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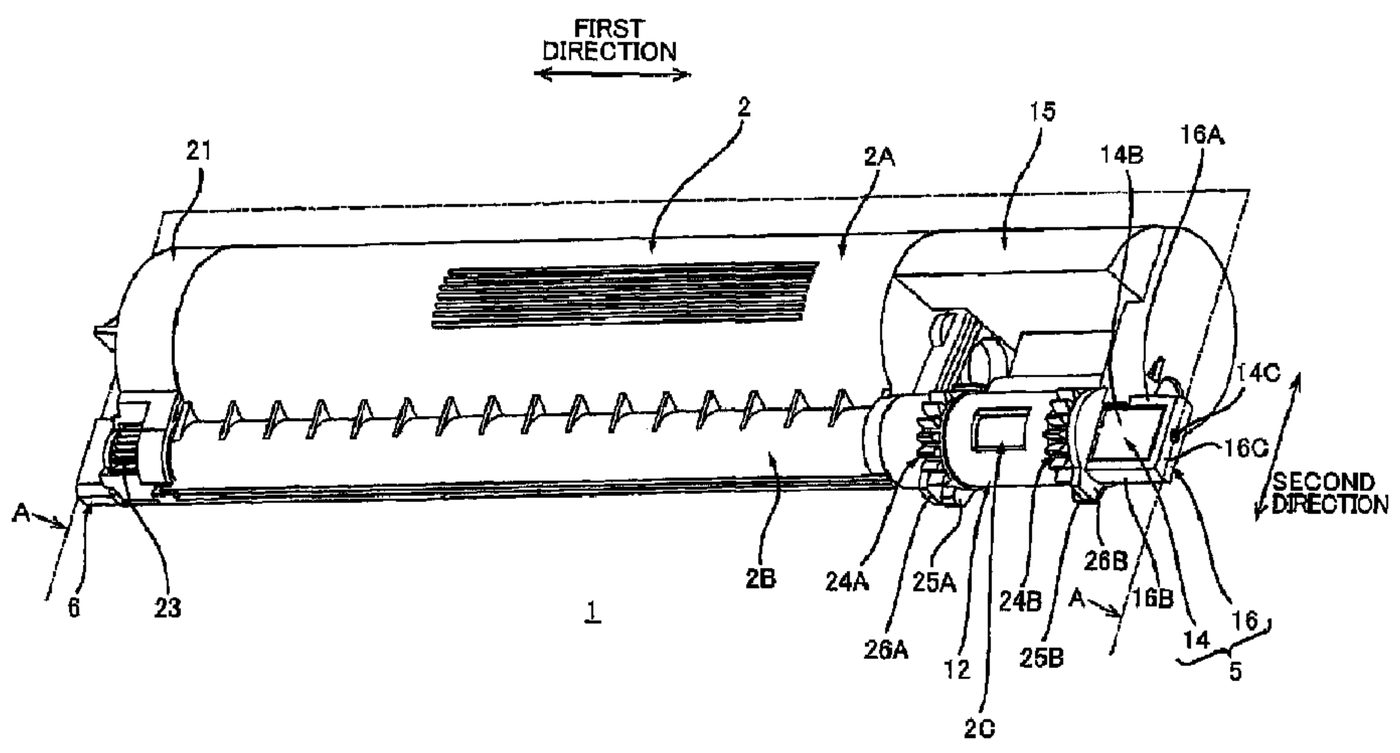

(57) Abrégé/Abstract:
[Problem] To enable positioning with respect to a developing device or an image forming apparatus in accordance with an attachment operation, while transporting, in an axial direction of a rotation axis of an agitator, toner transported by the agitator. [Solution] This toner cartridge 1 comprises a casing 2, an agitator 3, an auger 4, a first protrusion 5, and a second protrusion 6. The casing 2 includes a first toner-housing part 2A, a second toner-housing part 2B, and a first opening 2C. The agitator 3 transports a toner from the first toner-housing part 2A to the second toner-housing part 2B. The auger 4 transports the toner from the second toner-housing part 2B to the first opening 2C in a first direction. The first protrusion 5 and the second protrusion 6 are separated from one another in the first direction, and are positioned with respect to a developing device 31 when the toner cartridge 1 is attached to the developing device 31. The auger 4 and the first opening 2C are located between the first protrusion 5 and the second protrusion 6.

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(54) Title: TONER CARTRIDGE

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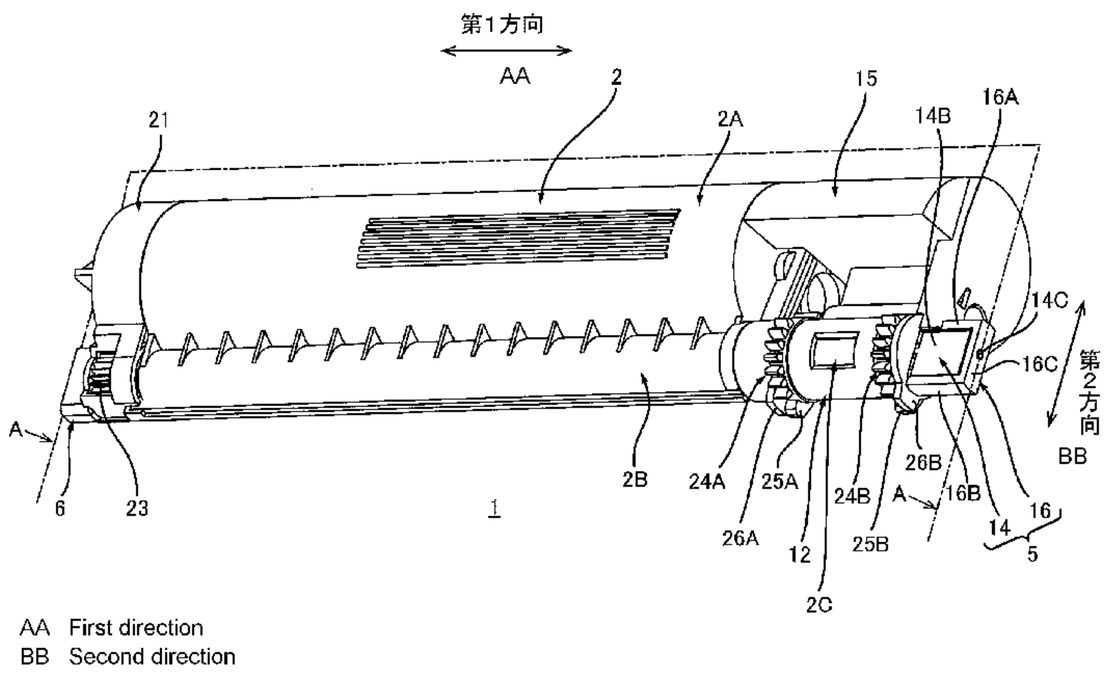

AA First direction
BB Second direction

(57) Abstract: [Problem] To enable positioning with respect to a developing device or an image forming apparatus in accordance with an attachment operation, while transporting, in an axial direction of a rotation axis of an agitator, toner transported by the agitator. [Solution] This toner cartridge 1 comprises a casing 2, an agitator 3, an auger 4, a first protrusion 5, and a second protrusion 6. The casing 2 includes a first toner-housing part 2A, a second toner-housing part 2B, and a first opening 2C. The agitator 3 transports a toner from the first toner-housing part 2A to the second toner-housing part 2B. The auger 4 transports the toner from the second toner-housing part 2B to the first opening 2C in a first direction. The first protrusion 5 and the second protrusion 6 are separated from one another in the first direction, and are positioned with respect to a developing device 31 when the toner cartridge 1 is attached to the developing device 31. The auger 4 and the first opening 2C are located between the first protrusion 5 and the second protrusion 6.

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— 国際調査報告（条約第 21 条(3)）

【課題】アジテータによって搬送されたトナーをアジテータの回転軸の軸方向に搬送しつつ、装着動作に合せて現像器または画像形成装置に対して位置決めすることができる。 【解決手段】 トナーカートリッジ１は、筐体２、アジテータ３、オーガ４、第１突起５および第２突起６を備える。筐体２は、第１トナー収容部２Ａと、第２トナー収容部２Ｂとを備え、第１開口２Ｃを有する。アジテータ３は、第１トナー収容部２Ａから第２トナー収容部２Ｂへトナーを搬送する。オーガ４は、第１方向において、第２トナー収容部２Ｂから第１開口２Ｃへトナーを搬送する。第１突起５と第２突起６とは、第１方向において互いに離れており、トナーカートリッジ１が現像器３１に装着されるときに、現像器３１に対して位置決めされる。オーガ４および第１開口２Ｃは、第１突起５と第２突起６との間に位置する。

[Name of Document] Specification

[Title of the Invention] Toner Cartridge

[Technical Field]

[0001]

The present disclosure relates to a toner cartridge.

[Background Art]

[0002]

A toner cartridge that is attachable to an image-forming apparatus is known in the art. The toner cartridge accommodates therein toner.

[0003]

A toner cartridge described in Patent Literature 1, for example, includes a housing for accommodating toner, an opening for discharging toner, and an agitator for conveying the toner toward the opening. The toner cartridge further includes a first protrusion that protrudes from one side surface of the toner cartridge in an axial direction aligned with the rotational shaft of the agitator, and a second protrusion that protrudes from the other side surface of the toner cartridge in the axial direction of the agitator. When the toner cartridge is attached to or mounted on a developing unit, the first and second protrusions on the toner cartridge are fitted into grooves formed in the developing unit, thereby locating the cartridge relative to the developing unit during the attaching operation. Subsequently, the toner cartridge is pivoted about the first and second protrusions. The opening is formed at a central position between the first and second protrusions. The agitator is positioned between the first and second protrusions and conveys toner in a direction that intersects the axial direction of the agitator shaft.

[Citation List]

[Patent Literature]

[0004]

[Document 1] Japanese Patent Application Publication No.2011-13367

[Summary of the Invention]

[Solution to Problem]

[0005]

In the toner cartridge described in Patent Document 1, in some cases, the toner conveyed by the agitator may be needed to be conveyed in the axial direction of the agitator shaft.

[0006]

However, the Patent Literature 1 does not disclose a toner cartridge having a structure for conveying toner in the axial direction of the agitator (such as an auger, for example). Further, the Patent Literature 1 does not disclose a structure for locating the toner cartridge having such configuration to a developing unit or image-forming apparatus during the attaching operation of the toner cartridge.

[0007]

In view of the foregoing, it is an object of the present disclosure to provide a toner cartridge capable of being located to a developing unit or an image-forming apparatus during attaching operation of the toner cartridge to the developing unit or the image-forming apparatus while the toner conveyed by the agitator is conveyed in the axial direction of the rotation shaft of the agitator.

[Means for solving the Problem]

[0008]

(1) A toner cartridge according to the present disclosure includes a housing, an agitator, an auger, a first protrusion, and a second protrusion.

[0009]

The housing extends in a first direction. The housing includes a first toner-accommodating section and a second toner-accommodating section. The first toner-accommodating section has a first interior space elongated in the first direction. The second toner-accommodating section has a second interior space elongated in the first direction. The second toner-accommodating section is in communication with the first interior space. The second toner-accommodating section is positioned at one side of the first toner-accommodating section in a second direction. The second toner-accommodating section has a first opening. The first opening is positioned at one side of the second toner-accommodating section in the first direction. The first opening allows toner in the second interior space to be discharged therethrough.

[0010]

The agitator is rotatable about a first axis extending in the first direction. The agitator is configured to agitate the toner in the first interior space. The agitator conveys the toner from the first interior space to the second interior space.

[0011]

The auger is rotatable about a second axis extending in the first direction. The

auger is configured to convey the toner from the second interior space to the first opening.

[0012]

The first protrusion is positioned at the one side of the second toner-accommodating section and at one side of the first opening in the first direction. The first protrusion extends in the first direction.

[0013]

The second protrusion is positioned at an other side of the second toner-accommodating section in the first direction. The second protrusion extends in the first direction.

[0014]

With this structure, the second toner-accommodating section is positioned at the one side of the first toner-accommodating section in the second direction. This arrangement allows the toner cartridge to be made more compact in the first direction while still securing sufficient toner capacity in the first toner-accommodating section and second toner-accommodating section in the second direction.

[0015]

Further, when attaching the toner cartridge to the developing unit, the toner cartridge can be located relative to the developing unit or the image forming apparatus by the first protrusion and second protrusion. Accordingly, the toner cartridge can be located relative to the developing unit or the image forming apparatus in conformance with the attaching operation, and the first opening can be accurately positioned relative to the developing unit or the image forming apparatus.

[0016]

After the toner cartridge is attached to the developing unit or the image forming apparatus, the agitator conveys toner in the first toner-accommodating section to the second toner-accommodating section, and the auger conveys toner in the second toner-accommodating section to the first opening.

[0017]

With this configuration, toner conveyed by the agitator can be conveyed by the auger in an axial direction of a rotation axis of the agitator, and the agitator and the auger can convey toner smoothly from the first toner-accommodating section to the first opening. Further, by conveying toner with the auger, amount of toner discharged from the first opening can be adjusted. Note that, since the first opening is positioned at the one side of

the second toner-accommodating section in the first direction, toner can be conveyed to the first opening with a simple construction including the auger extending in the first direction. This construction can reduce the number of parts required for conveying toner to the first opening.

[0018]

In summary, the first protrusion is positioned at the one side of the second toner-accommodating section in the first direction, and the second protrusion is positioned at the other side of the second toner-accommodating section in the first direction. Further, the auger conveys toner to the first opening between the first protrusion and second protrusion. Accordingly, this structure can reduce the number of parts and members, while conveying toner smoothly to the first opening accurately located relative to the developing unit or the image forming apparatus, and can adjust the amount of toner discharged through the first opening.

(2) The first protrusion may protrude in the second direction defined by connecting the first axis and the second axis. The second protrusion may protrude in the second direction.

(3) A width of the second protrusion in a third direction crossing the first direction and the second direction may be different from a width of the first protrusion in the third direction.

(4) The auger has one end portion and an other end portion separated from the one end portion in the first direction. A part of a peripheral surface of the one end portion of the auger is exposed through the first opening.

(5) The toner cartridge may further include a shutter. The shutter has a closed state closing the first opening and an open state opening the first opening. The shutter is positioned at one end portion of the second toner-accommodating section in the first direction. The shutter includes the first protrusion.

(6) The first protrusion may protrude from the shutter in the first direction.

(7) The shutter is rotatable about a third axis extending in the first direction. The shutter is rotatable from a closed position to an open position. The shutter closes the first opening when the shutter is positioned at the closed position. The shutter opens the first opening when the shutter is positioned at the open position.

(8) The first protrusion may be rotatable together with the shutter.

(9) The shutter may have a second opening. At least part of the second opening

overlaps with at least part of the first opening, when the shutter is at the open position.

(10) One end portion of the auger may be exposed to outside through the first opening, when the shutter is at the open position.

(11) The housing may further include a cover. The cover covers the one end portion of the second toner-accommodating section. The cover covers the first opening.

(12) The second toner-accommodating section may include a third opening. The third opening is positioned at the one end portion of the second toner-accommodating section. The one end portion of the auger is exposed from the second toner-accommodating section through the third opening. The cover may cover at least part of the one end portion of the auger.

(13) The cover may include a plurality of gear teeth. The plurality of gear teeth are positioned at an outer surface of the cover. The plurality of gear teeth is juxtaposed along a rotating direction of the auger.

(14) The auger may have one end portion and an other end portion separated from the one end portion in the first direction. The toner cartridge further comprising an auger gear. The auger gear is mounted to the other end portion of the auger. The auger gear is rotatable together with the auger. The second protrusion may be positioned farther from the first opening than the auger gear is from the first opening.

(15) The toner cartridge may further have a gear cover. The gear cover covers at least part of the auger gear. The second protrusion protrudes from the gear cover in the first direction.

(16) The second toner-accommodating section may have a first through-hole. The first through-hole is positioned at an other end portion of the second toner-accommodating section in the first direction. The first through-hole penetrates the second toner-accommodating section in the first direction. The other end portion of the auger in the first direction may be inserted in the first through hole. The auger gear may be positioned at an outer surface of the second toner-accommodating section.

(17) The first opening may be positioned closer to the one side in the first direction than the first toner-accommodating section to the one side in the first direction.

(18) The agitator may have an agitator shaft extending along the first axis, and a blade rotatable together with the agitator shaft, the blade being positioned in the first interior space. The first opening may be positioned closer to the one side in the first direction than the blade is to the one side in the first direction.

(19) The first protrusion and the second protrusion may be configured to be positioned to a developing unit when the toner cartridge is mounted to the developing unit. After the toner cartridge is mounted to the developing unit, the toner cartridge may be mounted to the developing unit by pivotally moving the housing relative to the developing unit about the first protrusion and the second protrusion.

[Effects of the Invention]

[0019]

A toner cartridge according to the present invention can be fixed in position to a developing unit or image-forming apparatus during attaching operation of the toner cartridge to the developing unit or image-forming apparatus while the toner conveyed by the agitator is conveyed in the axial direction of the rotation shaft of the agitator.

