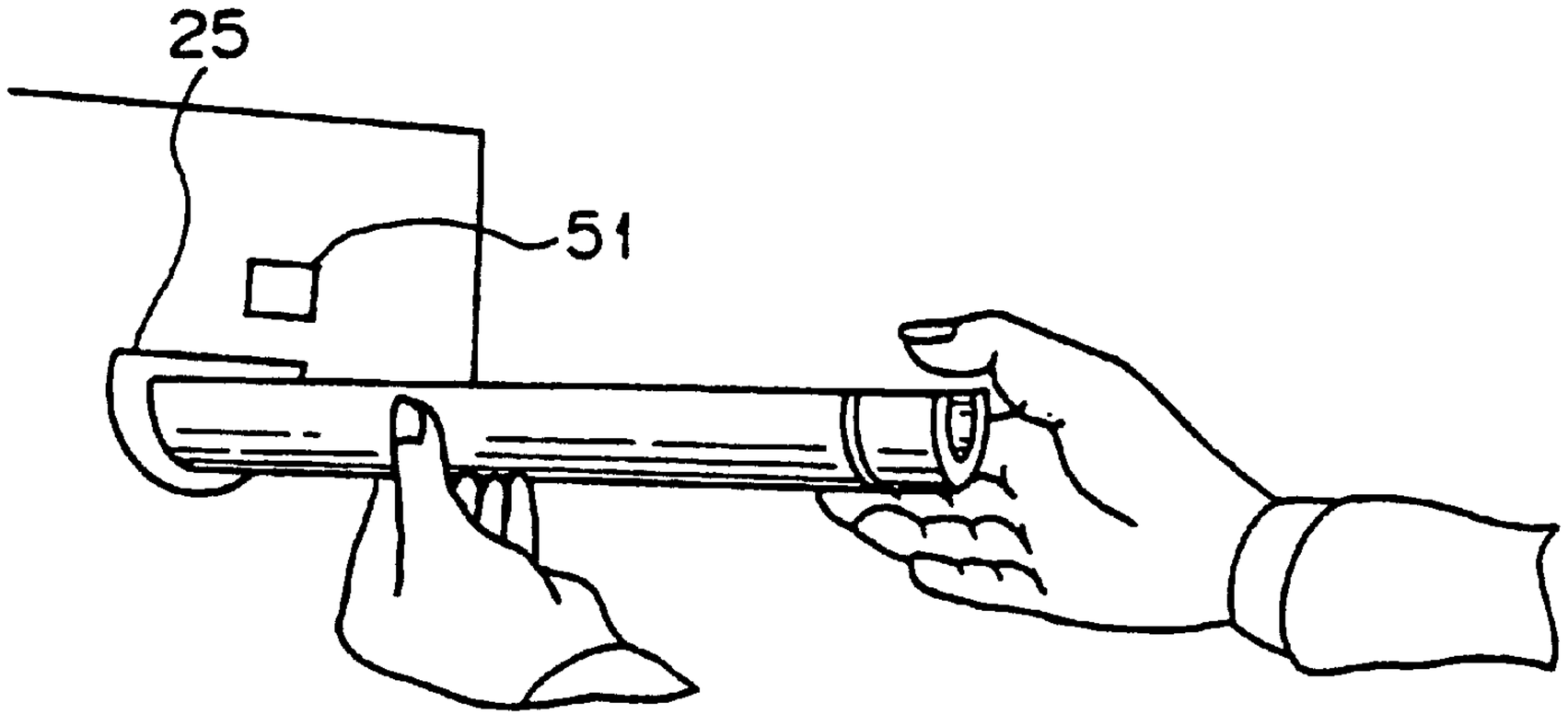
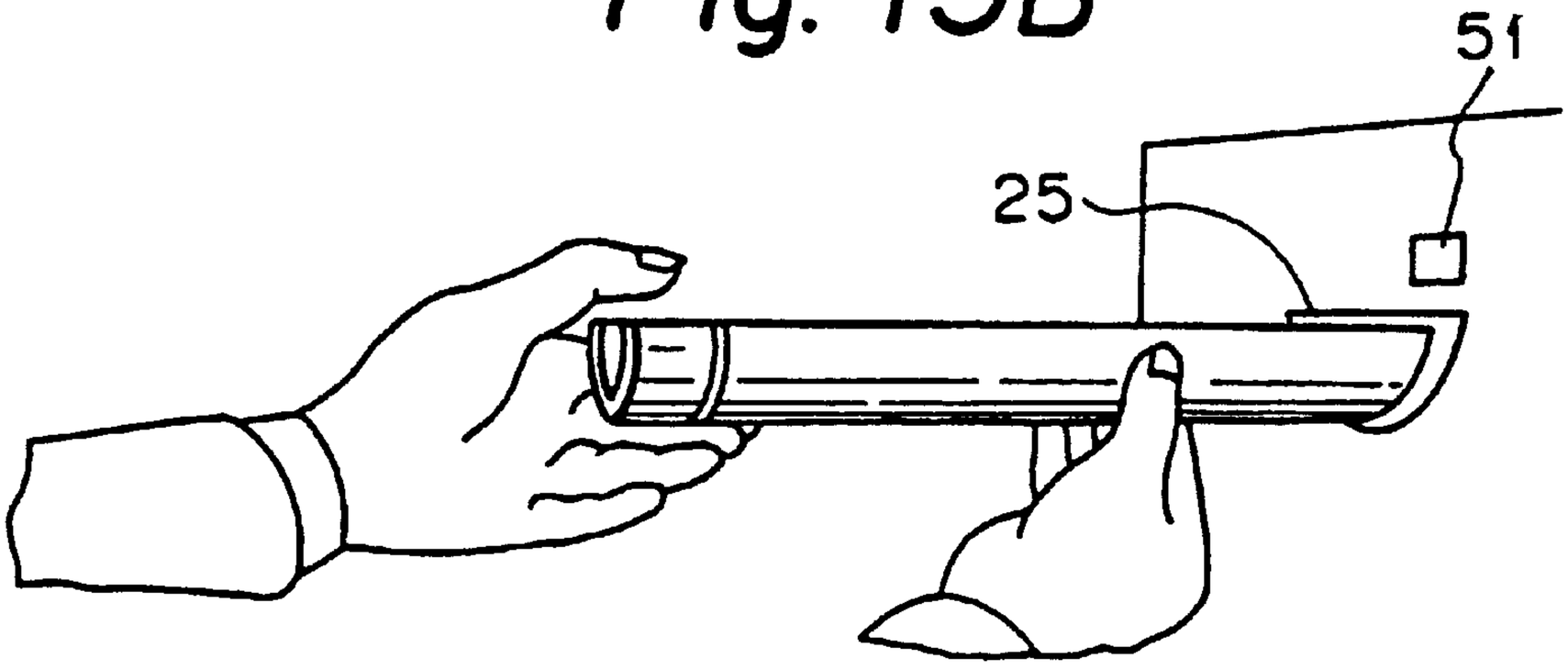


Fig. 15B



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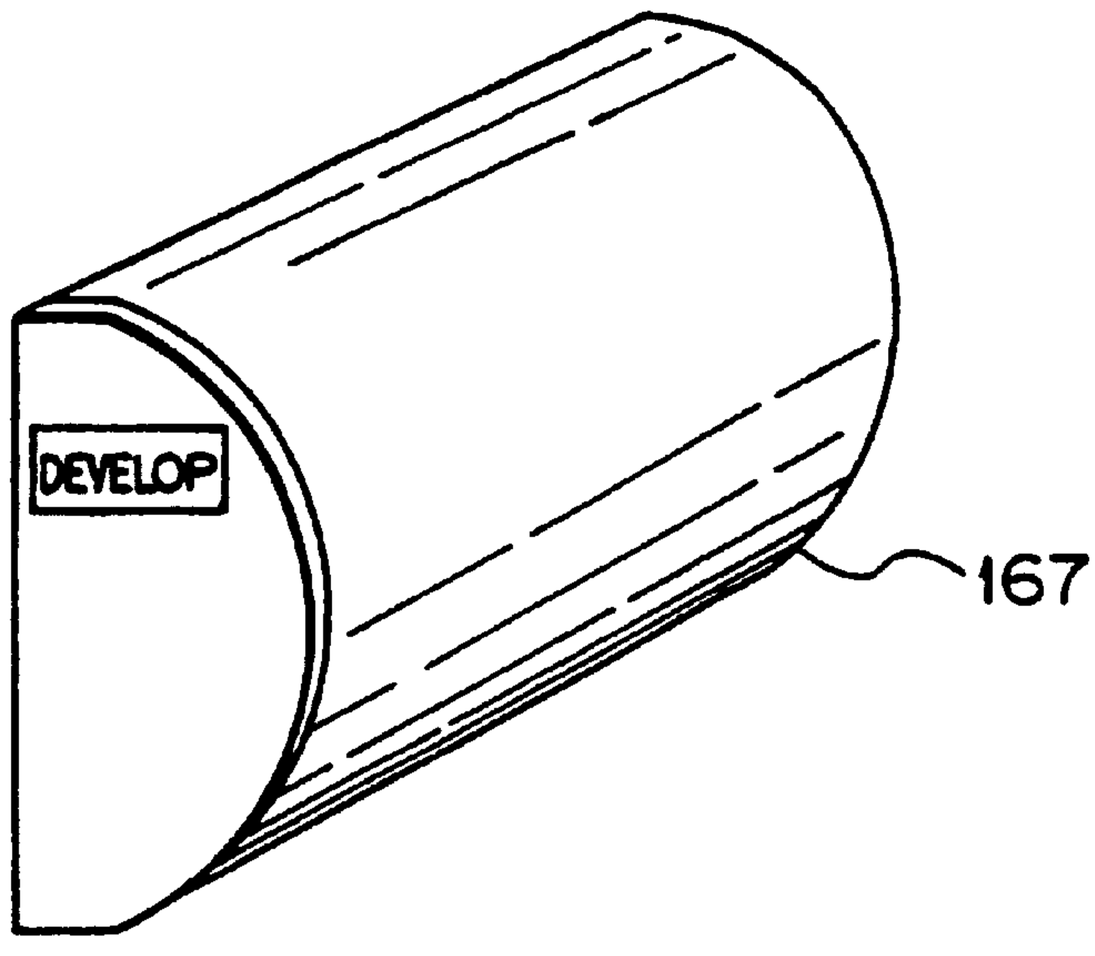

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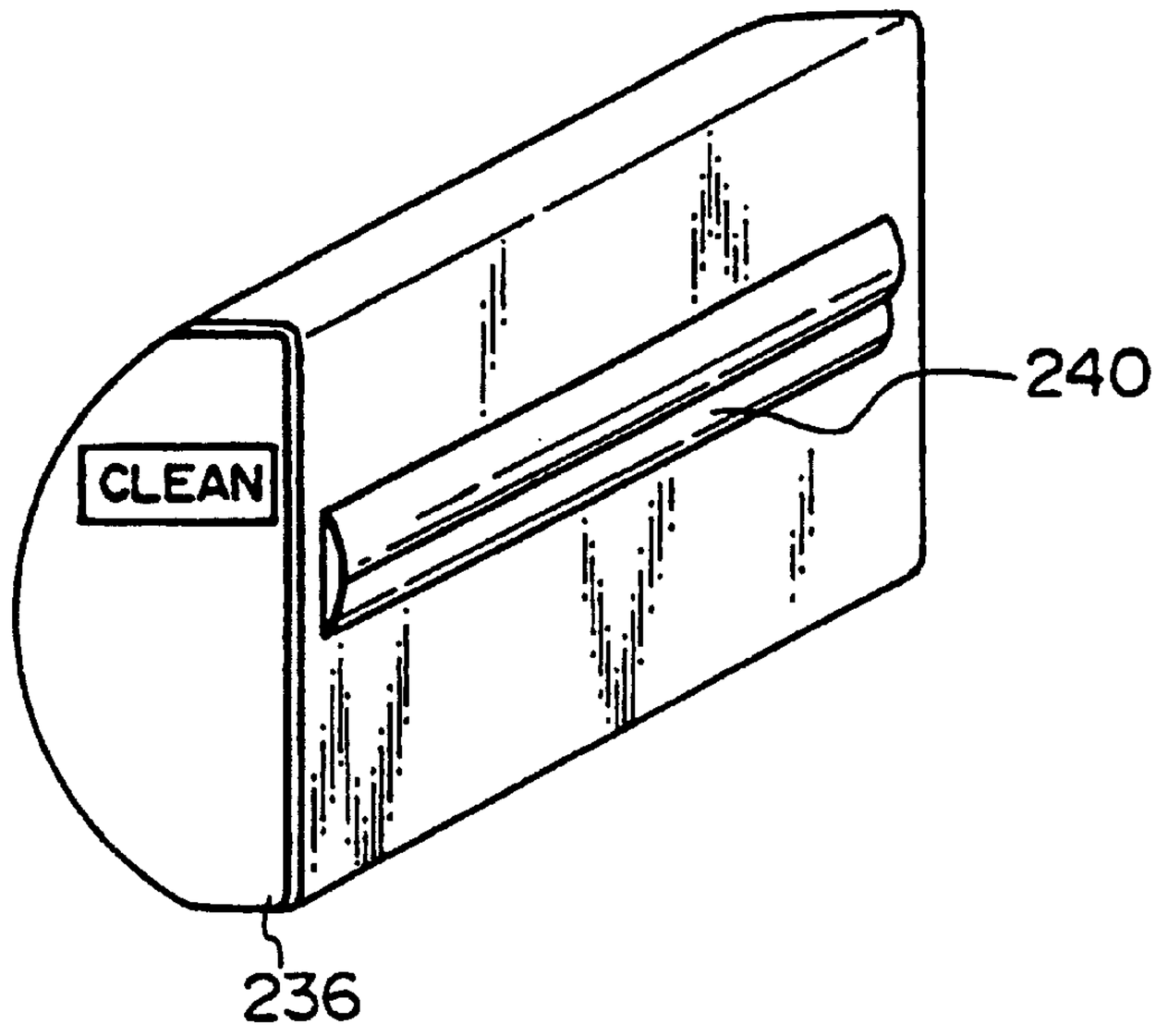

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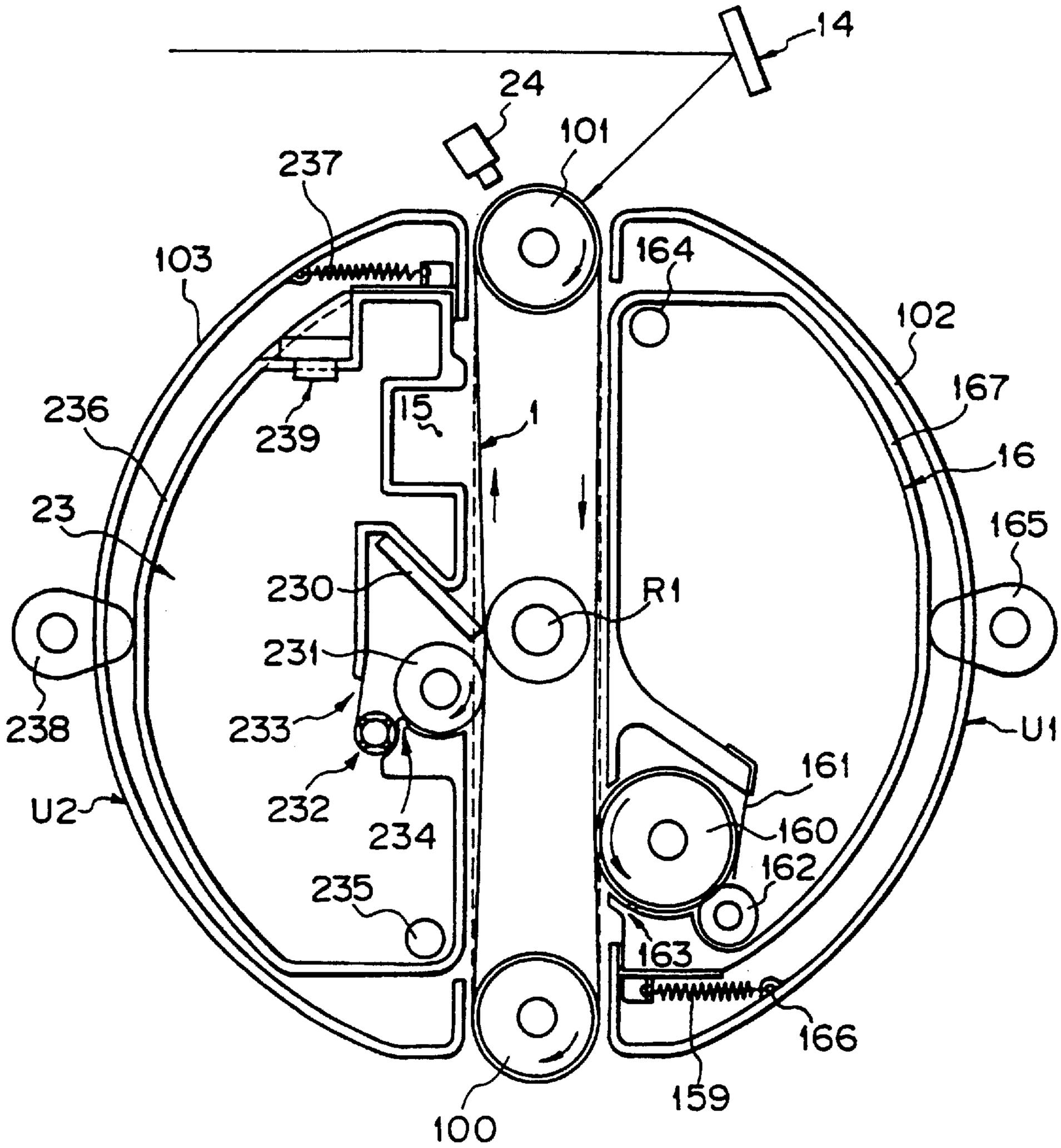
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Fig. 18

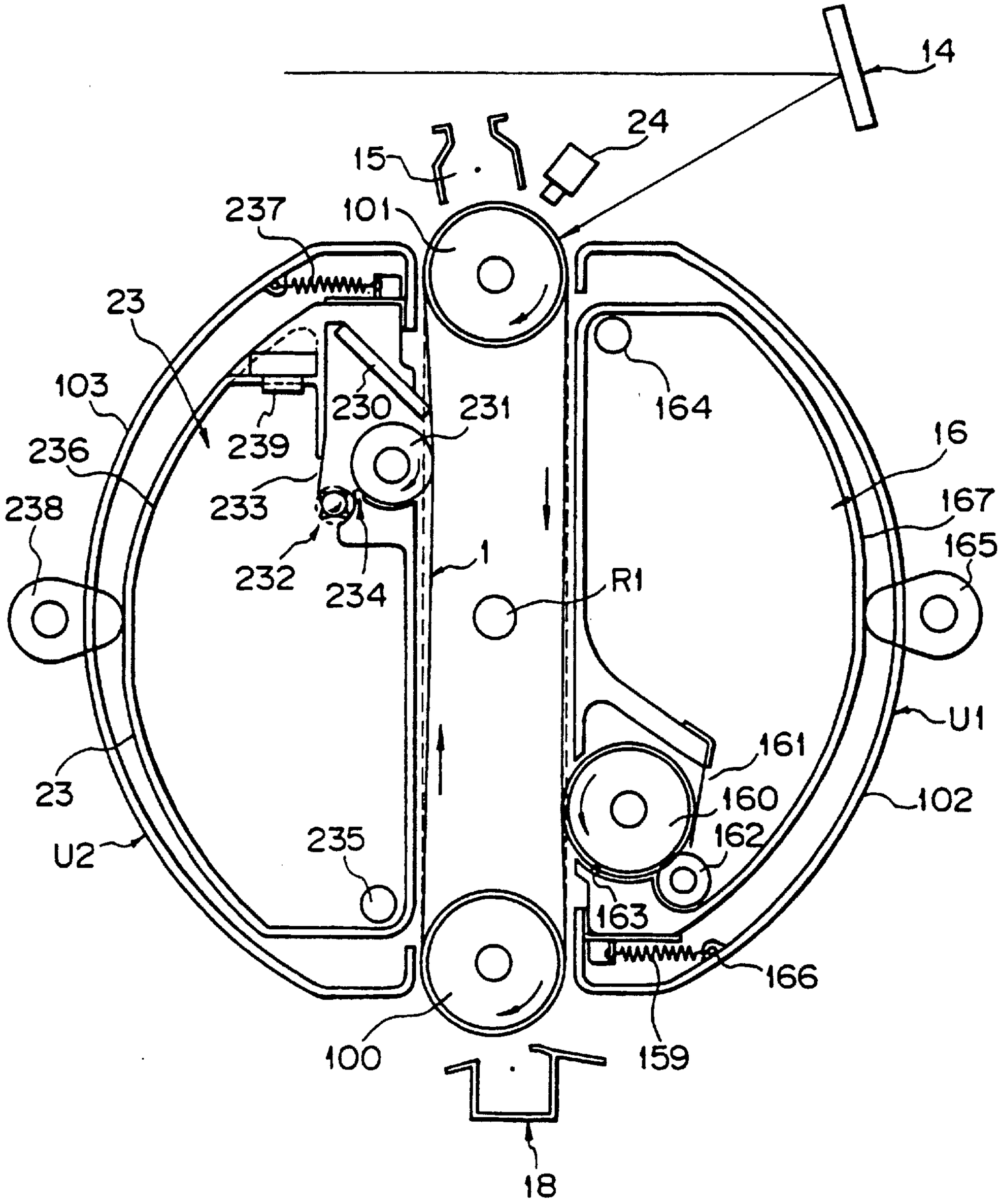
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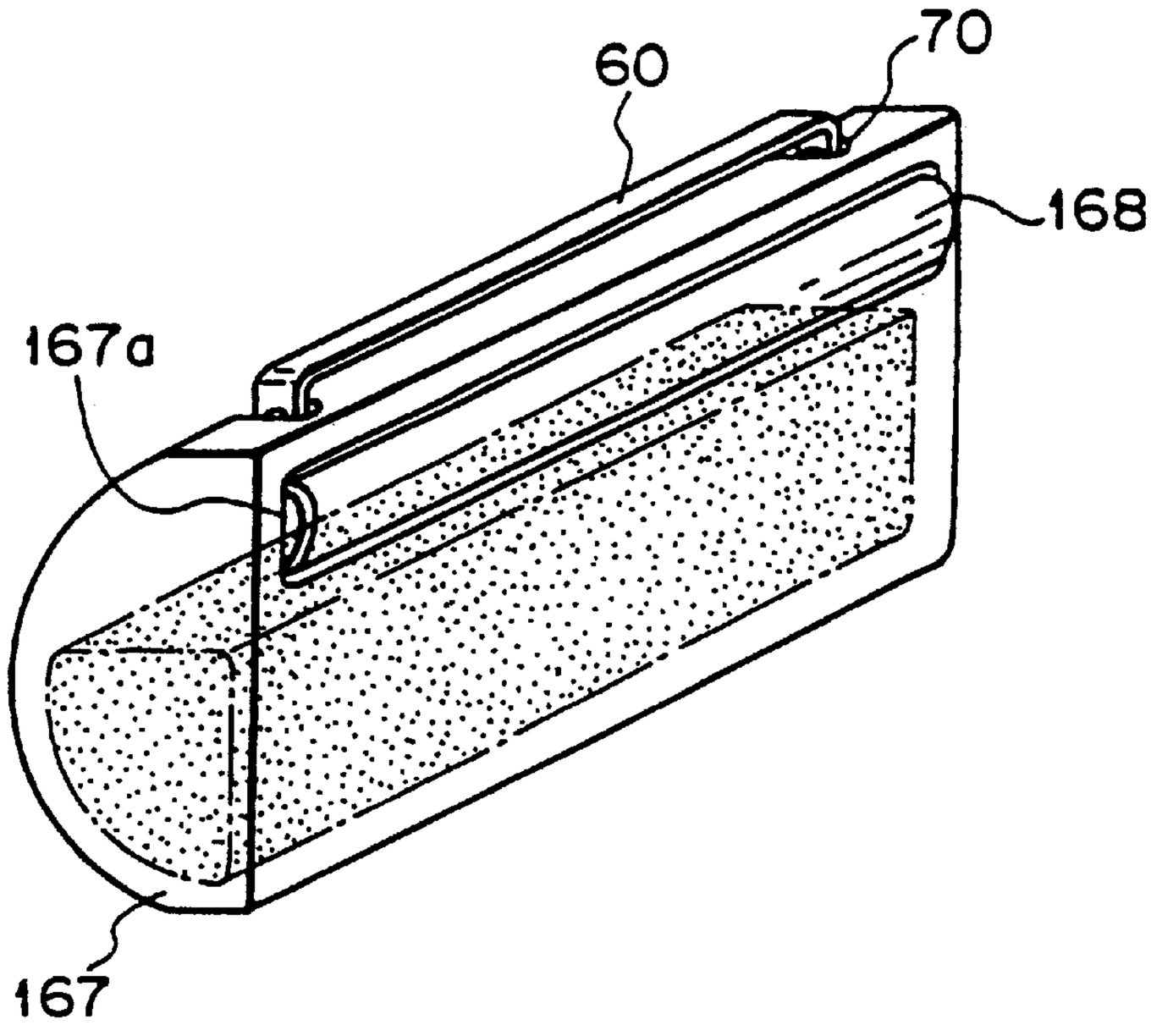
Fig. 19A



