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Park et al.

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(54) **ROTATIONAL FORCE TRANSMISSION STRUCTURE**

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(73) Assignee: **Hewlett-Packard Development Company, L.P.**, Spring, TX (US)

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G03G 21/16	(2006.01)
G03G 21/18	(2006.01)

(52) **U.S. Cl.**

CPC ***G03G 21/1647*** (2013.01); ***G03G 15/757*** (2013.01); ***G03G 21/186*** (2013.01)

(58) **Field of Classification Search**

CPC . G03G 15/757; G03G 21/1647; G03G 21/186

See application file for complete search history.

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(57) **ABSTRACT**

A cartridge unit detachable from a main body of an image forming device includes: a rotation member; a driven coupler arranged at one end portion of the rotation member in an axial direction of the rotation member; and a coil spring arranged to be expandable and compressible in the axial direction, a first end portion of the coil spring being fixed onto the driven coupler, and the coil spring being wound in a first direction from the first end portion toward a second end portion. When a rotational force is transmitted to the second end portion of the coil spring in the first direction or in a second direction opposite to the first direction, a portion of the transmitted rotational force is converted into a force that decreases or increases a diameter of the coil spring, and the first end portion of the coil spring presses the driven coupler in a direction perpendicular to the axial direction.

15 Claims, 16 Drawing Sheets

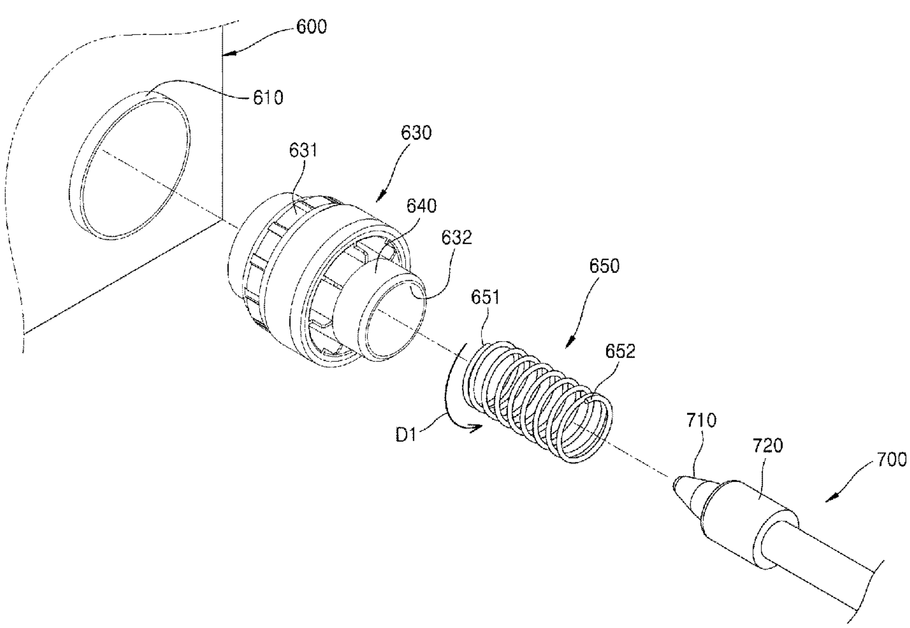

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FIG. 1

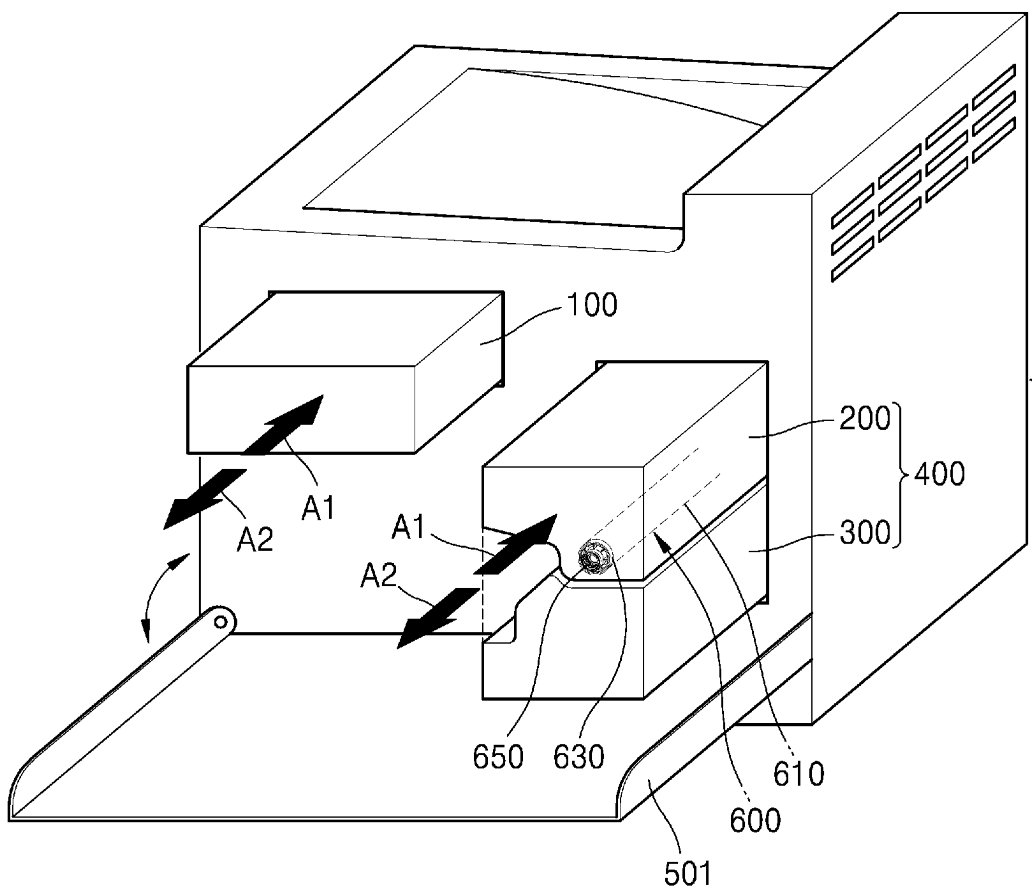


FIG. 2

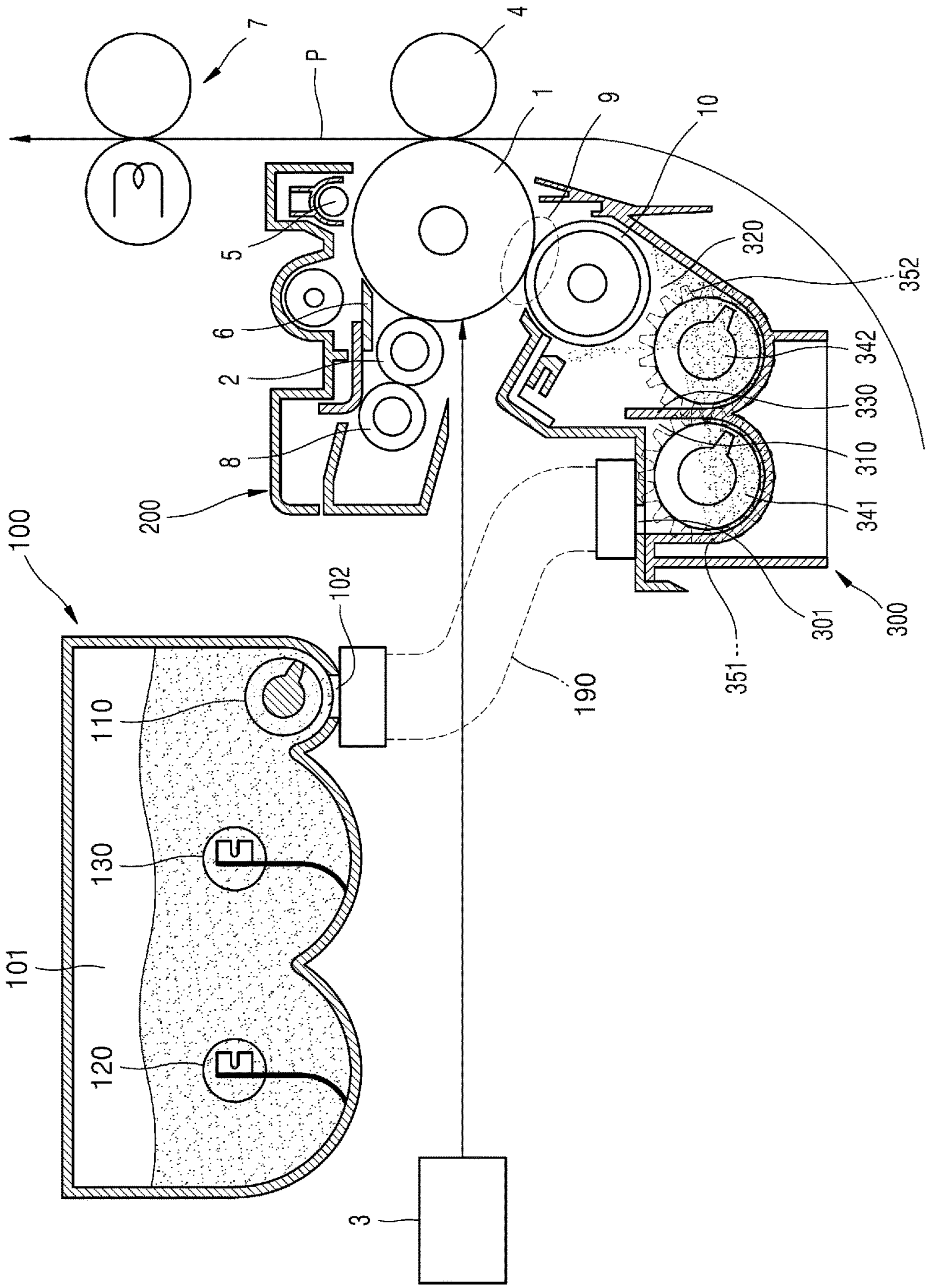

7
P
4
1
9
10
5
6
2
8
200
320
352
342
330
310
341
301
300
351
100
102
110
190
101
130
120
3

FIG. 3

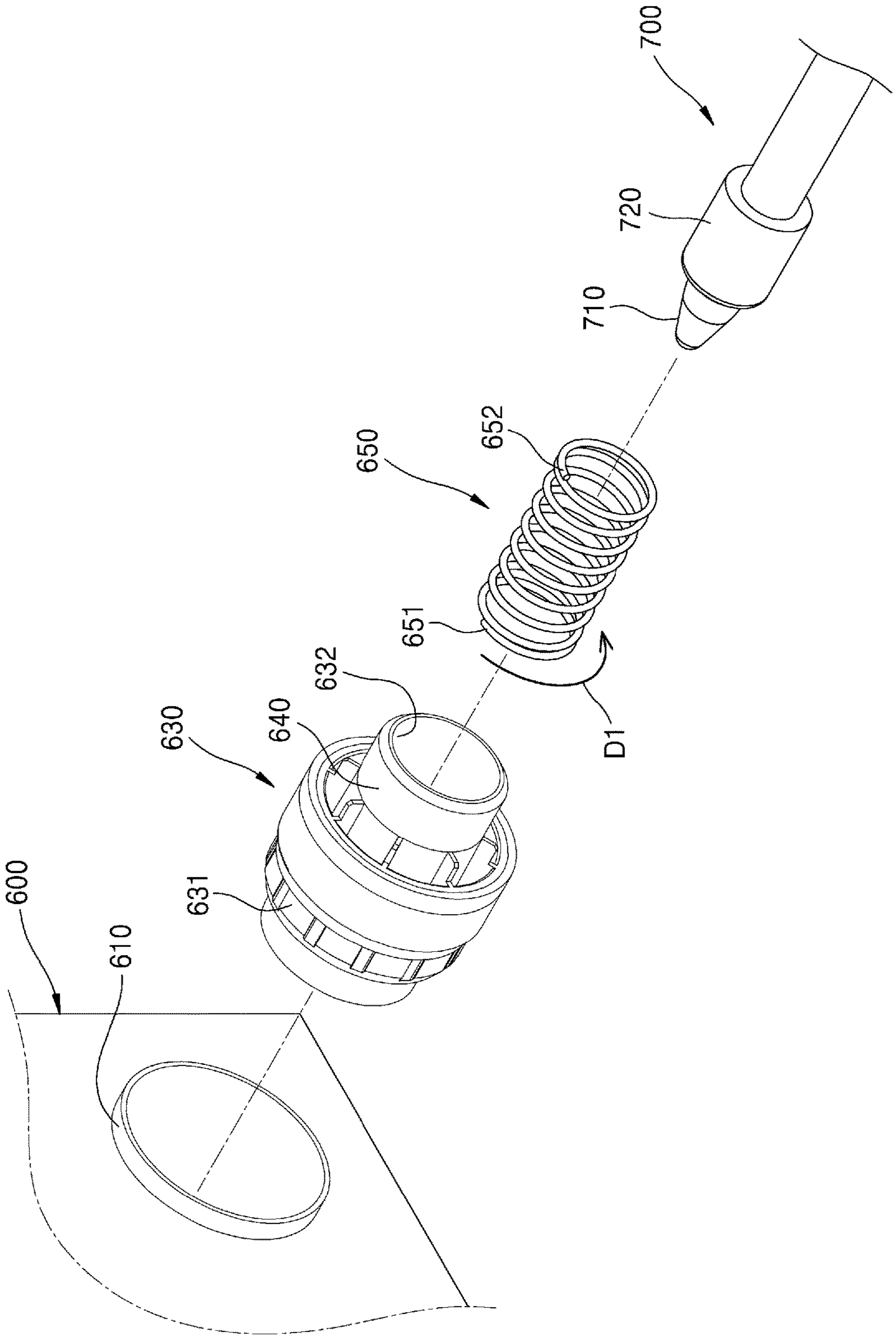


FIG. 4

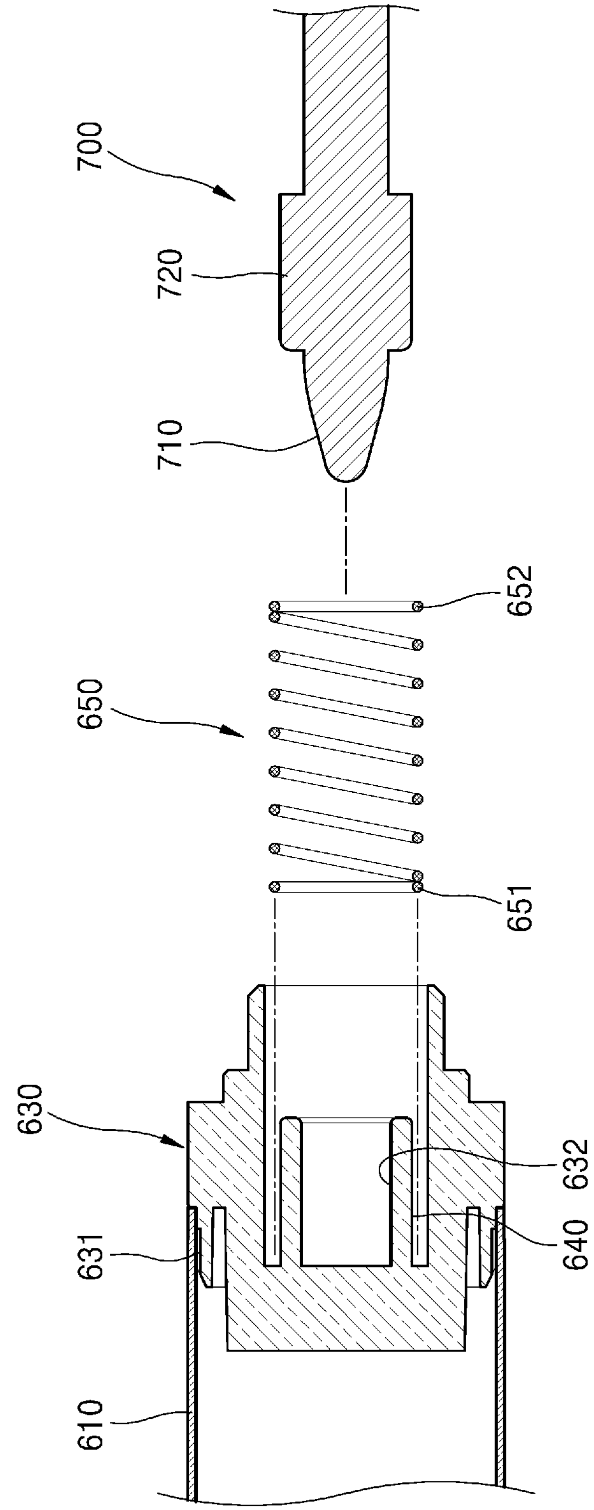


FIG. 5

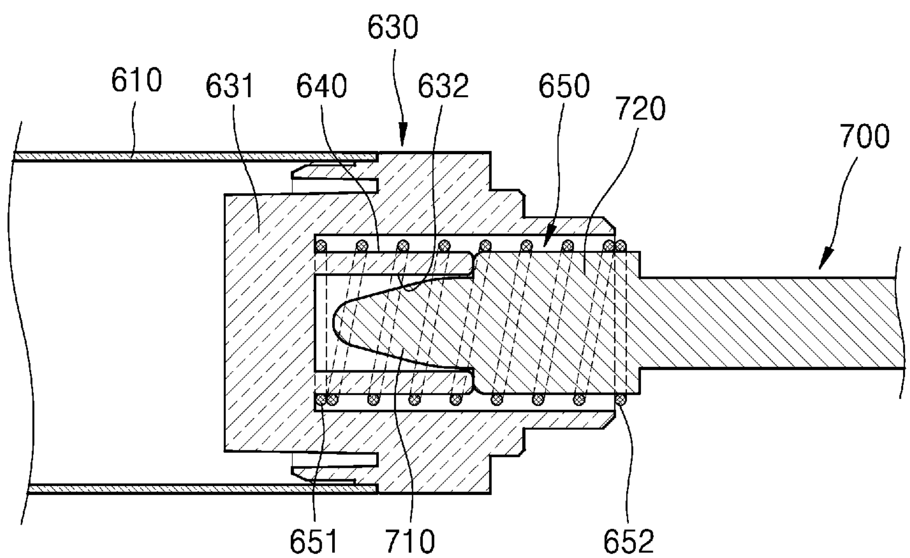


FIG. 6

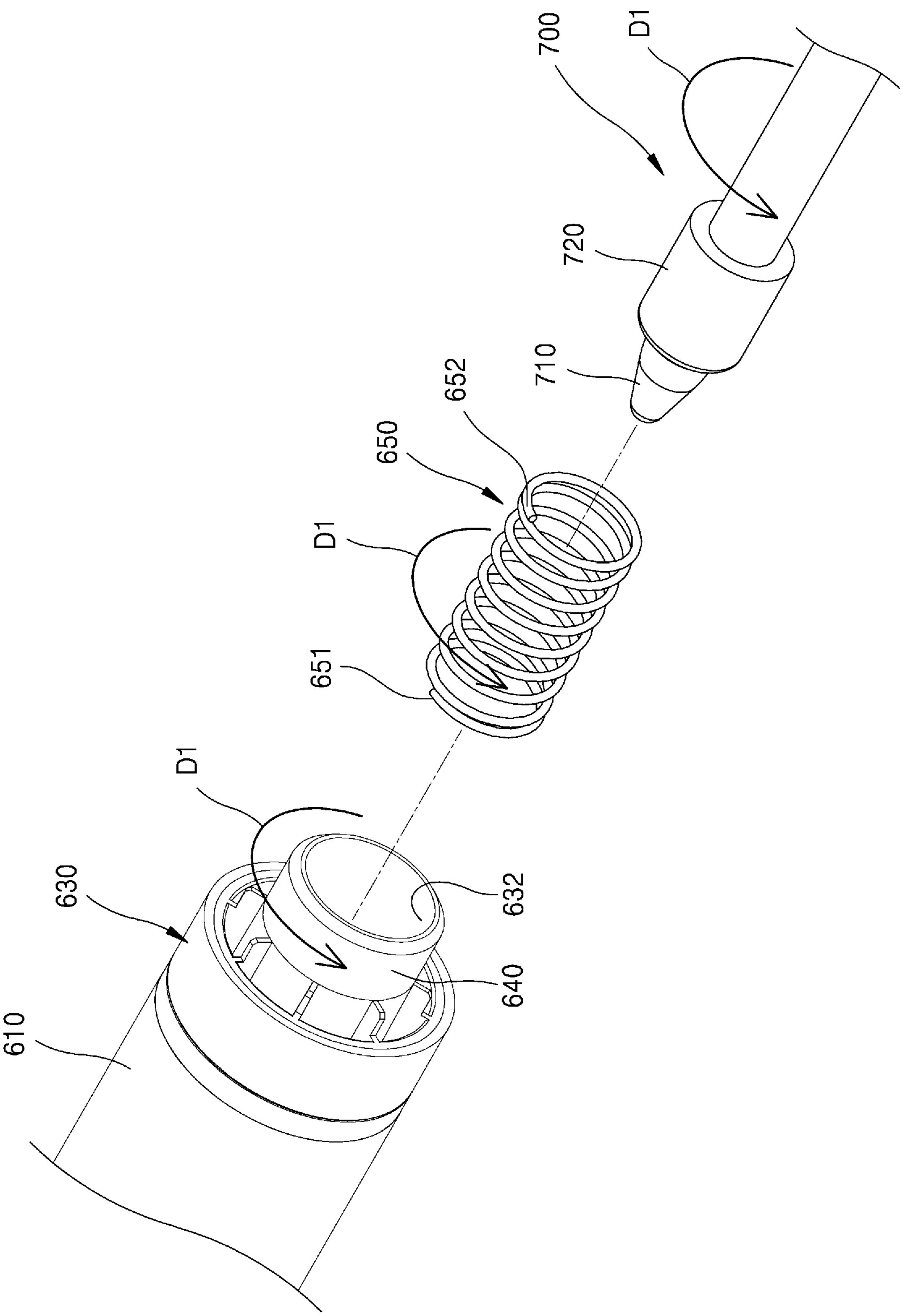


FIG. 7

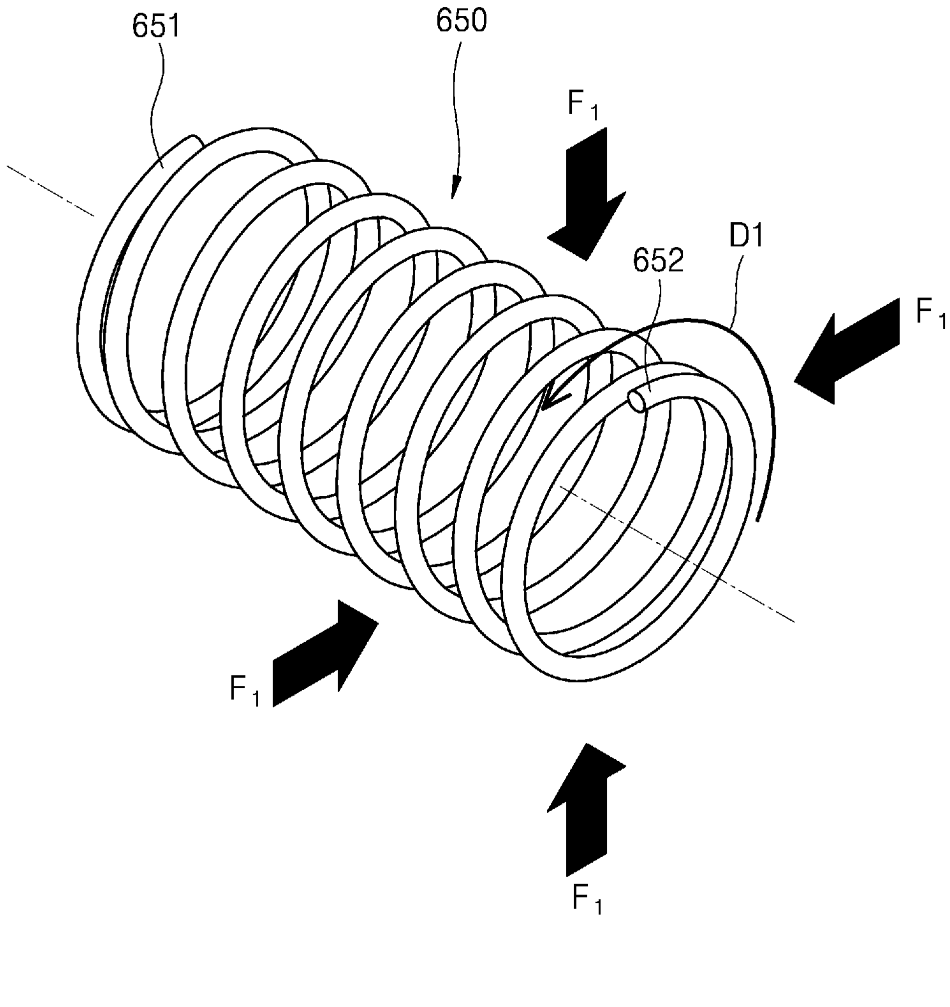


FIG. 8

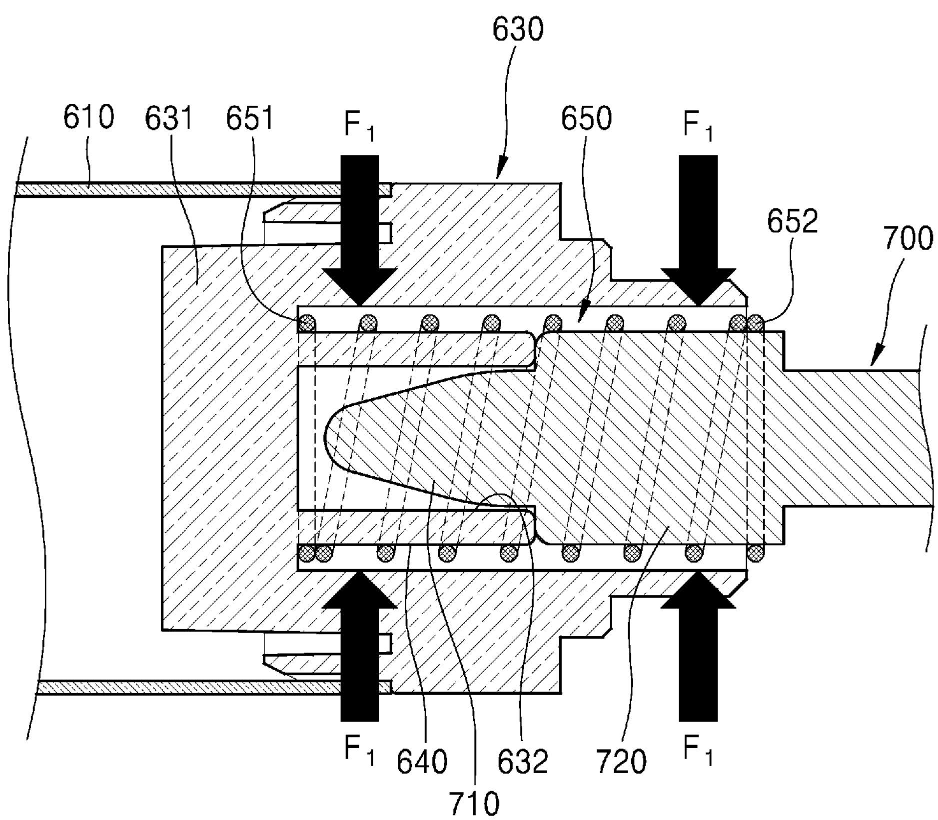
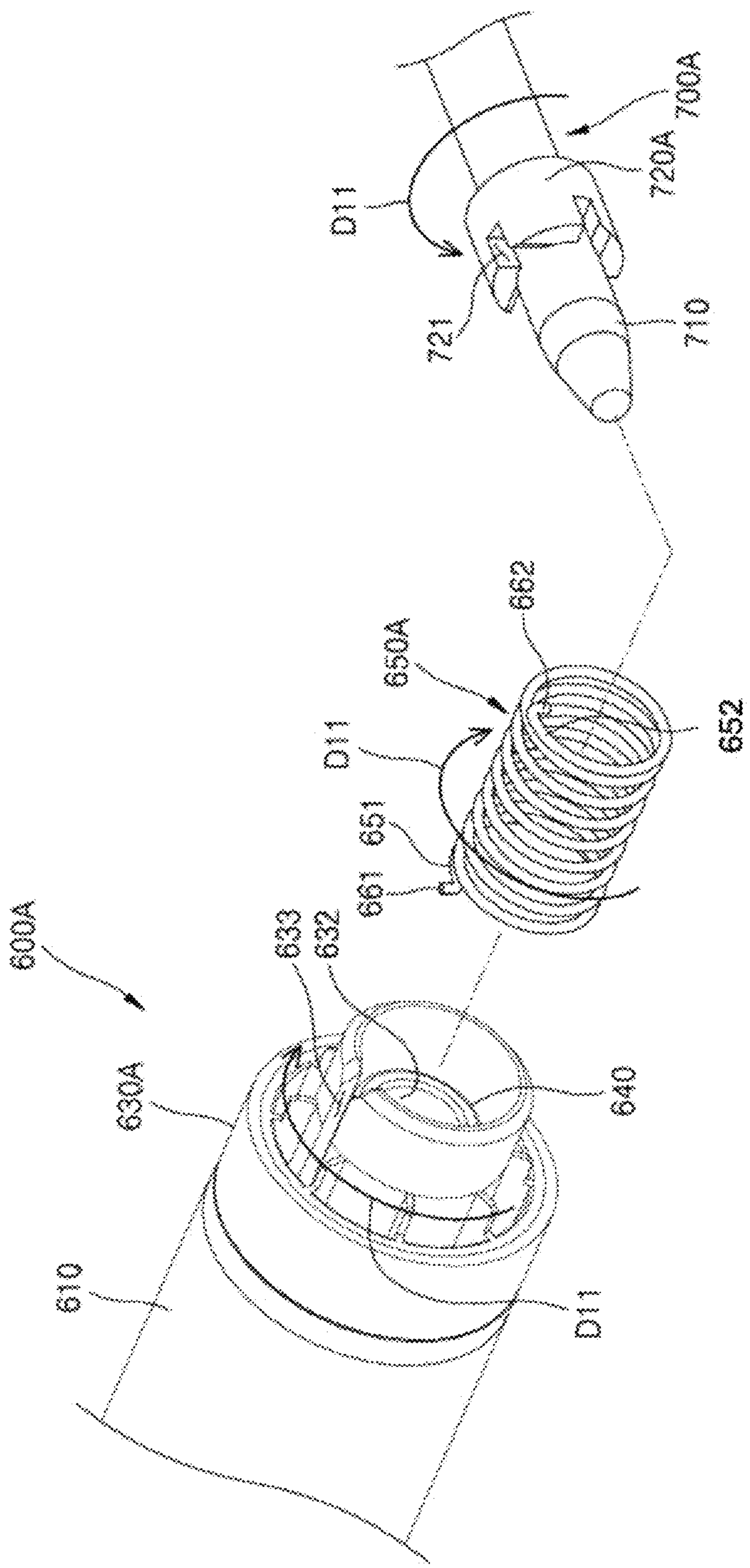