[Brief Description of the Drawings]

[0020]

Fig. 1 is a perspective view of a toner cartridge 1;

Fig. 2 is a cross-sectional view of a center portion of the toner cartridge 1;

Fig. 3 is a cross-sectional view taken along a line A-A of Fig. 1;

Fig. 4 is an exploded perspective view of one end portion of the toner cartridge 1;

Fig. 5 is an exploded perspective view of another end portion of the toner cartridge 1;

Fig. 6A is a side view of the toner cartridge 1 as viewed in a direction crossing a second direction and illustrating a state where a shutter 13 is positioned at a closed position;

Fig. 6B is a side view of the toner cartridge 1 as viewed in the direction crossing the second direction and illustrating a state where the shutter 13 is positioned at an open position;

Fig. 7 is a cross-sectional view taken along a line A-A of Fig. 6A;

Fig. 8 is a cross-sectional view taken along a line B-B of Fig. 6A;

Fig. 9 is a side view of a developing unit 31 as viewed in a mounting direction of the toner cartridge 1 to the developing unit 31;

Fig. 10 is a cross-sectional view of the developing unit 31 taken along a line A-A of Fig. 9, as viewed in a direction toward a groove 34 in a first direction;

Fig. 11 is a cross-sectional view of the developing unit 31 taken along a line B-B of Fig. 9, as viewed in a direction toward a groove 35 in the first direction;

Fig. 12 is an explanatory view for description of attachment of the toner cartridge 1 to the developing unit 31, and illustrating a state before the toner cartridge 1 is mounted to the developing unit 31;

Fig. 13 is an explanatory view for description of the attachment of the toner cartridge 1 to the developing unit 31, and illustrating a state where the toner cartridge 1 is mounted to the developing unit 31 and a housing 2 is at a first position;

Fig. 14 is an explanatory view for description of engagement between a second protrusion 6 and a groove 35 in a state as illustrated in Fig. 13;

Fig. 15 is a cross-sectional view of the developing unit 31 and the toner cartridge 1 illustrated in Fig. 13 and taken along a line passing through a locking member 18 positioned at a release position;

Fig. 16 a cross-sectional view, similar to Fig. 15, of the developing unit 31 and the toner cartridge 1 illustrated in Fig. 13 and taken along a line passing through a second opening 13D of the shutter 13, and illustrating a state where the housing 2 is at the first position, the shutter 13 is at the closed position, and a developing shutter 51 is at the closed position;

Fig. 17 is a cross-sectional view, similar to Figs. 15 and 16, of the developing unit 31 and the toner cartridge 1 illustrated in Fig. 13 and taken along a line passing through a locking member 52A, and illustrating a state where the housing 2 is at the first position and a protrusion 26A of the toner cartridge 1 contacts a protrusion 58 of the locking member 52A;

Fig. 18 is a cross-sectional view, similar to Figs. 15 through 17, of the developing unit 31 and the toner cartridge 1 illustrated in Fig. 13 and taken along a line passing through a gear part 54A of the developing shutter 51, and illustrating a state where the housing 2 is at the first position and a protrusion 53A of the developing shutter 51 is positioned between a protrusion 25A and a gear part 24A of the toner cartridge 1;

Fig. 19 is a cross-sectional view of the developing unit 31 and the toner cartridge 1 taken along a line passing through the second opening 13D of the shutter 13 in a situation where the housing 2 is pivotally moved relative to the developing unit 31 from the first position toward the second position, and illustrating a state where the protrusion 26A of the toner cartridge 1 contacts the protrusion 58 of the locking member 52A;

Fig. 20 is a cross-sectional view of the developing unit 31 and the toner cartridge 1 illustrated in Fig. 19 and taken along a line passing through the gear part 54A of the

developing shutter 51, and illustrating a state where the gear part 24A of the toner cartridge 1 contacts the protrusion 53A of the developing shutter 51;

Fig. 21 is a cross-sectional view of the developing unit 31 and the toner cartridge 1 taken along a line passing through the locking member 52A in a situation where the housing 2 is pivoted to a second position from the first position with respect to the developing unit 31, and illustrating a state where the protrusion 26A of the toner cartridge 1 is moved away from the protrusion 58 of the locking member 52A;

Fig. 22 is a cross-sectional view of the developing unit 31 and the toner cartridge 1 illustrated in Fig. 21 and taken along a line passing through the gear part 54A of the developing shutter 51, and illustrating a state where a protrusion 59 of the locking member 52A contacts a protrusion 57 of the developing shutter 51, and the gear part 24A of the toner cartridge 1 engages the gear part 54A of the developing shutter 51;

Fig. 23 is a side view of the developing unit 31 and the toner cartridge 1 illustrated in Fig. 21;

Fig. 24 is a side view of the developing unit 31 and the toner cartridge 1 in a state where the housing 2 is at the second position;

Fig. 25 is an explanatory view for description of engagement between the protrusion 6 and the groove 35 in the state of Fig. 24;

Fig. 26 is a cross-sectional view of the developing unit 31 and the toner cartridge 1 illustrated in Fig. 24 and taken along a line passing through the gear part 54A of the developing shutter 51, and illustrating a state where the protrusion 59 of the locking member 52A is positioned in a recessed part 56 of the developing shutter 51; and

Fig. 27 is a cross-sectional view of the developing unit 31 and the toner cartridge 1 illustrated in Fig. 24 and taken along a line passing through the second opening 13D of the shutter 13, and illustrating a state where the shutter 13 is at the open position and the developing shutter 51 is at the open position.

[Mode for Carrying out the Invention]

[0021]

1. Outline of Toner Cartridge 1

[0022]

An outline of the toner cartridge 1 will be described.

The toner cartridge 1 illustrated in Fig. 1 is a cartridge that accommodates therein toner. As will be described later in greater detail, the toner cartridge 1 is attached to or mounted

to a developing unit 31 described later, as illustrated in Figs. 12 and 13. The toner cartridge 1 is subsequently attached to the developing unit 31 by pivoting the toner cartridge 1 relative to the developing unit 31 from the state illustrated in Fig. 13 to the state illustrated in Fig. 24. In the attached state of the toner cartridge 1 to the developing unit 31, the toner cartridge 1 can supply toner to the developing unit 31.

[0023]

Incidentally, the action of pivoting the toner cartridge 1 implies an action of pivoting the toner cartridge 1 about an axis provided at one end portion of the toner cartridge 1 itself. Specifically, the axis at the toner cartridge 1 itself is a second axis A2 described later.

[0024]

As illustrated in Figs. 1 through 3, the toner cartridge 1 includes a housing 2, an agitator 3, an auger 4, a first protrusion 5, and a second protrusion 6.

[0025]

1.1 Housing 2

The housing 2 is elongated in a first direction. The housing 2 includes a first toner-accommodating section 2A, and a second toner-accommodating section 2B. The second toner-accommodating section 2B is positioned at one side of the first toner-accommodating section 2A in a second direction. The second direction is defined as a direction of a line connecting a first axis A1 (described later) and a second axis A2 (described later). The first toner-accommodating section 2A is elongated in the first direction. The first toner-accommodating section 2A has a hollow cylindrical shape. The first toner-accommodating section 2A provides a first interior space 2D that is elongated in the first direction. The first interior space 2D can accommodate therein toner. The second toner-accommodating section 2B is elongated in the first direction. The second toner-accommodating section 2B is hollow cylindrical in shape, and has an outer diameter smaller than an outer diameter of the first toner-accommodating section 2A. The second toner-accommodating section 2B provides a second interior space 2E elongated in the first direction. The first interior space 2D and second interior space 2E are juxtaposed with each other in the second direction. The second interior space 2E is in communication with the first interior space 2D. The second interior space 2E has an inner volume smaller than that of the first interior space 2D. Note that the first toner-accommodating section 2A and second toner-accommodating section 2B may be integrally

configured. Alternatively, the first toner-accommodating section 2A and second toner-accommodating section 2B may be configured of separate members that are assembled together.

[0026]

The housing 2 has a first opening 2C. The first opening 2C is positioned at a one side of the second toner-accommodating section 2B in the first direction. Further, the first opening 2C is positioned closer to the one side in the first direction than the first toner-accommodating section 2A is to the one side. That is, the first opening 2C is positioned closer to the one side in the first direction than the agitator 3 is to the one side. As will be described later in greater detail, the first opening 2C allows toner to be discharged from the second interior space 2E. By positioning the first opening 2C closer to the one side in the first direction than the first toner-accommodating section 2A and the agitator 3 are to the one side, toner conveyed by the agitator 3 from the first interior space 2D to the second interior space 2E is not directly discharged from the first opening 2C. Toner in the second interior space 2E can be conveyed to the first opening 2C only by the auger 4. Thus, toner in the first toner-accommodating section 2A can be quantitatively conveyed to the first opening 2C to be discharged therefrom.

[0027]

When the toner cartridge 1 is mounted to the developing unit 31 described later, the housing 2 can pivot relative to the developing unit 31 between a first position (see Fig. 13) and a second position (see Fig. 24).

[0028]

1.2 Agitator 3

The agitator 3 is disposed in the first interior space 2D. The agitator 3 can stir or agitate toner in the first interior space 2D and can convey the toner from the first interior space 2D to the second interior space 2E. The agitator 3 is rotatable about a first axis A1 extending in the first direction. The agitator 3 includes an agitator shaft 3A and a blade 3B. The agitator shaft 3A extends along the first axis A1. The blade 3B extends from the agitator shaft 3A in a radial direction of the first toner-accommodating section 2A. The blade 3B is capable of rotating together with the agitator shaft 3A. The blade 3B is disposed in the first interior space 2D. The blade 3B has a base end connected to the agitator shaft 3A, and a distal end positioned farthest from the agitator shaft 3A. The distal end of the blade 3B contacts the inner surface of the first toner-accommodating

section 2A. By the contact of the distal end with the inner surface of the first toner-accommodating section 2A, the blade 3B is so curved that the distal end of the blade 3B is positioned most upstream side in the rotating direction of the agitator 3. By rotating the blade 3B, the agitator 3 can stir toner in the first interior space 2D and can convey the toner from the first interior space 2D to the second interior space 2E.

[0029]

1.3 Auger 4

The auger 4 is disposed inside the second interior space 2E. As will be described later in greater detail, the auger 4 is configured to convey toner from the second interior space 2E to the first opening 2C. The auger 4 is elongated in the first direction. The auger 4 is rotatable about a second axis A2 extending in the first direction. Specifically, the auger 4 includes a shaft 4A and a helical part 4B. The shaft 4A extends along the first axis A1. The helical part 4B protrudes from the shaft 4A in radial directions of the first toner-accommodating section 2A. The helical part 4B has a helical shape whose axis extends along the first direction.

[0030]

1.4 First protrusion 5 and second protrusion 6

The first protrusion 5 is positioned at a one end portion of the toner cartridge 1 in the first direction. The first protrusion 5 is positioned opposite to the second toner-accommodating section 2B with respect to the first opening 2C in the first direction. In other words, the first protrusion 5 is positioned at the one side of the second toner-accommodating section 2B in the first direction and on the one side of the first opening 2C in the first direction. The first protrusion 5 is elongated or extending both in the first direction and the second direction. As will be described later in greater detail, the first protrusion 5 includes a protrusion 14 provided at a shutter 13 described later, and a protrusion 16 provided at a second cover 15 described later. Incidentally, the protrusion 14 may be configured of at least one of the protrusion 14 provided on the shutter 13 described later, and the protrusion 16 provided on the second cover 15 described later. Specifically, the protrusion 14 may be configured of the protrusion 14 provided on the shutter 13 described later. In this case, the toner cartridge 1 need not be provided with the second cover 15. Alternatively, the protrusion 14 may be configured of the protrusion 16 provided on the second cover 15 described later. In this case, the toner cartridge 1 need not be provided with the shutter 13.

[0031]

The second protrusion 6 is positioned at an other end portion of the toner cartridge 1 in the first direction. The second protrusion 6 is positioned opposite to the first protrusion 5 with respect to the second toner-accommodating section 2B in the first direction. That is, the second protrusion 6 is positioned at the other end portion of the second toner-accommodating section 2B in the first direction. The second protrusion 6 extends in both the first direction and the second direction.

[0032]

2. Details of toner cartridge 1

The toner cartridge 1 will be described in detail with reference to Figs. 3 through 8.

[0033]

2.1 Second toner-accommodating section 2B

As illustrated in Figs. 3 and 4, the second toner-accommodating section 2B has a third opening 11. The third opening 11 is positioned at the one end portion of the second toner-accommodating section 2B. The one end portion of the second toner-accommodating section 2B protrudes farther in the first direction than the one end portion of the first toner-accommodating section 2A. That is, the length of the second toner-accommodating section 2B in the first direction is greater than the length of the first toner-accommodating section 2A in the first direction. Consequently, the length of the first interior space 2D in the first direction is shorter than the length of the second interior space 2E in the first direction. The one end portion of the second toner-accommodating section 2B has a hollow cylindrical shape. The third opening 11 penetrates the one end portion of the second toner-accommodating section 2B in the first direction. The third opening 11 is in communication with the second interior space 2E, thereby allowing toner in the second interior space 2E to be discharged from the third opening 11. Further, the auger 4 is inserted through the third opening 11. The auger 4 has a one end portion 4C in the first direction, and an other end portion 4D remote from the one end portion 4C in the first direction. The one end portion 4C of the auger 4 protrudes out from the third opening 11 in the first direction. That is, the one end portion 4C of the auger 4 is exposed to an outside of the second toner-accommodating section 2B through the third opening 11. With this configuration, the auger 4 can convey toner from the second interior space 2E to the third opening 11.

[0034]

2.2 Cover 12

As illustrated in Figs. 3 and 4, the housing 2 further includes a cover 12.

[0035]

The cover 12 is positioned at the one end portion of the second toner-accommodating section 2B. Specifically, the cover 12 is assembled on the one end portion of the second toner-accommodating section 2B. Hence, the cover 12 is movable together with the housing 2. The cover 12 covers the one end portion of the second toner-accommodating section 2B. The cover 12 also covers the third opening 11. The cover 12 also covers the one end portion 4C of the auger 4. Specifically, the cover 12 covers the peripheral surface of the one end portion 4C of the auger 4. The cover 12 extends along the peripheral surface of the one end portion 4C of the auger 4. Specifically, the cover 12 has a hollow cylindrical shape and is elongated in the first direction. The cover 12 has the first opening 2C described above.

[0036]

The first opening 2C is formed at a position away from the second toner-accommodating section 2B in the first direction. Specifically, the first opening 2C is positioned away from the third opening 11 in the first direction. The first opening 2C penetrates the peripheral surface of the cover 12, thereby allowing toner to be discharged from the cover 12. The first opening 2C has an area smaller than that of the third opening 11. Incidentally, the auger 4 extends to the first opening 2C in the first direction, thereby enabling the auger 4 to convey toner from the second interior space 2E to the first opening 2C.

[0037]

2.3 Shutter 13

As illustrated in Figs. 3 and 4, the toner cartridge 1 further includes a shutter 13.

[0038]

The shutter 13 is positioned at the one end portion of the second toner-accommodating section 2B in the first direction. Specifically, the shutter 13 is inserted into the cover 12 and the one end portion of the second toner-accommodating section 2B. In this way, the shutter 13 is assembled on the one end portion of the second toner-accommodating section 2B. The shutter 13 is rotatable from a closed position (see Fig. 6A) to an open position (see Fig. 6B). When the shutter 13 is at the closed position, the

shutter 13 closes the first opening 2C. When the shutter 13 is at the open position, the shutter 13 opens the first opening 2C. Hence, the shutter 13 provides a closed state closing the first opening 2C (see Fig. 6A) and an open state opening the first opening 2C (see Fig. 6B).

[0039]

More specifically, the shutter 13 is elongated in the first direction. The shutter 13 has a one end portion and an other end. The other end portion is positioned farther from the second toner-accommodating section 2B than the one end portion is from the second toner-accommodating section 2B in the first direction. The shutter 13 includes an insertion part 13A and a cover part 13B. The insertion part 13A is positioned at the one end portion of the shutter 13. The insertion part 13A is inserted into the third opening 11. The insertion part 13A has an opening 13C. The opening 13C penetrates the insertion part 13A in the first direction, thereby allowing toner in the second interior space 2E to be introduced into the interior space of the shutter 13. The cover part 13B is juxtaposed with the insertion part 13A in the first direction. The cover part 13B is positioned between the insertion part 13A and the protrusion 14 described later in the first direction. The cover part 13B protrudes through the third opening 11 in the first direction. The cover part 13B covers the outer peripheral surface of the one end portion 4C of the auger 4. The cover part 13B extends along a peripheral surface of the one end portion 4C of the auger 4. The cover part 13B also extends along an inner peripheral surface of the cover 12. In other words, the cover 12 extends along the outer peripheral surface of the cover part 13B and covers the outer peripheral surface of the cover part 13B. Specifically, the cover part 13B has a hollow cylindrical shape and is elongated in the first direction. The cover part 13B has a second opening 13D (see Fig. 6B). That is, the shutter 13 has the second opening 13D. The second opening 13D penetrates the peripheral surface of the cover part 13B. When the shutter 13 is at the open position, at least a part of the second opening 13D overlaps at least a part of the first opening 2C. In this way, the second opening 13D allows toner in the interior space of the shutter 13 to be discharged through the first opening 2C. Further, since at least the part of the second opening 13D overlaps at least the part of the first opening 2C when the shutter 13 is at the open position, the one end portion 4C of the auger 4 is exposed to the outside through the first opening 2C. That is, a part of the peripheral surface of the one end portion 4C of the auger 4 in the first direction is exposed to the outside through the first opening 2C. Here, a seal S (see Fig. 16) is provided around

the second opening 13D. The seal S is positioned between the inner peripheral surface of the cover 12 and the cover part 13B. With this configuration, the seal S prevents toner from entering between the inner surface of the cover 12 and the cover part 13B.

[0040]

As illustrated in Fig. 4, the shutter 13 is provided with a protrusion 14.

[0041]

The protrusion 14 is positioned farther away from the one end portion of the second toner-accommodating section 2B in the first direction than the cover 12 is from the one end portion. The protrusion 14 is positioned opposite to the insertion part 13A with respect to the cover part 13B in the first direction. The protrusion 14 is fixed in position relative to the developing unit 31 described later (see Fig. 9) when the toner cartridge 1 is mounted to the developing unit 31. The protrusion 14 is elongated in the first direction. The protrusion 14 extends in the first direction from the shutter 13. Specifically, the protrusion 14 extends from the cover part 13B. Accordingly, the protrusion 14 is rotatable together with the shutter 13 relative to the housing 2 and cover 12. The protrusion 14 has a base end and a distal end in the first direction. The base end is connected to the cover part 13B. The distal end is positioned opposite to the cover part 13B with respect to the base end in the first direction. Specifically, the protrusion 14 includes a shaft part 14A, a flat plate part 14B, and a boss 14C. The shaft part 14A is positioned at the base end of the protrusion 14. The shaft part 14A extends in the first direction from the cover part 13B and is connected to the flat plate part 14B. The flat plate part 14B is positioned opposite to the cover part 13B with respect to the shaft part 14A in the first direction. The flat plate part 14B extends in the second direction when the shutter 13 is at the closed position. In other words, the protrusion 14 extends in the second direction when the shutter 13 is at the closed position. The flat plate part 14B is longer than the shaft part 14A in the second direction. The boss 14C is positioned at the distal end of the protrusion 14. That is, the boss 14C is positioned opposite to the shaft part 14A with respect to the flat plate part 14B in the first direction. The boss 14C extends in the first direction from the flat plate part 14B. The boss 14C is elongated along a third axis A3. Note that the third axis A3 may be aligned with the second axis A2. Further, the boss 14C has a cylindrical shape.

[0042]

2.4 Second cover 15.

As illustrated in Fig. 4, the toner cartridge 1 includes a second cover 15.

[0043]

The second cover 15 is elongated in the first direction. The second cover 15 has a one end portion and an other end portion. The other end portion is farther from the housing 2 than the one end portion is from the housing in the first direction. The one end portion of the second cover 15 is attached to the first toner-accommodating section 2A. With this configuration, the second cover 15 is movable together with the housing 2 and cover 12 relative to the shutter 13. The second cover 15 includes a protrusion 16.

[0044]

The protrusion 16 is positioned at the other end portion of the second cover 15. The protrusion 16 protrudes in the first direction from the other end portion of the second cover 15. The protrusion 16 extends in the second direction. The protrusion 16 has a fourth opening 17. The fourth opening 17 penetrates the protrusion 16 in a direction orthogonal to the first and second directions. The protrusion 16 includes a first frame part 16A, a second frame part 16B, and a third frame part 16C. The first frame part 16A is separated from the second frame part 16B in the second direction. The fourth opening 17 is positioned between the first frame part 16A and second frame part 16B. The third frame part 16C is positioned opposite to the housing 2 with respect to the fourth opening 17 in the first direction. The third frame part 16C extends in the second direction. The third frame part 16C is connected to the first frame part 16A and the second frame part 16B. The third frame part 16C has a through-hole 16D. The through-hole 16D penetrates the third frame part 16C in the first direction.