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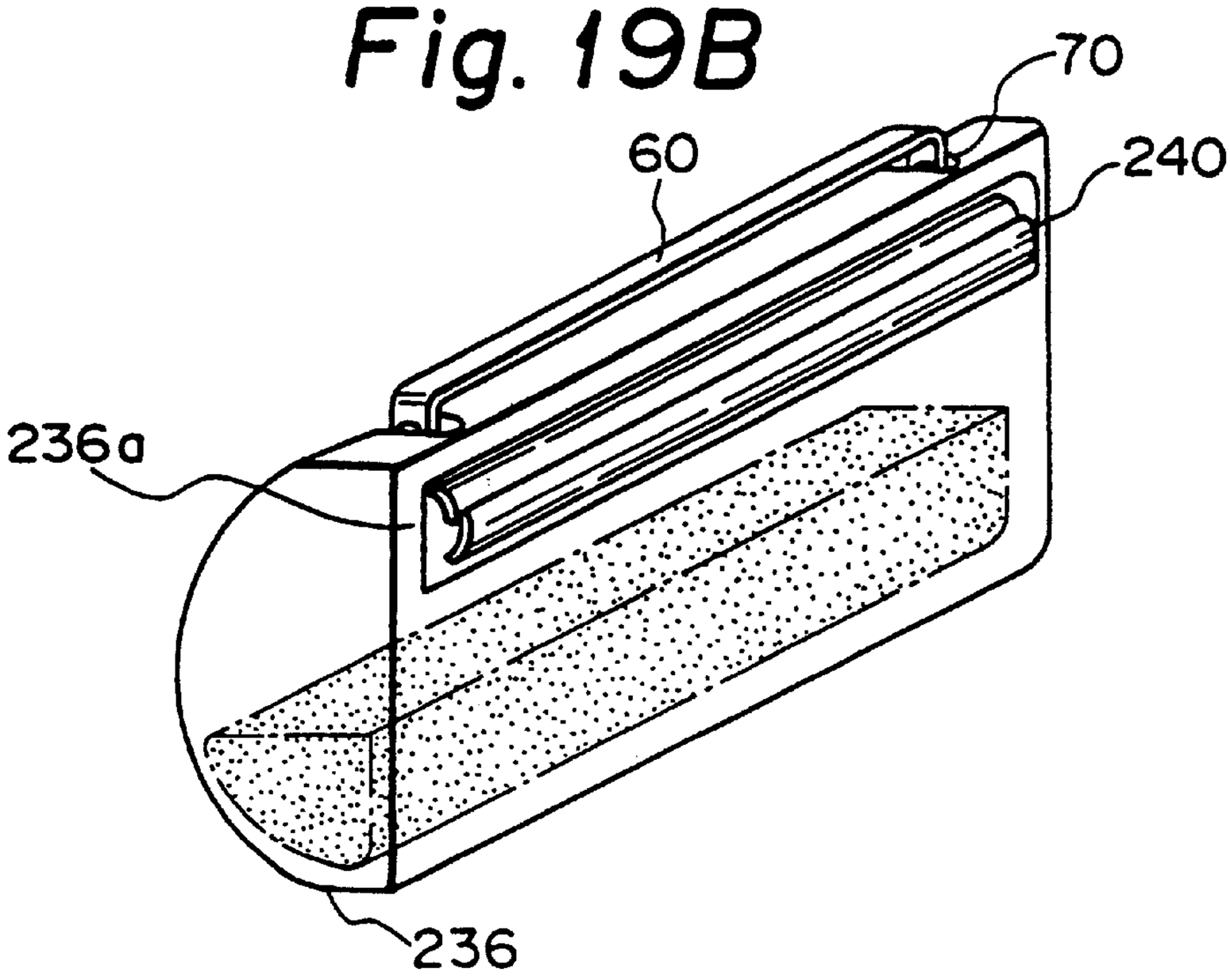

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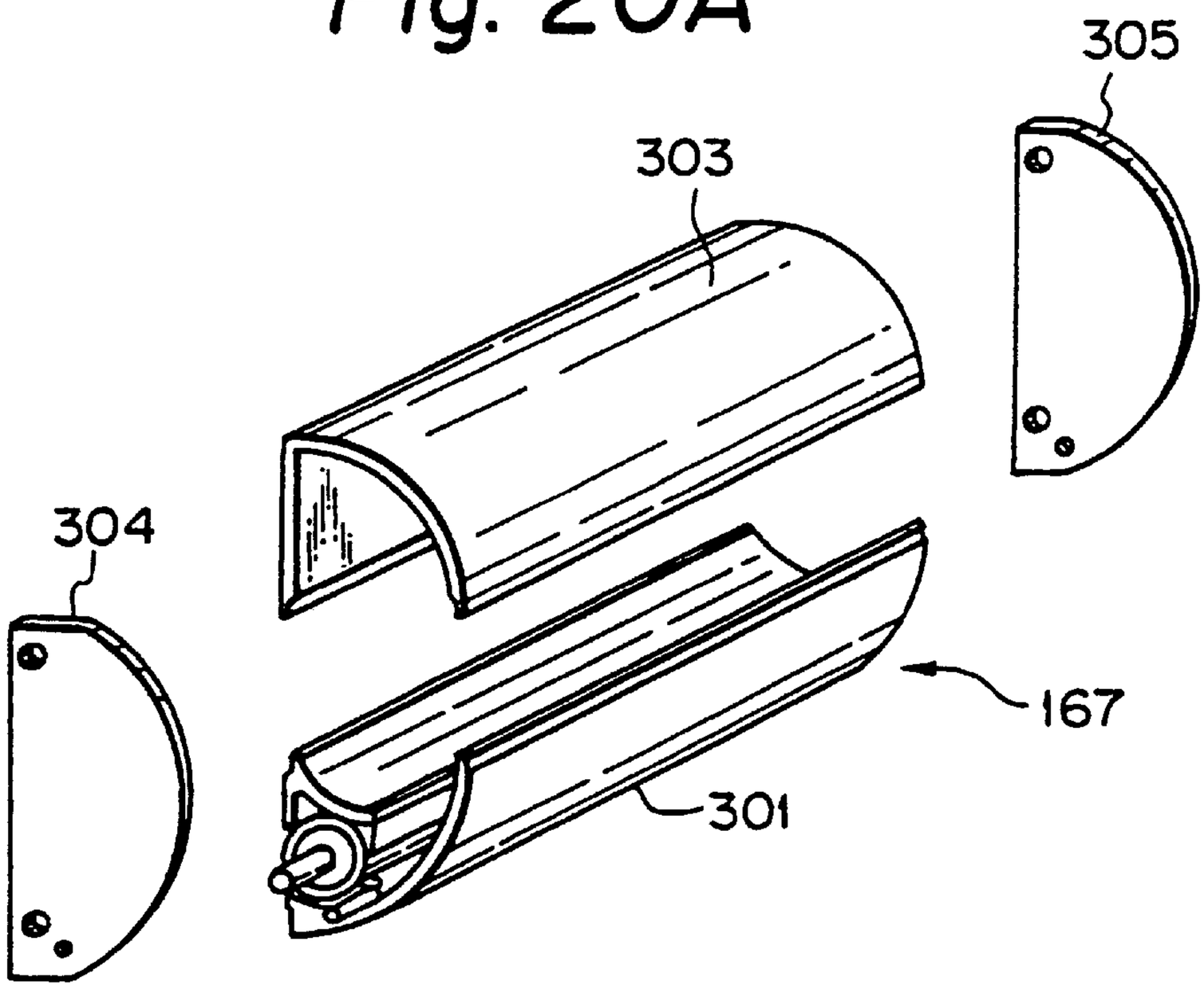

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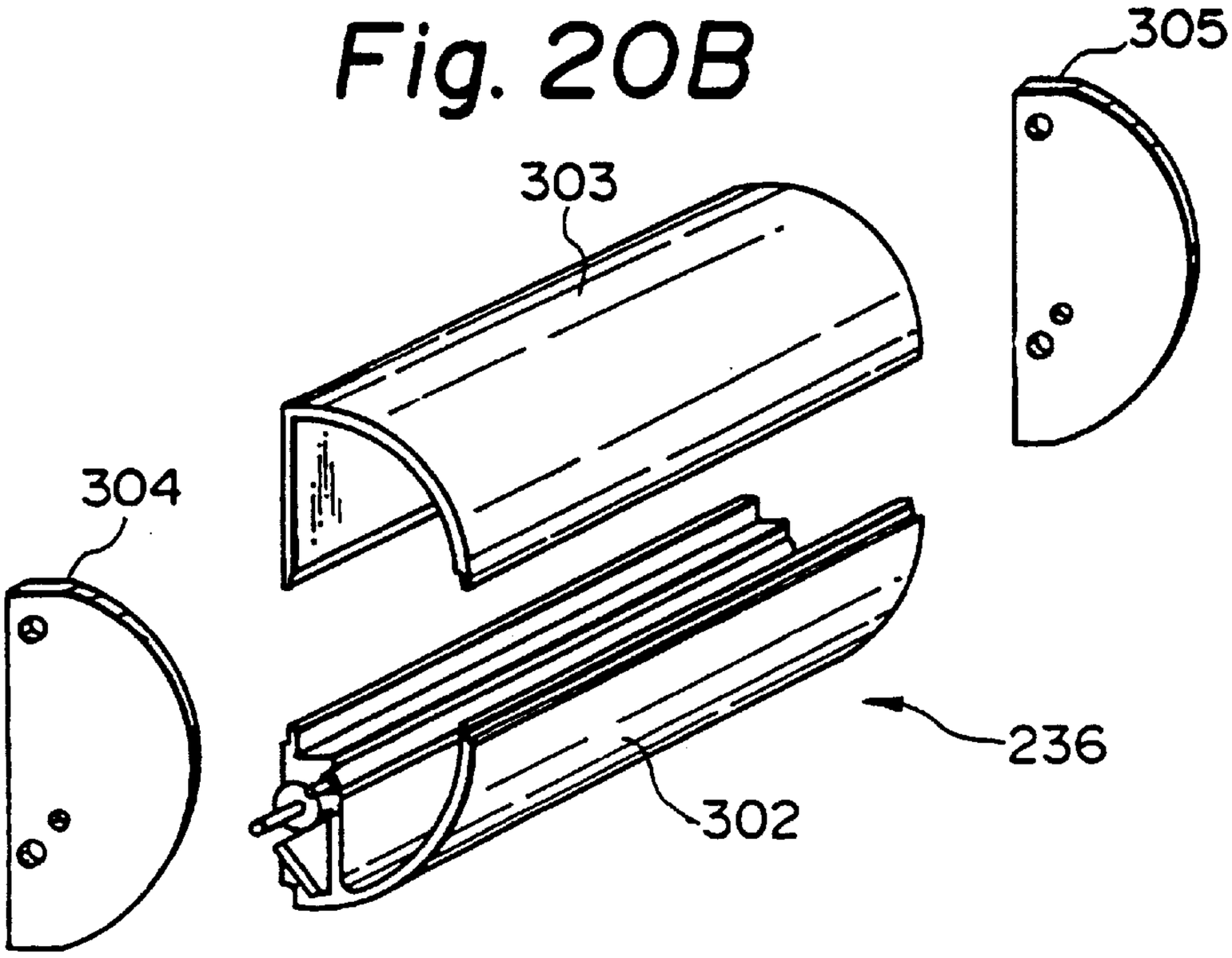