FIG. 9



700A
720A
D11
721
710
662
650A
652
D11
651
661
600A
633
632
630A
640
610
D11

FIG. 10

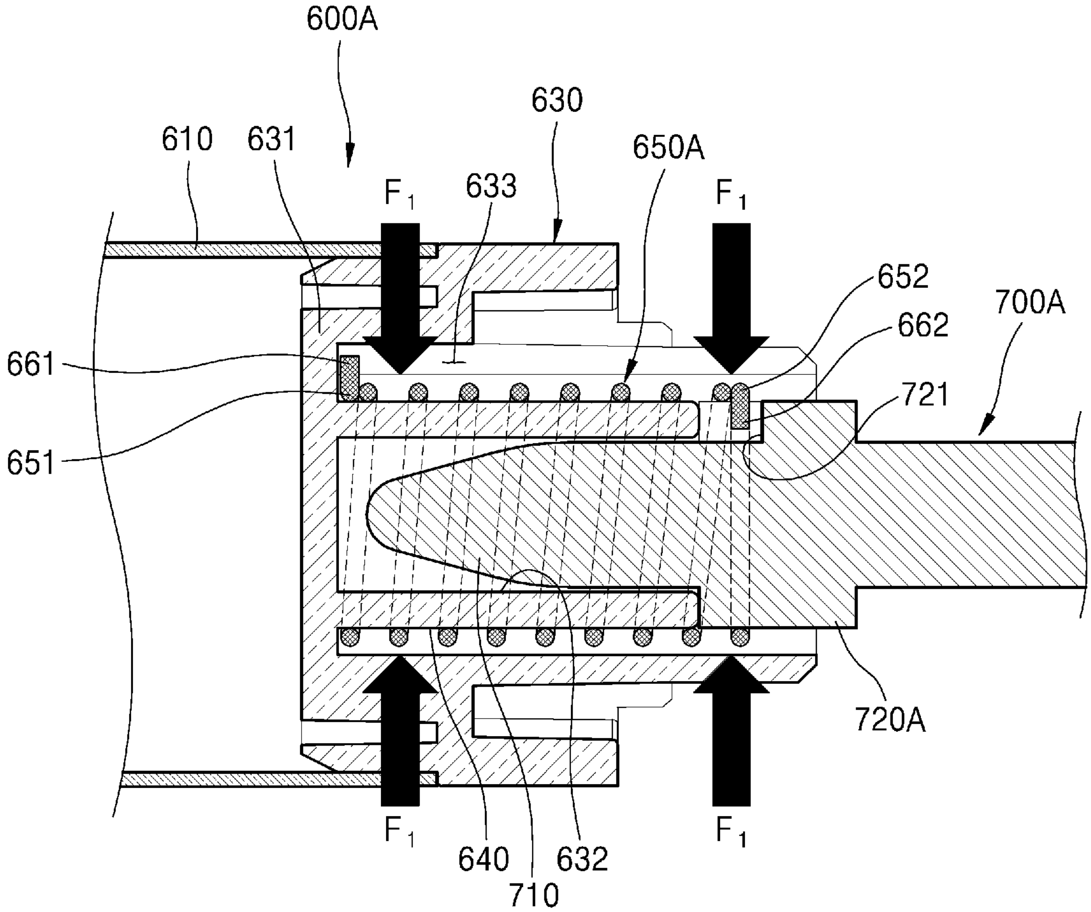

600A
630
610
631
650A
F1
633
F1
652
700A
662
661
721
651
720A
F1
F1
640
632
710

FIG. 11

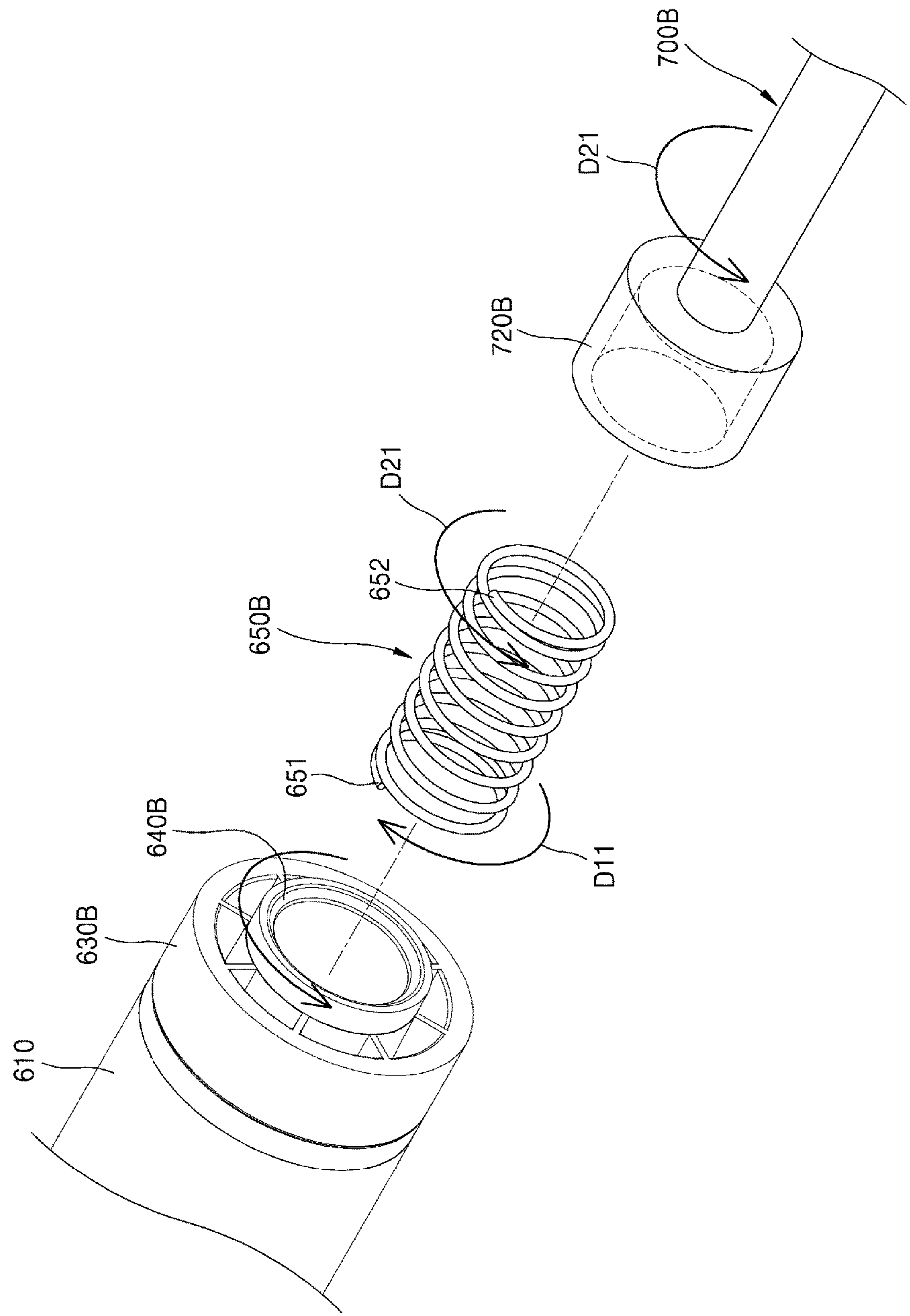


FIG. 12

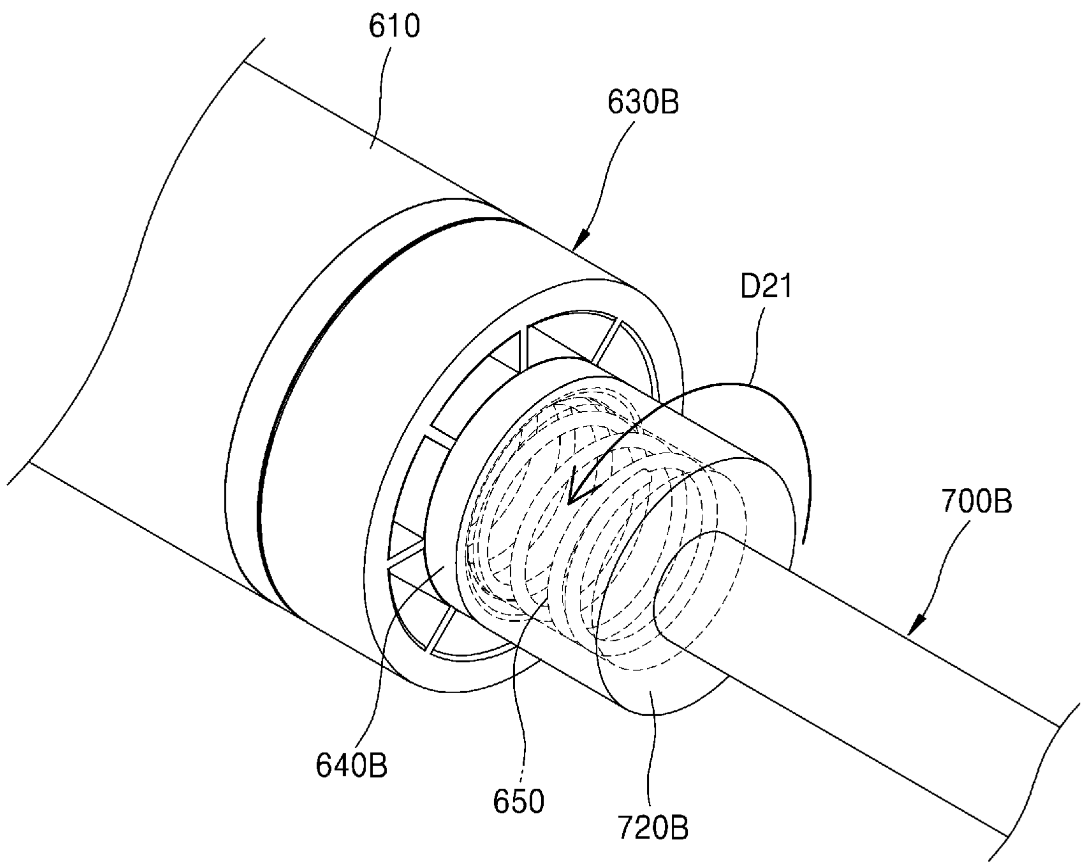


FIG. 13

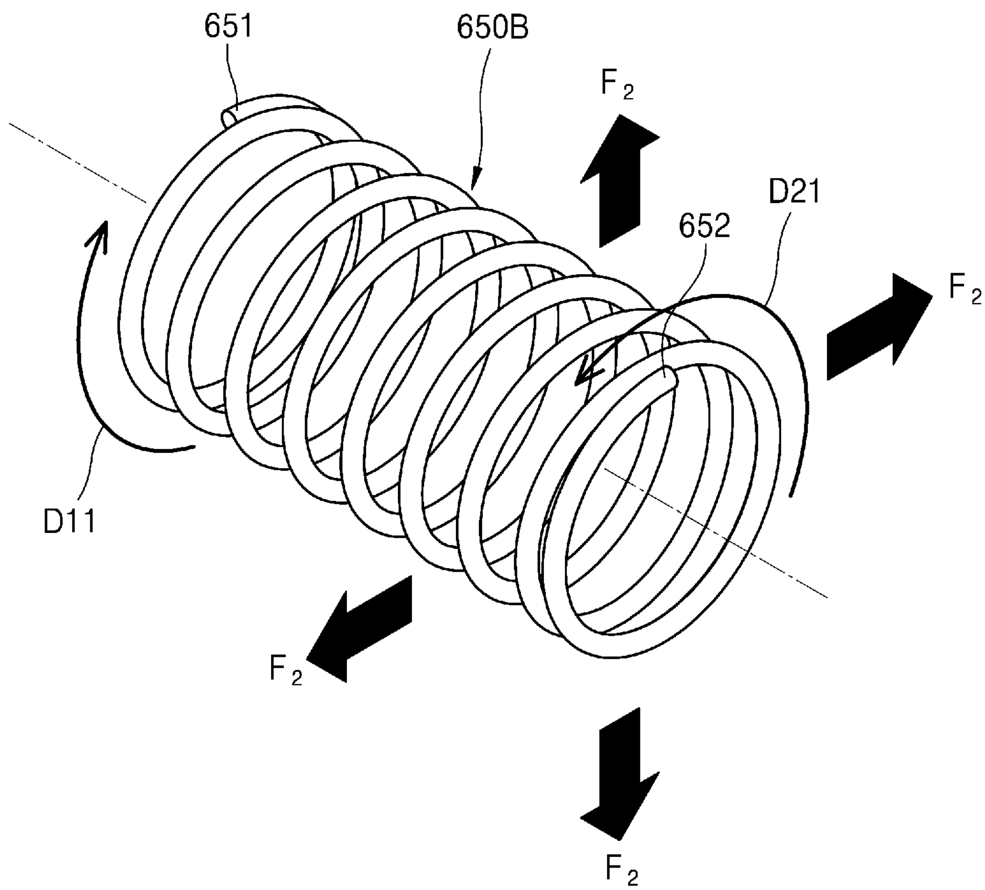


FIG. 14

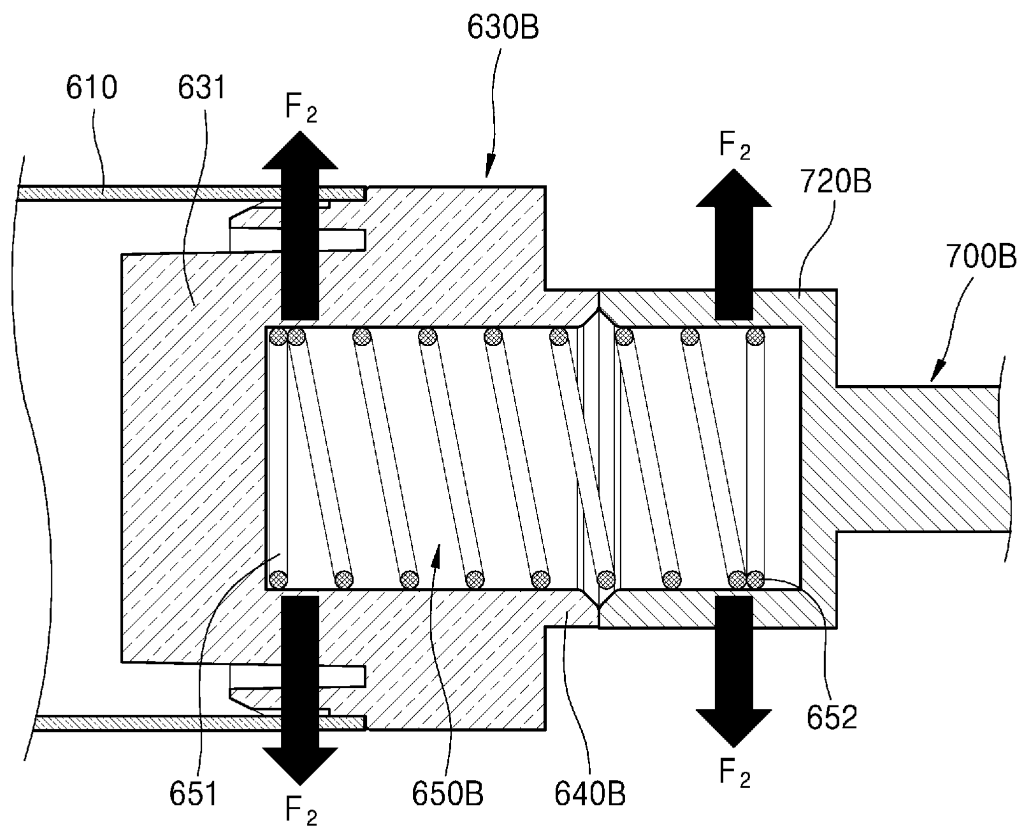


FIG. 15

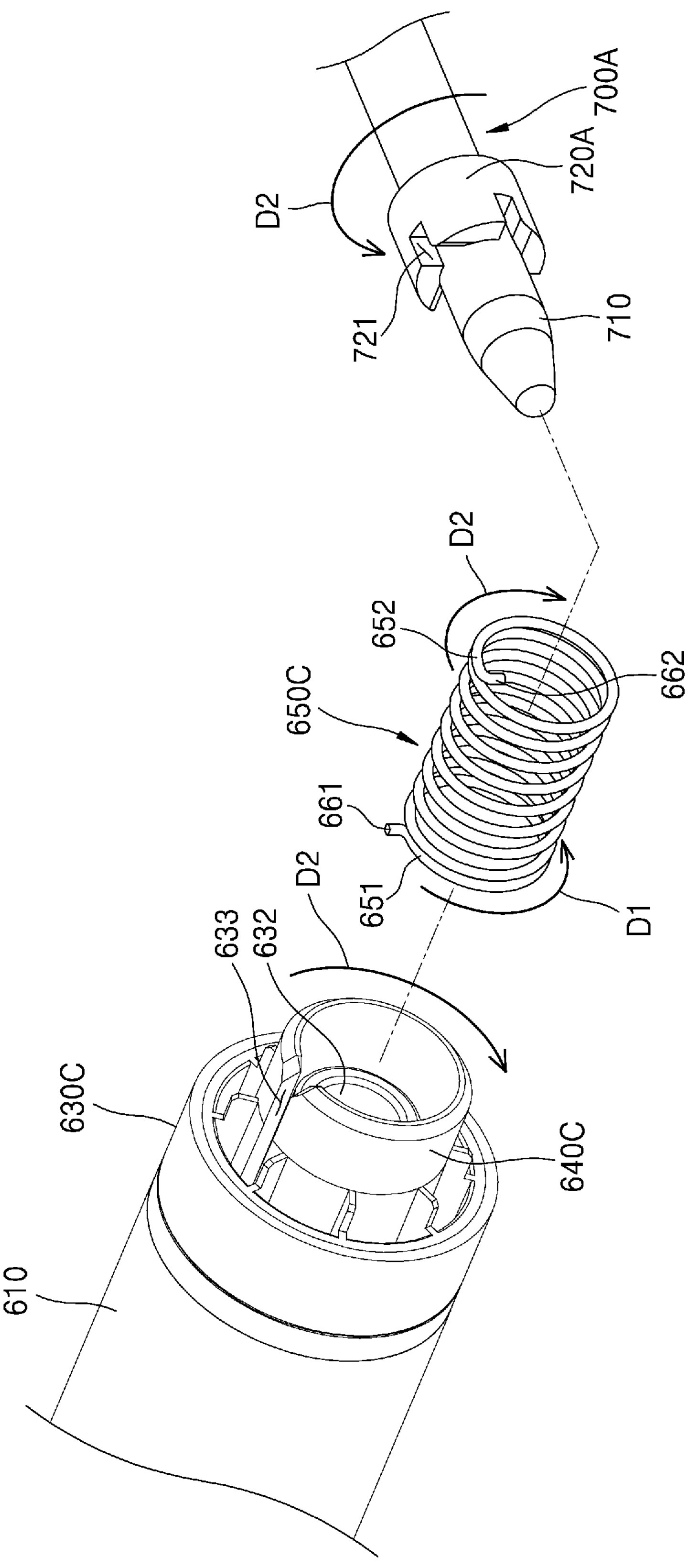
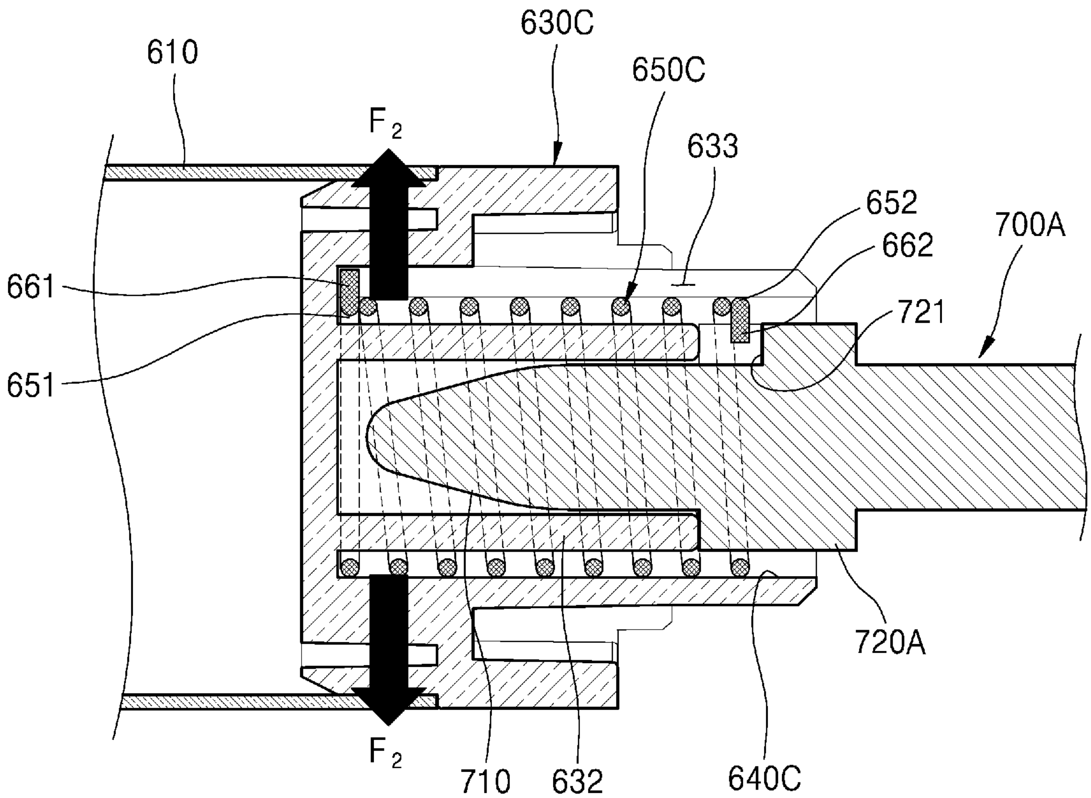

700A
720A
D2
721
710
D2
652
662
650C
661
D2
651
D1
633
632
D2
630C
640C
610

FIG. 16


610
630C
650C
633
652
662
700A
721
661
651
F_2
F_2
710
632
640C
720A

ROTATIONAL FORCE TRANSMISSION STRUCTURE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a U.S. National Stage Patent Application under 35 U.S.C. § 371 of PCT/US2022/070030, filed Jan. 5, 2022, which claims priority to Korean Patent Application No. 10-2021-0116309, filed Sep. 1, 2021, which are hereby incorporated by reference in their entireties.

BACKGROUND

An electro-photographic image forming device forms a visible toner image on a photosensitive drum by supplying a toner to an electrostatic latent image formed on a photoconductor. The electro-photographic image forming device transfers the toner image onto a printing medium via an intermediate transfer medium or directly to fuse the transferred toner image onto the printing medium.

In such an electro-photographic image forming device, some components are configured as a cartridge unit, so that they are easily attached to and removed from a main body. The cartridge unit may be implemented in various forms. For example, the cartridge unit may include a photosensitive cartridge including a photosensitive drum, or a developing cartridge including a developing roller, or an imaging cartridge including a photosensitive drum and a developing roller, and the like. The cartridge unit may include a rotation member and a driven coupler configured to rotate the rotation member by receiving a rotational force from the main body.