[0045]

As illustrated in Figs. 1 and 4, the protrusion 14 is inserted into the protrusion 16. This insertion results in the flat plate part 14B of the protrusion 14 being positioned between the first frame part 16A and second frame part 16B. The fourth opening 17 exposes the flat plate part 14B of the protrusion 14 to the outside. With this configuration, the first frame part 16A and second frame part 16B cover the edges of the flat plate part 14B when the shutter 13 is in the closed position. Further, the third frame part 16C confronts the flat plate part 14B in the first direction. Accordingly, the third frame part 16C covers at least a part of the distal end of the protrusion 14 in the first direction. Hence, the second cover 15 covers at least the part of the distal end of the protrusion 14. Further, the boss 14C of the protrusion 14 is inserted through the through-hole 16D. In this way,

the second cover 15 rotatably supports the distal end portion of the protrusion 14. Accordingly, the shutter 13 is rotatable about the third axis A3 extending in the first direction.

[0046]

As illustrated in Fig. 7, the second cover 15 also includes a locking member 18, and a stopper 19.

[0047]

The locking member 18 is movable between a locking position (see Fig. 7) and a release position (see Fig. 15). Specifically, the locking member 18 is pivotally movable between the locking position and the release position. The locking member 18 is urged toward the locking position by a spring 18C.

[0048]

The locking member 18 includes a shaft 18A and a protrusion 18B. The shaft 18A is rotatably supported by the second cover 15. Accordingly, the locking member 18 is pivotally movable relative to the second cover 15. The protrusion 18B extends from the shaft 18A toward the protrusion 14. The protrusion 18B confronts a one end portion of the flat plate part 14B when the locking member 18 is at the locking position. The one end portion of the flat plate part 14B is the end portion that faces the first frame part 16A (see Fig. 1) in the second direction when the shutter 13 is at the closed position. The protrusion 18B contacts the one end portion of the protrusion 14. Thus, when the locking member 18 is at the locking position, the locking member 18 can lock the protrusion 14 to the second cover 15. Here, "locking the protrusion 14 to the second cover 15" implies that the locking member prevents the protrusion 14 from rotating relative to the second cover 15. By locking the protrusion 14 to the second cover 15 in a state where the toner cartridge 1 is removed from the developing unit 31 described later, the locking member 18 prevents the shutter 13 from moving from the closed position to the open position. Further, when the locking member 18 is at the release position, the protrusion 18B cannot contact the one end portion of the flat plate part 14B. Accordingly, the protrusion 14 is no longer locked to the second cover 15 when the locking member 18 is in the release position.

[0049]

The spring 18C is a coil spring. Specifically, the spring 18C includes a one end portion, an other end portion positioned away from the one end portion, and a coil part

positioned between the one end portion and the other end portion. The one end portion of the spring 18C contacts the second cover 15, while the other end portion contacts the protrusion 18B of the locking member 18. With this configuration, the spring 18C urges the locking member 18 toward the locking position.

[0050]

The stopper 19 is positioned at an inner surface of the second frame part 16B. The stopper 19 protrudes toward the first frame part 16A from the inner surface of the second frame part 16B. The stopper 19 faces an other end portion of the flat plate part 14B when the shutter 13 is at the closed position. The other end portion of the flat plate part 14B is the end portion that faces the second frame part 16B in the second direction when the shutter 13 is at the closed position. The other end portion of the flat plate part 14B has an engaging part 14D. The engaging part 14D protrudes in the second direction from the other end portion of the flat plate part 14B when the shutter 13 is at the closed position. The stopper 19 confronts the engaging part 14D. The stopper 19 is contact with the engaging part 14D. Accordingly, when the shutter 13 is at the closed position, the stopper 19 prevents the protrusion 14 from rotating in a direction opposite to the direction in which the protrusion 14 rotates when the shutter 13 rotates from the closed position to the open position. If the protrusion 14 is rotated in the opposite direction when the shutter 13 is at the closed position, the engaging part 14D of the protrusion 14 contacts the stopper 19.

[0051]

2.5 Gear train and gear cover 21

As illustrated in Figs. 3 and 5, the toner cartridge 1 also includes an auger gear 23, an agitator gear 22, an idle gear 61, and a gear cover 21.

[0052]

2.5.1 Auger gear 23

The auger gear 23 is mounted to the other end portion 4D of the auger 4. The auger gear 23 is rotatable together with the auger 4 about the second axis A2. Specifically, the second toner-accommodating section 2B has a first through-hole 20A. The first through-hole 20A is positioned at the other end portion of the second toner-accommodating section 2B in the first direction. The first through-hole 20A penetrates the second toner-accommodating section 2B in the first direction. The other end portion 4D of the auger 4 in the first direction is inserted through the first through-hole 20A. In this way, the other

end portion 4D of the auger 4 penetrates the housing 2 in the first direction. The auger gear 23 is positioned at the outer surface of the second toner-accommodating section 2B.

[0053]

2.5.2 Agitator gear 22

The agitator gear 22 is mounted to the agitator 3. The agitator gear 22 is rotatable together with the agitator 3 about the first axis A1. Specifically, the agitator shaft 3A has a first end portion 3C, and a second end portion 3D away from the first end portion 3C in the first direction. The first toner-accommodating section 2A has a second through-hole 20B. The second through-hole 20B is positioned at the other end portion of the first toner-accommodating section 2A in the first direction. The second through-hole 20B penetrates the first toner-accommodating section 2A in the first direction. The second end portion 3D is inserted through the second through-hole 20B. In this way, the second end portion 3D penetrates the housing 2 in the first direction. The agitator gear 22 is assembled on the second end portion 3D of the agitator 3. The agitator gear 22 is positioned at the outer surface of the first toner-accommodating section 2A. The agitator gear 22 is spaced apart from the auger gear 23. The agitator gear 22 has a diameter greater than that of the auger gear 23. Further, the diameter of the agitator gear 22 is greater than that of the idle gear 61. Accordingly, the agitator 3 can rotate at a slower peripheral speed than the auger 4.

[0054]

2.5.3 Idle gear 61

The idle gear 61 is positioned between the agitator gear 22 and auger gear 23. The idle gear 61 meshes with the auger gear 23 and the agitator gear 22. Thus, the auger gear 23 can transmit a drive force to the agitator gear 22 via the idle gear 61. Specifically, the idle gear 61 is meshed with a one end portion of the auger gear 23. Note that the other end portion of the auger gear 23 is exposed to the outside of the gear cover 21 through an opening 21A (described later) formed in the gear cover 21. Hence, the idle gear 61 is positioned opposite to the other end portion with respect to the one end portion of the auger gear 23. Incidentally, that the other end portion of the auger gear 23 is meshed with a gear 30 described later of the developing unit 31 when the toner cartridge 1 is attached to the developing unit 31 and the housing 2 is at the second position relative to the developing unit 31. That is, when the toner cartridge 1 is attached to the developing unit 31 and the housing 2 is in the second position relative to the developing unit 31, the idle gear 61 is

positioned opposite to the other end portion of the auger gear 23. In this way, the idle gear 61 can stably receive torque applied to the other end portion of the auger gear 23 from the gear 30 of the developing unit 31 at the end portion opposite to the other end portion of the auger gear 23. The idle gear 61 is rotatable about a boss 62 provided on the housing 2. The boss 62 is positioned between the agitator gear 22 and the auger gear 23. The boss 62 is positioned opposite to the other end portion of the auger gear 23 with respect to the one end portion of the auger gear 23. The boss 62 protrudes in the first direction from the outer surface of the first toner-accommodating section 2A. That is, the boss 62 extends in the first direction from the housing 2. The boss 62 is solid cylindrical. The idle gear 61 has a through-hole 61A through which the boss 62 is inserted. By inserting the boss 62 through the through-hole 61A, the idle gear 61 is rotatable about the boss 62. Incidentally, the boss 62 may extend through the idle gear 61 through the through-hole 61A, or may not completely extend through the idle gear 61.

[0055]

The boss 62 has a distal end portion and a base end portion. The base end portion of the boss 62 is connected to the housing 2. Specifically, the base end portion is connected to the outer surface of the first toner-accommodating section 2A. The distal end portion of the boss 62 is positioned opposite to the housing 2 with respect to the base end portion in the first direction. The distal end portion of the boss 62 is formed with a hole 62A. The hole 62A is recessed toward the base end portion from the distal end.

[0056]

2.5.4 Gear cover 21

The gear cover 21 is positioned opposite to the cover 12 with respect to the housing 2 in the first direction. The gear cover 21 covers the agitator gear 22, the idle gear 61, and the one end portion of the auger gear 23. That is, the gear cover 21 covers at least a part of the auger gear 23. The gear cover 21 has the opening 21A and a through-hole 21B. The opening 21A exposes the other end portion of the auger gear 23 to the outside. The opening 21A is positioned between the second protrusion 6 and the second toner-accommodating section 2B. The opening 21A penetrates the gear cover 21 in a third direction. The through-hole 21B is positioned at a position facing the boss 62 in the first direction. The through-hole 21B is positioned opposite to the opening 21A with respect to the second protrusion 6. The through-hole 21B penetrates the gear cover 21 in the first direction. The distal end portion of the boss 62 is inserted into the through-hole

21B. Thus, the through-hole 21B exposes the distal end portion of the boss 62 to the outside. Further, insertion of the boss 62 into the through-hole 21B can fix the gear cover 21 relative to the boss 62, thereby stably fixing the gear cover 21 to the housing 2.

[0057]

Further, the toner cartridge 1 includes a screw 63. The screw 63 has a shank 63A elongated in the first direction, and a head 63B positioned at a one end portion of the shank 63A. The shank 63A has a diameter smaller than that of the through-hole 21B. The head 63B has a diameter greater than that of the through-hole 21B. The shank 63A is inserted through the through-hole 21B into the hole 62A of the boss 62. At this time, the head 63B confronts an edge of the through-hole 21B. Hence, the screw 63 fixes the gear cover 21 to the boss 62.

[0058]

2.5.5 Second protrusion 6

The gear cover 21 is also provided with the second protrusion 6 described above.

[0059]

The second protrusion 6 is positioned opposite to the second toner-accommodating section 2B with respect to the auger gear 23 in the first direction. The second protrusion 6 is positioned farther from the first opening 2C than the auger gear 23 is from the first opening 2C in the first direction. The second protrusion 6 extends from the gear cover 21 in the first direction.

[0060]

As illustrated in Fig. 8, the second protrusion 6 has a width L1 in the third direction intersecting the first and second directions, which is different from a width L2 of the first protrusion 5 in the third direction. Incidentally, the width of the protrusion 14 in the third direction is equal to the width of the protrusion 16 in the third direction. Specifically, the width L1 of the second protrusion 6 in the third direction is greater than the width L2 of the first protrusion 5 in the third direction. Consequently, the second protrusion 6 cannot be fitted with a groove 34 (described later) that conforms to the width L2 of the first protrusion 5. Accordingly, the user cannot mount the toner cartridge 1 in the developing unit 31 in case where the user attempts to set the toner cartridge 1 to the developing unit 31 in its reversed posture. Incidentally, the width L1 of the second protrusion 6 in the third direction may be narrower than the width L2 of the first protrusion 5 in the third direction instead.

[0061]

2.6 Gear parts and protrusions

As illustrated in Figs. 1 and 4, the toner cartridge 1 further includes gear parts 24A and 24B, and protrusions 25A, 25B, 26A and 26B. The gear parts 24A and 24B and the protrusions 25A, 25B, 26A and 26B are configured for moving a developing shutter 51 of the developing unit 31 described later.

[0062]

The cover 12 is further provided with the gear parts 24A and 24B. The gear part 24A is positioned away from the gear part 24B in the first direction. The first opening 2C is positioned between the gear parts 24A and 24B. Each of the gear parts 24A and 24B has a plurality of gear teeth. Hence, the cover 12 has pluralities of gear teeth. The gear teeth of the gear part 24A and the gear teeth of the gear part 24B are positioned at the outer peripheral surface of the cover 12. Specifically, the gear teeth of the gear parts 24A and 24B are positioned at the peripheral surface of the cover 12 along a rotational direction of the cover 12 with respect to the shutter 13. The gear teeth of the gear parts 24A and 24B are respectively arrayed in the rotational direction of the cover 12 relative to the shutter13. Further, the gear teeth of the gear part 24A and the gear teeth of the gear part 24B are respectively arrayed in the rotating direction of the auger 4.

[0063]

The cover 12 is further provided with the protrusions 25A and 25B. The protrusion 25A is positioned away from the protrusion 25B in the first direction. The protrusion 25A is arrayed with the gear teeth of the gear part 24A in the rotational direction of the cover 12 relative to the shutter 13. The protrusion 25A is positioned at the upstream side of the gear teeth of the gear part 24A in the rotational direction R of the cover 12 when the housing 2 is pivotally moved relative to the developing unit 31 from the second position (see Fig. 24) to the first position (see Fig. 13). The protrusion 25A is arrayed with the gear teeth of the gear part 24A and is spaced apart from the gear teeth of the gear part 24A by a gap greater than the gap between neighboring gear teeth of the gear part 24A in the rotational direction R of the cover 12. Specifically, the gap between the protrusion 25A and gear part 24A in the rotational direction R of the cover 12 is the pitch of the gear teeth of the gear part 24A. The protrusion 25B is positioned at the upstream side of the gear teeth of the gear part 24B in the rotational direction R of the cover 12 when the housing 2 is pivotally moved relative to the developing unit 31 from the second position to the first

position. The protrusion 25B is spaced apart from the gear teeth of the gear part 24B by a gap greater than the gap between neighboring gear teeth of the gear part 24B. Specifically, the gap between the protrusion 25B and gear part 24B in the rotational direction R of the cover 12 is the pitch of the gear teeth of the gear part 24B. The protrusions 25A and 25B protrude in a direction away from the first toner-accommodating section 2A with respect to the second toner-accommodating section 2B in the second direction.

[0064]

The protrusion 26A is positioned opposite to the first opening 2C with respect to the protrusion 25A in the first direction. The protrusion 26B is positioned opposite to the first opening 2C with respect to the protrusion 25B in the first direction. The protrusion 26A is positioned at the one end portion of the second toner-accommodating section 2B. The protrusion 26B is positioned at the other end portion of the second cover 15. The protrusions 26A and 26B protrude in a direction away from the first toner-accommodating section 2A in the second direction with respect to the second toner-accommodating section 2B.

[0065]

3. Details of developing unit 31

Figs. 9 through 11 illustrate a developing unit 31 that is configured to receive toner supplied from the toner cartridge 1. The developing unit 31 is configured to develop images using toner supplied from the toner cartridge 1, for example. In this cmbodiment, the developing unit 31 includes a developing roller 32. The developing unit 31 may also be provided with a photosensitive member. The developing unit 31 may be a cartridge-type developing unit that is attachable to and detachable from an image-forming apparatus. The developing roller 32 is elongated in the first direction. The developing roller 32 is capable of contacting a photosensitive member. The developing unit 31 also includes a toner-accommodating section 33. The toner-accommodating section 33 can accommodate toner.

[0066]

The developing unit 31 has grooves 34 and 35, and a developer opening 36.

[0067]

The groove 34 is positioned at a one end portion of the developing unit 31 in the first direction, while the groove 35 is positioned at an other end portion of the developing

unit 31 in the first direction. The groove 35 is positioned away from the groove 34 in the first direction. The grooves 34 and 35 will be described in greater detail.

[0068]

3.1 Groove 34

As illustrated in Figs. 10 and 13, the groove 34 is elongated in a mounting direction in which the toner cartridge 1 is mounted to the developing unit 31, i.e., the direction indicated by an arrow in Fig. 12. The groove 34 has one end portion in the mounting direction, and another end portion opposite the one end portion in the mounting direction. The one end portion of the groove 34 is positioned farther from the developer opening 36 than the other end portion is from the developer opening 36 in the mounting direction. Further, the groove 34 has sufficient width in a direction intersecting the mounting direction for receiving the first protrusion 5 of the toner cartridge 1 (see Fig. 1). Specifically, the groove 34 has the width the same as the width of the first protrusion 5 of the toner cartridge 1(see Fig. 1) in the direction intersecting the mounting direction. The groove 34 has flat surfaces 38A and 38B, recessed parts 39A and 39B, and protrusions 41A and 41B.

[0069]

3.1.1 Flat surface 38A and flat surface 38B

The flat surface 38A is positioned at one end portion of the groove 34, and the flat surface 38B is positioned at an other end portion of the groove 34. Both the flat surfaces 38A and 38B extend in the mounting direction. When the toner cartridge 1 is mounted to the developing unit 31, the flat surface 38A confronts the first frame part 16A of the protrusion 16 (see Fig. 1). When the toner cartridge 1 is mounted to the developing unit 31, the flat surface 38B confronts the second frame part 16B of the protrusion 16. When the housing 2 is pivotally moved relative to the developing unit 31 from the second position (see Fig. 24) to the first position (see Fig. 13), at least one of the flat surfaces 38A and 38B contacts the protrusion 16 to maintain the housing 2 at the first position.

[0070]

3.1.2 Recessed parts 39A and 39B

As illustrated in Figs. 10, 13, 23, and 24, the recessed part 39A is recessed away from the flat surface 38A in the widthwise direction of the groove 34, and the recessed part 39B is recessed away from the flat surface 38B in the widthwise direction of the groove 34. The recessed part 39A has an arcuate surface 42A, and a flat surface 40A. The

recessed part 39B has an arcuate surface 42B, and a flat surface 40B. The arcuate surface 42A extends relative to the flat surface 38A in a moving direction of the first frame part 16A when the housing 2 is pivotally moved relative to the developing unit 31 from the first position to the second position. The arcuate surface 42B extends relative to the flat surface 38B in a moving direction of the second frame part 16B when the housing 2 is pivotally moved relative to the developing unit 31 from the first position to the second position. The flat surface 40A is positioned at a downstream end portion of the arcuate surface 42A in the moving direction of the first frame part 16A when the housing 2 is pivotally moved relative to the developing unit 31 from the first position to the second position. The flat surface 40B is positioned at a downstream end portion of the arcuate surface 42B in the moving direction of the second frame part 16B when the housing 2 is pivotally moved relative to the developing unit 31 from the first position to the second position. Both of the flat surfaces 40A and 40B extend in a direction intersecting the mounting direction. Specifically, the flat surfaces 40A and 40B extend in a direction orthogonal to the mounting direction. When the housing 2 pivots from the second position to the first position relative to the developing unit 31, at least one of the flat surfaces 40A and 40B contacts the protrusion 16 to stop the housing 2 at the second position.

[0071]

3.1.3 Protrusions 41A and 41B

The protrusions 41A and 41B are positioned between the arcuate surfaces 42A and 42B in the widthwise direction of the groove 34. The protrusion 41A is positioned between the arcuate surface 42A and the protrusion 41B in the widthwise direction of the groove 34, and the protrusion 41B is positioned between the arcuate surface 42B and the protrusion 41A in the widthwise direction of the groove 34. The protrusion 41B is spaced away from the protrusion 41A in the widthwise direction of the groove 34. Both the protrusions 41A and 41B extend in the mounting direction. When the toner cartridge 1 is mounted to the developing unit 31, the flat plate part 14B (see Fig. 15) is positioned between the protrusions 41A and 41B. When the toner cartridge 1 is mounted to the developing unit 31, the protrusions 41A and 41B contact the flat plate part 14B. Thus, the protrusions 41A and 41B prevent the protrusion 14 from rotating when the toner cartridge 1 is mounted to the developing unit 31. Hence, the shutter 13 is fixed in position relative to the developing unit 31.