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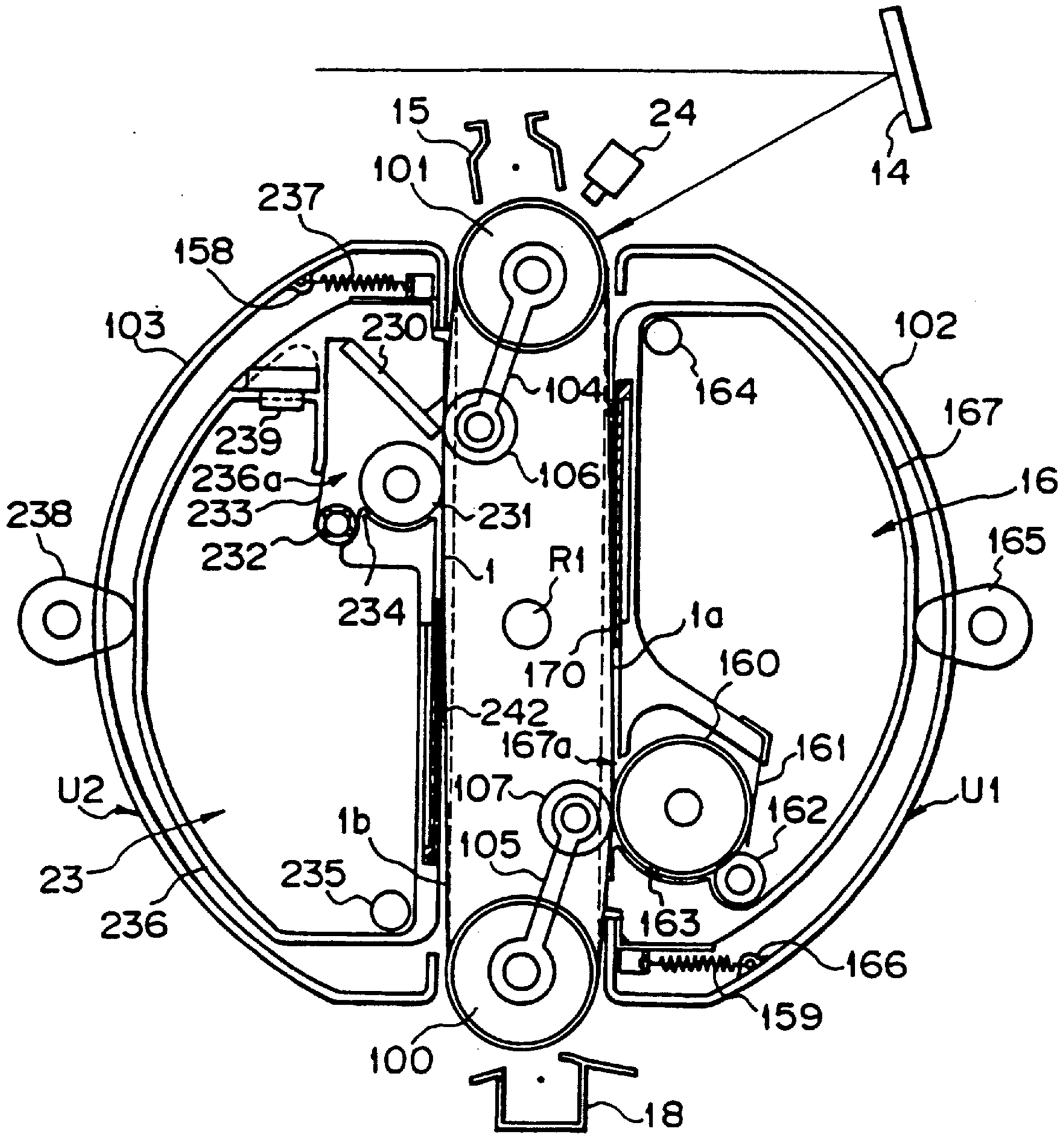
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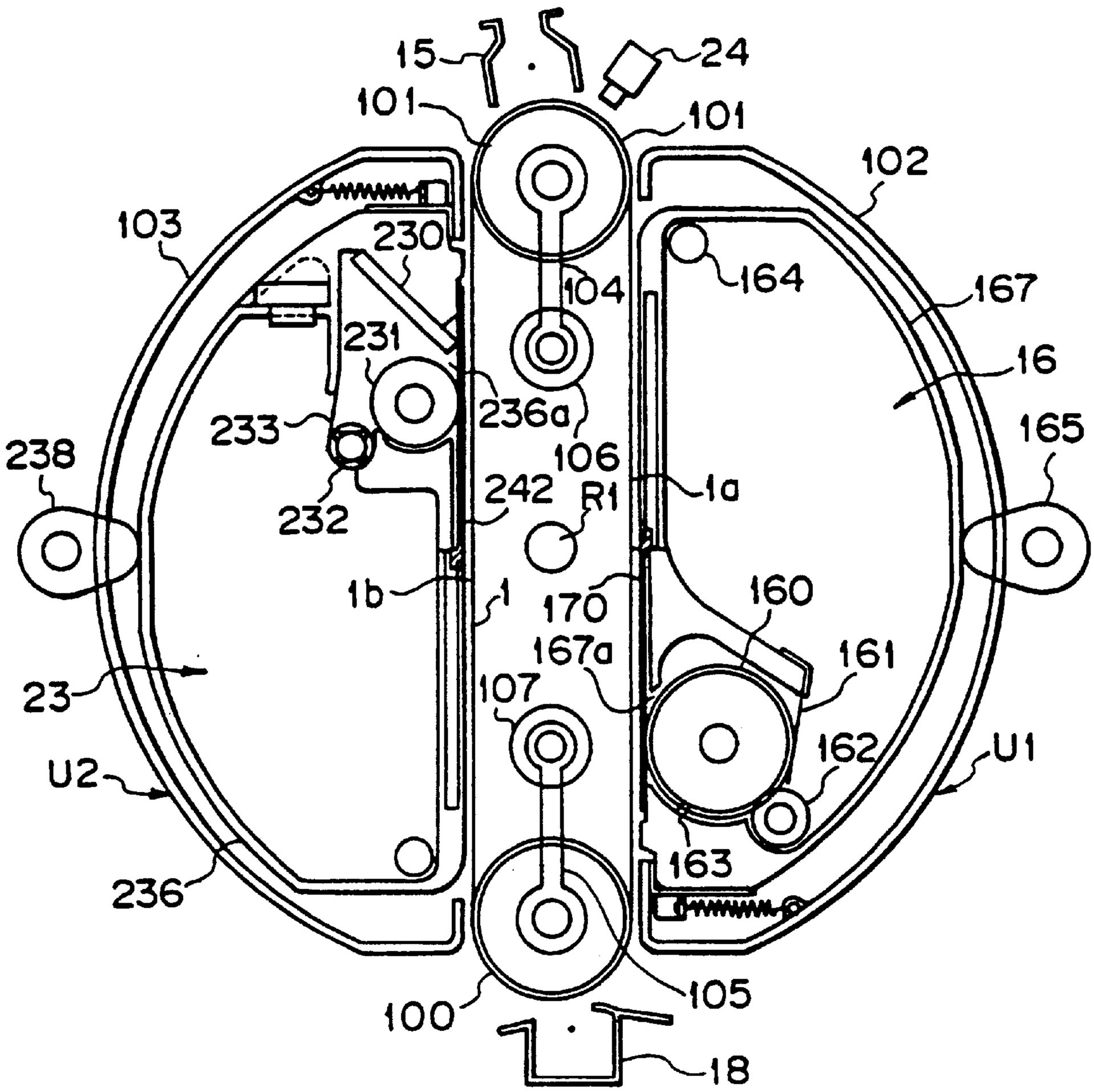
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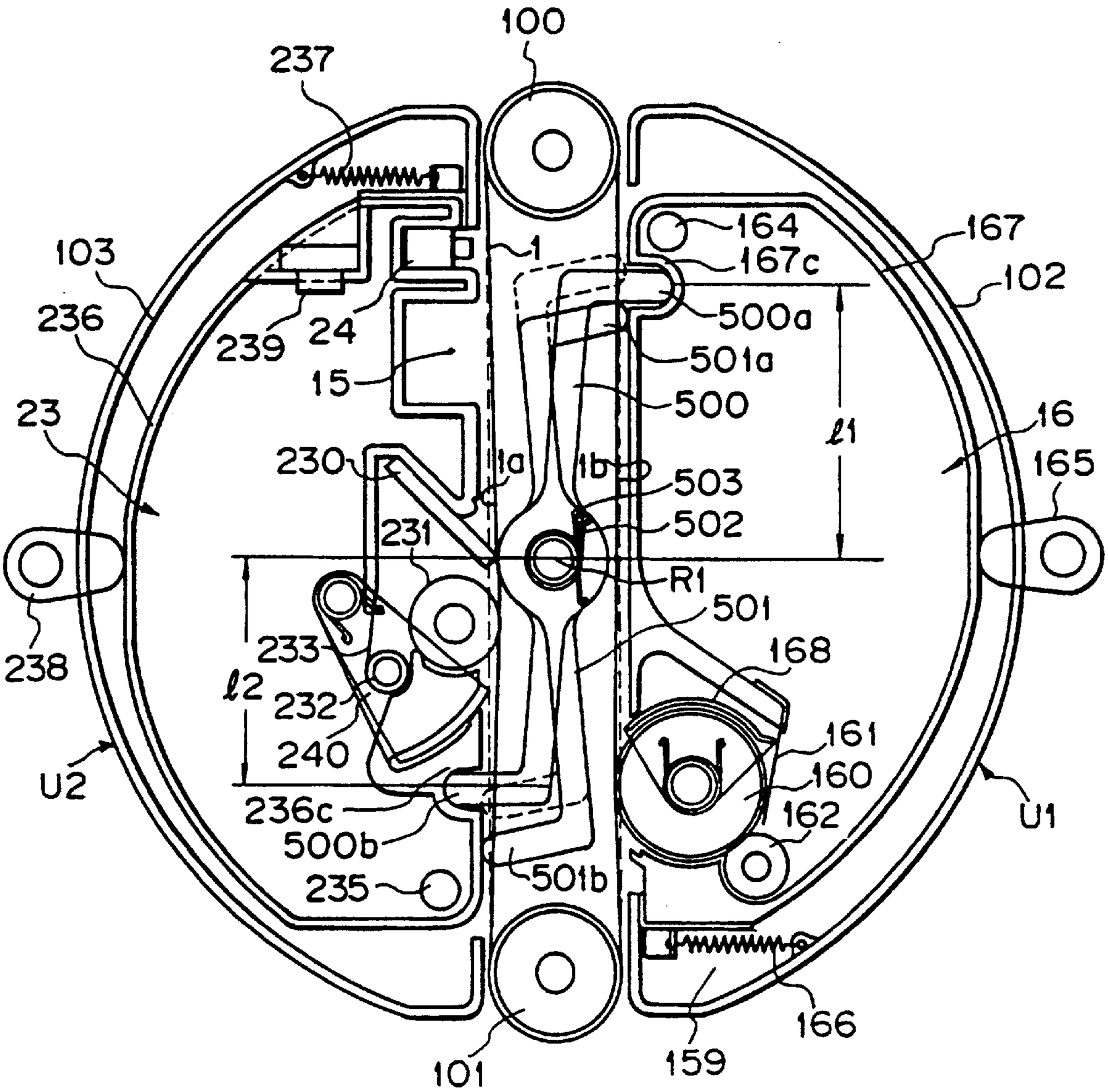
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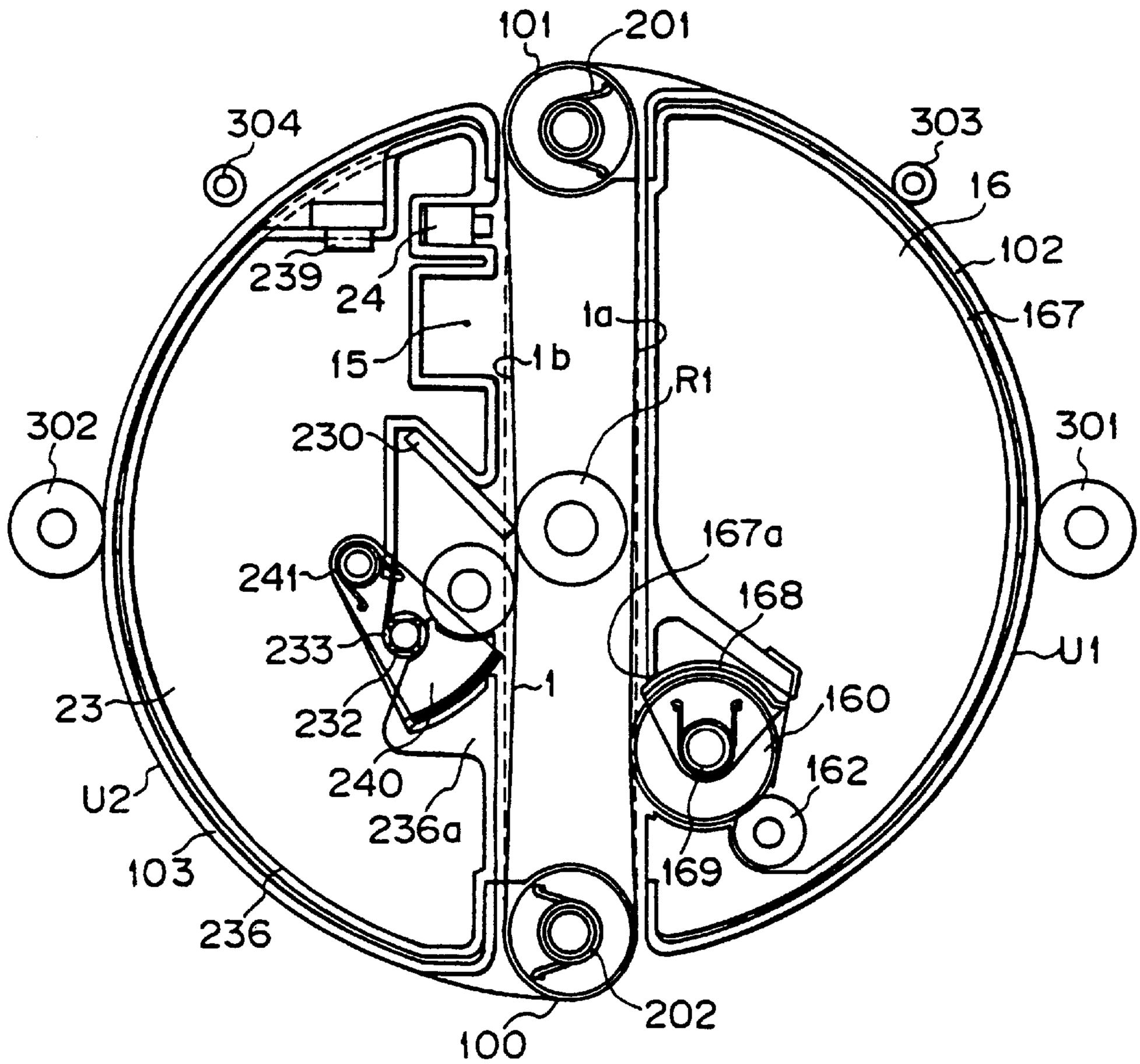
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Fig. 25

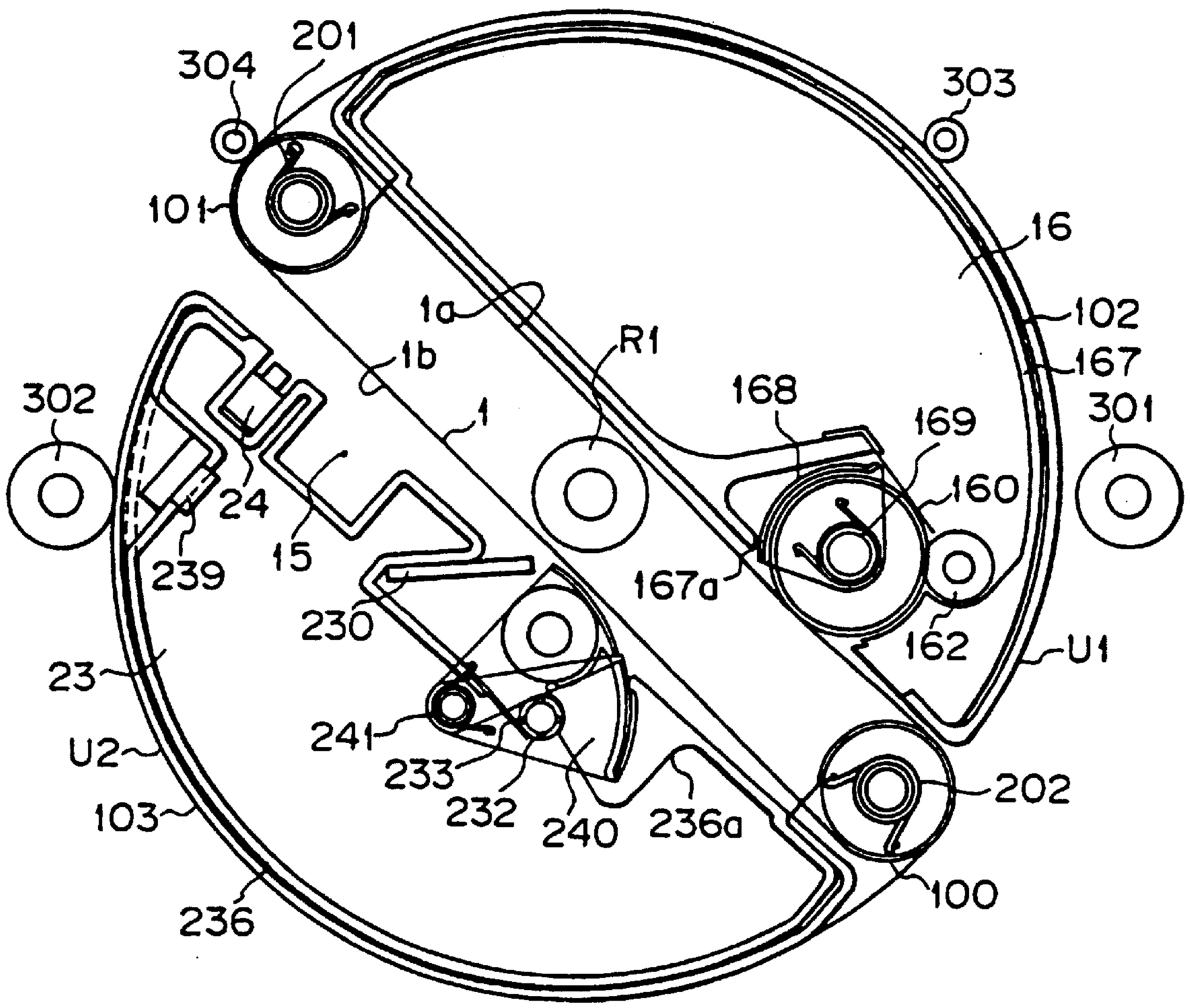
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Fig. 26

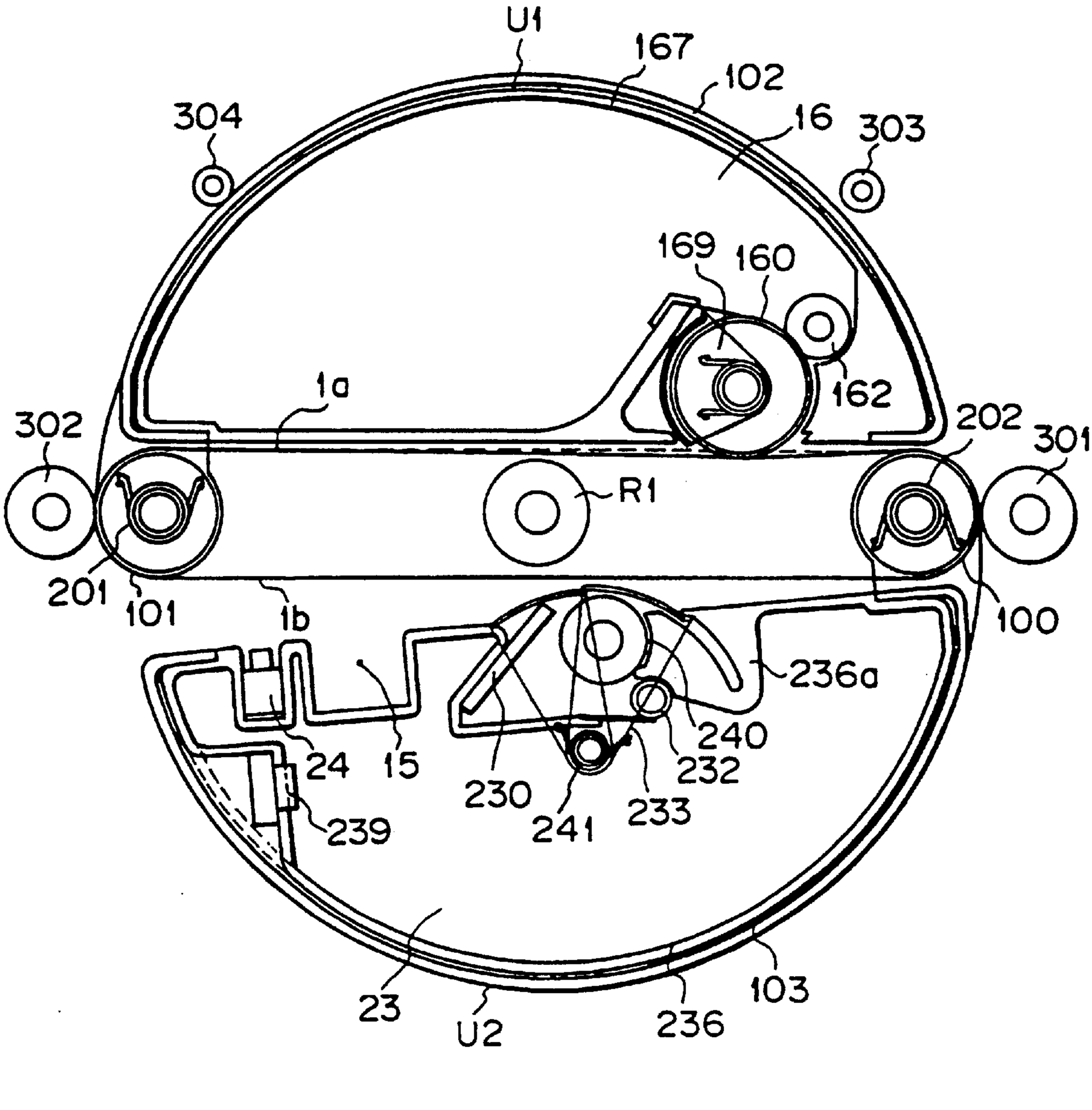
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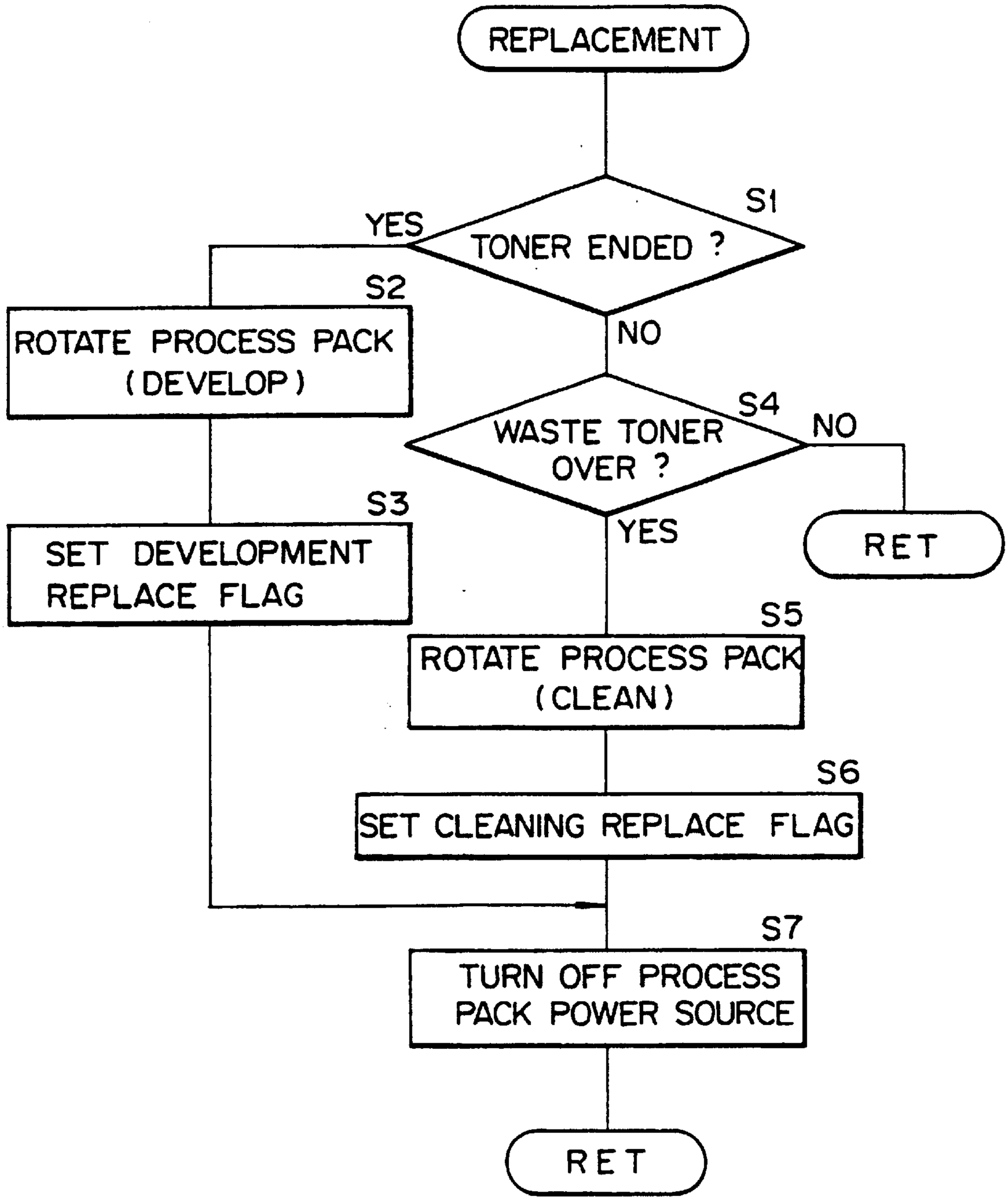
Fig. 27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S2
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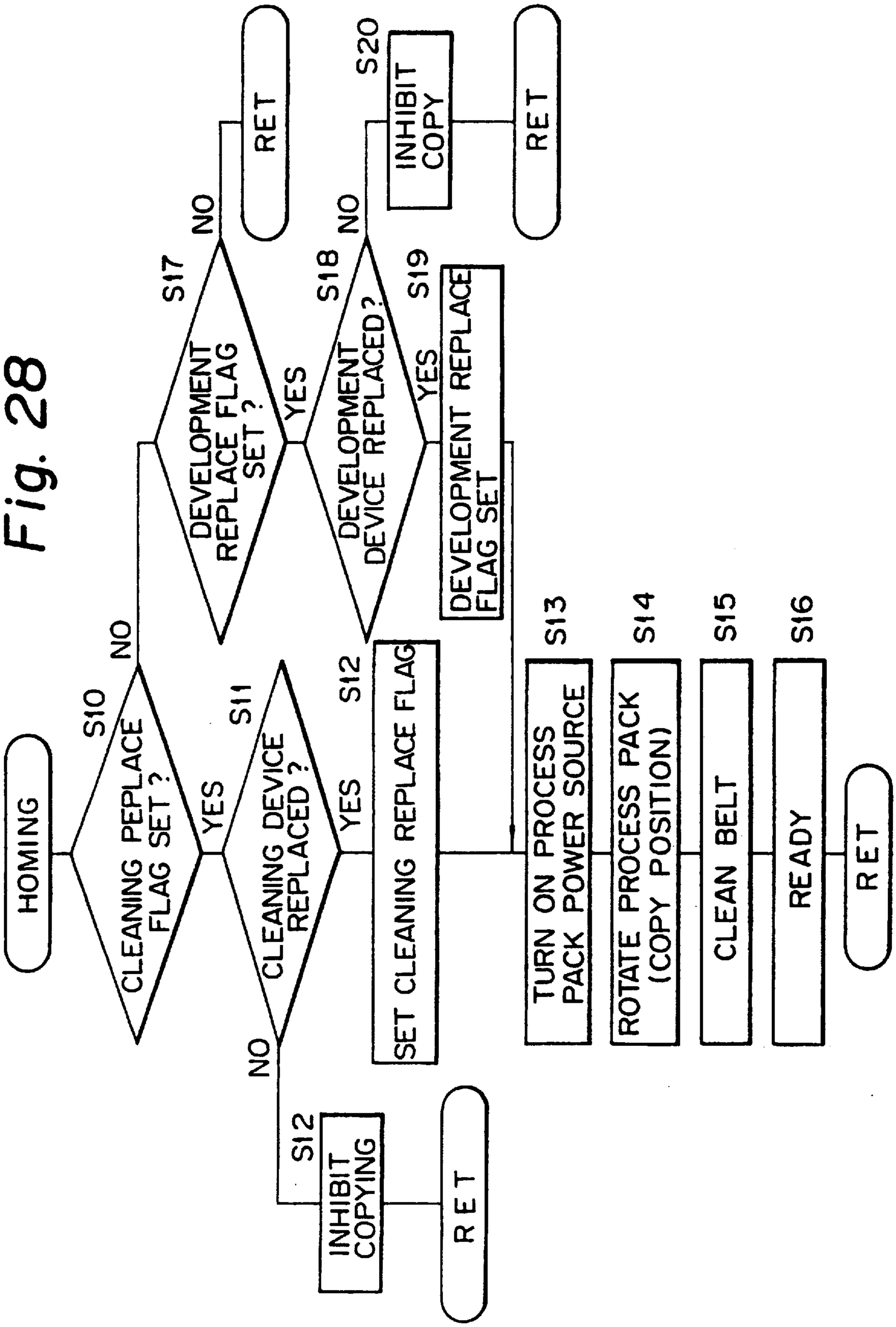
S4
WASTE TONER OVER ?
NO
RET
YES
S3
SET DEVELOPMENT REPLACE FLAG
S5
ROTATE PROCESS PACK (CLEAN)
S6
SET CLEANING REPLACE FLAG
S7
TURN OFF PROCESS PACK POWER SOURCE
RET