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of an image forming device showing a state in which a cartridge unit is detachable from a main body, according to an example.

FIG. **2** is a schematic diagram illustrating an electro-photographic image forming device, according to an example.

FIG. **3** is a perspective view of a coupling structure, according to the present example.

FIG. **4** is a cross-sectional view of the coupling structure shown in FIG. **3**.

FIG. **5** is a cross-sectional view showing a state in which the coupling structure shown in FIG. **3** is coupled.

FIG. **6** is an exploded perspective view illustrating an operation of a coupling structure, according to the present example.

FIG. **7** is a perspective view illustrating a coil spring according, to the present example.

FIG. **8** is a cross-sectional perspective view of a coupling structure illustrating an operation of the coil spring of FIG. **7**.

FIG. **9** is an exploded perspective view illustrating a coupling structure including a coil spring, according to another example.

FIG. **10** is a cross-sectional view showing a state in which the coupling structure of FIG. **9** is assembled.

FIG. **11** is an exploded perspective view of a coupling structure, according to another example.

FIG. **12** is an assembled perspective view of the coupling structure of FIG. **11**.

FIG. **13** is a perspective view illustrating an operation of the coil spring of FIG. **11**.

FIG. **14** is a cross-sectional view illustrating the operation of the coil spring of FIG. **11**.

FIG. **15** is an exploded perspective view of a coupling structure, according to another example.

FIG. **16** is a cross-sectional view illustrating an operation of a coil spring of FIG. **15**.