[0072]

On the other hand, when the toner cartridge 1 is mounted to the developing unit 31, the protrusions 41A and 41B do not contact the first frame part 16A, the second frame part 16B, and the third frame part 16C (see Fig. 1) in the widthwise direction of the groove 34. Therefore, when the toner cartridge 1 is mounted to the developing unit 31, the first frame part 16A, the second frame part 16B, and the third frame part 16C are rotatable relative to the shutter 13 while the shutter 13 is fixed in position relative to the developing unit 31. In this way, the housing 2 is pivotally movable together with the cover 12 and the second cover 15 relative to the developing unit 31, while the shutter 13 is fixed relative to the developing unit 31. Pivotal movement of the housing 2 together with the cover 12 and second cover 15 from the first position (see Fig. 13) to the second position (see Fig. 24) relative to the developing unit 31 permits the shutter 13 to move to the open position relative to the housing 2. When the shutter 13 is at the open position (see Fig. 27), at least a part of the second opening 13D overlaps at least a part of the first opening 2C, thereby opening the first opening 2C.

[0073]

Incidentally, the protrusion 41A is separated from the arcuate surface 42A in a radial direction of the arcuate surface 42A. A gap between the protrusion 41A and arcuate surface 42A is greater than a dimension of the first frame part 16A (see Fig. 1) in the mounting direction. Thus, the first frame part 16A can pass through the gap between the protrusion 41A and arcuate surface 42A when the housing 2 is pivotally moved relative to the developing unit 31. Similarly, the protrusion 41B is separated from the arcuate surface 42B in a radial direction of the arcuate surface 42B. A gap between the protrusion 41B and arcuate surface 42B is greater than a dimension of the second frame part 16B (see Fig. 1) in the mounting direction. Thus, the second frame part 16B can pass through the gap between the protrusion 41B and arcuate surface 42B when the housing 2 is pivotally moved relative to the developing unit 31.

[0074]

3.2 Groove 35

As illustrated in Fig. 11, the groove 35 is elongated in the mounting direction. The groove 35 has one end portion and another end portion in the mounting direction. The one end portion of the groove 35 is positioned farther from the toner-accommodating section 33 than the other end portion is from the toner-accommodating section 33 in the mounting direction. The groove 35 has a sufficient width in a direction intersecting the

mounting direction for receiving the second protrusion 6 of the toner cartridge 1 (see Fig. 1). Specifically, the groove 35 has the width equal to the width of the second protrusion 6 of the toner cartridge 1 in the direction intersecting the mounting direction. The groove 35 has flat surfaces 43A and 43B and recessed parts 44A and 44B.

[0075]

3.2.1 Flat surface 43A and 43B

The flat surface 43A is positioned at the one end portion of the groove 35. The flat surface 43B is positioned at the other end portion of the groove 35. The flat surfaces 43A and 43B both extend in the mounting direction. When the toner cartridge 1 is mounted to the developing unit 31, the flat surface 43A faces one end portion which is positioned at upstream of the second protrusion 6 in the mounting direction. When the toner cartridge 1 is mounted to the developing unit 31, the flat surface 43B confronts another end portion which is positioned downstream of the second protrusion 6 in the mounting direction. When the housing 2 is pivotally moved from the second position to the first position relative to the developing unit 31, at least one of the flat surfaces 43A and 43B contacts the second protrusion 6 to maintain the housing 2 at the first position.

[0076]

3.2.2 Recessed parts 44A and 44B

The recessed part 44A is recessed away from the flat surface 43A in the widthwise direction of the groove 35. The recessed part 44B is recessed away from the flat surface 43B in the widthwise direction of the groove 35. The recessed part 44A has an arcuate surface 46A and a flat surface 45A. The recessed part 44B has an arcuate surface 46B and a flat surface 45B. The arcuate surface 46A extends relative to the flat surface 43A in a moving direction of the one end portion of the second protrusion 6 when the housing 2 is pivotally moved from the first position to the second position relative to the developing unit 31. The arcuate surface 46B extends relative to the flat surface 45B in a moving direction of the other end portion of the second protrusion 6 when the housing 2 is pivotally moved from the first position to the second position relative to the developing unit 31. The flat surface 45A is positioned at the downstream end portion of the arcuate surface 46A in the moving direction of the one end portion of the second protrusion 6 when the housing 2 is pivotally moved from the first position to the second position relative to the developing unit 31. The flat surface 45B is positioned at the downstream end portion of the arcuate surface 46B in the moving direction of the other end portion of the second

protrusion 6 when the housing 2 is pivotally moved from the first position to the second position relative to the developing unit 31. The flat surfaces 45A and 45B extend in a direction that intersects the mounting direction. Specifically, the flat surfaces 45A and 45B extend in a direction orthogonal to the mounting direction. When the housing 2 is pivotally moved from the first position to the second position relative to the developing unit 31, at least one of the flat surfaces 45A and 45B contacts the second protrusion 6 to stop the housing 2 at the second position.

[0077]

3.3 Developer opening 36

As illustrated in Fig. 9, the developer opening 36 is positioned between the grooves 34 and 35 in the first direction. The developer opening 36 is positioned closer to the groove 34 than to a center of the developing unit 31 in the first direction. As illustrated in Fig. 10, the developer opening 36 penetrates the outer surface of the toner-accommodating section 33 in the mounting direction. The developer opening 36 has one end 36A which is open at the outer surface of the toner-accommodating section 33, and another end 36B communicating with the interior space of the toner-accommodating section 33.

[0078]

3.4 Developing shutter 51

As illustrated in Figs. 9 and 10, the developing unit 31 also includes a developing shutter 51.

[0079]

The developing shutter 51 is positioned between one end portion 36A and another end portion 36B of the developer opening 36 in the mounting direction. The developing shutter 51 has one surface 51B and another surface 51C. The one surface 51B is positioned closer to the one end portion 36A of the developer opening 36 than to the other end portion 36B of the developer opening 36 in the mounting direction. The other surface 51C is positioned closer to the other end portion 36B of the developer opening 36 than to the one surface 51B in the mounting direction. The developing shutter 51 is movable between a closed position (see Fig. 16) for closing the developer opening 36, and an open position (see Fig. 27) for opening the developer opening 36. The developing shutter 51 has an opening 51A. The opening 51A penetrates the developing shutter 51 in the mounting direction. When the developing shutter 51 is at the open position, as

illustrated in Fig. 27, the opening 51A overlaps at least a part of the developer opening 36. Accordingly, when the developing shutter 51 is at the open position, the opening 51A allows toner in the toner cartridge 1 to enter the toner-accommodating section 33 through the developer opening 36 and the opening 51A.

[0080]

As illustrated in Figs. 9 and 18, the developing shutter 51 further includes protrusions 53A and 53B, and gear parts 54A and 54B.

[0081]

The protrusion 53A is configured to contact the gear part 24A (see Fig. 19) when the toner cartridge 1 is mounted to the developing unit 31 and the housing 2 is pivoted from the first position to the second position relative to the developing unit 31. The protrusion 53B is configured to contact the gear part 24B (see Fig. 1) when the toner cartridge 1 is mounted to the developing unit 31 and the housing 2 is pivoted from the first position to the second position relative to the developing unit 31. When the housing 2 is pivoted from the first position to the second position relative to the developing unit 31, a leading gear tooth of the plurality of gear teeth of the gear part 24A presses against the protrusion 53A while a leading gear tooth of the plurality of gear teeth of the gear part 24B presses against the protrusion 53B, causing the developing shutter 51 to start moving from the closed position toward the open position. Subsequently, the remaining gear teeth of the gear part 24A mesh with the gear part 54A while the remaining gear teeth of the gear part 24B mesh with the gear part 54B. Further, the protrusion 53A is configured to contact the protrusion 25A (see Fig. 18) when the housing 2 is pivoted from the second position to the first position relative to the developing unit 31. The protrusion 53B is configured to contact the protrusion 25B (see Fig. 1) when the housing 2 is pivoted from the second position to the first position relative to the developing unit 31. When the housing 2 is pivoted from the second position to the first position relative to the developing unit 31, the gear part 24A is separated from the gear part 54A and the gear part 24B is separated from the gear part 54B. Subsequently, the protrusion 25A presses against the protrusion 53A and the protrusion 25B presses against the protrusion 53B, placing the developing shutter 51 at the closed position. Further, when the toner cartridge 1 is mounted to the developing unit 31, the gear part 54A meshes with the gear part 24A of the toner cartridge 1 (see Fig. 22). Further, when the toner cartridge 1 is mounted to the developing unit 31, the gear part 54B meshes with the gear part 24B of the toner cartridge 1 (see Fig. 1).

[0082]

The protrusion 53A is positioned opposite to the groove 34 with respect to the developer opening 36 in the first direction. The protrusion 53B is positioned between the developer opening 36 and groove 34 in the first direction. The protrusions 53A and 53B are disposed on the one surface 51B of the developing shutter 51 and protrude from the one surface 51B. When the developing shutter 51 is at the closed position, the protrusions 53A and 53B are exposed at the outer surface of the toner-accommodating section 33.

[0083]

The gear part 54A is positioned at the upstream side of the protrusion 53A in a moving direction M of the developing shutter 51. Here, the moving direction M of the developing shutter 51 is the direction that the developing shutter 51 moves from the closed position to the open position. The gear part 54A is positioned apart from the protrusion 53A in the moving direction M of the developing shutter 51. The gear part 54B is positioned at the upstream side of the protrusion 53B in the moving direction M of the developing shutter 51. The gear part 54B is positioned apart from the protrusion 53B in the moving direction M. Both the gear parts 54A and 54B have a plurality of gear teeth arrayed in the moving direction M of the developing shutter 51.

[0084]

As illustrated in Figs. 18, 20, 22, and 26, the developing shutter 51 further includes recessed parts 55 and 56, and a protrusion 57. The recessed part 55 is configured to receive a protrusion 59, described later, when the toner cartridge 1 is removed from the developing unit 31 and the developing shutter 51 is at the closed position. The protrusion 57 is configured to contact the protrusion 59 fitted in the recessed part 55 when the toner cartridge 1 is removed from the developing unit 31 and the developing shutter 51 at the closed position is urged to move toward the open position, to thus prevent the developing shutter 51 from moving from the closed position to the open position. The recessed part 56 is configured to receive the protrusion 59 when the toner cartridge 1 is attached to the developing unit 31 and the developing shutter 51 is at the open position. The recessed part 55, the recessed part 56, and the protrusion 57 are positioned at the other surface 51C of the developing shutter 51. The recessed part 56 is positioned at the upstream side of the recessed part 55 in the moving direction M of the developing shutter 51, i.e., the direction in which the developing shutter 51 moves from the closed position to the open position. The protrusion 57 is positioned between the recessed part 55 and recessed part

56 in the moving direction M of the developing shutter 51. The recessed part 55 is recessed in a direction from the other surface 51C to the one surface 51B of the developing shutter 51. The recessed part 56 is also recessed in the direction from the other surface 51C to the one surface 51B of the developing shutter 51. The protrusion 57 protrudes in a direction from the one surface 51B to the other surface 51C. The protrusion 57 has a sloped surface 57A. The sloped surface 57A slopes toward the one surface 51B of the developing shutter 51 in a direction from the recessed part 55 toward the recessed part 56.

[0085]

3.5 Locking member

As illustrated in Fig. 9, the developing unit 31 is also provided with locking members 52A and 52B.

[0086]

The locking members 52A and 52B are configured to lock the developing shutter 51 at the closed position when the toner cartridge 1 is removed from the developing unit 31. Here, locking the developing shutter 51 at the closed position implies that the developing shutter 51 is prevented from moving from the closed position to the open position. The locking member 52A engages with one end portion of the developing shutter 51 in the first direction when the toner cartridge 1 is removed from the developing unit 31 and the developing shutter 51 is positioned at the closed position. The locking member 52B engages with another end portion of the developing shutter 51 in the first direction when the toner cartridge 1 is removed from the developing unit 31 and the developing shutter 51 is positioned at the closed position. The other end portion of the developing shutter 51 is positioned closer to the groove 34 than the one end portion is to the groove 34 in the first direction.

[0087]

The locking member 52A is positioned opposite to the groove 34 with respect to the developing shutter 51 in the first direction. The locking member 52B is positioned between the developing shutter 51 and the groove 34 in the first direction. The locking member 52B is positioned apart from the locking member 52A in the first direction. The developing shutter 51 is positioned between the locking members 52A and 52B in the first direction. The locking members 52A and 52B are exposed at the outer surface of the toner-accommodating section 33. The locking members 52A and 52B extend in the moving direction M of the developing shutter 51.

[0088]

As illustrated in Figs. 17, 19, and 21, each of the locking members 52A and 52B has a base end E1, and a distal end E2 apart from the base end E1 in the moving direction M of the developing shutter 51. The distal end E2 is positioned at the upstream side of the base end E1 in the moving direction M of the developing shutter 51, i.e., the direction in which the developing shutter 51 moves from the closed position to the open position. The base end E1 of the locking member 52A and the base end E1 of the locking member 52B are fixed to the developing unit 31. The locking members 52A and 52B are positioned away from the toner-accommodating section 33 in the mounting direction. With this configuration, the locking members 52A and 52B are deflectable in a curved manner in the mounting direction. Each of the locking members 52A and 52B is provided with a protrusion 58 and a protrusion 59 (see also Fig. 18).

[0089]

The protrusion 58 of the locking member 52A protrudes from the locking member 52A in the mounting direction, and specifically in a direction away from the toner-accommodating section 33. The protrusion 58 of the locking member 52B (see Fig. 9) protrudes from the locking member 52B in the mounting direction, and specifically in the direction away from the toner-accommodating section 33. The protrusion 58 of the locking member 52A contacts the protrusion 26A when the toner cartridge 1 is mounted to the developing unit 31. The protrusion 58 of the locking member 52B contacts the protrusion 26B (see Fig. 1) when the toner cartridge 1 is mounted to the developing unit 31.

[0090]

As illustrated in Figs. 18, 20, 22, and 26, the protrusion 59 of the locking member 52A is positioned at the distal end E2 of the locking member 52A, and the protrusion 59 of the locking member 52B is positioned at the distal end E2 of the locking member 52B. The protrusion 59 extends in the first direction. Note that the protrusion 59 is fitted into the recessed part 55 formed in the developing shutter 51 when the developing shutter 51 is positioned at the closed position. in a state where the toner cartridge 1 is removed from the developing unit 31. The protrusion 59 contacts the protrusion 57 of the developing shutter 51 when the developing shutter 51 is moved from closed position to the open position in a state where the protrusion 59 is fitted into the recessed part 55. This contact prevents the developing shutter 51 from further moving.

[0091]

4. Attachment and detachment of toner cartridge 1 to and from developing unit 31

Next, the operations for attaching the toner cartridge 1 to the developing unit 31 and for removing the toner cartridge 1 from the developing unit 31 will be described with reference to Figs. 12 through 27.

[0092]

4.1 Attachment of toner cartridge 1 to developing unit 31

For attaching the toner cartridge 1 to the developing unit 31, the toner cartridge 1 is first mounted to the developing unit 31 by fitting the first protrusion 5 into the groove 34 and the second protrusion 6 into the groove 35, as illustrated in Figs. 12, 13, and 14. Here, the first protrusion 5 is fixed in position relative to the developing unit 31 when fitted into the groove 34, and the second protrusion 6 is fixed in position relative to the developing unit 31 when fitted into the groove 35. Note that the housing 2 is disposed at the first position relative to the shutter 13 at this time, as illustrated in Fig. 1. The shutter 13 is disposed at the closed position relative to the cover 12 for closing the first opening 2C. In other words, the shutter 13 closes the first opening 2C when the housing 2 is at the first position.

[0093]

Through this operation, the toner cartridge 1 is mounted to the developing unit 31, as illustrated in Figs. 13 and 14. Here, the first protrusion 5 is fitted into the groove 34 and the second protrusion 6 is fitted into the groove 35. At this time, the protrusion 14 is subjected to positioning at a position between the protrusions 41A and 41B, as illustrated in Fig. 15. Hence, the protrusion 14 is fixed in position relative to the developing unit 31 when the toner cartridge 1 is mounted to the developing unit 31.

[0094]

Also at this time, by the contact of the protrusion 41B with the protrusion 18B of the locking member 18, the locking member 18 moves from the locking position to the release position against the urging force of the spring 18C. In other words, when the toner cartridge 1 is mounted to the developing unit 31, the locking member 18 contacts a part of the developing unit 31 and moves from the locking position to the release position. Consequently, the locking member 18 releases the lock on the protrusion 14 when the toner cartridge 1 is mounted to the developing unit 31. That is, by the movement of the locking member 18 from the locking position to the release position, the protrusion 14 becomes

rotatable relative to the second cover 15. Put another way, the second cover 15 becomes rotatable relative to the protrusion 14 by the movement of the locking member 18 from the locking position to the release position. Accordingly, the housing 2 becomes pivotally movable together with the cover 12 and second cover 15 relative to the shutter 13.

[0095]

Also at this time, the developing shutter 51 is disposed at the closed position, as illustrated in Fig. 16. Further, the protrusion 26A of the toner cartridge 1 contacts the protrusion 58 of the locking member 52A, as illustrated in Fig. 17. Through this contact, the locking member 52A is bent such that the distal end E2 of the locking member 52A is moved away from the developing shutter 51. Consequently, the protrusion 59 of the locking member 52A is retracted from the recessed part 55 of the developing shutter 51, as illustrated in Fig. 18. Also at this time, the protrusion 53A of the developing shutter 51 is positioned between the protrusion 25A and gear part 24A of the toner cartridge 1.

[0096]

Next, the user pivotally moves the housing 2 relative to the developing unit 31 from the first position toward the second position.

[0097]

Through this operation, the housing 2 is pivotally moved about the first protrusion 5 and second protrusion 6 from the first position toward the second position relative to the developing unit 31, and the gear part 24A applies pressure to the protrusion 53A while the protrusion 26A of the toner cartridge 1 is in contact with the protrusion 58 of the locking member 52A, as illustrated in Figs. 19 and 20. Accordingly, the developing shutter 51 is moved from the closed position toward the open position while the protrusion 59 is disengaged from the recessed part 55.

[0098]

Next, in accordance with further pivotal movement of the housing 2 from the first position toward the second position relative to the developing unit 31, the developing shutter 51 continues to move from the closed position toward the open position, and the protrusion 57 moves past an area opposite to the toner-accommodating section 33 with respect to the protrusion 59.

[0099]

Further, the protrusion 26A of the toner cartridge 1 separates from the protrusion 58 of the locking member 52A, as illustrated in Fig. 21. As a consequence, the locking

member 52A is restored from its bent state so that the distal end E2 of the locking member 52A approaches the developing shutter 51. As a result, the protrusion 59 contacts the sloped surface 57A of the protrusion 57, as illustrated in Fig. 22. Further, the gear teeth of the gear part 24A mesh with the gear teeth of the gear part 54A. In other words, when the toner cartridge 1 is capable of pivoting relative to the developing unit 31, at least one of the gear teeth of the gear part 24A is engaged with the developing shutter 51 for opening and closing the developer opening 36 formed in the developing unit 31. Also at this time, the first frame part 16A of the protrusion 16 is positioned inside the recessed part 39A of the groove 34, while the second frame part 16B of the protrusion 16 is positioned inside the recessed part 39b of the groove 34, as illustrated in Fig. 23.