Fig. 28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S11
CLEANING DEVICE REPLACED?
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SET CLEANING REPLACE FLAG
S12
INHIBIT COPYING
RET
S13
TURN ON PROCESS PACK POWER SOURCE
S14
ROTATE PROCESS PACK (COPY POSITION)
S15
CLEAN BELT
S16
READY
RET
S17
DEVELOPMENT REPLACE FLAG SET?
NO
YES
S18
DEVELOPMENT DEVICE REPLACED?
NO
YES
S19
DEVELOPMENT REPLACE FLAG SET
S20
INHIBIT COPY
RET

Fig. 29A

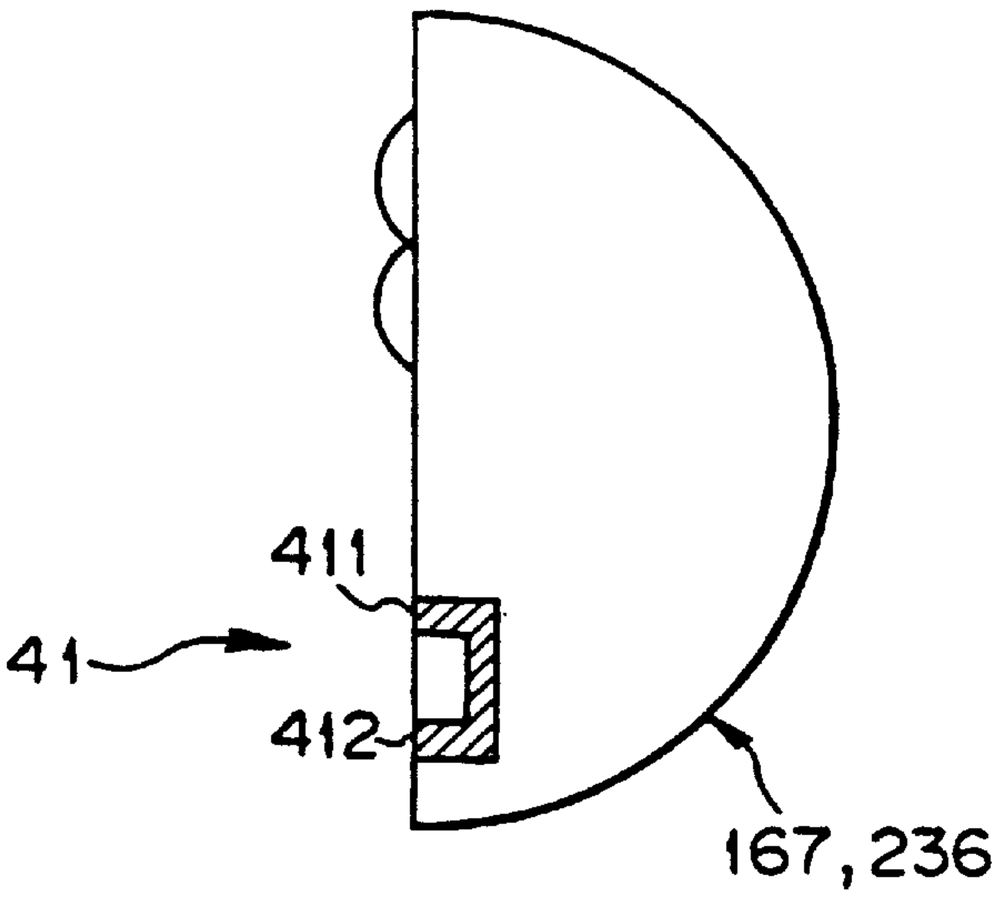


Fig. 29B

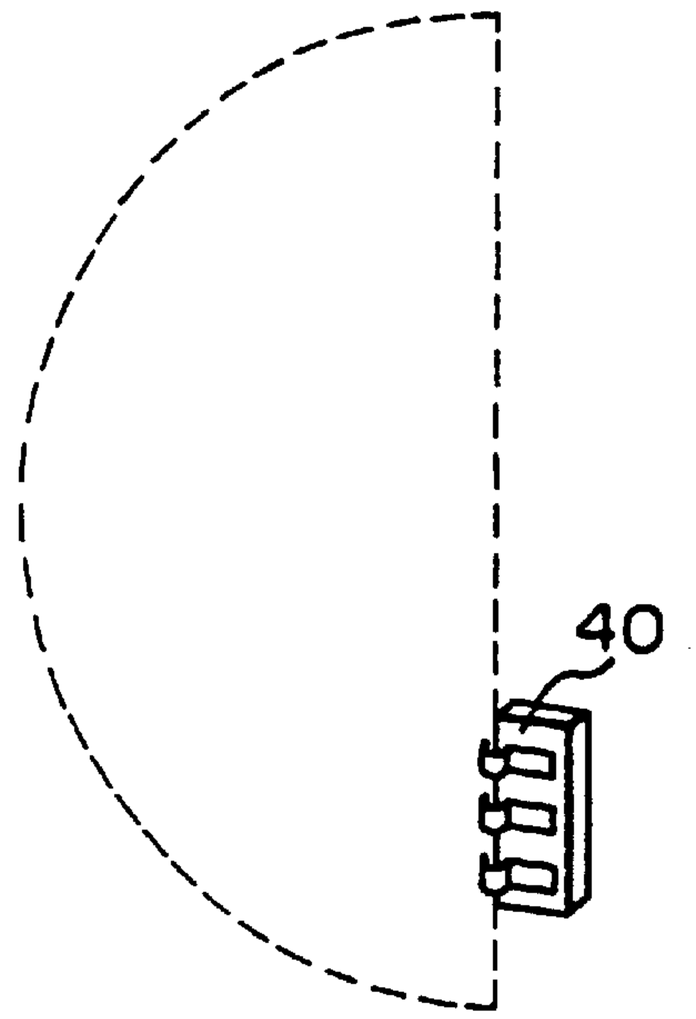


Fig. 29C

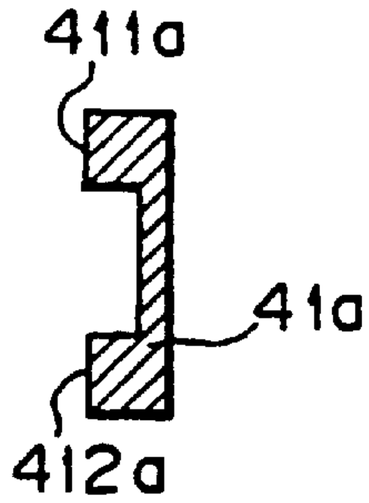


Fig. 29D

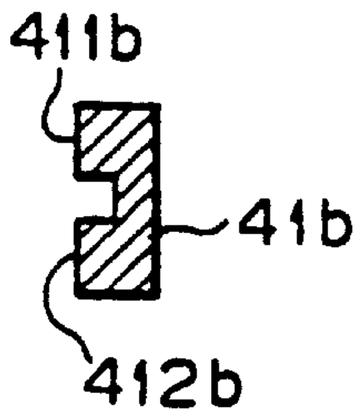
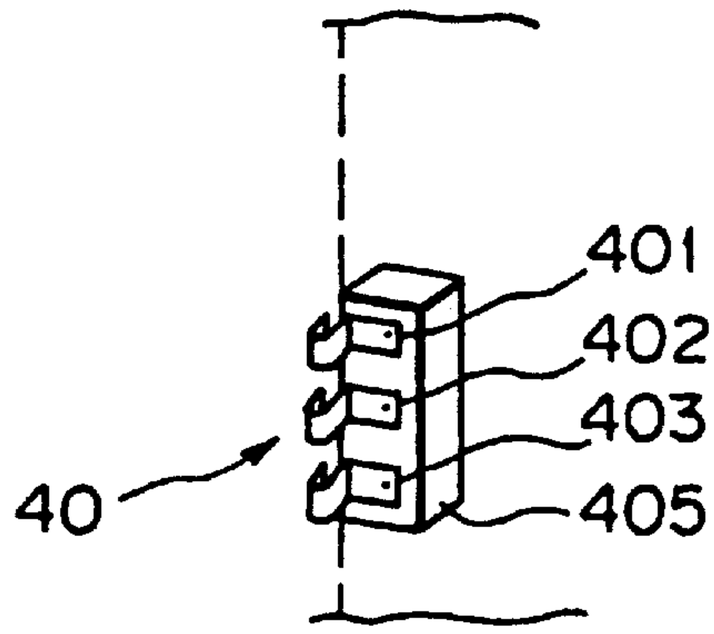