DETAILED DESCRIPTION

In an image forming device, some components may be configured as a cartridge unit and may be detachably attached to a main body. For example, the cartridge unit includes a rotation member such as a photosensitive drum, a developing roller, and the like. The cartridge unit may be mounted or removed in an axial direction of the rotation member.

When mounted on the main body, the cartridge unit is connected to a motor through a coupling structure, and receives rotational force from the motor to rotate the rotation member of the cartridge unit. Examples of the coupling structure may include a driving coupler provided in the main body and a driven coupler provided in the cartridge unit. The driven coupler is coupled to the driving coupler, and receives rotational force from the driving coupler.

In the foregoing examples, a rotational shaft of the driving coupler and a rotational shaft of the driven coupler are arranged coaxially with each other, and the rotational force of the driving coupler may be directly transmitted to the driven coupler. Under actual conditions, due to various causes, such as manufacturing tolerances and assembly tolerances of the driving coupler and the driven coupler, the rotational shaft of the driving coupler and the rotational shaft of the driven coupler may not be coaxially arranged. As a result, a driving force may not be properly transmitted from the main body to the cartridge unit, and in some cases, the coupling structure or a component connected thereto may be damaged. In a cartridge unit and an image forming device according to some examples of the present disclosure, a stable driving force transmission is secured from the main body to the rotation member of the cartridge unit through a rotational force transmission structure using a reduction or increase in a diameter of a coil spring, and the driven coupler and the driving coupler may be coaxially arranged.

Hereinafter, a cartridge unit and an example of the image forming device including the cartridge unit are described in detail with reference to the accompanying drawings. In the present specification and the drawings, constituent elements having substantially the same functions are referenced by the same reference numerals, and thus, redundant descriptions thereof are omitted.

FIG. **1** is a perspective view of an image forming device showing a state in which a cartridge unit is detachable from a main body, according to an example. FIG. **2** is a schematic diagram illustrating an electro-photographic image forming device, according to an example. The image forming device according to some examples is a monochromatic image forming device configured to employ a two-component developer that contains a toner and a magnetic carrier. A color of the toner is, for example, black.

Referring to FIG. **1**, a door **501** of the image forming device may open to partially expose a main body **500** and detachably attach a cartridge unit **600** to the main body **500**. The cartridge unit **600** may slide in a mounting direction A**1** or a removal direction A**2** to be mounted on or removed from the main body **500**. The mounting direction A**1** and the removal direction A**2** may be axial directions of a rotation member provided in the cartridge unit **600**.

Referring to FIG. **2**, the image forming device on which the cartridge unit **600** is mounted may include a photo scanner **3**, a photosensitive unit **200**, a developing unit **300**, a transfer device, and a fusing device **7**.

The photosensitive unit **200** includes a photosensitive drum **1** and a charging roller **2** configured to rotate. The photosensitive drum **1** is an example of a photoconductor on which an electrostatic latent image is formed. The charging roller **2** is an example of a charging machine configured to charge a surface of the photosensitive drum **1** to a uniform surface potential. The charging roller **2** is configured to be in contact with the photosensitive drum **1** to rotate, and a charging bias voltage is applied to the charging roller **2**. The photosensitive unit **200** may further include a cleaning roller **8** configured to remove foreign matters from a surface of the charging roller **2** and a cleaning blade **6** configured to remove toner remaining on the surface of the photosensitive drum **1**. A static eliminator **5** configured to remove residual potentials on the photosensitive drum **1** may be arranged upstream of the cleaning blade **6** with respect to a rotational direction of the photosensitive drum **1**. The static eliminator **5** may irradiate light onto the surface of the photosensitive drum **1**, for example.

The photo scanner **3** irradiates the surface of the charged photosensitive drum **1** with light corresponding to image information to form an electrostatic latent image. The developing unit **300** mixes and stirs the toner and the carrier, and supplies the toner to the electrostatic latent image formed on the photosensitive drum **1** to form a visible toner image on the surface of the photosensitive drum **1**. The developing unit **300** may include a developing roller **10** configured to supply the toner to the photosensitive drum **1** while rotating, and an agitation member configured to stir and convey a developer. The agitation member may include a first agitator **341** and a second agitator **342**. The agitation member may be connected to gears **351** and **352** configured to transmit a rotational force.

An inner space of the developing unit **300** may be divided into an agitation chamber **310** and a developing chamber **320** parallel to each other. The first agitator **341** is installed in the agitation chamber **310**. The developing roller **10** and the second agitator **342** are installed in the developing chamber **320**. The agitation chamber **310** and the developing chamber **320** are separated from each other by a partition wall **330** extending in an axial direction of the developing roller **10**. In a case where the first agitator **341** rotates, the developer in the agitation chamber **310** is conveyed in the axial direction (first direction) by the first agitator **341**, and conveyed to the developing chamber **320** through an opening provided near one end portion of the partition wall **330**. The developer in the developing chamber **320** is conveyed in a second direction opposite to the first direction by the second agitator **342**, and conveyed to the agitation chamber **310** through an opening provided near the other end portion of the partition wall **330**. Therefore, the developer is circulated along the agitation chamber **310** and the developing chamber **320**, and supplied to the developing roller **10** in the developing chamber **320** during a circulation process.

The developing roller **10** conveys the developer including the toner and the carrier to a developing area **9** facing the photosensitive drum **1**. The toner is attached to the carrier by electrostatic force, and the carrier is attached to a surface of the developing roller **10** by magnetic force. As a result, a developer layer is formed on the surface of the developing roller **10**. The developing roller **10** may be arranged apart from the photosensitive drum **1** by a developing gap. The developing gap may be set on the order of several tens to several hundreds of micrometers. The toner is moved from the developing roller **10** to the photosensitive drum **1** by a developing bias voltage applied between the developing roller **10** and the photosensitive drum **1**, and a visible toner image is formed on the surface of the photosensitive drum **1**.

A transfer roller **4** is an example of a transfer mechanism configured to transfer the toner image formed on the photosensitive drum **1** to a printing medium P. The transfer roller **4** faces the photosensitive drum **1** to form a transfer nip, and a transfer bias voltage is applied to the transfer roller **4**. The toner image developed on the surface of the photosensitive drum **1** is transferred to the printing medium P by a transfer electric field formed between the photosensitive drum **1** and the transfer roller **4** by the transfer bias voltage. A corona transfer mechanism using corona discharge may be employed instead of the transfer roller **4**.

The toner image transferred to the printing medium P is attached to the printing medium P by an electrostatic force. The fusing device **7** applies heat and pressure to fuse the toner image onto the printing medium P.

If the toner in the developing unit **300** is consumed, a toner may be supplied from a toner container **100** to the developing unit **300**. The toner container **100** may include a toner accommodation portion **101** configured to accommodate a toner, and conveyance members **110**, **120**, and **130** configured to convey the toner of the toner accommodation portion **101** to a toner outlet **102**. A toner supply member **190** connects the toner outlet **102** to a toner supply port **301** of the developing unit **300**.

The conveyance member **110** conveys the toner to the toner outlet **102**. Although not shown in the drawings, the toner container **100** may include a shutter configured to selectively open or close the toner outlet **102**.

Referring back to FIG. **1**, the image forming device may include at least one detachable cartridge unit **600**. The cartridge unit **600** includes at least one rotation member **610**. For example, the photosensitive unit **200** may be a photosensitive cartridge that is replaced when the photosensitive drum **1** is used up. The developing unit **300** may be a developing cartridge that is replaced when internal members are used up. The photosensitive unit **200** and the developing unit **300** may be integrally replaceable cartridge units (imaging cartridge **400**).

When the cartridge unit **600** is mounted on the main body **500**, the cartridge unit **600** is connected to a motor by a coupling structure and receives a rotational force from the motor to rotate the rotation member **610** of the cartridge unit **600**, for example, the photosensitive drum **1** of the photosensitive unit **200**, the charging roller **2** of the photosensitive unit **200**, the developing roller **10** of the developing unit **300**, and the like.

The coupling structure may include a driving coupler provided in the main body **500** and a driven coupler **630** provided in the cartridge unit **600**. The driven coupler **630** is coupled to the driving coupler, and receives a rotational force from the driving coupler.

FIG. **3** is a perspective view of a coupling structure, according to the present example. In FIG. **3**, the cartridge unit **600** may be a photosensitive unit (photosensitive cartridge), a developing unit (developing cartridge), an imaging cartridge or a toner container (toner cartridge) in which the photosensitive unit and the developing unit are integrated. FIG. **4** is a cross-sectional view of the coupling structure shown in FIG. **3**. FIG. **5** is a cross-sectional view showing a state in which the coupling structure shown in FIG. **3** is coupled.

Referring to FIGS. **3** to **5**, the cartridge unit **600** may include the rotation member **610** and the driven coupler **630** described above. The driven coupler **630** may receive a rotational force from the outside, for example, a driving coupler **700** provided on the main body **500** to rotate the rotation member **610**.

The rotation member **610** may be a photosensitive drum. However, the rotation member **610** is not limited thereto. The rotation member **610** may be a component included in the cartridge unit **600** to be easily mounted on and removed from the main body **500**, for example, a developing roller, an agitation member, or a gear that transmits a rotational force thereto. In other words, the rotation member **610** may be at least one of the photosensitive drum, the developing roller, the agitation member, and the gear that transmits a rotational force thereto.

The driven coupler **630** is arranged on one end portion of the rotation member **610** in an axial direction. The axial direction of the rotation member **610** may be a direction in which the cartridge unit **600** is mounted. The driven coupler **630** may be fixed to the rotation member **610** and may rotate the rotation member **610** by receiving a rotational force from the outside.

The driven coupler **630** includes a flange portion **631** fixed and coupled to the rotation member **610**, and a coupling portion **632** extending in the axial direction of the rotation member **610** from the flange portion **631**. The coupling portion **632** may have a hollow cylinder shape extending in the axial direction of the rotation member **610**. The coupling portion **632** may be integrally formed with the flange portion **631**.

The driving coupler **700** may be coupled and connected to the coupling portion **632** of the driven coupler **630**. For example, the driving coupler **700** may include an insertion portion **710** inserted into the coupling portion **632**, and a support **720** configured to support the insertion portion **710**. The insertion portion **710** and the coupling portion **632** may be fitted and coupled to each other. A frictional force acts between the fitted insertion portion **710** and the coupling portion **632**. For fitting, the insertion portion **710** may be slightly larger than or equal to an inner diameter of the coupling portion **632**. The insertion portion **710** may have a diameter decreasing toward one end portion thereof to facilitate insertion into the coupling portion **632**. When the driving coupler **700** and the driven coupler **630** are connected to each other, the driven coupler **630** and the rotation member **610** rotate by receiving a rotational force from the driving coupler **700**.

Under ideal conditions, a rotational shaft of the driving coupler **700** and a rotational shaft of the driven coupler **630** are arranged coaxially with each other, and a rotational force of the driving coupler **700** is transmitted to the driven coupler **630**. However, under actual conditions, due to various causes, such as manufacturing tolerances and assembly tolerances of the driving coupler **700** and the driven coupler **630**, the rotational shaft of the driving coupler **700** and the rotational shaft of the driven coupler **630** may not be coaxially arranged. As a result, a driving force may not be properly transmitted from the main body **500** to the cartridge unit **600**, and in some cases, a coupling structure or components connected thereto may be damaged. In order to overcome such issues, the cartridge unit **600** according to the some examples may further include a coil spring **650** configured to connect the driven coupler **630** to the driving coupler **700** or to supplement the connection.