[0100]

Next, as illustrated in Figs. 24 and 25, at least one of the first frame part 16A and second frame part 16B of the protrusion 16 contacts the flat surface 40A or 40B of the groove 34, and at least one of the one end portion and the other end portion of the second protrusion 6 contacts the respective flat surface 45A or 45B of the groove 35, thereby positioning the housing 2 at the second position relative to the shutter 13. At this time, the developing shutter 51 is at the open position and the protrusion 59 is positioned inside the recessed part 56, as illustrated in Fig. 26. Further, the shutter 13 is at the open position relative to the housing 2, and at least the part of the second opening 13D overlaps at least the part of the first opening 2C, as illustrated in Fig. 27. Thus, the second opening 13D allows toner in the toner cartridge 1 to be discharged from the toner cartridge 1 through the first opening 2C.

[0101]

This completes the operations for attachment of the toner cartridge 1 to the developing unit 31.

[0102]

4.2 Detachment of toner cartridge 1from developing unit 31

To remove the toner cartridge 1 from the developing unit 31, the user pivots the housing 2 relative to the developing unit 31 from the second position illustrated in Figs. 24 and 25 to the first position illustrated in Figs. 13 and 14.

[0103]

Through this operation, the developing shutter 51 moves from the open position toward the closed position through the meshing of the gear part 24A in the toner cartridge

1 and the gear part 54A and the meshing of the gear part 24B in the toner cartridge 1 and the gear part 54B, as illustrated in Fig. 22.

[0104]

At this time, the protrusion 59 moves along the sloped surface 57A of the protrusion 57 to move in the direction away from the developing shutter 51 in the mounting direction.

[0105]

Next, as the housing 2 further approaches the first position, as illustrated in Fig. 19, the protrusion 26A of the toner cartridge 1 contacts the protrusion 58 of the locking member 52A. Also at the same time, as illustrated in Fig. 20, the gear part 24A of the toner cartridge 1 moves apart from the gear part 54A and the gear part 24B of the toner cartridge 1 moves apart from the gear part 54B, thereby temporarily halting movement of the developing shutter 51.

[0106]

As the housing 2 further approaches the first position, the protrusion 25A of the toner cartridge 1 contacts the protrusion 53A of the developing shutter 51, and the protrusion 25B of the toner cartridge 1 contacts the protrusion 53B of the developing shutter 51. The protrusion 25A of the toner cartridge 1 applies pressure to the protrusion 53A of the developing shutter 51, while the protrusion 25B of the toner cartridge 1 applies pressure to the protrusion 53B of the developing shutter 51. Thus, the developing shutter 51 again moves toward the closed position.

[0107]

Next, as illustrated in Figs. 13 and 14, at least one of the first frame part 16A and second frame part 16B of the protrusion 16 contacts the corresponding flat surface 38A or 38B of the groove 34, and at least one of the one end portion and the other end portion of the second protrusion 6 contacts the corresponding flat surface 43A or 43B of the groove 35, thereby stopping the housing 2 at the first position. At this time, the developing shutter 51 is at the closed position, as illustrated in Fig. 18. Also, at this time, the shutter 13 is at the closed position relative to the cover 12, closing the first opening 2C, as illustrated in Fig. 16.

[0108]

Next, the user pulls the toncr cartridge 1 away from the developing unit 31 in the second direction, as illustrated in Fig. 12.

[0109]

This completes the operations for detaching the toner cartridge 1 from the developing unit 31.

[0110]

5. Conveying operation of toner from developing unit to toner cartridge

When the toner cartridge 1 is mounted to the developing unit 31 and the housing 2 is positioned at the second position, the auger gear 23 of the toner cartridge 1 is meshed with the gear 30 of the developing unit 31 (see Fig. 9).

[0111]

When the image-forming apparatus subsequently performs image-forming operation, a drive force is inputted into the auger gear 23 of the toner cartridge 1 from the gear 30 of the developing unit 31. This drive force rotates the auger 4, as illustrated in Fig. 2. The drive force is further inputted from the auger gear 23 into the agitator 3 via a gear train (not illustrated) to rotate the agitator 3.

[0112]

The rotation of the agitator 3 conveys toner from the first interior space 2D to the second interior space 2E.

[0113]

Next, the auger 4 conveys the toner in the second interior space 2E into the interior space of the shutter 13, as illustrated in Fig. 4.

[0114]

The toner in the interior of the shutter 13 is subsequently supplied into the toner-accommodating section 33 of the developing unit 31 via the opening formed by the overlapping second opening 13D and first opening 2C, and via the opening formed by the overlapping opening 51A of the developing shutter 51 and developer opening 36, as illustrated in Fig. 27. Hence, the first opening 2C allows toner to be discharged from the second interior space 2E.

[0115]

7. Technical effect

As illustrated in Figs. 1 through 3, the second toner-accommodating section 2B is positioned at one side of the first toner-accommodating section 2A in the second direction. This arrangement allows the toner cartridge 1 to be made more compact in the first direction, while still securing sufficient toner capacity in the first toner-

accommodating section 2A and second toner-accommodating section 2B in the second direction.

[0116]

When attaching the toner cartridge 1 to the developing unit 31, as illustrated in Figs. 13 and 14, the toner cartridge 1 can be fixed in position relative to the developing unit 31 by the first protrusion 5 and second protrusion 6. Accordingly, the first opening 2C can be accurately fixed in position relative to the developing unit 31.

[0117]

After the toner cartridge 1 has been attached to the developing unit 31, the agitator 3 conveys toner in the first toner-accommodating section 2A to the second toner-accommodating section 2B, as illustrated in Fig. 2. And, the auger 4 conveys toner in the second toner-accommodating section 2B to the first opening 2C, as illustrated in Fig. 4.

[0118]

With this configuration, the agitator 3 and auger 4 can convey toner smoothly from the first toner-accommodating section 2A to the first opening 2C. Further, by conveying toner with the auger 4, amount of toner discharged from the first opening 2C can be adjusted. Note that, since the first opening 2C is positioned at the one side of the second toner-accommodating section 2B in the first direction, toner can be conveyed to the first opening with a simple construction including the auger 4 extending in the first direction. This construction can reduce the number of parts required for conveying toner to the first opening 2C.

[0119]

In summary, the first protrusion 5 is positioned at the one side of the second toner-accommodating section 2B in the first direction, and the second protrusion 6 is positioned at the other side of the second toner-accommodating section 2B in the first direction, as illustrated in Fig. 1. Further, the auger 4 conveys toner to the first opening 2C between the first protrusion 5 and second protrusion 6. Accordingly, this structure can reduce the number of parts and members, while conveying toner smoothly to the first opening 2C accurately fixed in position relative to the developing unit 31, and can adjust the amount of toner to be discharged through the first opening 2C.

[0120]

Thus, the toner cartridge 1 can convey toner smoothly and can adjust the amount of discharged toner.

[Description of Reference Numerals]

1 toner cartridge

2 housing

2A first toner-accommodating section

2B second toner-accommodating section

2C first opening

2D first interior space

2E second interior space

3 agitator

4 auger

4C one end portion

4D other end portion

5 first protrusion

6 second protrusion

11 third opening

12 cover

13 shutter

13D second opening

20 first through-hole

21 gear cover

23 auger gear

24A gear part

24B gear part

31 developing unit

A1 first axis

A2 second axis

A3 third axis

L1 width

L2 width

What is claimed is:

1. A toner cartridge comprising:

a housing extending in a first direction, the housing including:

a first toner-accommodating section having a first interior space elongated in the first direction;

a second toner-accommodating section having a second interior space elongated in the first direction and in communication with the first interior space, the second toner-accommodating section being positioned at one side of the first toner-accommodating section in a second direction; and

a first opening positioned at one side of the second toner-accommodating section in the first direction, the first opening allowing toner in the second interior space to be discharged therethrough;

an agitator rotatable about a first axis extending in the first direction, the agitator being configured to agitate the toner in the first interior space and to convey the toner from the first interior space to the second interior space;

an auger rotatable about a second axis extending in the first direction, the auger being configured to convey the toner from the second interior space to the first opening;

a first protrusion positioned at the one side of the second toner-accommodating section and at one side of the first opening in the first direction, the first protrusion extending in the first direction; and

a second protrusion positioned at an other side of the second toner-accommodating section in the first direction, the second protrusion extending in the first direction, and wherein

a width of the second protrusion in a third direction crossing the first direction and the second direction is different from a width of the first protrusion in the third direction.

2. A toner cartridge comprising:

a housing extending in a first direction, the housing including:

a first toner-accommodating section having a first interior space elongated in the first direction;

a second toner-accommodating section having a second interior space elongated in the first direction and in communication with the first interior space, the second

toner-accommodating section being positioned at one side of the first toner-accommodating section in a second direction; and

a first opening positioned at one side of the second toner-accommodating section in the first direction, the first opening allowing toner in the second interior space to be discharged therethrough;

an agitator rotatable about a first axis extending in the first direction, the agitator being configured to agitate the toner in the first interior space and to convey the toner from the first interior space to the second interior space;

an auger rotatable about a second axis extending in the first direction, the auger being configured to convey the toner from the second interior space to the first opening;

a first protrusion positioned at the one side of the second toner-accommodating section and at one side of the first opening in the first direction, the first protrusion extending in the first direction; and

a second protrusion positioned at an other side of the second toner-accommodating section in the first direction, the second protrusion extending in the first direction, wherein

the first protrusion and the second protrusion are configured to be positioned to a developing unit when the toner cartridge is mounted to the developing unit, and wherein

after the toner cartridge is mounted to the developing unit, the toner cartridge is mounted to the developing unit by pivotally moving the housing relative to the developing unit about the first protrusion and the second protrusion.

3. The toner cartridge according to claim 1 or 2, wherein the second direction is defined by connecting the first axis and the second axis, and wherein

the first protrusion protrudes in the second direction, and the second protrusion protrudes in the second direction.

4. The toner cartridge according to claim 2, wherein a width of the second protrusion in a third direction crossing the first direction and the second direction is different from a width of the first protrusion in the third direction.

5. The toner cartridge according to any one of claims 1 through 4, wherein the auger has one end portion and another end portion separated from the one end portion in the

first direction, a part of a peripheral surface of the one end portion of the auger being exposed through the first opening.

6. The toner cartridge according to any one of claims 1 through 5, further comprising:

a shutter having a closed state closing the first opening and an open state opening the first opening, the shutter being positioned at one end portion of the second toner-accommodating section in the first direction, the shutter including the first protrusion.

7. The toner cartridge according to claim 6, wherein the first protrusion protrudes from the shutter in the first direction.

8. The toner cartridge according to claim 6 or claim 7, wherein the shutter is rotatable about a third axis extending in the first direction and rotatable from a closed position to an open position,

the shutter closes the first opening when the shutter is positioned at the closed position, and

the shutter opens the first opening when the shutter is positioned at the open position.

9. The toner cartridge according to claim 8, wherein the first protrusion is rotatable together with the shutter.

10. The toner cartridge according to claim 8 or claim 9, wherein the shutter has a second opening; and wherein

at least part of the second opening overlaps with at least part of the first opening when the shutter is at the open position.

11. The toner cartridge according to any one of claims 8 through 10, wherein the auger has one end portion and an other end portion separated from the one end portion in the first direction, a part of a peripheral surface of the one end portion of the auger in the first direction being exposed through the first opening , the one end portion of the auger being exposed through the first opening when the shutter is positioned at the open position.

12. The toner cartridge according to any one of claims 1 through 11, wherein the second toner-accommodating section has a third opening positioned at the one end portion of the second toner-accommodating section, and wherein

the housing further includes a cover covering the one end portion of the second toner-accommodating section and covering the third opening.

13. The toner cartridge according to claim 12, wherein the auger has one end portion and another end portion separated from the one end portion in the first direction, and wherein

the one end portion of the auger is exposed from the second toner-accommodating section through the third opening; and wherein

the cover covers at least part of the one end portion of the auger.

14. The toner cartridge according to claim 12 or claim 13, wherein the cover includes a plurality of gear teeth positioned at an outer surface of the cover, the plurality of gear teeth being juxtaposed along a rotating direction of the auger.

15. The toner cartridge according to any one of claims 1 through 14, wherein the auger has one end portion and another end portion separated from the one end portion in the first direction, and

the toner cartridge further comprising an auger gear mounted to the other end portion of the auger, the auger gear being rotatable together with the auger, wherein

the second protrusion is positioned farther from the first opening than the auger gear is from the first opening.

16. The toner cartridge according to claim 15, further comprising a gear cover covering at least part of the auger gear, wherein

the second protrusion protrudes from the gear cover in the first direction.

17. The toner cartridge according to claim 15 or claim 16, wherein the second toner-accommodating section has a first through-hole positioned at another end portion of the second toner-accommodating section in the first direction, the first through-hole penetrating the second toner-accommodating section in the first direction, wherein

the other end portion of the auger in the first direction is inserted in the first through hole, and wherein

the auger gear is positioned at an outer surface of the second toner-accommodating section.

18. The toner cartridge according to any one of claims 1 through 17, wherein the first opening is positioned closer to the one side in the first direction than the first toner-accommodating section to the one side in the first direction.

19. The toner cartridge according to any one of claims 1 through 18, wherein the agitator comprises an agitator shaft extending along the first axis, and a blade rotatable together with the agitator shaft, the blade being positioned in the first interior space; and

wherein the first opening is positioned closer to the one side in the first direction than the blade is to the one side in the first direction.

20. The toner cartridge according to claim 1, wherein the first protrusion and the second protrusion are configured to be positioned to a developing unit when the toner cartridge is mounted to the developing unit, and wherein

after the toner cartridge is mounted to the developing unit, the toner cartridge is mounted to the developing unit by pivotally moving the housing relative to the developing unit about the first protrusion and the second protrusion.

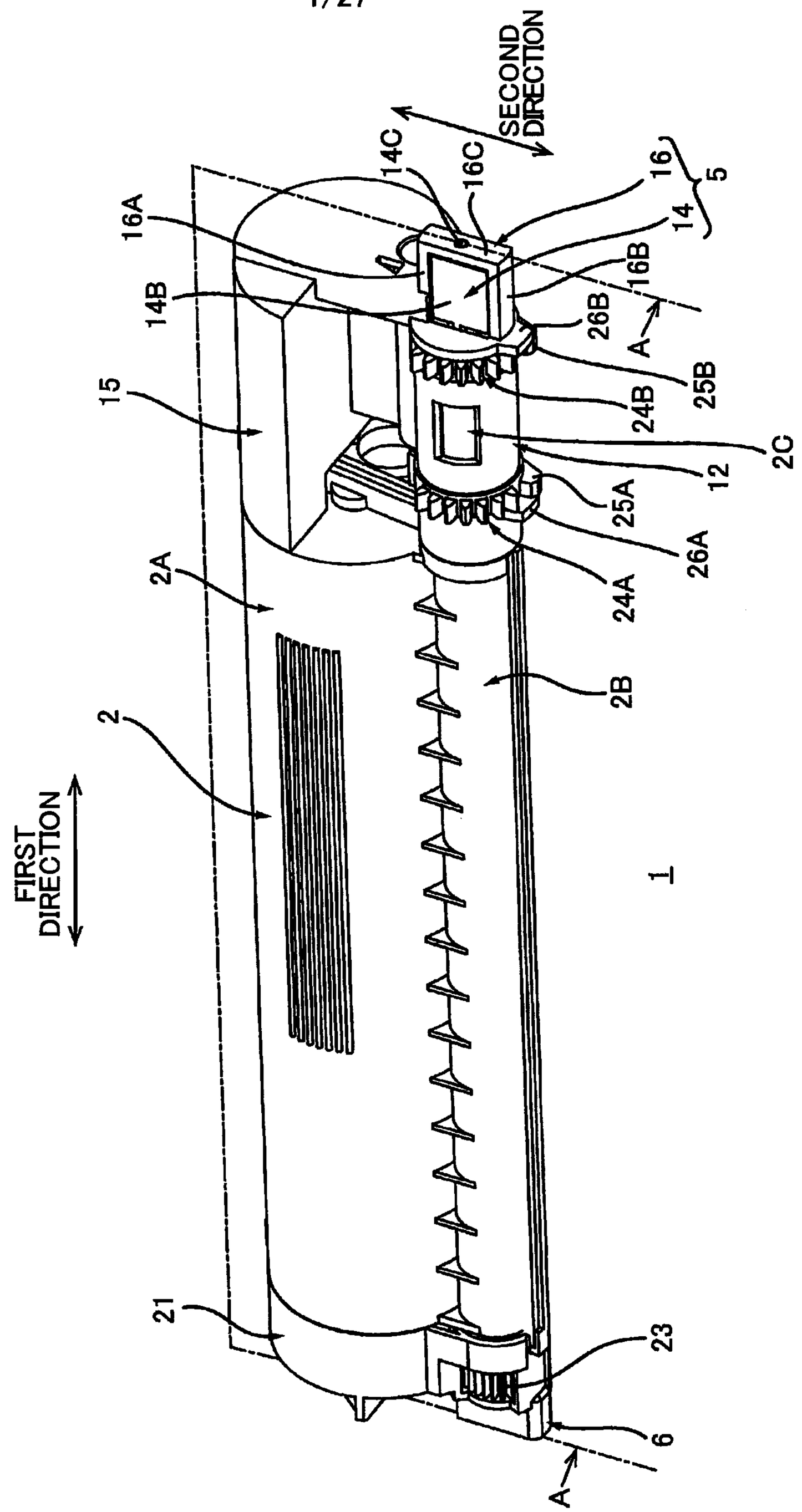
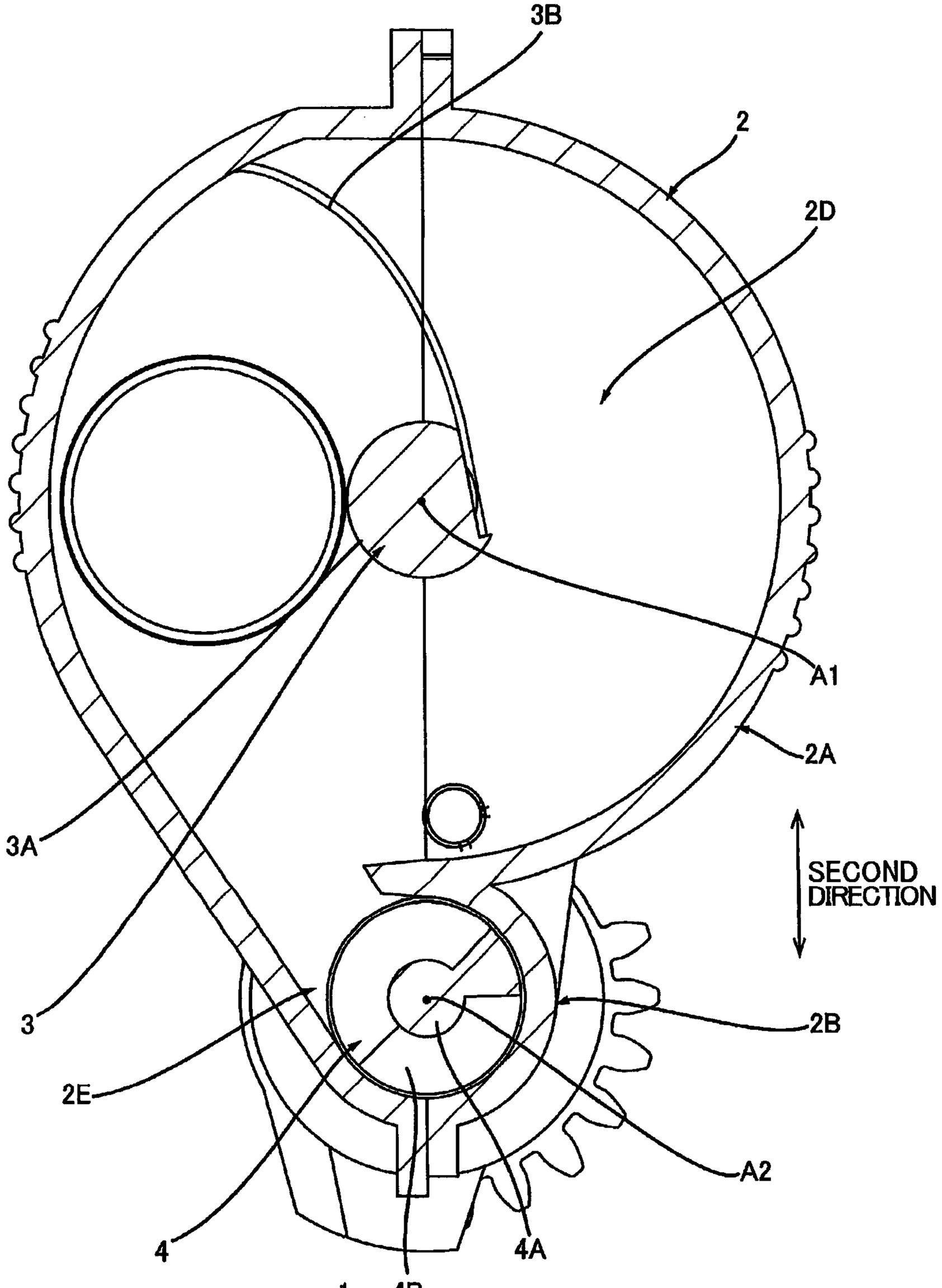