Fig. 29E



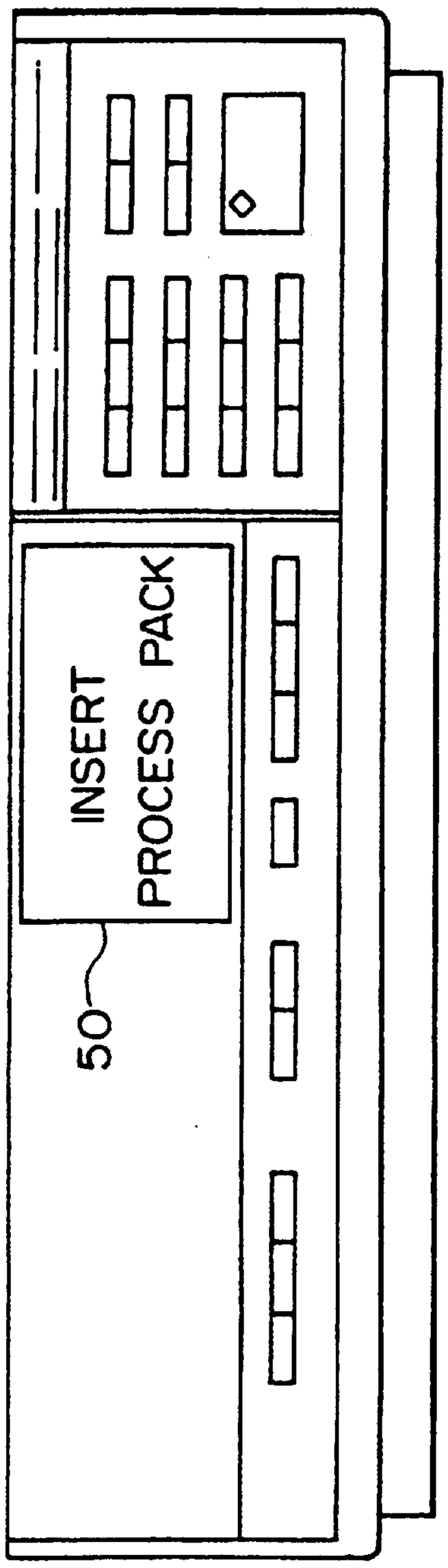


Fig. 30

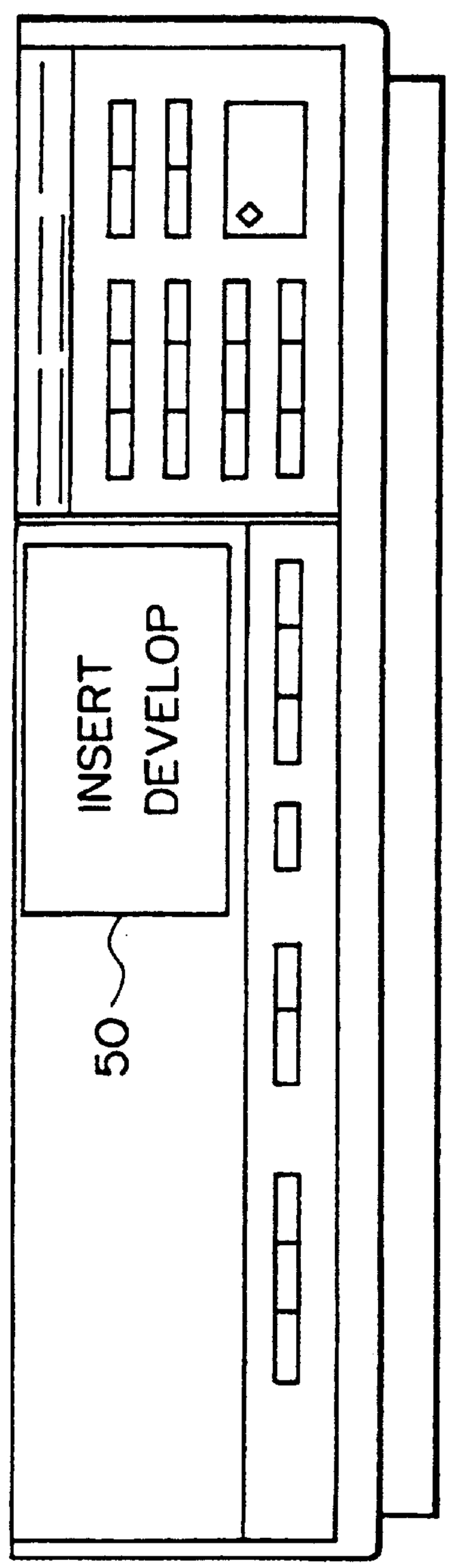


Fig. 31

Fig. 32A

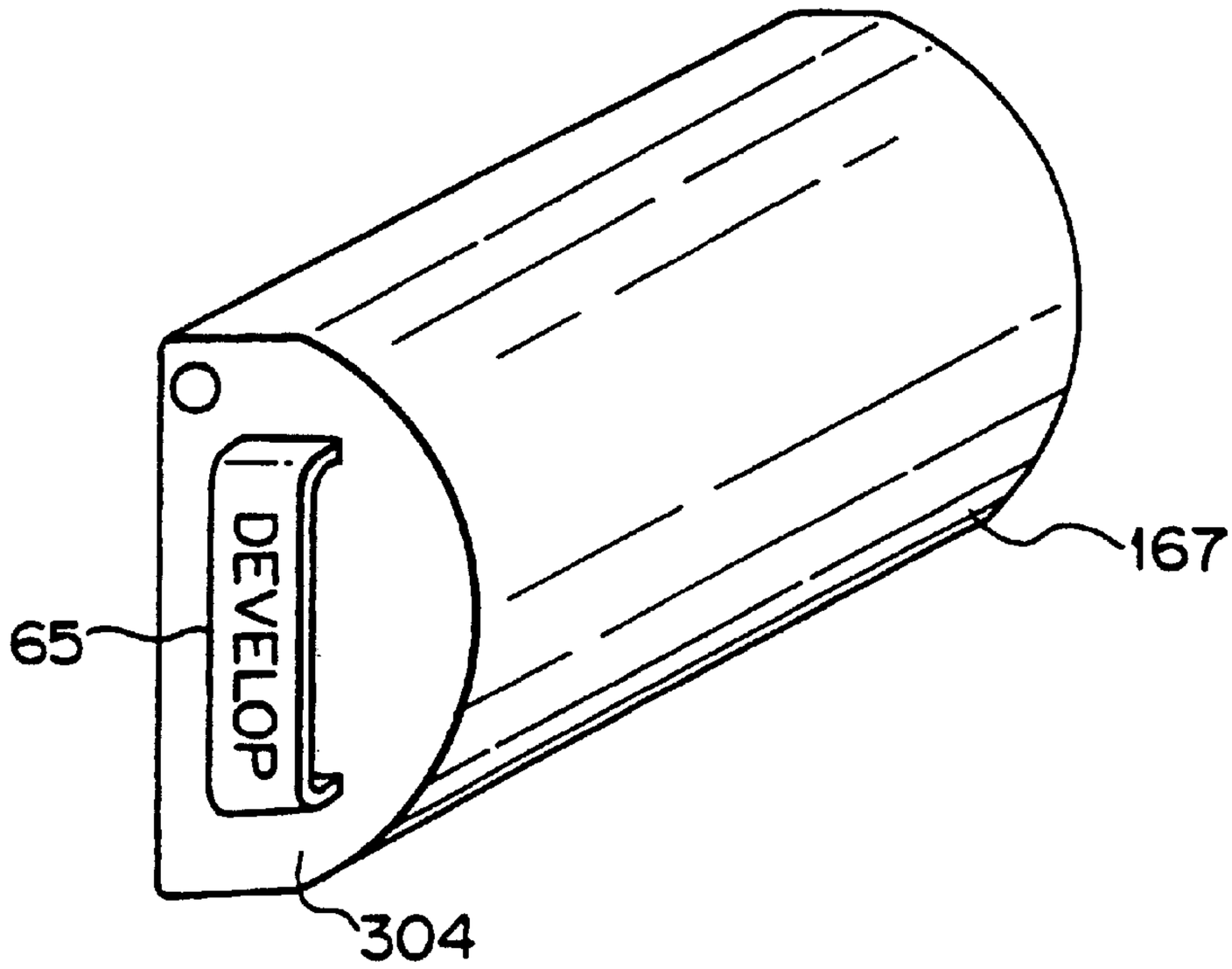


Fig. 32B

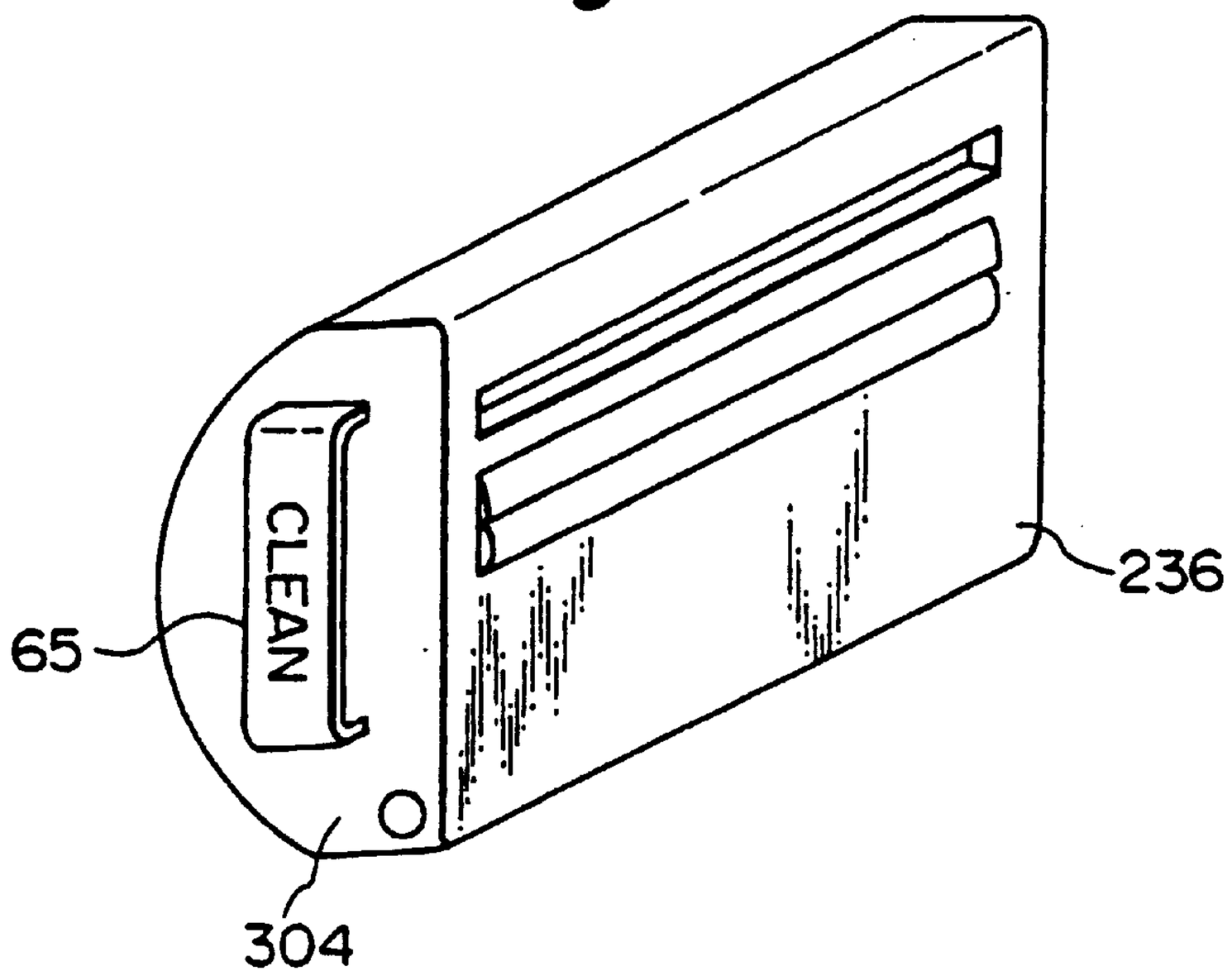


Fig. 33

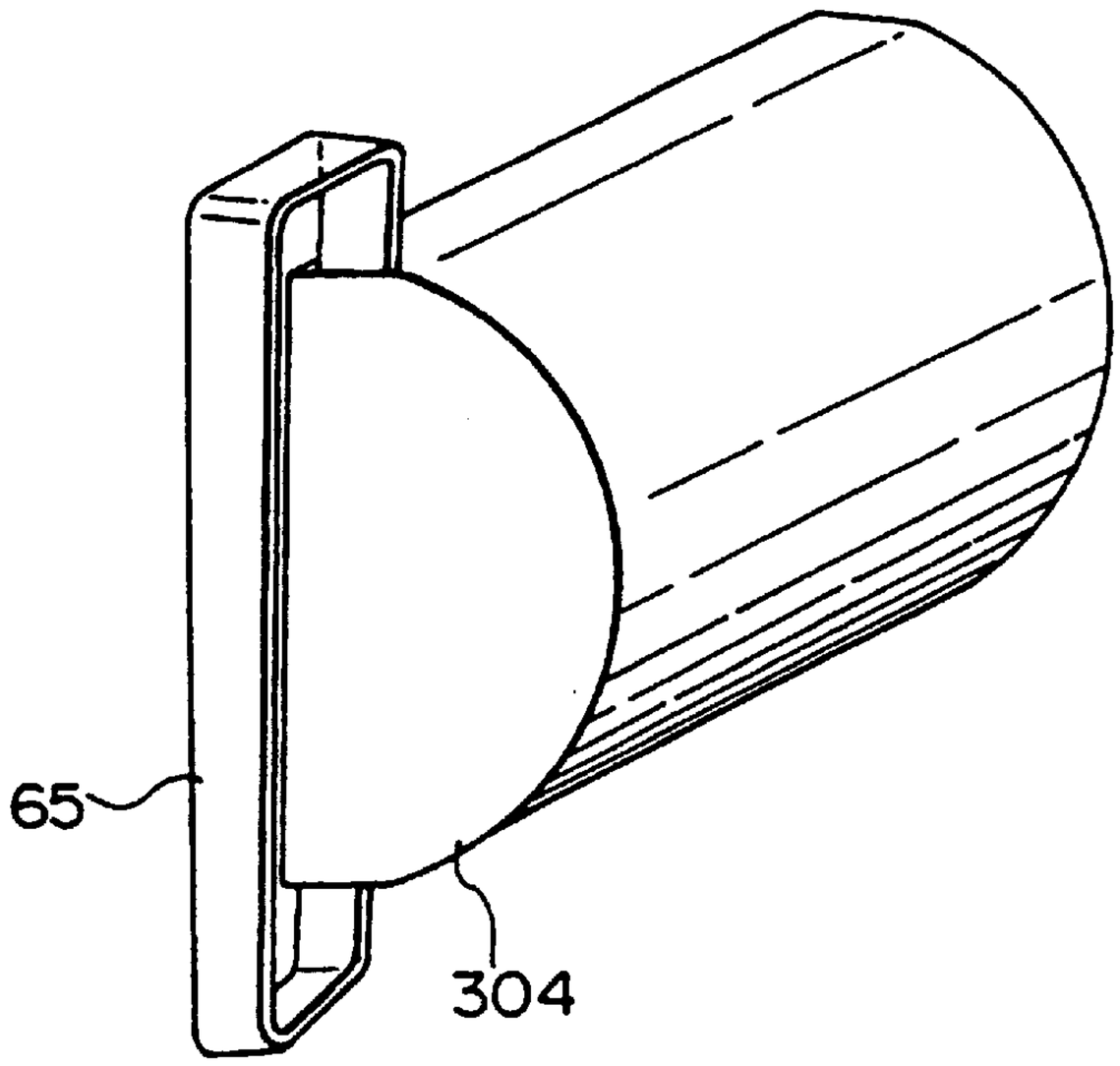


Fig. 34A

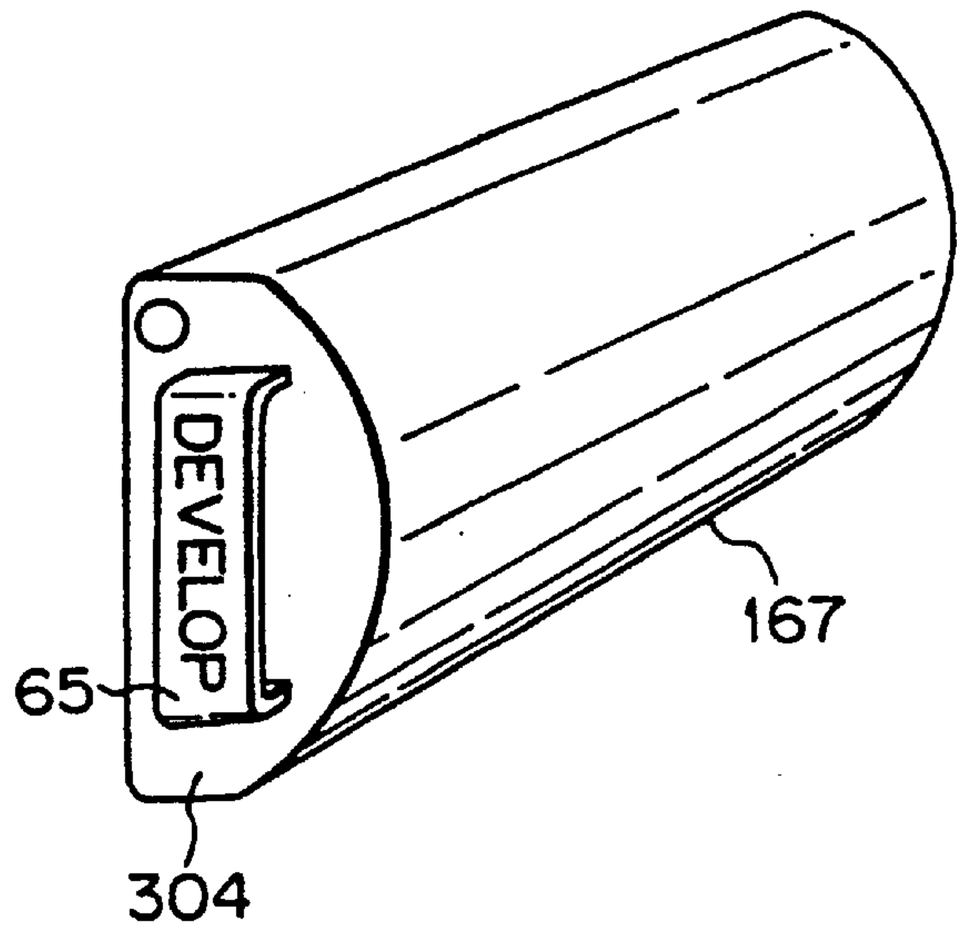
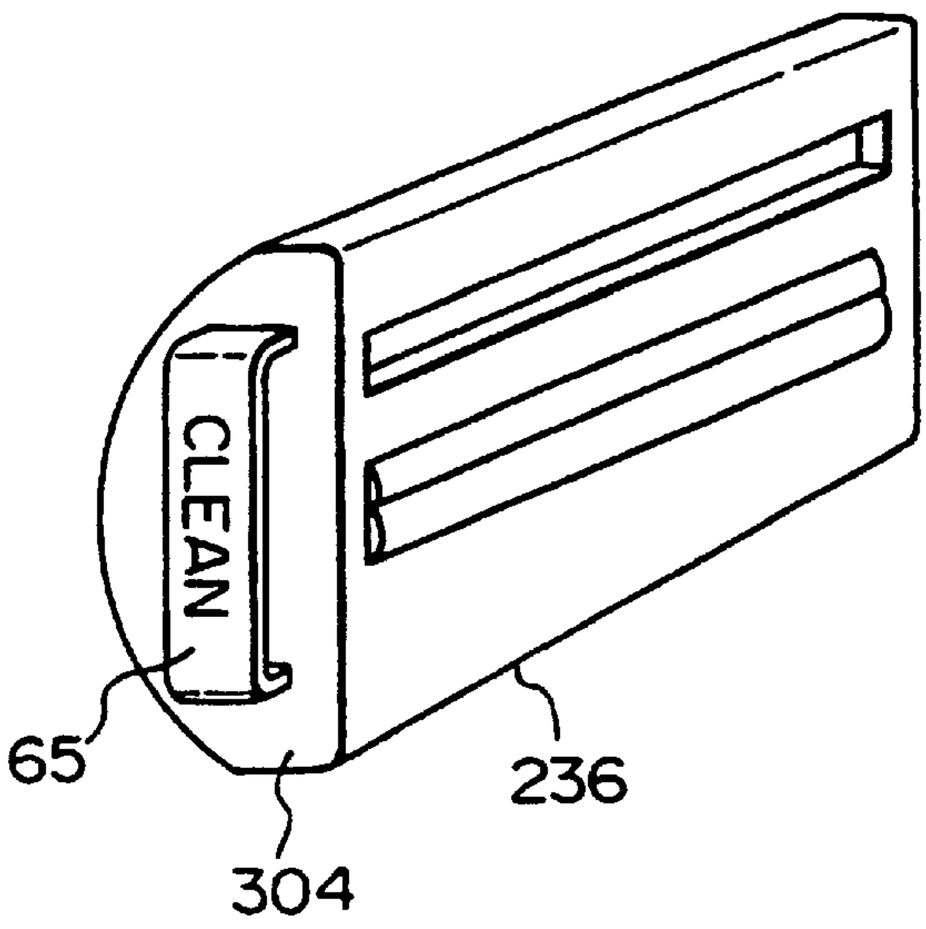


Fig. 34B



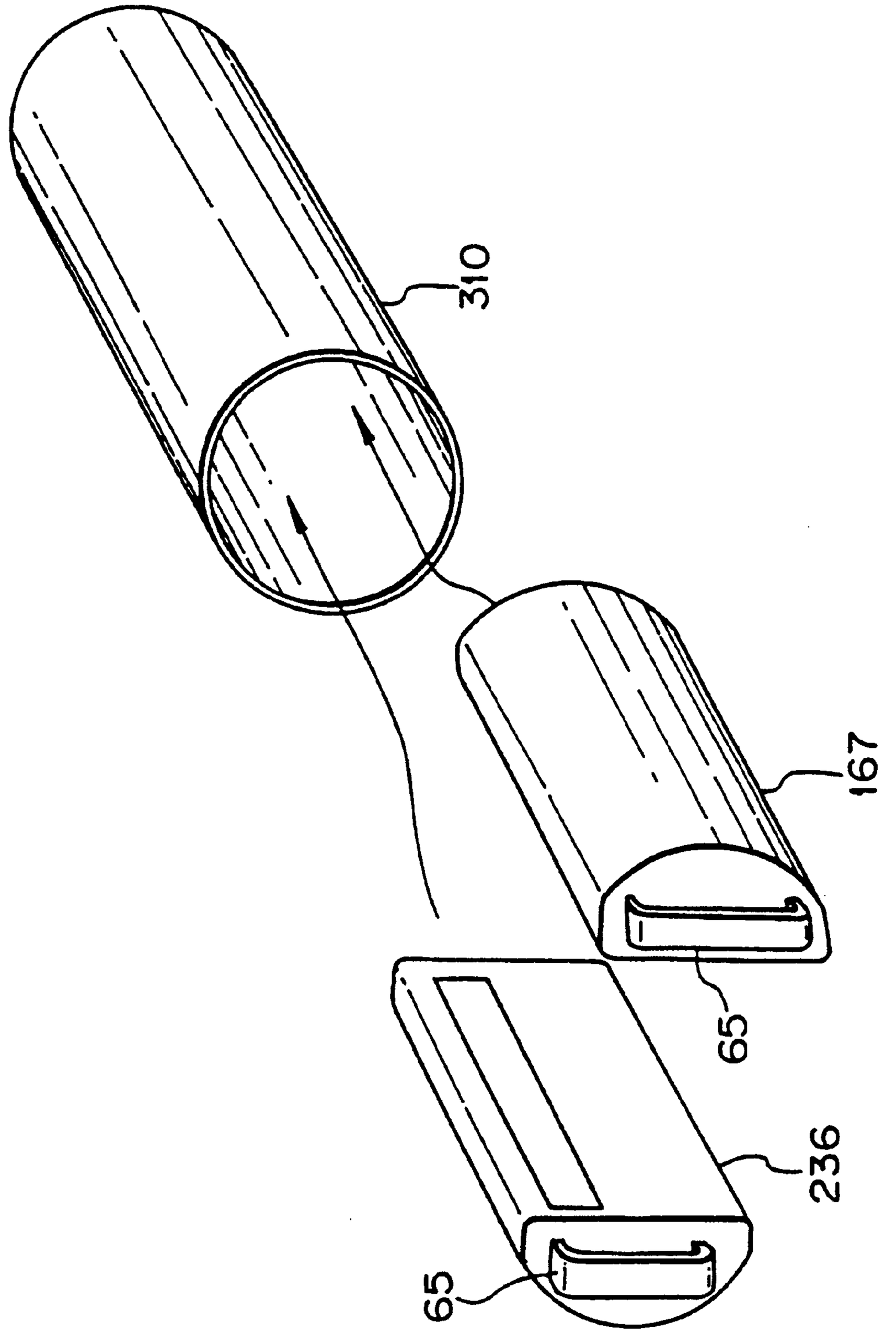


Fig. 35

Fig. 36

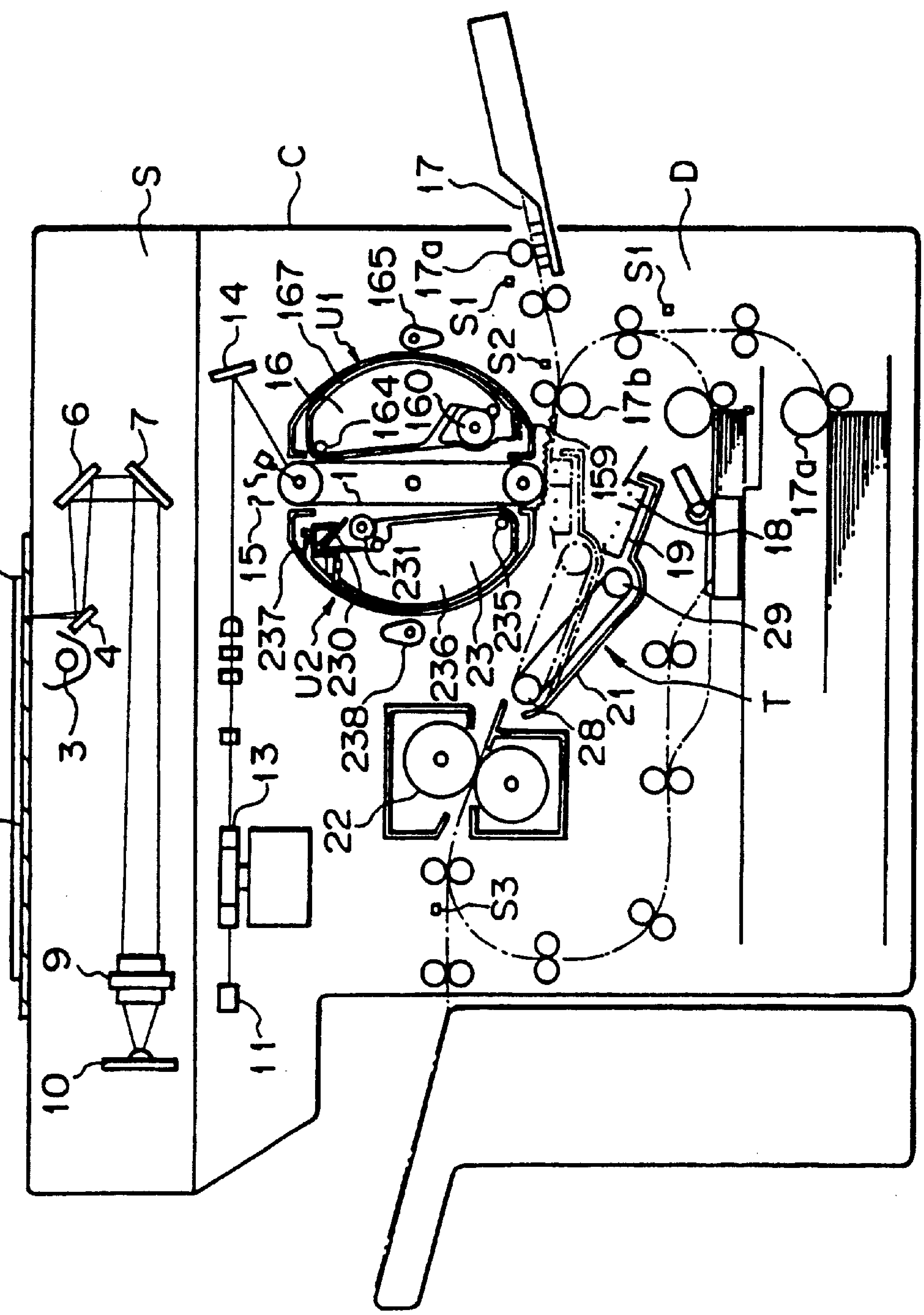

S
C
D
17
17a
S1
S2
165
U1
167
14
16
164
160
159
17b
18
19
29
T
21
28
0
2
3
4
6
7
9
10
11
13
15
1
237
U2
230
231
236
23
235
238
22
S3

Fig. 37

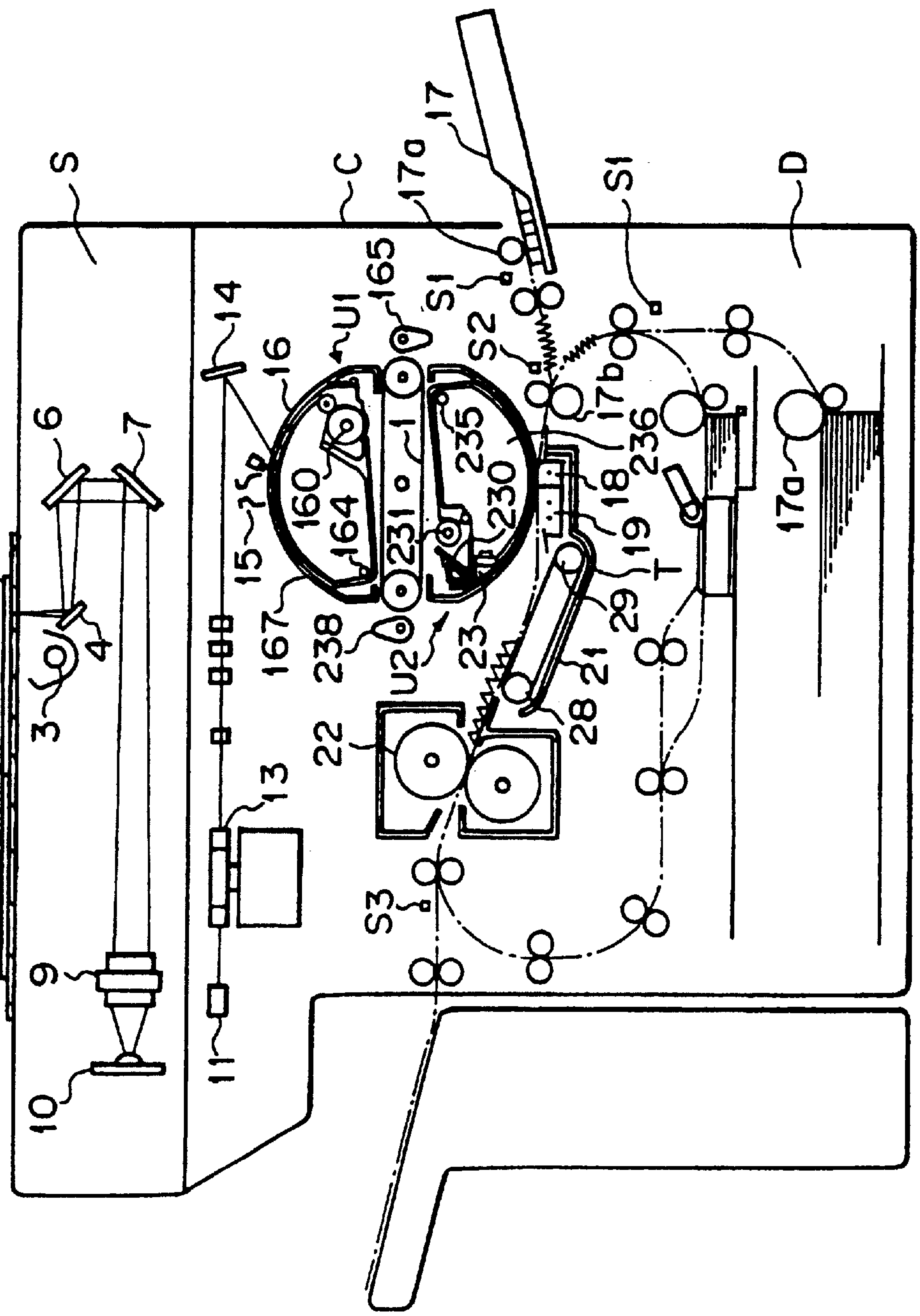

S
C
17
17a
S1
D
O
2
3
4
6
7
9
10
11
13
14
15
16
U1
165
S1
S2
160
164
1
231
235
230
17b
18
236
19
T
29
21
28
23
U2
238
167
22
S3
17a

IMAGE FORMING APPARATUS HAVING ROTATABLE ELECTROPHOTOGRAPHIC PROCESS UNIT

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

BACKGROUND OF THE INVENTION

The present invention relates to a copier or similar image forming apparatus of the type forming a desired image on a recording sheet by electrophotographic process devices which are implemented as units.

A conventional image forming apparatus, e.g., a copier has a main charger, developing device, transfer charger cleaning device and other process devices arranged around a rotatable photoconductive element Such process devices are sequentially arranged in a particular order and mounted on the framework or similar structural member of the copier body with consideration given to their intervals. Today, while the process devices of a copier are increasing in number and in size to meet the demand for versatile functions, there is an increasing demand for a miniature copier. These contradictory demands make the internal layout of the copier complicated. A copier needs daily maintenance associated with the operation of the copier, e.g., the supply of fresh toner and the discharge of waste toner. Also, when the copier stops operating due to an error such as a paper jam on a transport path or the contamination or deterioration of some process device, the copier has to be inspected and repaired. Such maintenance, as well as periodic inspection, is usually performed by dividing and opening part of interest of the copier. This kind of implementation, however, is not always feasible when it comes to the maintenance and inspection of the individual process units, although desirable for the removal of a jamming sheet. In light of this, the photoconductive element and various process devices may be integrally supported by a process unit, as disclosed in Japanese Patent Laid-Open Publication No. 140264/1985, for example. The process unit is removably mounted on the copier body, and the photoconductive element and process units are each movable relative to the others.