The coil spring **650** is arranged to be expandable and compressible in the axial direction of the rotation member **610**. A first end portion **651** of the coil spring **650** is fixed to the driven coupler **630**. The driven coupler **630** may include a support **640** extending in the axial direction of the rotation member **610** and configured to support the coil spring **650** to be fixed. The support **640** may protrude in the axial direction of the rotation member **610** to be inserted into the coil spring **650**. The support **640** and the coupling portion **632** may be integrally formed. For example, an outer circumferential surface of the coupling portion **632** for coupling with the driving coupler **700** may function as the support **640**. However, an arrangement and configuration of the support **640** is not limited thereto, and various arrangements and configurations may be possible.

The coil spring **650** may be fixed onto an outer circumferential surface of the support **640** of the driven coupler **630**. For example, the first end portion **651** of the coil spring **650** may be fitted and fixed to the outer circumferential surface of the support **640**. A frictional force acts between the first end portion **651** of the coil spring **650** and the support **640**. For fitting, a diameter of the coil spring **650** before being coupled to the support **640** may be slightly less than or equal to an outer diameter of the support **640**.

The coil spring **650** has the first end portion **651** fixed to and supported by the support **640**, and the other end portion (a second end portion) **652** located on an opposite side of the first end portion **651**. The coil spring **650** is wound from the first end portion **651** toward the second end portion **652** in a first direction D**1**. Before being coupled to the driving coupler **700**, the second end portion **652** of the coil spring **650** is not fixed and may be expanded and compressed.

FIG. **6** is an exploded perspective view illustrating an operation of a coupling structure, according to the present example. FIG. **7** is a perspective view illustrating the coil spring **650**, according to the present example, and FIG. **8** is a cross-sectional perspective view of a coupling structure illustrating an operation of the coil spring **650** of FIG. **7**.

Referring to FIGS. **6** to **8**, while the insertion portion **710** of the driving coupler **700** is coupled to the coupling portion **632** of the driven coupler **630**, the second end portion **652** of the coil spring **650** is fixed onto the driving coupler **700**. For example, the second end portion **652** of the coil spring **650** may be fixed onto the support **720** of the driving coupler **700**. The second end portion **652** of the coil spring **650** may be fixed by being fitted to an outer circumferential surface of the support **720** of the driving coupler **700**. A frictional force acts between the second end portion **652** of the coil spring **650** and the outer circumferential surface of the support **720**. For fitting, a diameter of the coil spring **650** before being coupled to the support **720** may be slightly less than or equal to an outer diameter of the support **720**.

While the driven coupler **630** and the driving coupler **700** are coupled to each other, when the driving coupler **700** rotates, the driven coupler **630** and the coil spring **650** that are fixed and connected to the driving coupler **700** rotate in the same direction as the driving coupler **700**. A direction in which the driving coupler **700** rotates may be the same direction as the first direction D**1** in which the coil spring **650** is wound. In that case, a rotational force is transmitted from the outside, for example, the driving coupler **700**, to the second end portion **652** of the coil spring **650** in the first direction D**1**. Since the frictional force is acting between the coil spring **650** and the driving coupler **700** due to the fitting, the rotational force is transmitted to the coil spring **650** in the first direction D**1** as shown in FIG. **7**. Since the direction in which the driving coupler **700** rotates is the same direction as the first direction D**1** in which the coil spring **650** is wound, some of the transmitted rotational force is converted into a force F1 that reduces the diameter of the coil spring **650**. Therefore, the second end portion **652** of the coil spring **650** presses the driving coupler **700** in a direction perpendicular to an axial direction of the rotation member **610**, and the first end portion **651** of the coil spring **650** presses the driven coupler **630** in the direction perpendicular to the axial direction of the rotation member **610**. In other words, as shown in FIG. **8**, some of the rotational force transmitted to the coil spring **650** in the first direction D**1** is converted into the force F**1** that reduces the diameter of the coil spring **650** to press an outer circumferential surface of the support **720** of the driving coupler **700** and an outer circumferential surface of the support **640** of the driven coupler **630**. Due to the pressing of the coil spring **650**, the frictional force acting between the second end portion **652** of the coil spring **650** and the support **720** increases, and the frictional force acting between the first end portion **651** of the coil spring **650** and the support **640** increases. In other words, since the rotational force is transmitted to the coil spring **650** in the first direction D**1** and the coil spring **650** presses the outer circumferential surface of the support **720** of the driving coupler **700**, the frictional force acting between the coil spring **650** and the support **720** increases. In addition, since the rotational force is transmitted to the coil spring **650** in the first direction D**1** and the coil spring **650** presses the outer circumferential surface of the support **640** of the driven coupler **630**, the frictional force acting between the coil spring **650** and the support **640** increases. Accordingly, a coupling force between the coil spring **650** and the driven coupler **630** increases, and a coupling force between the second end portion **652** of the coil spring **650** and the driving coupler **700** increases.

A coupling force between the driving coupler **700** and the driven coupler **630** may be supplemented by a pressing force of the coil spring **650**. A force is applied in a direction perpendicular to a rotation axis of the driving coupler **700** and the driven coupler **630** by the coil spring **650**. Therefore, even if the rotation axis of the driving coupler **700** and the rotation axis of the driven coupler **630** when assembled slightly deviate from a coaxial axis, the driving coupler **700** and the driven coupler **630** may be coaxially arranged.

In addition, the second end portion **652** of the coil spring **650** coupled to the driving coupler **700** receives a force while continuously surrounding an edge of the support **720** of the driving coupler **700**, and the first end portion **651** of the coil spring **650** coupled to the driven coupler **630** transmits a force while continuously surrounding an edge of the support **640** of the driven coupler **630**. As described above, since the coil spring **650** has a structure that transmits or receives force through the edges of the driving coupler **700** and the driven coupler **630** as a whole, damage due to concentration of force in some parts may be prevented.

FIG. **9** is an exploded perspective view illustrating a coupling structure including a coil spring **650**A, according to another example, and FIG. **10** is a cross-sectional view illustrating an assembled state of the coupling structure of FIG. **9**.

Referring to FIGS. **9** and **10**, a cartridge unit **600**A according to examples of FIGS. **9** and **10** includes a driven coupler **630**A and the coil spring **650**A. Hereinafter, descriptions are mainly on differences between the cartridge unit **600**A according to the examples of FIGS. **9** and **10** and the cartridge unit **600** described above, and redundant descriptions thereof are omitted.

The coil spring **650**A may further include a first locking protrusion **661** for coupling with the driven coupler **630**A. The first locking protrusion **661** may be arranged on the first end portion **651** of the coil spring **650**A, and may protrude in a radial direction of the coil spring **650**A. The driven coupler **630**A includes a first locking groove **633** into which the first locking protrusion **661** is inserted. Since the first locking protrusion **661** is inserted into the first locking groove **633**, a slip between the coil spring **650**A and the driven coupler **630**A may be prevented.

The coil spring **650**A further includes a second locking protrusion **662** at the second end portion **652** for coupling with a driving coupler **700**A. The driving coupler **700**A includes a second locking groove **721** into which the second locking protrusion **662** is inserted in a support **720**A. Since the second locking protrusion **662** is inserted into the second locking groove **721**, when the driving coupler **700**A rotates, a slip between the driving coupler **700**A and the coil spring **650**A may be prevented.

While the first end portion **651** of the coil spring **650**A is fixed onto the support **640**, and the first locking protrusion **661** of the coil spring **650**A is inserted into the first locking groove **633** of the driven coupler **630**, the driven coupler **630** and the driving coupler **700** are coupled to each other. While the driven coupler **630**A and the driving coupler **700**A are coupled to each other, the second end portion **652** of the coil spring **650**A is fixed onto the support **720**A, and the second locking protrusion **662** is inserted into the second locking groove **721**. In that state, while the driving coupler **700**A rotates in a first direction D**11**, which is the direction in which the coil spring **650**A is wound, a rotational force is transmitted to the second end portion **652** of the coil spring **650**A in the first direction D**11**, and a portion of the transmitted rotational force is converted into the force F**1** that reduces a diameter of the coil spring **650**A. Therefore, the second end portion **652** of the coil spring **650**A tightens onto the support **720**A of the driving coupler **700**A, thereby increasing a coupling force between the coil spring **650**A and the driving coupler **700**A. The first end portion **651** of the coil spring **650**A presses the driven coupler **630**A in a direction perpendicular to an axial direction of the rotation member **610**. The first end portion **651** of the coil spring **650**A tightens onto the support **640** of the driven coupler **630**A, thereby increasing a coupling force between the coil spring **650**A and the driven coupler **630**A.

The above-described examples describe that a rotational force is transmitted to the second end portion **652** of the coil springs **650** and **650**A in the first directions D**1** and D**11**, respectively, and the transmitted rotational force is converted into a force that reduces the diameter of the coil springs **650** and **650**A. However, the coil springs **650** and **650**A according to some examples are not limited thereto, and a force may be applied in an opposite direction to strengthen a coupling force of the coupler structure. In other words, in the cartridge unit **600** or **600**A according to some examples, when a rotational force is transmitted to the second end portion **652** of the coil spring **650** or **650**A from the outside in the first directions D**1** or D**11** or in the second direction, which is the opposite direction of the first direction D**1** or D**11**, a portion of the transmitted rotational force may be converted into a force to decrease or increase the diameter of the coil spring **650** or **650**A, so that the first end portion **651** of the coil spring **650** or **650**A may press the driven coupler **630** or **630**A in a direction perpendicular to the axial direction of the rotation member **610**.

FIG. **11** is an exploded perspective view of a coupling structure, according to another example, and FIG. **12** is an assembled perspective view of the coupling structure of FIG. **11**. FIG. **13** is a perspective view illustrating an operation of a coil spring **650**B of FIG. **11**, and FIG. **14** is a cross-sectional view illustrating the operation of the coil spring **650**B of FIG. **11**.

Referring to FIGS. **11** to **14**, a driven coupler **630**B includes the flange portion **631** fixed onto the rotation member **610**, and a support **640**B extending in an axial direction of the rotation member **610** from the flange portion **631**. The support **640**B may have a cylindrical shape that surrounds the coil spring **650**B. The support **640**B may extend in the axial direction of the rotation member **610**. The support **640**B may be formed integrally with the flange portion **631**.

The first end portion **651** of the coil spring **650**B may be inserted into the support **640**B of the driven coupler **630**B to be fixed and supported. The first end portion **651** of the coil spring **650**B may be inserted into the support **640**B to be fitted. A frictional force acts between the first end portion **651** of the coil spring **650**B and an inner circumferential surface of the support **640**B. For fitting, a diameter of the first end portion **651** of the coil spring **650**B may be slightly greater than or equal to an inner diameter of the support **640**B.

A driving coupler **700**B may be connected to the support **640**B of the driven coupler **630**B. For example, the driving coupler **700**B may include a support **720**B connected to the support **640**B of the driven coupler **630**B. The support **720**B may have a hollow cylindrical shape. The second end portion **652** of the coil spring **650**B may be inserted into and coupled to the support **720**B of the driving coupler **700**B. The second end portion **652** of the coil spring **650**B may be inserted into the support **720**B to be fitted. A frictional force acts between the second end portion **652** of the coil spring **650**B and an inner circumferential surface of the support **720**B. For fitting, a diameter of the second end portion **652** of the coil spring **650**B may be slightly greater than or equal to an inner diameter of the support **720**B.