SECOND DIRECTION
FIRST DIRECTION
14C
16C
16
5
14
16A
14B
16B
26B
A
15
24B
25B
2C
12
25A
26A
24A
2A
2B
2
1
21
23
6
A

FIG. 1

FIG. 2



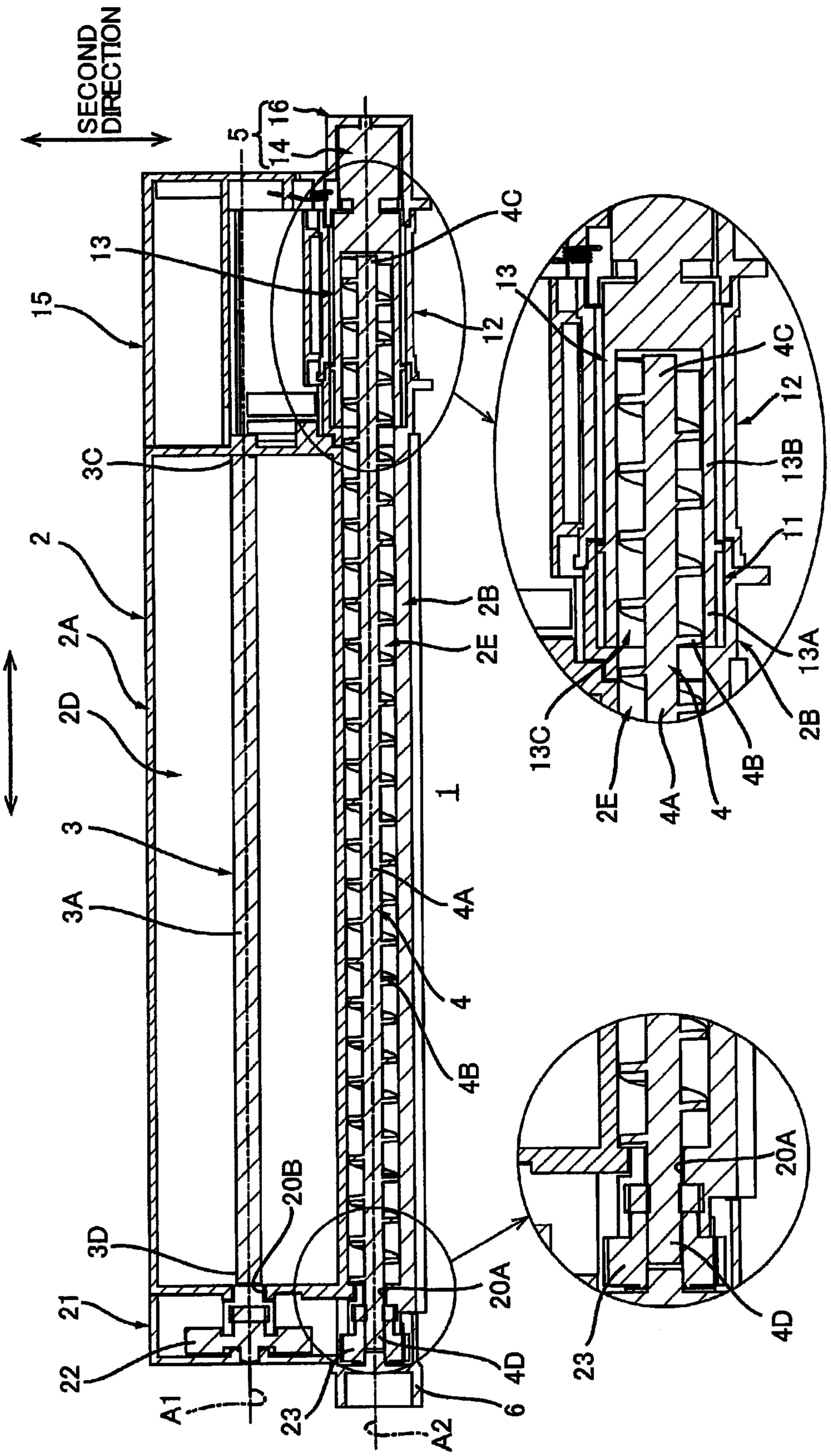

SECOND DIRECTION
FIRST DIRECTION
5
14
16
13
15
3C
2
2A
2D
3
3A
4C
12
2E
2B
1
4A
4
4B
13
11
13B
13A
13C
4B
20B
3D
21
22
20A
4D
23
6
A1
A2

FIG. 3

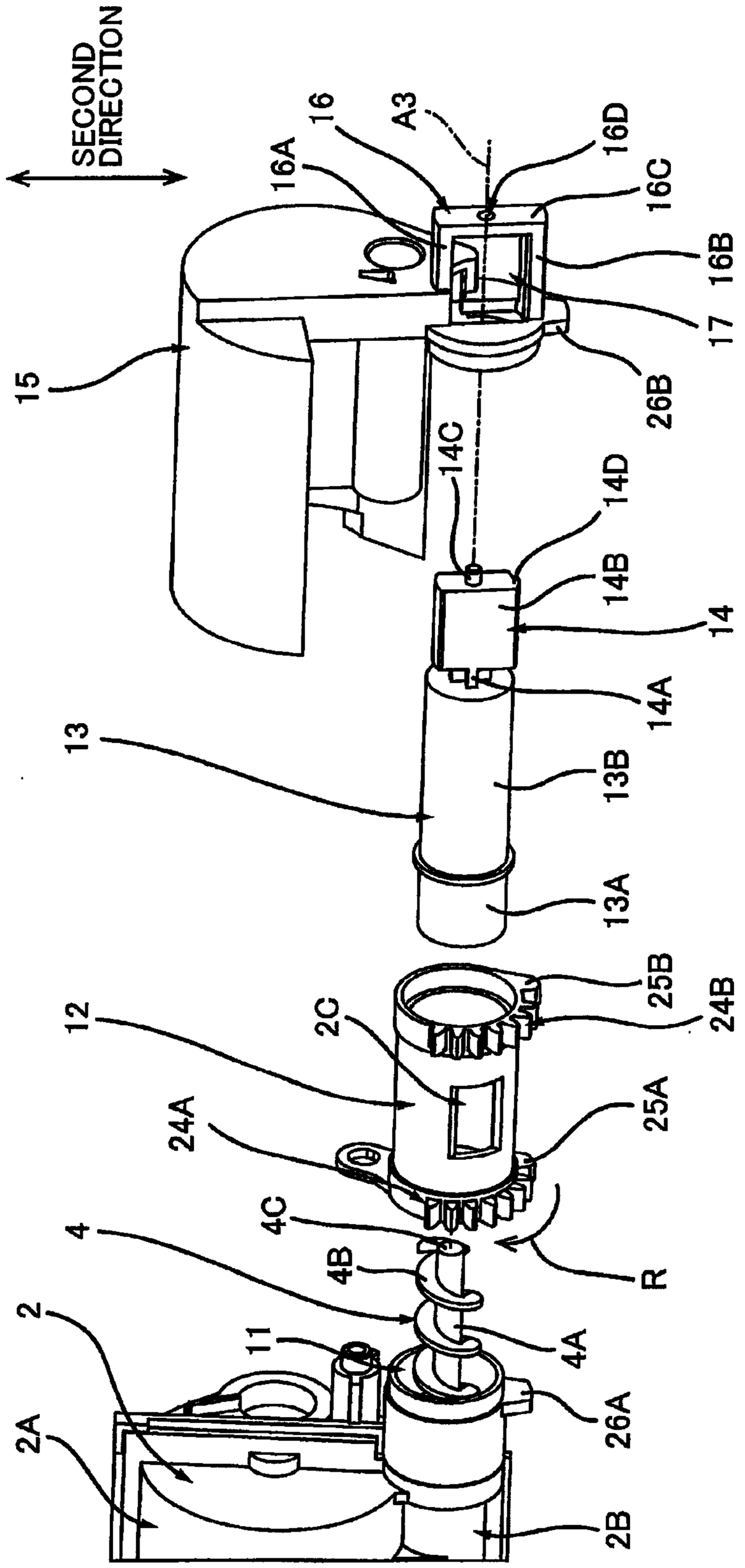

SECOND DIRECTION
FIRST DIRECTION
16
A3
16A
16D
16C
40
16B
17
15
26B
14C
14D
14B
14
14A
13
13B
13A
12
2C
25B
24B
24A
25A
4C
4
4B
4A
R
2
11
26A
2A
2B