A problem with the conventional process unit scheme is that the process unit cannot be readily inserted into or pulled out from the copier body since the mounting position within the copier body is fixed. The fixed mounting position brings about another problem that in the event of maintenance or inspection the toner deposited on, for example, the process devices is apt to smear the person's body and cloths and/or the person is apt to touch and damage the photoconductive element by accident. Moreover, even the routine work such as the supply of fresh toner cannot be done without calling for a serviceman with expert knowledge since it involves the disassembly of part of the copier body. In addition, when the copier is left unoperated over a long period of time, the photoconductive element and the process units have their contacting portions deteriorated due to the pressure continuously acting thereon and/or the toner is solidified at the contacting portions. Then, when the copier is started to operate again, a stripe pattern or similar defect appears on reproductions.

SUMMARY OF THE INVENTION

It is, therefore, an object of the present invention to provide an image forming apparatus which insures extremely easy and sure daily maintenance including toner supply without smearing the operator's cloths or damaging process units.

It is another object of the present invention to provide an image forming apparatus which substantially frees the operator from smears or prevents the operator from inadvertently damaging a photoconductive element in the event of maintenance.

It is another object of the present invention to provide an image forming apparatus which prevents the operator from accidentally damaging a photoconductive element and frees the operator from smears in the event of removal of a jamming sheet.

It is another object of the present invention to provide an image forming apparatus which allows each process device to be surely mounted in the event of replacement and, after the process device has been mounted, automatically cleans a photoconductive element to remove smears therefrom.

An image forming apparatus of the present invention comprises an image carrier, and a plurality of electrophotographic process devices. At least part of the plurality of electrophotographic process devices are constructed into two units each being engageable with the image carrier and rotatable integrally with the image carrier.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present invention will become more apparent from the following detailed description taken with the accompanying drawings in which:

FIG. **1** is a section showing a digital copier which is a specific form of the image forming apparatus in accordance with the present invention;

FIG. **2** is a perspective view of the digital copier;

FIG. **3** is a front view showing an electrophotographic process unit representative of a first embodiment of the image forming apparatus in accordance with the present invention in a locked condition;

FIG. **4** is a view similar to FIG. **3**, showing the process unit in an unlocked condition;

FIGS. **5**A and **5**B are perspective views each showing a process pack included in the embodiment in a particular position;

FIGS. **6**A and **6**B are exploded perspective views each showing a process pack in assembly;

FIG. **7** is a front view of a second embodiment of the present invention in a locked condition;

FIG. **8** is a view similar to FIG. **7**, showing the embodiment in an unlocked condition;

FIG. **9** is a perspective view of a process pack included in the second embodiment and put on a table

FIG. **10** is a front view showing a modified form of the second embodiment in a locked condition;

FIG. **11** is a front view showing the modification in an unlocked condition;

FIG. **12** is a front view showing a third embodiment of the present invention in a locked condition;

FIG, **13** is a view similar to FIG. **12**, showing the embodiment in an unlocked condition;

FIG. **14** is a perspective view of the third embodiment;

FIGS. **15**A and **15**B each shows a specific manner in which a process pack included in the third embodiment is inserted into or pulled out from the copier body;

FIGS. **16**A and **16**B are perspective views each showing a particular process pack included in the third embodiment and having been pulled out from the copier body;

FIG. **17** is a front view showing a fourth embodiment of the present invention in a locked condition;

FIG. **18** is a front view of a fifth embodiment in a locked condition;

FIGS. **19**A and **19**B are perspective views each showing a particular process pack included in the fifth embodiment and having been removed from the copier body;

FIGS. **20**A and **20**B are exploded perspective views each showing the process pack in assembly;

FIG. **21** is a front view of a sixth embodiment of the present invention in an image forming condition;

FIG. **22** is a front view of the sixth embodiment in a standby condition;

FIG. **23** is a front view of a seventh embodiment of the present invention in a locked condition;

FIGS. **24**, **25**, and **26** are front views each showing an eighth embodiment of the present invention in a particular condition;

FIGS. **27** and **28** are flowcharts demonstrating a specific cleaning operation to be executed by the embodiments;

FIGS. **29**A, **29**B, **29**C, and **29**E are fragmentary views each showing essential part of a conduction sensor included in any of the embodiments;

FIGS. **30** and **31** each shows a specific message appearing on an operation and display section;

FIGS. **32**A and **32**B are perspective views each showing a process pack pulled out of the copier body;

FIG. **33** is a respective view also showing a process pack pulled out of the copier body;

FIGS. **34**A and **34**B are perspective views each showing a process pack removed from the copier body.

FIG. **35** shows a specific manner in which process packs may be stored in a receptacle;

FIG. **36** shows a specific condition in which a recording sheet has jammed a transport path at an image transfer station; and

FIG. **37** shows another specific condition ill which a recording sheet has jammed the transport path at another position.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. **1** of the drawings, a digital copier which is a specific form of the image forming apparatus in accordance with the present invention is shown. As shown, the copier has housing C and a glass platen **2** mounted on the top of the housing C. A document O is laid on the glass platen **2**. A scanning section S is disposed below the glass platen **2** and has first optics **5**, second optics **8**, a stationary lens **9**, and a CCD array or similar image reading device **10**. The first optics **5** is movable for reading the document O and includes a lamp **3** and a mirror **4**, while the second optics **8** is also movable and includes mirrors **6** and **7**. Specifically, as a print switch provided on an operating section of the copier is pressed, the first and second optics **5** and **8** are moved in particular directions as indicated by arrows to thereby scan the document O. The image of the document O is read by the image reading device **10** via the optics **5** and **8** and lens **9**, converted to an electric signal, digitized, and then processed.

An image forming section D is arranged below the scanning section S. The image forming section D has

various electrophotographic process devices such as a laser diode (LD) **11**, a LD drive board **12**, a polygonal mirror **13**, a mirror **14**, a photoconductive element in the form of a belt **1**, a developing device **16**, a cleaning device **23**, a main charger **15**, a transfer charger **18**, and a separation charger **19**, as well as a transport belt **21** and a fixing roller pair **22**. A sheet feed section **17** is located upstream of an image transfer station and loaded with a stack of recording sheets. A pick-up roller **17**a feeds the recording sheets one by one toward a register roller pair **17**b. The register roller pair **17**b drives the sheet at a predetermined timing toward the image transfer station defined between the belt **1** and the transfer charger **18**. The signal generated by the image reading device **10** and processed is applied to the LD drive board **12**. In response, the LD drive board **12** applies a drive signal to the LD **11** with the result that the LD **11** emits a laser beam having been modulated by the drive signal. The laser beam is routed through the polygonal mirror **13** and mirror **14** to reach the belt **1** whose surface has been uniformly charged by the main charger **15**. As a result, a latent image representative of the document O is formed on the belt **1**. The latent image is developed by the developing device **16** to become a toner image. When the toner image is transported by the belt **1** to the lower end where the downward run of the belt **1** merges into the upward run, the transfer charger **18** transfers the toner image to the recording sheet by corona discharge. After the image transfer, the separation charger **19** separates the sheet from the belt **1**. The sheet carrying the toner image thereon is further driven to the fixing roller pair **22** to have the toner image fixed thereon and then driven out of the housing C. The cleaning device **23** removes the toner remaining on the belt **1** after the image transfer.

In the illustrative embodiments of the present invention to be described, the photoconductive belt **1** is implemented as an endless belt and passed over rollers, which are spaced apart: by a predetermined distance, such that it has a flat oblong vertical section, as shown in FIG. **1**. The developing device, **16**, cleaning device and other major process units for forming an image are selectively mounted on a pair of units U**1** and U**2** having a substantially identical semicylindrical configuration. The two units U**1** and U**2** are positioned at opposite sides of the parallel flat portions of the belt **1** and engageable with the latter, as described later in detail. An electrophotographic process unit made up of the units U**1** and U**2** and belt **1** has a generally cylindrical configuration having an axis extending in a direction perpendicular to the sheet surface of FIG. **1**. Such a process unit is bodily rotatable about the axis thereof. When the units U**1** and U**2** are rotated together with the belt **1** until either of them aligns with a generally semicircular opening **25**, FIG. **2**, formed through the side wall of the housing C, the unit aligned with the opening **25** can be removed via the opening **25** and replaced with another unit. The belt **1** extends in the vertical direction and has parallel runs **1**a and **1**b which move downward and upward, respectively. When the opposite runs **1**a and **1**b of the belt **1** are held between the units U**1** and U**2**, the upper and lower curved ends **1**c and **1**d, respectively, are bare and define an exposure position and an image transfer position. Therefore, it is not necessary to form an extra opening for image formation in the unit U**1** or U**2**, i.e., the units U**1** and U**2** each having a substantially semicylindrical configuration can cover the entire belt **1** except for the curved portions **1**c and **1**d.

When the copier is not in operation or when maintenance is needed, the electrophotographic process devices constructed into the units U**1** and U**2** are released from the belt **1**. For example, when the developing device substantially

runs out of toner while the copier is in operation or when a toner collecting tank included in the cleaning device is full, it is necessary to supply a toner or to discard the waste toner by interrupting the operation of the copier. In such a case, the embodiments of the present invention each displays an alarm and a guidance on an operation and display section provided on the copier body. As the operator manipulates an operation panel as instructed by the guidance, the unit U1 for development or the unit U2 for cleaning is brought into alignment with the opening **25**. Then, the operator can pull out the unit of interest U1 or U2 and then insert a substitute unit through the opening **25**. This allows any person to perform such replacement with ease. In addition, since the developing unit U1 and cleaning unit U2 are symmetrical to each other with respect to the axis of rotation, they can be inserted into the opening **25** in any order without being distinguished from each other. Hence, even a person not accustomed to the copier can safely set the units U1 and U2 without errors.

As stated above, to supply fresh a toner or to discard a waste toner, the operator has only to pull out one of the two units U1 and U2 through the same opening **25** and then insert a substitute new unis, i.e., it is not necessary for the operator to open a panel provided on the housing C. The operator, therefore, can effect maintenance without calling for or awaiting a serviceman. Moreover, the efficiency of maintenance is enhanced partly because the labor required of the operator is only negligible and partly because the down time and waiting time of the copier is saved.

Preferred embodiments of the present invention will be described hereinafter.

First Embodiment

Referring to FIGS. **3** and **4**, an electrophotographic process unit representative of a first embodiment of the present invention is shown in an locked position and an unlocked position, respectively. As shown, the belt **1** made of an organic photoconductor (OPC) is passed over rollers **100** and **101** having the same diameter. The rollers **100** and **101** are rotated clockwise to in turn rotate the belt **1** in a direction indicated by arrows in the figure. The developing unit U1 and the cleaning unit U2 are respectively located to face the opposite runs **1**a and **1**b of the belt **1** which move in opposite directions to each other, as stated earlier. Regarding the vertical extension, the two units U1 and U2 are symmetrial to each other with respect to the axis of rotation. The belt **1** and units U1 and U2 are bodily rotatable about an axis R1. This allows the units U1 and U2 to be loaded in the copier body in any desired order. The curved portions **1**c and **1**d of the belt **1** which wrap around the rollers **101** and **100**, respectively, are exposed to the outside through the gaps between the contours of the units U1 and U2. The curved portions **1**c and **1**d define respectively an exposure position to which a laser beam is incident and an image transfer position for transferring a toner image to a recording sheet.

The developing unit U1 has a casing **102** accommodating the developing device **16**. The developing device **16** has a developing roller **160** having magnets therein, a toner tank **167**, and an agitator **162** for agitating a toner. An opening **167**a is formed through the flat portion of the toner tank **167** adjacent to one end the flat portion. The developing roller **160** is rotatably mounted on the developing device **16** such that pat of the periphery thereof faces the opening **167**a. In the toner tank **167**, the agitator **162**, a discharge brush **163** and a developing blade **161** are arranged around the developing roller **16**. The discharge brush **163** is located in the vicinity of the opening **167**a. The toner tank **167** is filled with a toner. The agitator **162** is rotated to agitate the toner in the toner tank **167** while feeding it toward the developing blade **161**. The developing blade **161** deposits the toner on the periphery of the developing roller **160** in a predetermined thickness. The developing roller **160** in rotation transports the toner to a latent image electostatically formed on the belt **1** which is held in contact with the roller **160**. As a result, the toner is electrostatically transferred to the latent image to develop it. Part of the toner having not deposited on the belt **1** is transported by the developing roller **160** to the discharge brush **163**. Then, this part of toner is discharged by the discharge brush **163** and then returned to the toner tank **167**. The developing device **16** is supported at one end thereof by a positioning pin **164** and is bodily rotatable about the pin **164**. The casing **102** has a hook portion **166** while the toner tank **167** has a hook portion **167**b at the free end thereof. A spring **159** is anchored at opposite ends thereof to the hook portions **166** and **167**a to constantly bias the entire developing device **16** counterclockwise about the pin **164**, i.e., in a direction for moving the developing roller **160** away from the belt **1**. In an image forming condition, a solenoid, not shown, rotates a cam **165** associated with the developing device **16** to a position shown in FIG. **3**. The cam **165** presses the outer periphery of the toner tank **167** toward the belt **1** against the action of the spring **159** until the free end of the tank **167** abuts against a stop **102**a. The stop **102**a is formed by bending one end of the casing **102** inwardly. In this condition, the developing roller **160** presses the corresponding portion of the belt **1** by a predetermined pressure. The developing unit U1 and cleaning unit U2 are fixed in place by fixing means, not shown, and prevented from rotating about the axis R1.

The cleaning unit U2 has a flat portion which faces the other run **1**b of the belt **1**. A casing **103** accommodates the cleaning device **23** in the flat portion thereof. The cleaning device **23** has the main charger **15** for uniformly charging the belt **1**, and the eraser **24**. A collecting tank **236** has an opening **236**a in alignment with the main charger **15** and eraser **24** in a portion thereof which faces the run **1**b of the belt **1**. A cleaning blade **230** and a rotatable fur brush **231** are located in the vicinity of the opening **236**a and in contact with the belt **1**. A flicker bar **234** is formed integrally with the tank **236** and disposed in the opening **236**a in contact with the fur brush **231**. A toner separating plate **233** extends out from the case **236** and presses against a rotatable toner collecting rod **232**. The separating plate **233** and collecting rod **232** are disposed in the opening **236**a in such a manner as to face the flicker bar **234**. The flicker bar **234**, separating plate **233** and collecting rod **232** close the opening **236**a in cooperation. A full sensor **239** is disposed in the tank **236** in close proximity to the eraser **23** so as to generate an alarm signal when the tank **236** is filled with the waste toner. The tank **236** is rotatably supported at one end thereof by a positioning pin **235** which is positioned symmetrically to the positioning pin **164** of the developing device with respect to the axis of rotation R1. The casing **103** has a hook portion **158** while the tank **236** has a hook portion **236**b at the outer edge of the free end thereof. A spring **237** is anchored at opposite ends thereof to the hook portions **158** and **236**b. In an image forming condition, a cam **238** is rotated to urge the back of the tank **236** toward the belt **1** against the action of the spring **237** until the free end of the tank **236** abuts against a stop **103**a. The stop **103**a is also formed by bending the edge of the casing **103** inwardly. In this condition, the cleaning blade **230** and fur brush **231** are pressed against the upward run **1**b of the belt **1**. The fur brush **231** scrapes off

the toner remaining on the belt **1** while the fur brush **231** beat down the toner from the fur brush **231**. The cleaning blade **230** removes the toner having not scraped off by the fur brush **231**. The toner so removed from the belt **1** is sequentially deposited in the tank **236** by the rotation of the collecting rod **232** and the restriction by the separating plate **233**. After the belt **1** has been so cleaned, the main charger **15** uniformly charges the surface of the belt **1**. Subsequently, the eraser **24** erases the charge except for an image region where a latent image should be electrostatically formed, thereby preparing the belt **1** for another image forming cycle.

As stated above, the developing device **16**, cleaning device **23**, main charger **15** and eraser **24** execute a sequence of latent image forming steps with the belt **1**.

When the toner tank **167** runs out of toner, a toner end sensor, not shown, detects such a condition due to the decrease in the load on the agitator **162** and generates a toner end signal. When the collecting tank **236** is full, the full sensor **239** detects it and causes the operation and display section to display an alarm, as stated earlier. This urges the operator to replace either of the developing unit U1 and cleaning unit U2. As the operator presses a particular switch provided on the operation panel for effecting maintenance, the belt **1** and units U1 and U2 are unlocked and bodily rotated about the axis R1 until the unit U1 or U2 which should be replaced aligns with the opening **25**. Specifically, when the solenoid, not shown, is deenergized, the cam **165** or **238** is rotated unlock the developing device **16** from the casing **102** or unlock the cleaning device **23** from the casing **103**. As a result, the toner tank **167** or the collecting tank **236** is rotated about the positioning pin **164** or **235** away from the belt **1** by the spring **159** or **237**. In this condition, the toner tank **167** or the collecting tank **236** is ready to be pulled out through the opening **25**. The toner tank **167** or the collecting tank **236** to be replaced is implemented as a cartridge which can be attached and detached by a single manual operation (hereinafter referred to as a process pack). After removing the used tank **167** or **236**, the operator inserts a new tank **167** or **236** and then presses a button provided on the operation panel for entering the end of replacement In response, the cam **165** or **238** is again rotated to lock the associated process pack, and then the developing unit U1 and cleaning unit U2 are rotated about the axis R1 to the predetermined vertical position. Then, the copier is ready to operate again.

Since the casings **102** and **103** of the units U1 and U2 have an identical contour, the two different kinds of process packs can each be mounted on either side of the opposite runs **1**a and **1**b of the belt **1**. As stated above, the toner tank **167** and collecting tank **236** have generally semicylindrical configurations which are identical with and symmetric to each other, and tanks **167** and **236** are rotatable integrally with each other. The operator, therefore, can readily replace the developing device **16** run out of toner or full of waste toner simply by pulling out the process pack of interest through the opening **25**, i.e., without calling for a serviceman. Since the major part of the belt **1** and the major process devices are constantly covered by the casings **102** and **103**, the operator intending to, for example, locate a sheet jam or to remove a jamming sheet is prevented from inadvertently touching and, therefore, smearing or damaging the belt **1**. Moreover, the entire electrophotographic process unit can be unlocked except for the image forming condition to release the process devices from the belt **1**. This is successful in freeing the belt **1** and cleaning blade **230** from deterioration otherwise caused by continuous pressurization and preventing the toner from effecting the image formation by being slidified between the belt **1** and the blade **230**.

Each process pack is provided with a handle, as shown in FIGS. **5**A and **5**B. Specifically, the process pack having been pulled out of the copier body is laid on a table with a handle **60** raised as shown in FIG. **5**A or lowered as shown in FIG. **5**B. While the process pack is constituted by a hermetically sealed container except for the opening **167**a or **236**a thereof, the toner or the waste toner stored therein is apt to leak through the opening **167**a or **236**a when the process pack having been pulled out through the opening **25** is carried or put on a table. If the operator carries the process pack in the horizontally long position by holding it by both hands, the operation cannot touch or operate any other thing. In light of this, the handle **60** is provided on the flat portion of the sealed container of the process pack to be movable between the raised position and the lowered position. Opposite ends of the handle **60** are hinged to the flat portion of the sealed container such that they lie in a vertical plane containing the center of gravity of the process pack when brought to the raised position. When the handle **60** is needless, it is received in a groove **70**. When the process pack is pulled out of the copier body, the handle **60** is raised to the position shown in FIG. **5**A. When the process pack is to be inserted into the copier body, the handle **60** is lowered to the position shown in FIG. **5**B. Further, the sealed container of the process pack has a front end plate **304** which extends lightly radially outward from the semicylindrical portion **300** and, therefore, has a slightly greater cross-sectional area than the semicylindrical portion **300**. In addition, the front plate **304** has a slightly greater radial dimension than the casing **102** or **103**. Hence, while the body of the process pack can enter the casing **102** or **103**, the end plate **304** is prevented from entering it by the front edge of the casing **102** or **103**. This is successful in preventing the process pack from being inserted into the copier body in a wrong position and in, when former is inserted into the copier body in a correct position into the latter, accurately positioning it.

As shown in FIG. **6**A, the toner tank **167** is made up of a developing function section **301**, and a semicylindrical container cover **300**. As shown in FIG. **6**B, the collecting tank **236** is made up of a cleaning function section **302** and a semicylindrical container cover **300**. The function sections **301** and **302** are each combined with associated cover **300** and then connected to the latter by fusing. Since both of the function sections **301** and **302** include the covers **300** having an identical configuration, the two different kinds of process packs can be produced on quantity basis. The containers may be made of resin to facilitate the assembly and cut down the cost.

Second Embodiment

Referring to FIGS. **7** and **8**, a second embodiment of the present invention will be described. The conditions shown in FIGS. **7** and **8** correspond to FIGS. **3** and **4**, respectively. This embodiment is distinguishable from the first embodiment in that when the cam **165** or **238** is rotated to unlock the associated unit U1 or U2, the opening of the process pack associated with the unit U1 or U2 is closed by a shutter mechanism. In the figures, the same or similar parts or structural elements are designated by like reference numerals, and redundant description will be avoided for simplicity.

Specifically, as shown in FIG. **7**, a shutter **168** is concentrically associated with the developing roller **160** of the developing device **16**. A coiled torsion spring **169** is affixed to the shaft of the developing roller **160** coaxially with the roller **160**. The torsion spring **169** is anchored at one end to

the toner tank **167** and at the other end to the shutter **168**. In an unlocked condition (FIG. **8**), the shutter **168** is urged by the torsion spring **169** in a direction for closing the opening **167**a of the toner tank **167**. In a locked condition or image forming condition (FIG. **7**), the shutter **168** uncovers the opening **167**a against the action of the torsion spring **169**. Likewise, a coiled torsion spring **241** is positioned in close proximity to the toner separating plate **233** of the cleaning device **23**. This torsion spring **241** is anchored at one end to the collecting tank **236** and at the other end to one of two members which constitute a shutter **240**. The dual shutter **240** is rotatable about the core of the torsion spring **241**. In the unlocked condition (FIG. **8**), the shutter **240** is urged by the torsion spring **241** in a direction for covering the opening **236**a. As shown in FIG. **8**, when the cam **165** is rotated to unlock the associated unit U**1**, the toner tank **167** is moved away from the downward run **1**a of the belt **1** by the action of the spring **159**. As a result, the shutter **168** is rotated by the torsion spring **169** to cover the opening **169**a. A gear mechanism, not shown, interlocks the shutter **168** to the toner tank **167**.