The driving coupler **700**B and the driven coupler **630**B may be connected to each other by the coil spring **650**B. Therefore, a rotational force of the driving coupler **700**B is transmitted to the driven coupler **630**B through the coil spring **650**B, and the rotation member **610** fixed onto the driven coupler **630**B rotates.

A direction in which the driving coupler **700**B rotates may be a second direction D**21** opposite to the first direction D**11**, in which the coil spring **650**B is wound. While a frictional force is applied between the driving coupler **700**B and the second end portion **652** of the coil spring **650**B, when the driving coupler **700**B rotates in the second direction D**21**, a rotational force is transmitted in the second direction D**21** to the second end portion **652** of the coil spring **650**B coupled to the driving coupler **700**B. Some of the transmitted rotational force is converted into a force F**2** that increases a diameter of the coil spring **650**B as shown in FIG. **13**. While the force F**2** that increases the diameter of the coil spring **650**B acts on the coil spring **650**B, the second end portion **652** of the coil spring **650**B presses the driving coupler **700**B in a direction perpendicular to an axial direction of the rotation member **610**, and the first end portion **651** of the coil spring **650**B presses the driven coupler **630**B in the direction perpendicular to the axial direction of the rotation member **610**. When a rotational force is transmitted to the second end portion **652** of the coil spring **650**B in the second direction D**21**, some of the transmitted rotational force is converted into the force F**2** that increases the diameter of the coil spring **650**B and presses an inner circumferential surface of the support **640**B of the driven coupler **630**B and an inner surface of the support **720**B of the driving coupler **700**B. Therefore, the first end portion **651** of the coil spring **650**B is in close contact with the support **640**B of the driven coupler **630**B, and the second end portion **652** of the coil spring **650**B is in close contact with the support **720**B of the driving coupler **700**B. Due to the pressing of the coil spring **650**B, the frictional force acting between the second end portion **652** of the coil spring **650**B and the support **720**B increases, and the frictional force acting between the first end portion **651** of the coil spring **650**B and the support **640**B increases. Since a rotational force is transmitted to the coil spring **650**B in the second direction D**21**, the coil spring **650**B presses the inner circumferential surface of the support **720**B of the driving coupler **700**B. Therefore, the frictional force acting between the coil spring **650**B and the support **720**B increases. Since a rotational force is transmitted to the coil spring **650**B in the second direction D**21**, the coil spring **650**B presses the inner circumferential surface of the support **640**B of the driven coupler **630**B. Therefore, the frictional force acting between the coil spring **650**B and the support **640**B increases. Accordingly, a coupling force between the first end portion **651** of the coil spring **650**B and the driven coupler **630**B increases, and a coupling force between the second end portion **652** of the coil spring **650**B and the driving coupler **700**B increases.

FIG. **15** is an exploded perspective view of a coupling structure, according to another example, and FIG. **16** is a cross-sectional view illustrating an operation of a coil spring **650**C of FIG. **15**.

Referring to FIGS. **15** and **16**, the coil spring **650**C according to the present example may include the first locking protrusion **661** for coupling with a driven coupler **630**C. The first locking protrusion **661** may be arranged on the first end portion **651** of the coil spring **650**C, and may protrude in a radial direction of the coil spring **650**C. The driven coupler **630**C includes the first locking groove **633** into which the first locking protrusion **661** is inserted. Since the first locking protrusion **661** is inserted into the first locking groove **633**, a slip between the coil spring **650**C and the driven coupler **630**C may be prevented.

The coil spring **650**C further includes the second locking protrusion **662** on the second end portion **652** for coupling with the driving coupler **700**A. The support **720**A of the driving coupler **700**A includes the second locking groove **721** into which the second locking protrusion **662** is inserted. Since the second locking protrusion **662** is inserted into the second locking groove **721**, in a case where the driving coupler **700**A rotates, a slip between the driving coupler **700**A and the coil spring **650**C may be prevented.

While the first end portion **651** of the coil spring **650**C is fixed onto a support **640**C, and the first locking protrusion **661** of the coil spring **650**C is inserted into the first locking groove **633** of the driven coupler **630**C, the driven coupler **630**C and the driving coupler **700**A are coupled to each other. While the driven coupler **630**C and the driving coupler **700**A are coupled to each other, the second end portion **652** of the coil spring **650**C is fixed onto the support **720**A, and the second locking protrusion **662** is inserted into the second locking groove **721**. The first end portion **651** of the coil spring **650**C may be fixed onto an inner circumferential surface of the support **640**C by fitting, and the second end portion **652** of the coil spring **650**C may be fixed onto an outer circumferential surface of the support **720**A by fitting.

In that state, while the driving coupler **700**A rotates in the second direction D**2** opposite to the first direction D**1**, in which the coil spring **650**C is wound, a rotational force is transmitted to the other end portion **652** of the coil spring **650**C in the second direction D**2**, and some of the transmitted rotational force is converted into the force F**2** that increases a diameter of the coil spring **650**C. Accordingly, the first end portion **651** of the coil spring **650**C presses the driven coupler **630**C in a direction perpendicular to an axial direction of the rotation member **610**. The first end portion **651** of the coil spring **650**C tightens the support **640**C of the driven coupler **630**C, thereby increasing a coupling force between the coil spring **650**C and the driven coupler **630**C.

According to some examples described above (e.g., FIGS. **3**-**8**), it has been described that while the first end portion **651** and the second end portion **652** of the coil spring **650** are fitted into the support **640** of the driven coupler **630** and the support **720** of the driving coupler **700**, respectively, and coupled by a frictional force, the first locking protrusion **661** and the second locking protrusion **662** are caught by the first locking groove **633** and the second locking groove **721**, respectively, and thus, the coil spring **650** is fixed to and supported on the driven coupler **630** and the drive coupler **700**. However, instead of being fitted or coupled by a frictional force, the coil spring **650** may be fixed onto and supported on the driven coupler **630** and the driving coupler **700**, as the first locking protrusion **661** and the second locking protrusion **662** are caught by the first locking groove **633** and the second locking groove **721**, respectively. In addition, the cartridge unit **600** employed in a monochromatic image forming device is exemplified in the above-described examples. However, examples of the present disclosure are not limited thereto. For example, the cartridge unit **600** according to the present examples may be employed in a color image forming device.

It should be understood that examples described herein should be considered in a descriptive sense only and not for purposes of limitation. Descriptions of features or aspects within each example should typically be considered as available for other similar features or aspects in other examples. While one or more examples have been described with reference to the figures, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope as defined by the following claims.

What is claimed is:

1. A cartridge unit detachable from a main body of an image forming device, the cartridge unit comprising:
- a rotation member;
- a driven coupler arranged at an end portion of the rotation member in an axial direction of the rotation member; and
- a coil spring arranged to be expandable and compressible in the axial direction of the rotation member, wherein a first end portion of the coil spring is fixed onto the driven coupler, the coil spring being wound from the first end portion toward a second end portion of the coil spring in a first direction,
- wherein, when a rotational force is transmitted from an outside of the cartridge unit to the second end portion of the coil spring in the first direction or in a second direction opposite to the first direction, a portion of the transmitted rotational force is converted into a force that decreases or increases a diameter of the coil spring, and the first end portion of the coil spring presses the driven coupler in a direction perpendicular to the axial direction of the rotation member.

2. The cartridge unit of claim **1**, wherein the driven coupler comprises a support extending in the axial direction of the rotation member and supporting the coil spring.

3. The cartridge unit of claim **2**, wherein the support protrudes in the axial direction of the rotation member so as to be inserted into the coil spring.

4. The cartridge unit of claim **3**, wherein, when the rotational force is transmitted to the second end portion of the coil spring in the first direction, the portion of the transmitted rotational force is converted into the force that decreases the diameter of the coil spring, thereby pressing an outer circumferential surface of the support.

5. The cartridge unit of claim **4**, wherein the first end portion of the coil spring is fitted onto the outer circumferential surface of the support, and a frictional force is provided between the coil spring and the support, and
- when the rotational force is transmitted to the coil spring in the first direction, the coil spring presses the outer circumferential surface of the support and the frictional force between the coil spring and the support increases.

6. The cartridge unit of claim **2**, wherein the support has a cylindrical shape that surrounds the coil spring.

7. The cartridge unit of claim **6**, wherein when the rotational force is transmitted to the second end portion of the coil spring in the second direction, the portion of the transmitted rotational force is converted into the force that increases the diameter of the coil spring, and presses an inner circumferential surface of the support of the driven coupler.

8. The cartridge unit of claim **7**, wherein the first end portion of the coil spring is inserted and fitted into the support, and a frictional force is provided between the coil spring and the support, and
- when the rotational force is transmitted to the coil spring in the second direction, the coil spring presses the inner circumferential surface of the support and the frictional force between the coil spring and the support increases.

9. The cartridge unit of claim **1**, wherein the main body of the image forming device comprises a driving coupler,
- the driving coupler is fixed to transmit the rotational force to the second end portion of the coil spring, and
- when the rotational force is transmitted from the driving coupler to the second end portion of the coil spring in the first direction or in the second direction, the portion of the transmitted rotational force is converted into the force that decreases or increases the diameter of the coil spring, and the second end portion of the coil spring presses the driving coupler in a direction perpendicular to the axial direction of the rotation member.

10. The cartridge unit of claim **1**, wherein the first end portion of the coil spring comprises a first locking protrusion to protrude in a radial direction of the rotation member, and
- the driven coupler comprises a first locking groove into which the first locking protrusion is inserted.

11. The cartridge unit of claim **1**, wherein the rotation member is at least one of a photosensitive drum, a developing roller, an agitation member, or a gear.

12. An image forming device comprising:
- a main body; and
- a cartridge unit detachably installed in the main body, wherein the cartridge unit comprises:
  - a rotation member;
  - a driven coupler arranged at one end portion of the rotation member; and
  - a coil spring capable of being expanded and compressed in an axial direction of the rotation member, wherein a first end portion of the coil spring is fixed onto the driven coupler, the coil spring being wound in a first direction from the first end portion toward a second end portion of the coil spring,

wherein the main body comprises a driving coupler to transmit a rotational force to the cartridge unit, and

when the rotational force is transmitted from the driving coupler to the second end portion of the coil spring in the first direction or in a second direction opposite to the first direction, the transmitted rotational force is converted into a force that decreases or increases a diameter of the coil spring, the second end portion of the coil spring presses the driving coupler in a direction perpendicular to the axial direction of the rotation member, and the first end portion of the coil spring presses the driven coupler in the direction perpendicular to the axial direction of the rotation member.

13. The image forming device of claim **12**, wherein the driven coupler comprises a support extending in the axial direction of the rotation member and supporting the coil spring to be fixed.

14. The image forming device of claim **13**, wherein the support protrudes in the axial direction of the rotating member so as to be inserted into the coil spring, and

when the rotational force is applied to the second end portion of the coil spring in the first direction, the transmitted rotational force is converted into the force that reduces the diameter of the coil spring, and presses an outer circumferential surface of the support.

15. The image forming device of claim **13**, wherein the support has a cylindrical shape that surrounds the coil spring, and

when the rotational force is transmitted to the second end portion of the coil spring in the second direction, the transmitted rotational force is converted into the force that increases the diameter of the coil spring, and presses an inner circumferential surface of the support.

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