FIG. 4

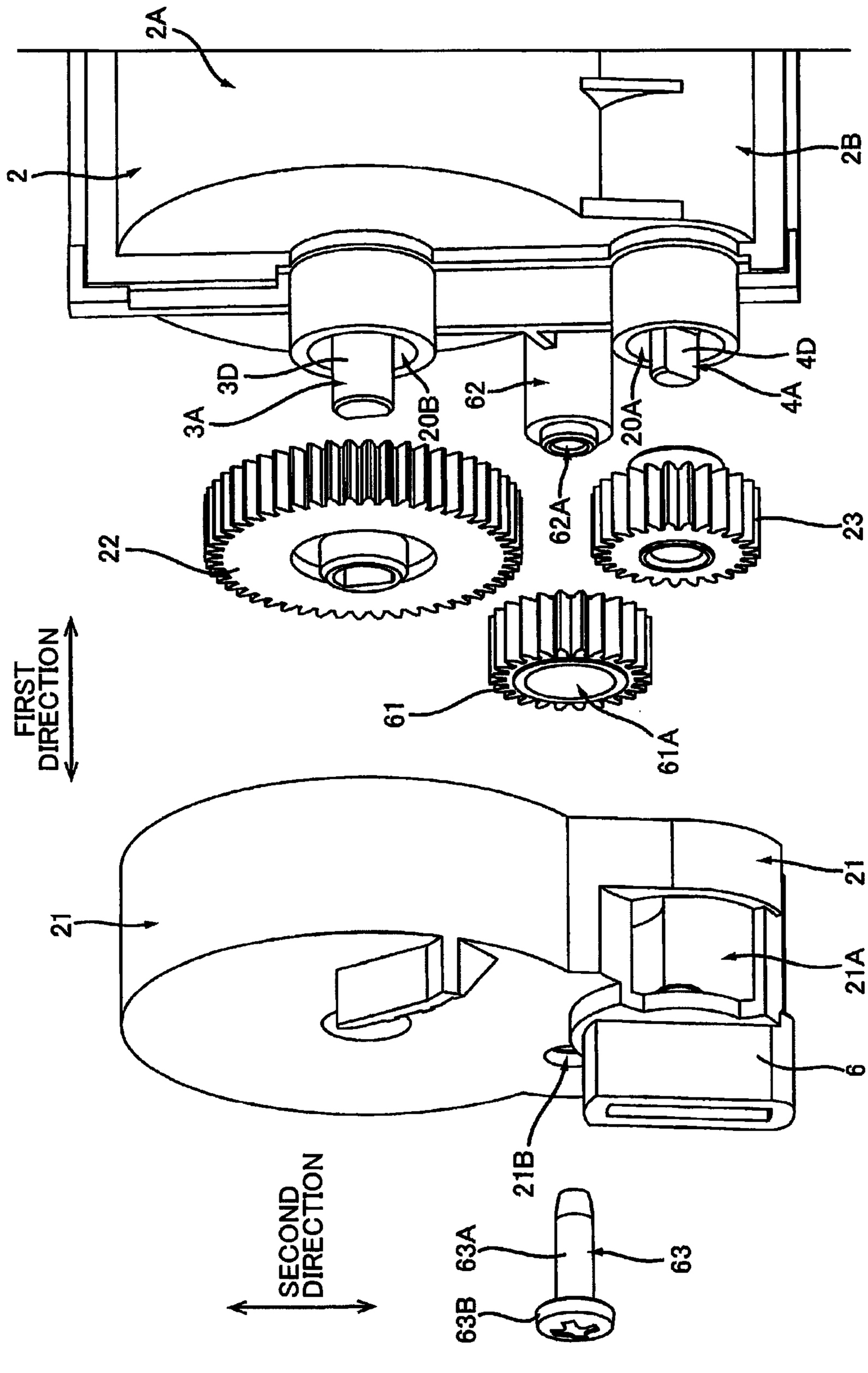

2A
2
2B
3D
3A
20B
62
20A
4D
4A
22
62A
23
61
61A
FIRST DIRECTION
21
21
21A
6
SECOND DIRECTION
63A
21B
63
63B

FIG. 5

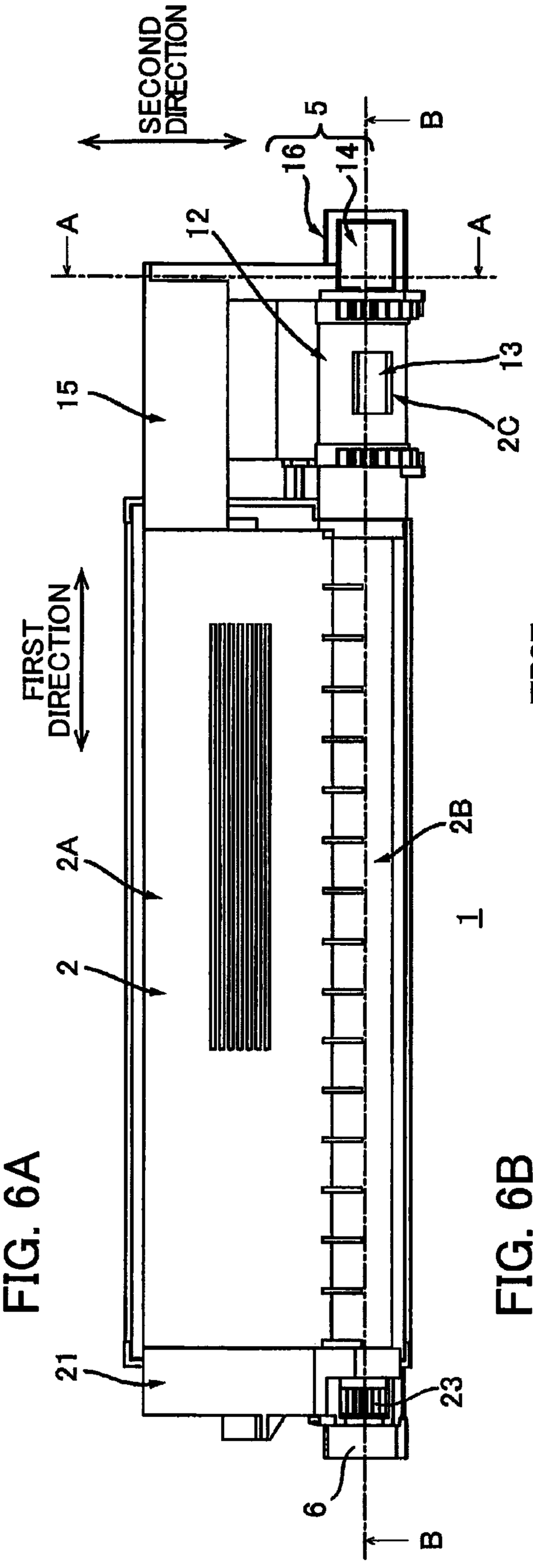

SECOND DIRECTION
5
16
14
B
A
A
12
15
13
2C
FIRST DIRECTION
2A
2
2B
1
21
23
6
B

FIG. 6A

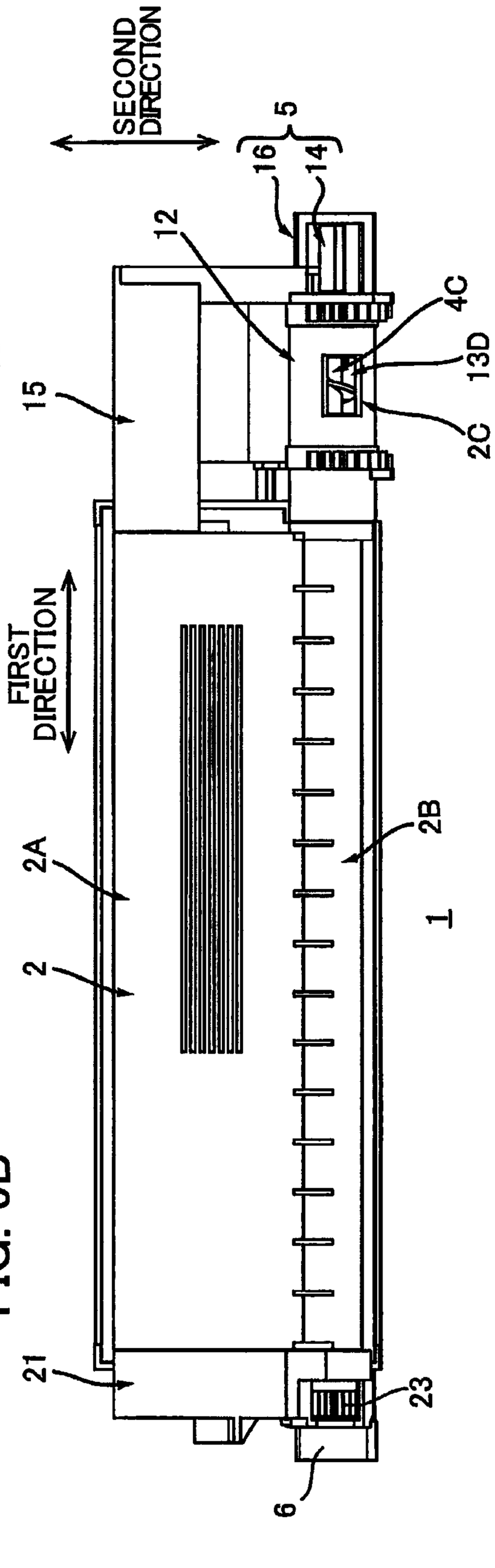
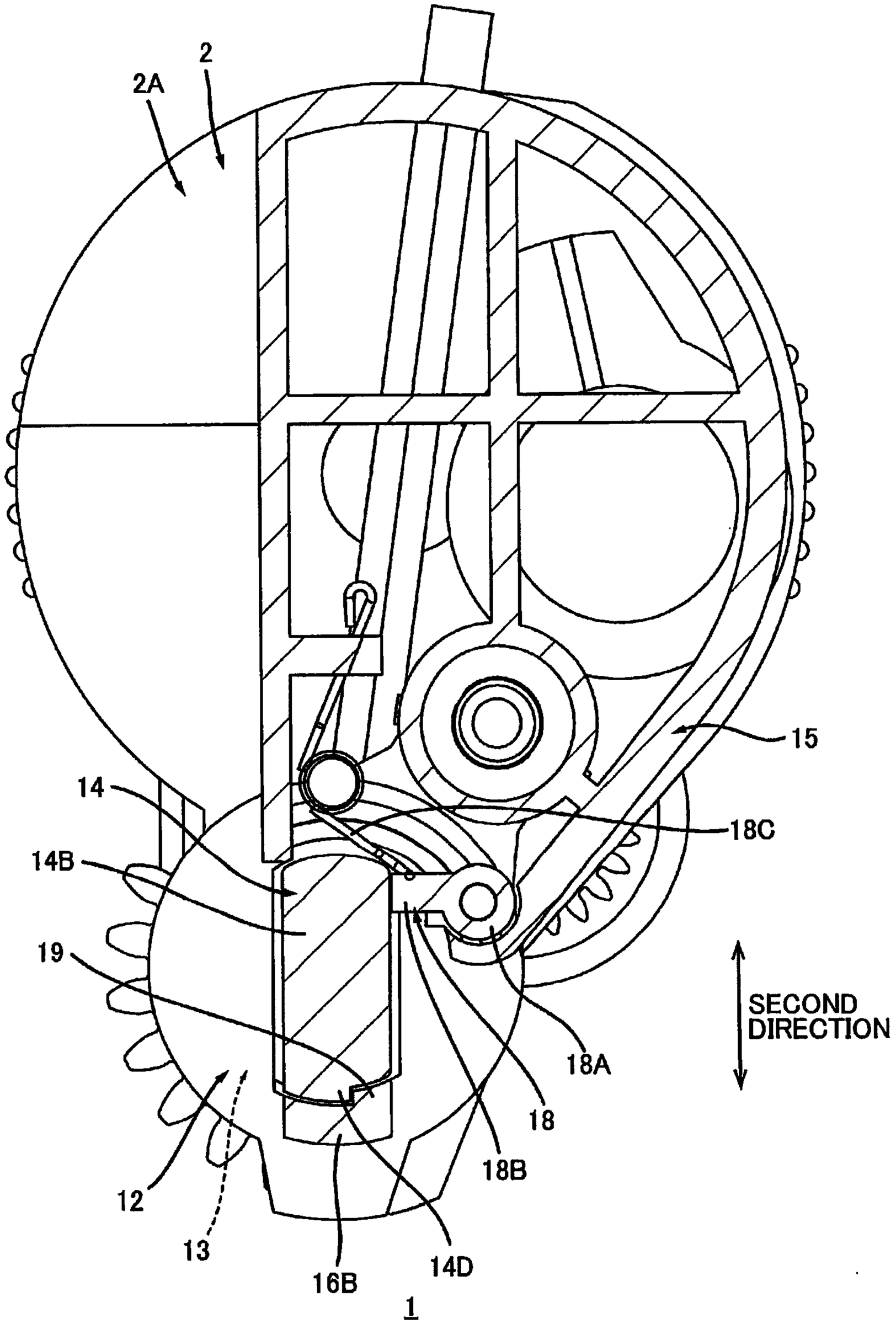