As stated above, when the developing device **16** is pulled out, the shutter **168** closes the opening **167**a of the toner tank **167**. In this condition, the toner is prevented from leaking via the opening **167**a and smearing the operator's body or the room. Likewise, when the cam **238** is rotated to unlock the cleaning unit U**2**, the collecting tank **236** is rotated away from the upward run **1**b of the belt **1** and, at the same time, the shutter **240** closes the opening **236**a of the collecting tank **236** due to the force of the torsion spring **241**. As a result, the waste toner collected in the tank **236** is prevented from leaking to the outside. In this embodiment, too, the developing unit U**1** and cleaning unit U**2** have an identical sectional shape and, therefore, can each be mounted on any side of the opposite runs **1**a and **1**b of the belt **1**. If desired, the process packs may be colored for distinction, e.g. the toner tank **167** and the collecting tank **236** may be painted red and blue, respectively. In such a case, the kinds of the two process packs may be displayed in red and blue on the operation and display section. This allows the operator to see a process pack to be mounted on the basis of the color.

FIG. **9** shows the process pack of the illustrative embodiment which is pulled out from the copier body and placed on a table. In the first embodiment, since the process pack has the opening **167**a or **236**a in the flat portion thereof, it has to be put on a table with the curved wall facing downward in order to prevent the toner from leaking. However, such a curved bottom is not stable and is apt to roll when subjected to even a slight shock, causing the toner to leak. By contrast, since the second embodiment causes the shutter **168** or **240** to close the associated opening **167**a or **236**a of the process pack, the toner or the waste toner does not leak even when the process pack is placed on a table with the flat portion facing downward. Legs **61** extend out from opposite ends of the flat portion of the process pack. When the process pack is put on a table in the above-mentioned position, the legs **61** prevent the shutter **168** or **240** slightly protruding from the flat portion and the process device facing the opening **167**a or **236**a from contacting the table. When the handle **60** is raised, opposite ends thereof hinged to the process pack lie in a vertical plane containing the center of gravity of the process pack. The handle **60** is received in the groove **70** when not necessary.

While the embodiment moves both the process pack of the developing unit U**1** and the process pack of the cleaning unit U**2** away from the belt **1** in the event of replacement, an arrangement may be so made as to move only the unit which should be pulled out from the opening **25** away from the belt **1**. Specifically, FIG. **10** shows a condition wherein the developing unit U**1** is aligned with the opening **25**, and only the process pack of the developing unit U**1** is spaced apart from the belt **1**. FIG. **11** shows a condition wherein the cleaning unit U**2** is aligned with the opening **25**, and only the process pack of the cleaning unit U**2** is spaced apart from the belt **1**.

Third Embodiment

FIGS. **12** and **13** show a third embodiment of the present invention in a locked condition and an unlocked condition, respectively. This embodiment is distinguishable from the first embodiment in that the positioning pins **164** and **235** are absent, and in that the casing **102** and developing unit and the casing **103** and cleaning unit U**2** are respectively integrally rotatable about the rollers **100** and **101** to an unlocked position when the associated cams **16** and **238** are rotated. Specifically, the developing unit U**1** has the toner tank **167** and the casing **102** accommodating the toner tank **167** constructed into a single body which is rotatable about the axis of the roller **101**. A coiled torsion spring **201** is mounted on the shaft of the roller **101** coaxially with the roller **101** and constantly biases the developing unit U**1** away from the downward run **1**a of the belt **1**. The cam **165** presses the casing **102** such that the developing roller **160** presses against the run **1**a of the belt **1**, against the action of the torsion spring **168**. Likewise, the cleaning unit U**2** has the collecting tank **236** and the casing **103** accommodating the tank **236** constructed into a single body which is rotatable about the axis of the roller **100**. A coiled torsion spring **202** is mounted on the shaft of the roller **100** coaxially with the latter to constantly bias the cleaning unit U**2** away from the upward run **1**b of the belt **1**. The cam **238** presses the casing **103** such that the cleaning blade **230** and fur brush **231** press against the run **1**b of the belt, against the action of the torsion spring **202**. As shown in FIG. **13**, when the cam **165** is rotated to unlock the developing unit U**1**, the casing **102** with the toner tank **167** is rotated away from the run **1**a of the belt **1** by the torsion spring **201** to allow the tank **167** to be removed through the opening **25**. Likewise, when the cam **238** is rotated to unlock the cleaning unit U**2**, the casing **103** with the collecting tank **236** is rotated away from the belt **1** by the torsion spring **202** to allow the tank **236** to be removed through the opening **25**.

In this embodiment, too, the belt **1** is covered by the units U**1** and U**2** except for opposite ends **1**c and **1**d thereof which wrap around the rollers **101** and **100**, respectively. The ends **1**c and **1**d define the exposure position and the image transfer position, respectively. Of course, the developing unit U**1**, cleaning unit U**2** and belt **1** are bodily rotatable to a position where either of the units U**1** and U**2** faces the opening **25** for the replacement of the process pack.

In the illustrative embodiment, each of the process packs has an oscillator therein which oscillates at a particular high frequency. In this case, a microswitch is provided on the handle of each process pack. When the operator holds any of the process packs, the microswitch of the process pack is closed to apply a source voltage to the oscillator built in the process pack. A receiver capable of receiving such high frequencies is mounted on the copier body in close proximity to the opening **25**. In the event of replacement, as the operator picks up a particular process pack, the oscillator of the process pack transmits a particular high frequency wave to the receiver mounted on the copier body. Then, a controller identifies the kind of the process pack on the basis of the received frequency and displays a guidance message.

As shown in FIG. **14**, in this embodiment, the opening **25** formed through the front panel of the copier body has a semicircular shape whose flat portion faces upward. Hence, the process pack is pulled out through the opening **25** with the opening **167**a or **236** facing upward. Such an opening **25** allows the operator to remove or insert the process pack by holding the semicylindrical periphery by one hand and holding one end by the other hand.

Specifically, FIGS. **15**A and **15**B show respectively a condition wherein the process pack is held by right hand and condition wherein it is held by left hand. As these figures indicate, the operator, whether he or she be right-handed or left-handed, can remove or insert the process pack by holding the semicylindrical periphery by one hand and holding one end by the other hand. As shown in FIGS. **16**A and **16**B, labels or similar indications are provided on the process packs to distinguish the developing unit and the cleaning unit from each other.

Fourth Embodiment

FIG. **17** shows a fourth embodiment of the present invention in a locked condition. As shown, this embodiment differs from the first embodiment in that the eraser **24** is located outside the process unit and not mounted on the collecting tank **236** of the cleaning unit U2. Excluding the eraser **24**, which is a process device sparingly susceptible to aging, from the process pack is successful in reducing the cost of the process pack as well as waste.

Fifth Embodiment

FIG. **18** shows a fifth embodiment of the present invention in a locked condition. This embodiment differs from the first embodiment in that the main charger **15** and eraser **24** are excluded from the process unit, and in that the cleaning blade **230** and fur brush **231** are located at a substantial distance from the developing roller **160** and in the vicinity of the free end of the collecting tank **236**. With such a configuration, this embodiment achieves the object of the fourth embodiment and, in addition, enhances the collection of waste toner, increases the distance which the cleaning blade **230** and fur brush **231** move in the event of rotation, and causes the opening to face upward when the process pack is removed from the copier body. FIGS. **19**A and **19**B each shows one of the process packs of the embodiment which has been removed from the copier body and is ready to be carried by hand. In this embodiment, the handle **60** is hinged to the semicylindrical wall of the hermetic container of the process pack at an end portion adjacent to the opening **167**a or **236**a. The handle **60** may be received in the groove **70** when not used. As shown, when the operator carries the process pack by holding the handle **60**, the toner tank **167** or the collecting tank **236** has the opening **167**a or **236**a thereof closed by the shutter **168** or **240**. This, coupled with the fact that the opening **167**a or **236**a is located in an upper portion of the associated tank **167** or **236**, causes the toner or the waste toner to remain in a lower portion of the hermetic container and prevents it from leaking through the opening.

FIGS. **20**A and **20**B show respectively the developing tank **167** and the collecting tank **236** of the illustrative embodiment in exploded views. As shown, both the tank **167** and the tank **236** include a container cover **303** which defines one half of the flat portion. The container cover **303** constitutes the tank **167** in combination with the developing function section **301** or constitutes the tank **236** in combination with the cleaning function section **302**. Specifically, the container cover **303** has a trough-like configuration made up of a curved portion forming substantially one-quarter of a cylinder, and a flat portion having substantially one half of the width of the flat portion of the container. Such an assembly is as advantageous as the assembly described in relation to the first embodiment.

Sixth Embodiment

FIGS. **21** and **22** show a sixth embodiment of the present invention in an image forming condition and a standby condition, respectively. This embodiment is essentially similar to the fifth embodiment except that the developing roller **160** and the cleaning blade **230** and fur brush **231** are so positioned as not to protrude from the flat portions of the developing unit U1 and cleaning unit U2, respectively, that shutter mechanisms are respectively associated with the units U1 and U2 to be movable along the flat portions of the latter, and that a mechanism is provided for pressing the belt **1** against the developing roller **160** and the cleaning blade **230** and fur brush **231** which are exposed through the openings **167**a and **236**a, respectively.

Specifically, shutters **170** and **242** respectively close the openings **167**a and **236**a of the toner tank **167** of the developing unit U1 and the collecting tank of the cleaning unit U1 when the associated process packs are pulled out from the copier body. Bars **104** and **105** are rotatably and coaxially mounted on the shafts of the upper roller **100** and lower roller **101**, respectively. The bars **104** and **105** are constantly biased to face each other in the vertical direction by tension springs, not shown. Presser rollers **106** and **107** are rotatably mounted on the free ends of the bars **104** and **105**, respectively. In the standby condition shown in FIG. **22**, the bars **104** and **105** are positioned on a line connecting the shafts of the upper and lower rollers **100** and **102** such that the presser rollers **106** and **107** face each other with the intermediary of the axis of rotation R1. In this embodiment, the cleaning blade **230** and fur brush **231** and the developing roller **160** are each disposed in the associated casing **102** or **103** at a predetermined distance from a plane containing opposite inwardly bent edges of the casing. Hence, even when the process unit is locked, the cleaning blade **230** and fur brush **231** or the developing roller **160** is spaced apart from the belt **1** by a predetermined distance. The shutters **170** and **242** are each slidable along the flat portion of the associated process pack and constantly biased by a tension spring, not shown, in a direction for closing the opening **167**a or **236**a. In the illustrative embodiment, even when the process units are held in their locked state, the shutters **170** and **242** close their associated openings **167**a and **236**a so long as the process units are not operated. In this condition, the toner tank **167** and collecting tank **236** are hermetically closed by the shutters **170** and **242**, respectively.

When either of the process units should be removed from the copier body, the cam **165** or **238** is rotated to unlock the unit of interest U1 or U2, as in the fifth embodiment. Then, the unit of interest is rotated about the axis R1 to the position where it faces the opening **25**. The shutters **170** and **242** extend along the flat portions of the individual process packs. Hence, when the desired process pack is pulled out from the copier body, the flat portion thereof where the opening **167**a or **236**a is closed by the shutter **170** or **242** constitutes a sealed surface having no projections and is, therefore, easy to handle. In addition, the shutters **170** and **242** are each opened and closed by a simple mechanism and, therefore, free from errors due to, for example, the toner which may stop the mechanism.

As shown in FIG. **21**, in an image forming condition, each of the shutters **170** and **242** is caused to retract toward the pin

164 or 235 by a drive mechanism, not shown, against the action of the tension spring, thereby uncovering the opening 167a or 236a. At the same time, each bar 104 or 105 is rotated clockwise by a drive mechanism, no shown, against the force of the tension spring with the result that the associated presser roller 106 or 107 is pressed against the adjoining run 1a or 1b of the belt 1 from the inside. Consequently, the opposite runs 1a and 1b of the belt 1 are pressed against the cleaning blade 230 and fur brush 231 and the developing roller 160, respectively. In this condition, the presser rollers 106 and 107 are rotated by the belt 1 while the belt 1 is in movement.

As stated above, the belt 1 is urged from the inside thereof into pressing contact with the cleaning blade 230 and fur brush 231 and the developing roller and, therefore, can be so urged by only a low pressure.

Seventh Embodiment

FIG. 23 shows a seventh embodiment of the present invention in a locked condition. This embodiment is essentially similar to the second embodiment except that two engaging bodies are rotatable about the axis of rotation R1 and function to eliminate the accidental insertion of an unexpected process pack. The developing unit U1 accommodating the developing device 16, the cleaning unit U2 accommodating the cleaning device 23, and the belt 1 are bodily rotatable about the axis R1, as in the second embodiment. The casing 102 of the developing unit U1 is rotatable about the positioning pin 164 and constantly biased by the torsion spring 159 away from the downward run 1a of the belt 1. When the cam 165 is rotated, it presses the unit U1 such that the developing roller 160 presses against the run 1a of the belt 1 by a suitable pressure, against the force of the torsion spring 159. Likewise, the casing 103 of the cleaning unit U2 is rotatable about the positioning pin 235 and constantly biased by the torsion spring 237 away from the upward run 1b of the belt 1. When the cam 238 is rotated, it presses the unit U2 such that the cleaning blade 230 and fur brush 231 press against the upward run 1b of the belt 1 by a suitable pressure, against the force of the torsion spring 237.

Two generally Z-shaped engaging bodies 500 and 501 are rotatable about the axis R1 and located at different axial positions. Coiled torsion springs 502 and 503 are positioned coaxially with each other to constantly bias the engaging bodies 500 and 501 clockwise, respectively. The engaging body 500 has opposite ends thereof bent in opposite directions to form engaging pieces 500a and 500b. Likewise, the engaging body 501 has engaging pieces 501a and 501b at opposite ends thereof. The engaging pieces 500a and 500b are respectively located at distances l1 and l2 from the axis of rotation R1 which are different from each other. The engaging pieces 501 and 501b are respectively located at the distances l2 and l1 from the axis of rotation R1. The toner tank 167 and cleaning tank 236 are respectively formed with notches 167c and 236c which face the tips of the engaging pieces 500a and 500b, respectively.

In the above construction, assume that both of the process packs are removed from the copier body. Then, the engaging bodies 500 and 501 abut against stops, no shown, to remain in the positions indicated by a phantom line and a solid line in FIG. 23. When the toner tank 167 is mounted on the developing unit U1, the stop is released from the engaging body 500 to allow it to rotate clockwise until the engaging piece 500a mates with the notch 167c. Thereupon, the process unit is bodily rotated about the axis R1 to the position where the cleaning unit U2 aligns with the opening 25. At this instant, the engaging piece 500b is located at the position indicated by a solid line in FIG. 23, i.e., it protrudes from the run 1b of the belt 1. Therefore, the collecting tank 236 having the notch 236c at a position engageable with the protruding engaging piece 500b is the only process pack which can be inserted into the copier body via the opening 25. This prevents an inadequate process pack from being mounted on the copier body. When the stop associated with the other engaging body 501 is released, the tip of the engaging piece 501a of the engaging body 501 still rests on the flat portion of the toner tank 167. Hence, the engaging piece 501b does not protrude from the run 1b of the belt 1. When the collecting tank 236 is mounted before the toner tank 167, the operations of the engaging pieces 500 and 501 will be reversed. Specifically, the engaging piece 501a mates with the notch 236c first. In this condition, the engaging piece 501b protrudes from the run 1a of the belt to prevent process packs other than the toner tank 167 from being mounted.

Eighth Embodiment

Referring to FIGS. 24–26, an eighth embodiment of the present invention is shown which is the combination of the second and third embodiments. In this embodiment, the casings 102 and 103 are each configured such that the distance thereof from the axis of rotation R1 sequentially decreases toward the free end. As shown in FIG. 24, press rollers 301 and 302 are provided in place of the cams 165 and 238. Check rollers 303 and 304 are located at opposite sides of and at an angular distance of 45 degrees from the roller 101. The check rollers 303 and 304 are mounted on the copier body and do not rotate about the axis of rotation R1.

In operation, assume that the casings 102 and 103 and belt 1 are bodily rotated counterclockwise from the position shown in FIG. 24. Then, as shown in FIG. 25, the casing 103 begins to open while being pressed by the press roller 302 to the free end thereof. Although the other casing 102 also tends to open, it is prevented from doing so by the check roller 303. As the rotation proceeds, the casing 103 is released from the check roller 302 and fully opened, as shown in FIG. 26. The other casing 102 remains in the closed position since it meets the check roller 304 after the check roller 303. As the casing 103 moves away from the run 1b of the belt 1, the shutter 240 closes the opening 236a. In the position shown in FIG. 26, the opening 236a is fully closed by the shutter 240. The other shutter 168 remains open since the casing 102 does not move away from the belt 1, as stated earlier. In this manner, the opening 236a of the casing 103 brought into alignment with the opening 25 is closed by the shutter 240, and the process unit received in the casing 103 is pulled out. This, coupled with the fact that the opening 236a faces upward, prevents the toner from leaking to the outside to smear the operator's body or the room. The toner of the casing 102 which does not face the opening 25 surely remains in the casing 102.

As stated above, in the illustrative embodiment, when a particular process unit is to be replaced, it is rotated together with the other process unit to a position different from an image forming position and, therefore, easy to remove. Since a plurality of process units have an identical shape and mounted and dismounted at a fixed position, it is not necessary for the operator to confirm the mounting and dismounting positions of the individual process units. Since the positions where the individual units are expected to occupy are not limited, mounting an unexpected unit or similar occurrence is eliminated. The process means each

having a particular life may be constructed into independent units so as to be replaced at particular timings. The process units are each moved away from the belt only at the fixed mounting and dismounting position. This prevents an occurrence that the toner is scattered around out of a unit located at a position other than the mounting and dismounting position.

The first to eighth embodiments of the electrophotographic process unit in accordance with the present invention have been described above with reference to the drawings. Other characteristic features of the present invention which all the embodiments share will be described hereinafter.

In each of the embodiments, when the unit U1 or U2 is mounted again on the copier body, sensors sense the end of rotation of the belt **1** and the mounting of the unit U1 or U2 on the copier body. Then, the cleaning device **23** is operated. FIG. **27** shows a routine for the replacement of the process pack while FIG. **28** shows a routine for homing the process pack to a position where it is ready to function.

In FIG. **27**, whether or not a toner end condition is reached is determined (step S1) and, if the answer is positive, the process packs are rotated to bring the unit U1 to the replacing position (S2). Then, a development replace flag is set (S3). If a tone end condition is not reached as determined in the step S1, whether or not more than a predetermined amount of waste toner is collected in the collecting tank **236** is determined (S4). If the answer of the step S4 is positive, the process packs are rotated to move the unit U2 to the replacing position, and then a cleaning replace flag is set (S6). If the answer of the step S1 or S4 is positive, the power source of the process packs are turned off (S7). When none of the toner end condition and toner over condition is reached, the program returns to the step S1.

In FIG. **28**, whether or not the cleaning replace flag is set is determined (S10) and, if the answer is positive, whether or not the cleaning device has been replaced is determined (S11). If the cleaning device has not been replaced as determined in the step S11, the program inhibits a copying operation (S12) and then returns. If the answer of the step S11 is positive, the cleaning replace flag is reset (S12), and then the process pack power source is turned on (S13). Subsequently, the process packs are rotated to an operative position (S14). In this position, the belt **1** is cleaned (S15), and then a copying operation is allowed (S16). If the answer of the step S10 is negative, whether or not the development replace flag is set is determined (S17) and, if the answer is positive, whether or not the developing device has been replaced is determined (S18). If the answer of the step S18 is positive, the development replace flag is reset (S19), followed by the step **13**. If the answer of the step S18 is negative, the program advances to a step S20 for inhibiting the copier from operating.

FIGS. **29**A–**29**E show the rear end of a process pack and a conduction sensor provided on the rear panel, not shown, of the copier body. Specifically, FIG. **29**A shows the rear end of a process pack while FIG. **29**B shows a conduction sensor mounted on the rear panel of the copier body which the process pack is to face. FIGS. **29**C and **29**D show conduction sensors mounted on the toner tank **167** and collecting tank **236**, respectively. FIG. **29**E shows the conduction sensor of FIG. **29**B more specifically. As shown, a generally U-shaped conductive member **41** is provided on the rear end of the process pack and implemented as a film of aluminum or similar conductive metal. The conductive member **41** has two contact portions **411** and **412** spaced apart from each other by a predetermined distance, and a portion for short-circuiting the contact portions **411** and **412**. On the other hand, a sensing section **40** is provided on the copier body to face the conductive member **41**. The sensing section **40** has a base **405** made of resin and mounted on the rear panel of the copier body. Three terminals, i.e., a common terminal **401**, a developing unit terminal **402** and a cleaning unit terminal **403** are affixed to the base **405**. Leads extending from the terminals **401**, **402** and **403** terminate at a control device built in the copier body. The contact portions **411** and **412** of the sensing section **41**a are spaced apart by the same distance as the common terminal **401** and developing unit terminal **402**. A similar conductive member **41**b is provided on the collecting tank **286** and has contact portions **412**a and **412**b. The contact portions **412**a and **412**b are spaced apart by the same distance as the common terminal **401** and cleaning unit terminal **403**. When either of such process packs is mounted on the copier body, the conductive member **41**a or **41**b thereof contacts the associated terminals of the sensing section **40** mounted on the copier body. At the same time, the conductive film **41**a or is urged against the sensing section **40** by biasing means, not shown. Therefore, one contact portion **411**a or **411**b contacts the common terminal **401** of the sensing section **40** while the other contact portion **412**a or **412**b contacts either of the remaining terminals **402** or **403** of the sensing section **40**. Such a configuration allows the kind of the process pack mounted on the copier body to be determined on the basis of the conduction of the common terminal **401** and either of the developing unit terminal **402** and cleaning unit terminal **403**. The output of the conduction sensor is sent to the control device of the copier body which in turn displays the kind of the process pack on the operation and display section of the copier body.

FIGS. **30** and **31** each shows a specific message appearing on the operation and display section. When both of the process packs are removed from the copier body, the outputs of the conduction sensors of the two units U1 and U2 indicate non-conduction. Then, determining that the electrophotographic process unit is empty, the control device displays a message **50** on a screen **50** for urging the operator to insert a process pack, as shown in FIG. **30**. When the operator inserts, for example, the collecting tank **236** first, the control device displays another message indicative of the process pack to be mounted next, as shown in FIG. **31**. At the same time, the control device shows on a display **51**, FIGS. **2** and **14**, located in close proximity to the opening **25** that the toner tank **167** should be mounted next. When the toner tank **167** is correctly mounted on the copier body, the control device fixes the process unit, rotates it, and then informs the operator of the ready state of the copier body. If the process pack inserted after the collecting tank **236** is another collecting tank **236**, the control device displays a message in response to the resulting output of the conduction sensor (**40** and **41**), urging the operator to replace it. At the same time, the control device energizes a buzzer, not shown, to produce an alarm tone.

FIGS. **32**A and **32**B each shows a different process pack having been removed from the copier body. As shown, a handle **65** is provided on the front end plate **304** of each process pack in order to facilitate the mounting and dismounting operations and to prevent the process pack from being inserted in a wrong position. As shown in FIG. **33**, the handle **65** may be sized slightly greater than the front end plate **304** and casing **102** or **103**. Then, the process pack will have the handle **65** blocked by the front edge of the casing **102** or **103** to be thereby prevented from advancing deeper

into the casing **102** or **103**. Further, as shown in FIGS. **34**A and **34**B, the process packs may have their diameter sequentially reduced from the front end toward the rear end, in which case the casings **102** and **103** will be provided with a complementary configuration.

FIG. **35** shows a specific manner in which the process packs removed from the copier body are inserted into a receptacle. As shown, when each process pack is pulled out of the copier body, the entire opening **167**a or **236**a thereof is completely flat. Hence, the two process packs form a cylinder when combined with the flat portions thereof contacting each other. For this reason, such process packs removed from the copier body or new process packs to be sold in a package may be received in a simple hollow cylindrical receptacle **310**, as illustrated. The receptacle **310** accommodates the two process packages without any clearance and contributes a great deal to the reduction of cost due to the simple configuration. If desired, locking means for locking the flat portions of the two process packs to each other may be provided to insure the connection thereof.

As a copier is operated over a long period of time, toner particles and paper dust are apt to deposit on the mechanical arrangemens, resulting in a malfunction or a paper jam. Then, the operation of the copier is interrupted by a protection device. While the opposite runs **1**a and **1**b of the belt **1** are covered by the casings **102** and **103** of the process packs that hold the belt **1** therebetween, the curved portions of the belt **1** wrapping around the rollers **100** and **101** have to be exposed to define the exposure position and the image transfer position, as stated earlier. When the operator or a jamming sheet, for example, contacts such exposed portions of the belt **1** while the operator is removing the jamming sheet, grease, dust or similar impurity is likely to contaminate or scratch the belt **1**. This would produce a reproduction which is not clear-cut due to a stripe pattern or a shadow.

FIGS. **36** and **37** each shows a specific condition wherein a recording sheet has jammed a sheet transport path defined in the copier body. Specifically, FIGS. **36** and **37** respectively show a sheet jamming the path at the image transfer position and a sheet jamming the path at a position other than the same. Photosensors **S1**, **S2** and **S3** are arranged on the transport path in close proximity to the pick-up roller **17**a of the sheet feed section **17**, upstream of the register roller pair **17**b, and downstream of the fixing roller pair **22**, respectively. The photosensors **S1**–**S3** are each responsive to the leading edge or the trailing edge of a recording sheet. Each of the sensors **S1**–**S3** senses the time when a sheet passes it or travels the path between it and adjoining sensor. The control device compares the sensed time and a reference time and, if the former is not coincident with the latter, produces, for example, a jam signal to interrupt the operator of the copier.

Specifically, as shown in FIG. **36**, when a recording sheet jams the image transfer position due to, for example, incomplete separation from the belt **1**, the solenoids for rotating the cams **165** and **238** are deenergized and the two units U**1** and U**2** are not rotated. Then, as the cams **165** and **238** are rotated counterclockwise, the developing tank **167** and collecting tank **236** are rotated counterclockwise about their associated pins **164** and **235** by the action of the springs **159** and **237**. As a result, the developing roller **160** and the fur brush **231** and cleaning blade **230** are spaced apart from the belt **1** by a predetermined distance. An image transfer unit T carries the transfer charger **18** and seperation charger **19** thereon and supports the two rollers **28** and **29** around which the transport belt **21** is passed. In parallel with the movement of the units U**1** and U**2** away from the belt **1**, the image transfer unit T is rotated counterclockwise about the axis of the roller **28** to an inoperative position spaced apart from the image transfer position. As a result, a space desirable for the operator to remove the jamming sheet by hand is formed in the vicinity of the image transfer position. This prevents the operator from touching the belt **1** or prevents the jamming sheet from contacting the surface of the belt **1** or being torn off when forcibly pulled by the operator.

Assume that a recording sheet has jammed the transport path at a position other than the image transfer position, as shown in FIG. **37**. Then, the image forming operation is interrupted immediately. The solenoids for rotating the cams **165** and **238** are deenergized to allow the developing tank **167** and collecting tank **236** to move away from the belt **1**. Further, the two units U**1** and U**2** are rotated counterclockwise about 90 degrees to move the image transfer position of the belt **1** away from the transport path. In this case, the image transfer unit T is not retracted since the absence of a sheet at the image transfer position is known. In this condition, the operator is prevented from touching the belt **1** while removing the jamming sheet while the jamming sheet is prevented from damaging the belt **1**. Rotating the units U**1** and U**2** counterclockwise as mentioned above is advantageous over rotating them clockwise since the latter might allow the waste toner free from a charge to drop through the opening **236**a of the collecting tank **236**. Specifically, the counterclockwise rotation brings the developing tank **167** to above the collecting tank **236** and surely confines the toner in the tank **167** since this toner is sufficiently charged. Of course, the rotation angle of the units U**1** and U**2** is not limited to 90 degrees and may be suitable selected in consideration of the internal layout of the copier, so long as it prevents the operator from touching the belt by accident.

As stated above, the illustrative embodiments allow the operator to pull out a process pack received in either of the developing unit U**1** and cleaning unit U**2** from the casing C of the copier body and then maintain it or insert a substitute process pack into the casing C without considering the dismounting order or the mounting order of process packs and, moreover, by a single semiautomatic operation. The operator, therefore, can replace the electrophotographic process devices or replace the used toner with a fresh toner simply and rapidly.

In any of the embodiments shown and described, when a new process pack is mounted on the copier body, the copier is automatically operated in a forming mode to cause the process pack to adapt itself to the photoconductive belt.

While the embodiments are implemented with a developing device using a single component type developer, they are similarly practicable with a developing device using a two component or a multiple component type developer. When the toner tank **167** runs out of toner or the collecting tank **236** is full of waste toner, the embodiments cause the toner sensor or tile full sensor **239** to sense it and display such a condition on the operation and display board. If desired, an arrangement may be made such that in response to the output of the sensor either the developing unit U**1** or the cleaning unit U**2** is automatically unlocked and rotated into alignment with the opening **25**. In the second embodiment, each shutter sequentially closes the opening of the associated process pack as the casing moves away from the flat portion of the belt. Alternatively, the shutter may close the opening immediately after the casing has moved away from the belt. The shutter may be constituted by a single member or a plurality of (e.g. two) members, as desired.

In summary, the present invention promotes easy, rapid and sure daily maintenance including the supply of toner and protects an image carrier from damage ascribable to such maintenance. Also, the present invention allows a minimum of deterioration due to aging to occur in the image carrier and electrophotographic process means even when an image forming apparatus accommodating them is left in an inoperative state over a long period of time. Further, the present invention allows the operator to remove a jamming sheet from an image transfer station easily and rapidly and prevents the jamming sheet from being torn off during removal.

Various modifications will become possible for those skilled in the art after receiving the teachings of the present disclosure without departing from the scoe thereof.

What is claimed is:

1. An image forming apparatus comprising:

an image carrier; and

a plurality of electrophotographic process means arranged around said image carrier;

at least part of said plurality of electrophotographic process means being constructed into two units each being engageable with said image carrier and rotatable integrally with said image carrier, such that said image carrier and said two units are rotatable together as a unit;

said two units having a substantially identical configuration, and wherein said two units are shaped and positioned such that as said image carrier and said two units rotate together each of said two units are disposed inside of a locus of rotation of said image carrier, and wherein said locus of rotation is defined as a path of radially outermost points of said image carrier as said image carrier and said two units rotate together.

2. An apparatus as claimed in claim **1**, wherein one of said units comprises any of said electrophotographic process means whose life is comparatively long, the other of said units comprising any of said process means whose life is comparatively short.

3. An image forming apparatus comprising:

an image carrier; and

a plurality of electrophotographic process means;.

at least part of said plurality of electrophotographic process means being constructed into two units each being engageable with said image carrier and rotatable integrally with said image carrier, such that said image carrier and said two units are rotatable together as a unit;

said two units having a substantially identical configuration;

wherein one of said two units comprises any of said electrophotographic process means whose life is comparatively long, the other of said two units comprising any of said process means whose life is comparatively short; and

wherein said electrophotographic process means whose life is comparatively long comprises a developing device while said electrophotographic process means whose life is comparatively short comprises a cleaning device.

4. An apparatus as claimed in claim **1**, wherein said unit includes a flat portion and said two units are each constructed such that said electrophotographic process means received therein does not protrude from the flat portion included in said unit.

5. An apparatus as claimed in claim **4**, further comprising a cylindrical receptacle for storing said two units removed from a body of said apparatus.

6. An image forming apparatus comprising:

an image carrier; and

a plurality of electrophotographic process means;

at least part of said plurality of electrophotographic process means being constructed into two units each being engageable with said image carrier and rotatable integrally with said image carrier, such that said image carrier and said two units are rotatable together as a unit;

said two units having a substantially identical configuration;

wherein one of said two units comprises any of said electrophotographic process means whose life is comparatively long, the other of said two units comprising any of said process means whose life is comparatively short; and

wherein a body of said apparatus comprises a housing through which an opening is formed, said opening allowing only one of said two units to pass therethrough into or out of said body at a time.

7. An apparatus as claimed in claim **6**, wherein said other of said two units comprises said electrophotographic process means whose life is comparatively short and is positioned closest to said opening.

8. An apparatus as claimed in claim **6**, wherein said opening is oriented such that said two units are each inserted or pulled out with a portion thereof engageable with said image carrier facing upward.

9. An image forming apparatus comprising:

an image carrier; and

a plurality of electrophotographic process means;

at least part of said plurality of electrophotographic process means being constructed into two units each being engageable with said image carrier and rotatable integrally with said image carrier, such that said image carrier and said two units are rotatable together as a unit;

said image carrier being implemented as an endless belt and passed over two rotatable support means such that part of said belt forms two flat portions, said electrophotographic process means of said two units being arranged in such a manner as to face said flat portions of said belt respectively;

said two units each comprising a casing, the outer periphery of said casing forming, when each of said two units is engaged with said image carrier, part of a circumcircle of said image carrier.

10. An apparatus as claimed in claim **9**, wherein said electrophotographic process means of said two units which face said flat portions of said image carrier comprise a developing device and cleaning device, respectively.

11. An apparatus as claimed in claim **10**, wherein said developing device and said cleaning device are respectively accommodated in said two units and each faces a respective one of said flat portions of said image carrier.

12. An image forming apparatus comprising:

an image carrier;

a plurality of electrophotographic process means;

at least part of said plurality of electrophotographic process means being constructed into two units each being engageable with said image carrier and rotatable integrally with said image carrier, such that said image carrier and said two units are rotatable together as a unit; and

discriminating means for determining at least one of:

(1) a kind of each of said two units; and (2) a position of each of said two units.

13. An apparatus as claimed in claim **12**, wherein said discriminating means comprises a plurality of conductive contact pieces provided in spaced positions on an outer periphery of each of said two units, and a plurality of conductive terminals mounted on a body of said apparatus for contacting said conductive contact pieces.

14. An apparatus as claimed in claim **12**, wherein each of said two units includes a front end plate and wherein said discriminating means comprises a projection extending out from the front end plate of each of said two units and protruding from a front edge of an inlet formed in a mounting portion of a body of said apparatus.

15. An apparatus as claimed in claim **12**, wherein said discriminating means comprises a cross-sectional area which decreases from a front portion to a rear portion of each of said two units, a mounting portion of a body of said apparatus including a portion whose cross-sectional area is smaller than the cross-sectional area of said front portions of said two units.

16. An apparatus as claimed in claim **15**, wherein said front portion comprises an inlet.

17. An apparatus as claimed in claim **15**, wherein said front portion comprises handle means provided on an end face of said front portion.

18. An image forming apparatus comprising:

an image carrier;

a plurality of electrophotographic process means; and

at least part of said plurality of electrophotographic process means being constructed into two units each being engageable with said image carrier and rotatable integrally with said image carrier, such that said image carrier and said two units are rotatable together as a unit;

handle means provided on an outer periphery of each said two units to be selectively raised or lowered and, when raised, having support portions thereof lying in a vertical plane containing a center of gravity of said unit.

19. An image forming apparatus comprising:

an image carrier; and

a plurality of electrophotographic process means;

at least part of said plurality of electrophotographic process means being constructed into two units each being engageable with said image carrier and rotatable integrally with said image carrier, such that the integral arrangement itself having said image carrier and said two units are bodily rotatable together as a unit about an axis in a body of said image forming apparatus;

wherein said two units comprise respective casings having a substantially identical configuration, said casings each being formed with a notch at a particular position, a body of said apparatus comprising a housing through which an opening capable of passing only one of said casings at a time is formed and an engaging member which mates with said notch when one of said casings is mounted or dismounted.

20. An image forming apparatus comprising:

an image carrier; and

a plurality of electrophotographic process means;

at least part of said plurality of electrophotographic process means being constructed into two units each being engageable with said image carrier and rotatable integrally with said image carrier, such that the integral

arrangement itself having said image carrier and said two units are bodily rotatable together as a unit about an axis in a body of said image forming apparatus;

the apparatus further comprising display means, and discriminating means for determining a kind of said two units being mounted, said display means displaying a guidance matching the kind of said two units.

21. An apparatus as claimed in claim **20**, wherein said discriminating means is mounted on a body of said apparatus and determines the kind of each of said two units when said discriminating means contacts part of each of said two units.

22. An apparatus as claimed in claim **20**, wherein said discriminating means comprises transmitting means mounted on each of said two units for transporting a particular signal, and receiving means mounted on a body of said apparatus for receiving said signal from each of said two units.

23. An apparatus as claimed in claim **22**, wherein said two units each comprise a switch to be operated when an operator holds a handle provided on each of said two units for inserting said two units into a body of said apparatus, said transmitting means transmitting said signal when said switch is closed.

24. An apparatus as claimed in claim **20**, wherein said two units each include a particular color representative of the kind of each of said two units, said display means displaying the kind of each of said two units by using the same respective colors as said two units.

25. An apparatus as claimed in claim **20**, wherein when one of said two units is inserted into a body of said apparatus, said display means displays an error when said one of said two units being inserted is of the same kind as another of said two units already mounted on said body as determined by said discriminating means.

26. An apparatus as claimed in claim **20**, wherein said display means displays the kind of one of said two units which is not mounted as determined by said discriminating means.

27. An apparatus as claimed in claim **25**, wherein said display means is positioned in close proximity to an opening which is formed through said body of said apparatus for inserting and removing said two units.

28. An image forming apparatus comprising:

an image carrier; and

a plurality of electrophotographic process means;

at least part of said plurality of electrophotographic process means being constructed into two units each being engageable with said image carrier and rotatable integrally with said image carrier, such that the integral arrangement itself having said image carrier and said two units are bodily rotatable together as a unit about an axis in a body of said image forming apparatus;

the apparatus further comprising detecting means for detecting a paper jam occurring in a transport path, and control means for controlling the operation of said apparatus such that when said detecting means detects a paper jam, said two units are moved away from said image carrier.

29. An apparatus as claimed in claim **28**, wherein said control means controls said apparatus such that when said detecting means detects a paper jam occurred at a toner image transfer position, said image carrier is fixed in an image forming position.

30. An apparatus as claimed in claim **28**, wherein said control means control said apparatus such that when said

detecting means detects a paper jam at a toner image transfer position, image transferring means and devices associated therewith are moved away from said image carrier.

31. An image forming apparatus comprising:

an image carrier; and

a plurality of electrophotographic process means;

at least part of said plurality of electrophotographic process means being constructed into two units each being engageable with said image carrier and rotatable integrally with said image carrier, such that the integral arrangement itself having said image carrier and said two units are bodily rotatable together as a unit about an axis in a body of said image forming apparatus;

the apparatus further comprising:

support means for supporting said two units and said image carrier such that said two units and said image carrier are rotatable integrally;

first detecting means for detecting an end of a rotary motion of said two units and said image carrier;

second detecting means for detecting that said two units are mounted on a body of said apparatus; and

means for causing, among said plurality of electrophotographic process means, a cleaning device to operate and for rotating said image carrier in response to detection outputs of said first and second detecting means.

32. An image forming apparatus comprising:

an image carrier; and

a plurality of electrophotographic process means arranged around said image carrier,

at least part of said plurality of electrophotographic process means being constructed into two units each being engageable with said image carrier and rotatable integrally with said image carrier, such that the integral arrangement itself including said image carrier and said two units are bodily rotatable together as a unit about an axis in a body of said image forming apparatus, wherein a closed space is defined within said image carrier, and said axis is located in said closed space;

the apparatus further including first support means for supporting said two units and said image carrier such that said two units and said image carrier are rotatable integrally;

second support means for supporting said two units such that said two units each move into or out of contact with said image carrier in interlocked relation to the rotation of said two units and said image carrier; and

said second support means causing said two units to move away from said image carrier only at a position where said two units may be mounted or dismounted.

33. An apparatus as set forth in claim **28**, wherein said control means further controls said apparatus such that when said detecting means detects a paper jam on said transport path at a position other than a toner image transfer position, said two units are rotated together with said image carrier to move portions of said image carrier which are exposed away from said transport path.

34. An image forming apparatus comprising:

an image carrier; and

a plurality of electrophotographic process means arranged around said image carrier;

at least part of said plurality of electrophotographic process means being constructed into two units each being engageable with said image carrier and rotatable integrally with said image carrier, such that the integral arrangement itself including said image carrier and said two units are bodily rotatable together as a unit about an axis in a body of said image forming apparatus, wherein a closed space is defined within said image carrier, and said axis is located in said closed space, and further wherein said two units comprise a developing unit and a cleaning unit.

35. An image forming apparatus comprising:

an image carrier;

a plurality of electrophotographic process means arranged around said image carrier;

at least part of said plurality of electrophotographic process means being constructed into two units each being engageable with said image carrier and rotatable integrally with said image carrier, such that the integral arrangement itself including said image carrier and said two units are bodily rotatable together as a unit about an axis in a body of said image forming apparatus, wherein each of said two units include a contour which coincides with a locus of rotation of the image carrier, and wherein said locus of rotation is defined as a path of radially outermost points of said image carrier as said image carrier and said two units rotate together.

36. An image forming apparatus for forming a toner image on an image forming medium, comprising:

an outer housing which has an opening; and

a plurality of image forming units for forming said toner image on said image forming medium,

predetermined image forming units, each having a life which is shorter than that of said apparatus, among said plurality of image forming units being formed as a cylindrically shaped unit which rotates around a center of said cylindrically shaped unit, one of said predetermined image forming units being removed from said image forming apparatus when said predetermined image forming unit faces to said housing.

37. An image forming apparatus as claimed in claim 36, wherein said one of said predetermined image forming units comprises a developing unit having a developing roller which is covered when said developing unit faces to said opening.

38. An image forming apparatus comprising:

a housing;

an image carrier in said housing;

at least one image developing device rotatable mountable in said housing; and

an opening in a wall of said housing, said opening being generally aligned with said developing device when said developing device is mounted in said housing at a predetermined rotational position,

wherein said developing device is mounted in said housing such that said developing device may be introduced and removed from said housing through said opening when said developing device is at said predetermined rotational position.

39. The image forming apparatus of claim 38 including a generally cylindrical unit mounted for rotation in said housing about a cylinder axis thereof, said generally cylindrical unit having said at least one image developing device, wherein said at least one image developing device is mounted for rotation about the cylinder axis of said unit.

40. The image forming apparatus of claim 38 wherein said opening has a size and shape which is substantially the same as a size and shape of said developing device.

41. The image forming apparatus of claim 39 wherein said opening has a size and shape which is substantially the same as a size and shape of said developing device.

42. The image forming apparatus of claim 38 including discriminating means for discriminating an identifying characteristic of said image developing device.

43. The image forming apparatus of claim 38 including at least one image processing device which is outside a locus of revolution of said image developing device.

44. The image forming apparatus of claim 38 wherein said housing includes an element which mates with the developing device only when the developing device is correctly mounted in said housing.

45. The image forming apparatus of claim 38 including means for displaying that the developing device is empty.

46. The image forming apparatus of claim 38, wherein said developing device cooperates with said image carrier to develop an image on said image carrier when said developing device is in a developing position which is different from said predetermined rotational position.

47. The image forming apparatus of claim 38 including means for shutting off electrical power to said developing device when said developing device is at said predetermined position.

48. The image forming apparatus of claim 38 wherein said image developing device includes a developing roller which cooperates with said image carrier to develop an image on said image carrier.

49. The image forming apparatus of claim 39 wherein said image developing device includes a developing roller which cooperates with said image carrier to develop an image on said image carrier.

50. The image forming apparatus of claim 48 wherein said developing device includes an opening through which said developing roller is exposed so as to cooperate with said image carrier, further including a shutter which selectively closes said opening.

51. The image forming apparatus of claim 49 wherein said developing device includes an opening through which said developing roller is exposed so as to cooperate with said image carrier, further including a shutter which selectively closes said opening.

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