SECOND DIRECTION
5
16
14
12
4C
13D
2C
15
FIRST DIRECTION
2A
2
2B
1
21
23
6

FIG. 6B

FIG. 7



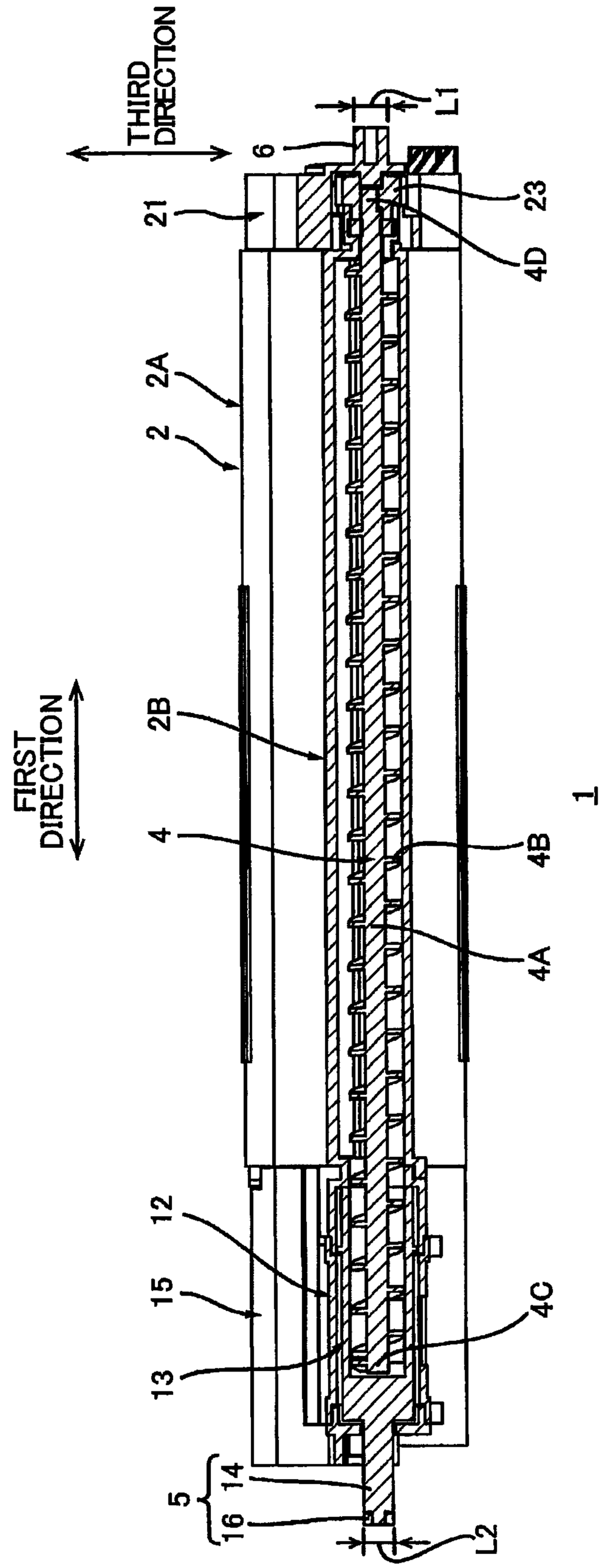

THIRD DIRECTION
L1
6
21
23
4D
2A
2
2B
FIRST DIRECTION
4
4B
4A
1
12
15
13
4C
5
14
16
L2

FIG. 8

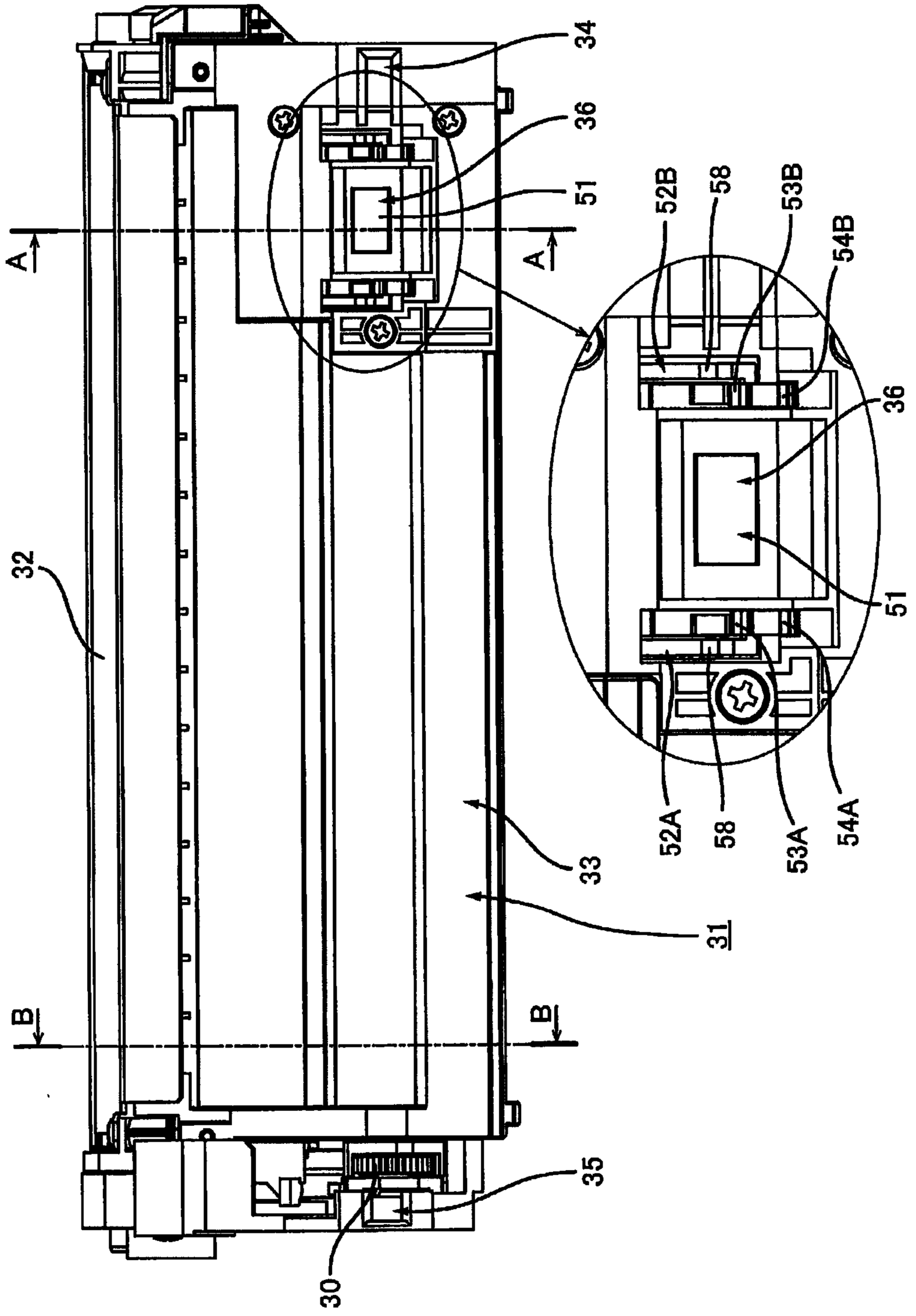


FIG. 9

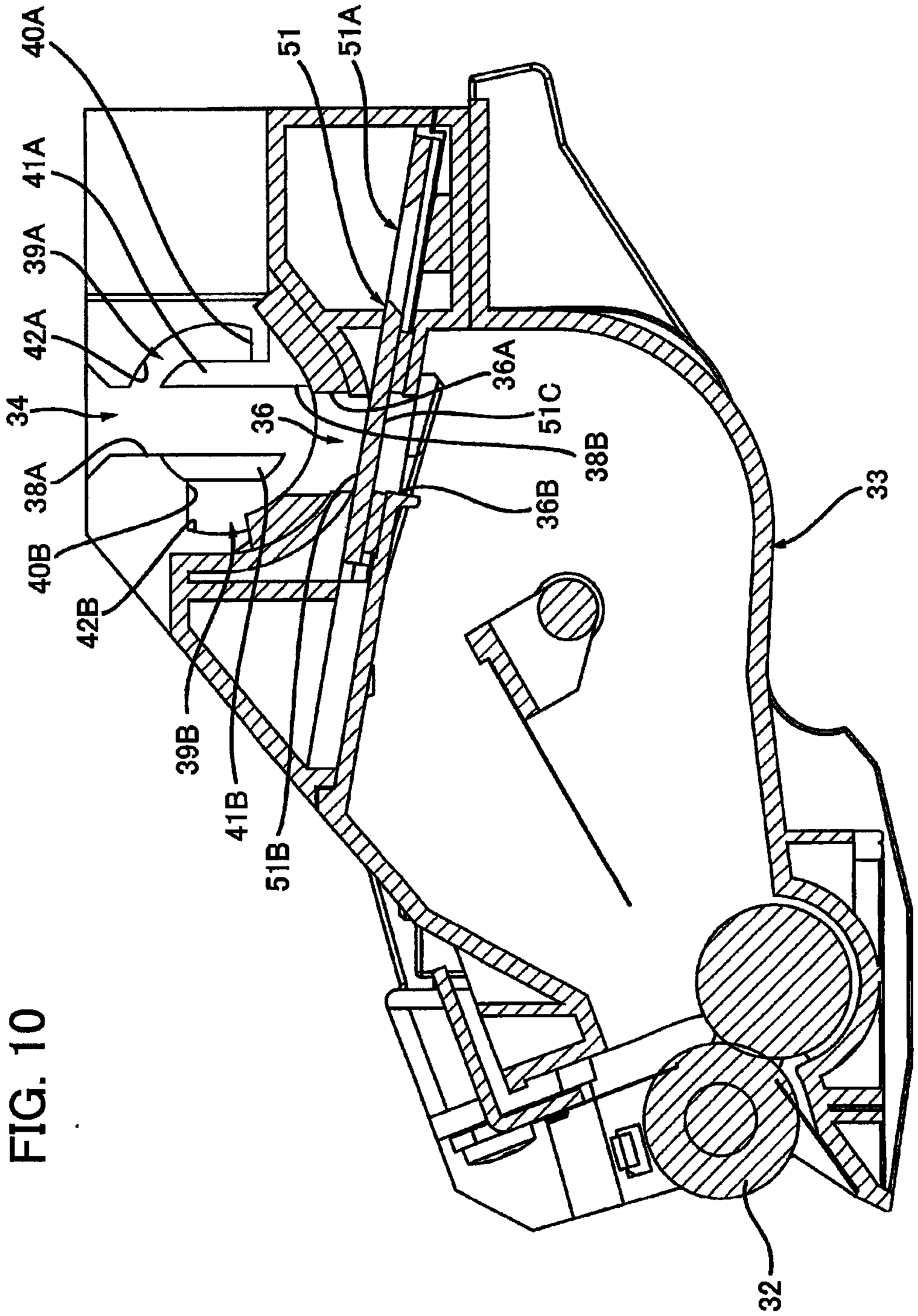

40A
51
51A
41A
39A
42A
34
36
36A
51C
38B
38A
36B
40B
42B
33
31
39B
41B
51B
32

FIG. 10

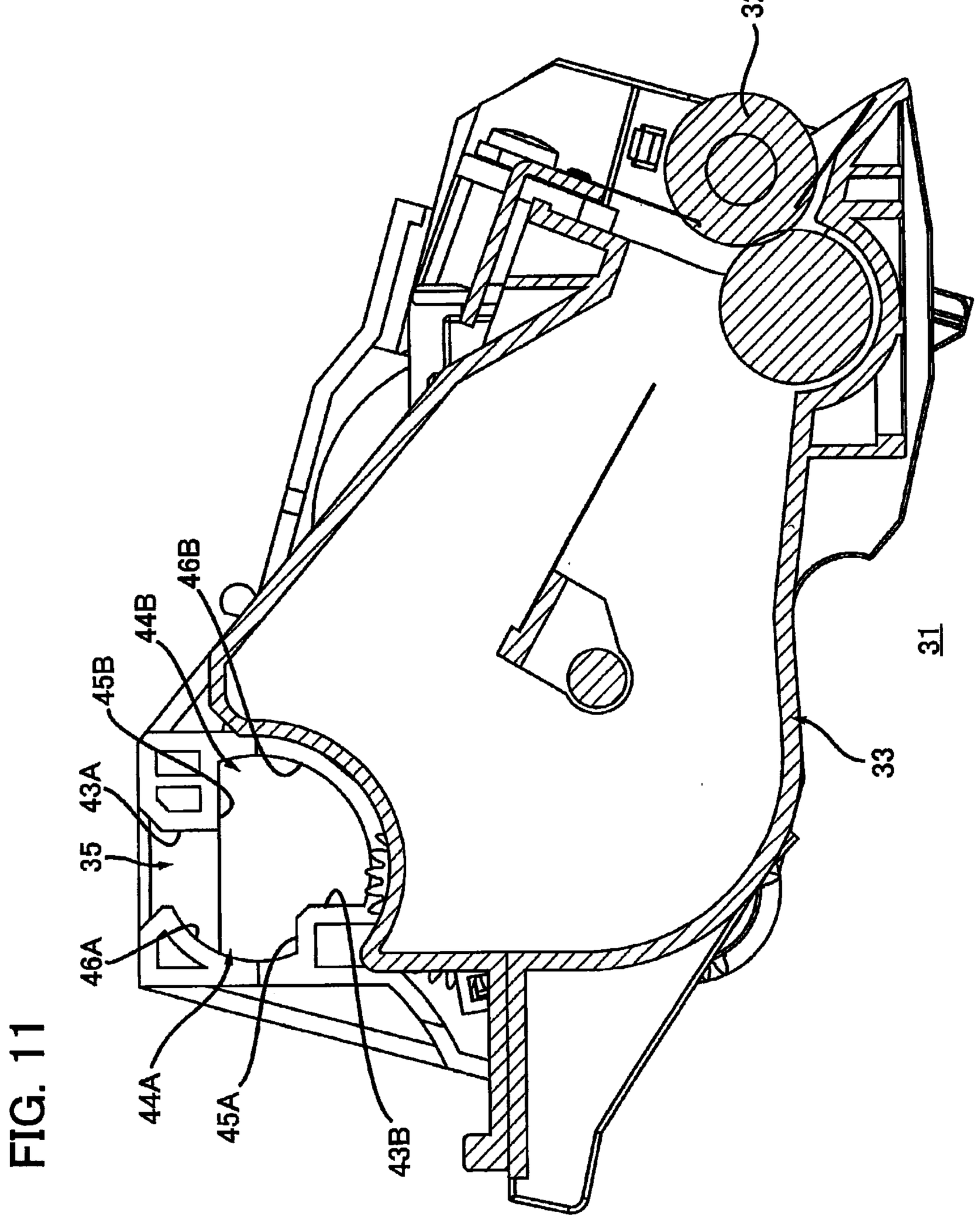


FIG. 11

FIG. 12

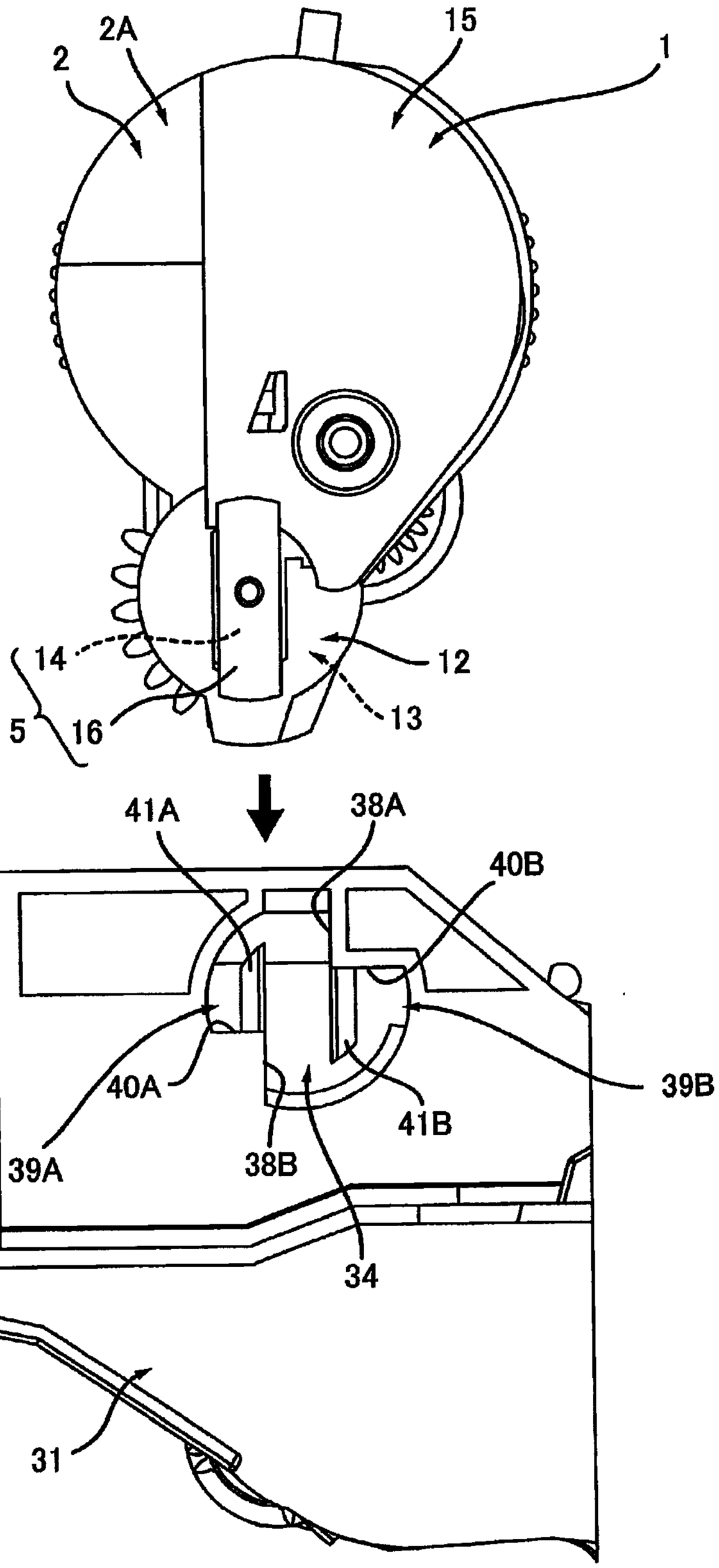


FIG. 13

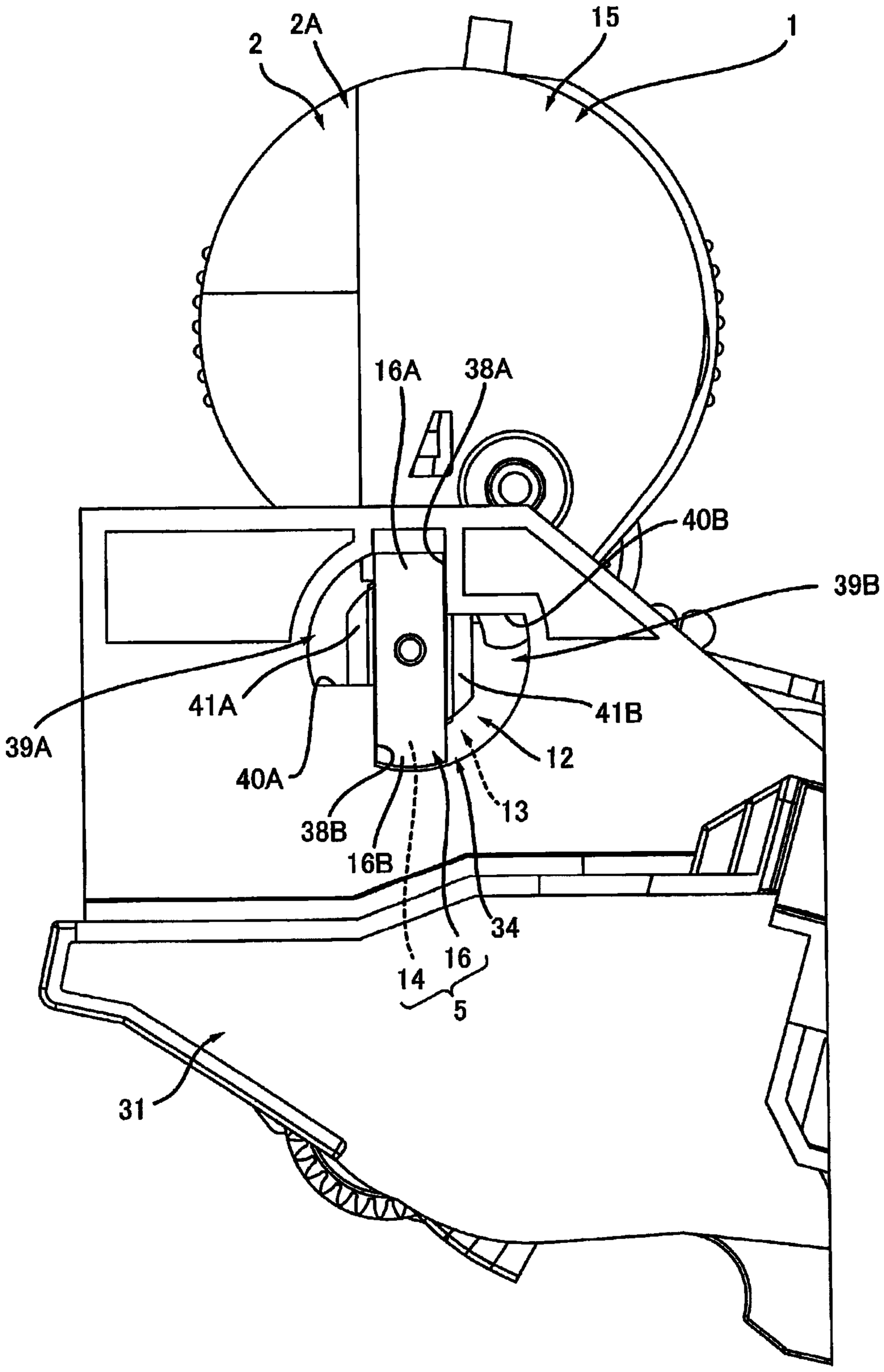


FIG. 14

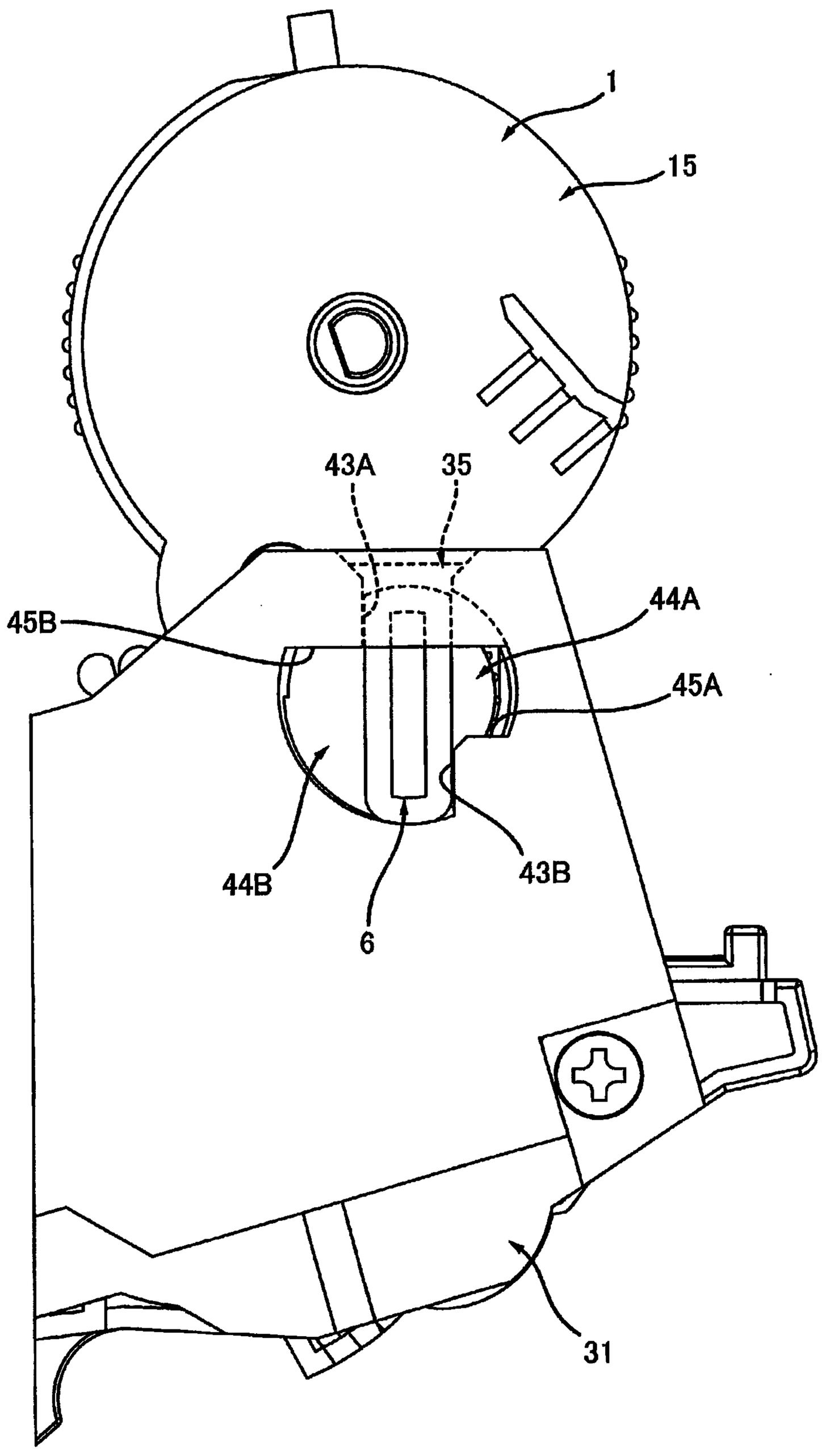


FIG. 15

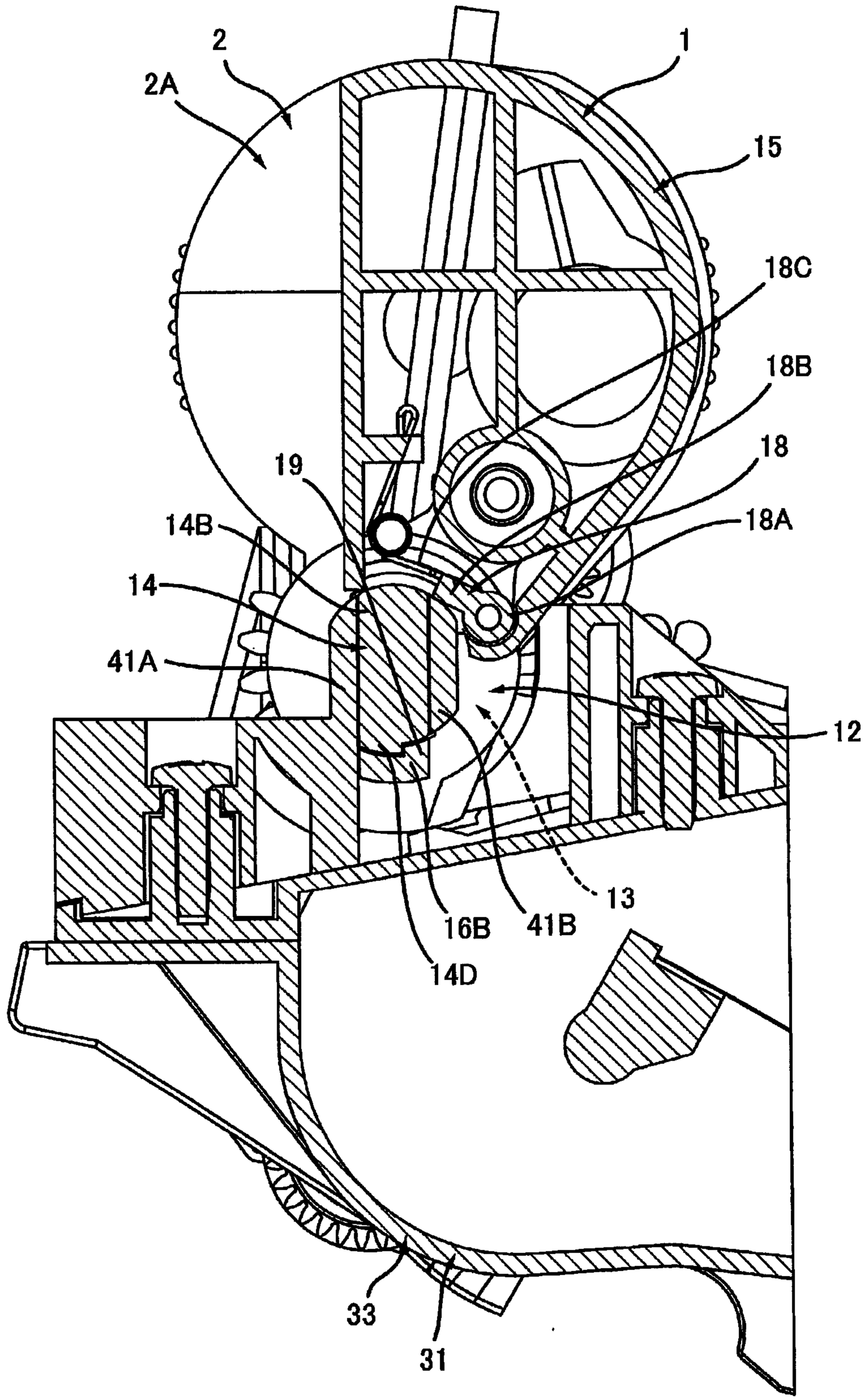


FIG. 16

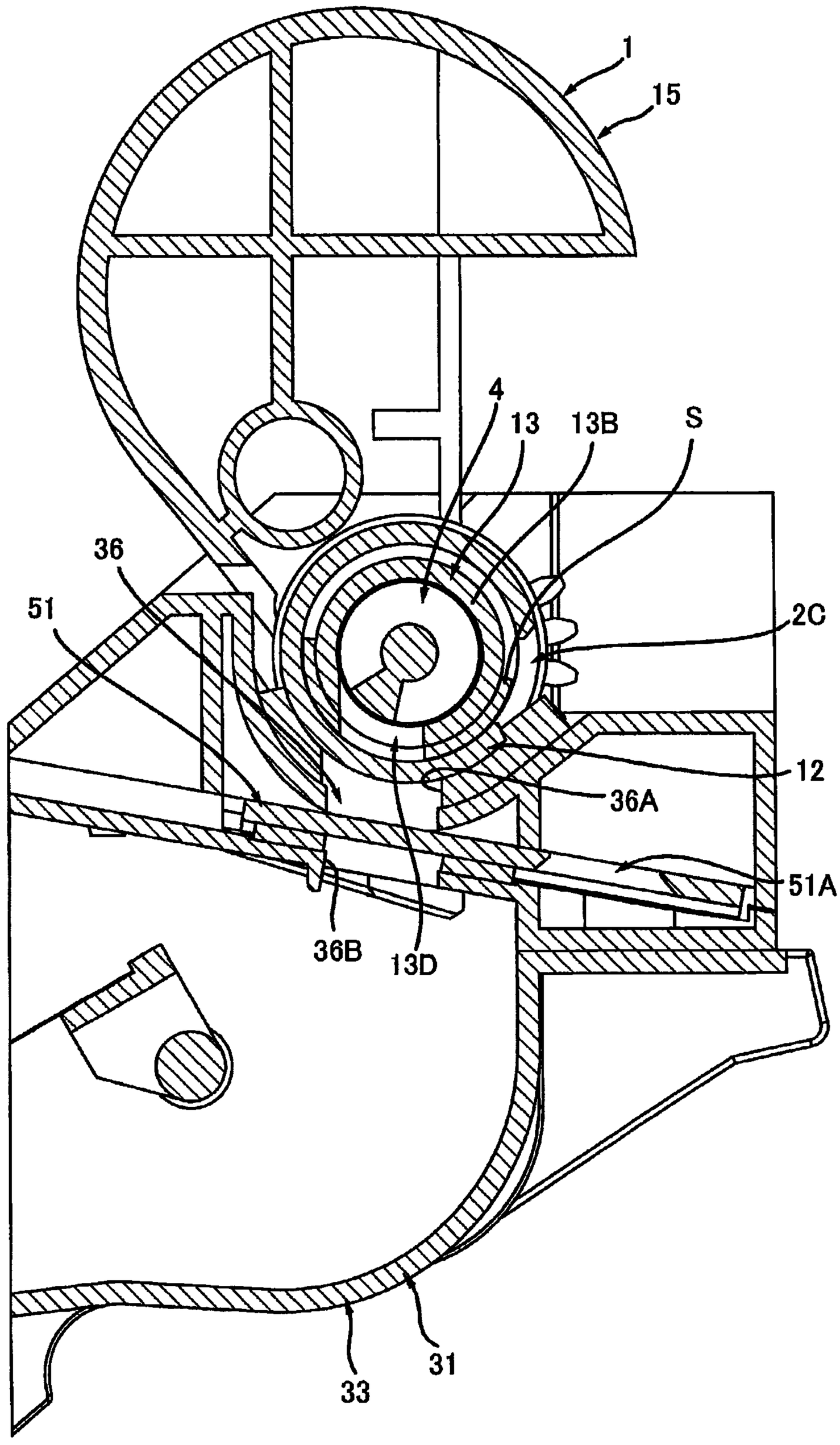


FIG. 17

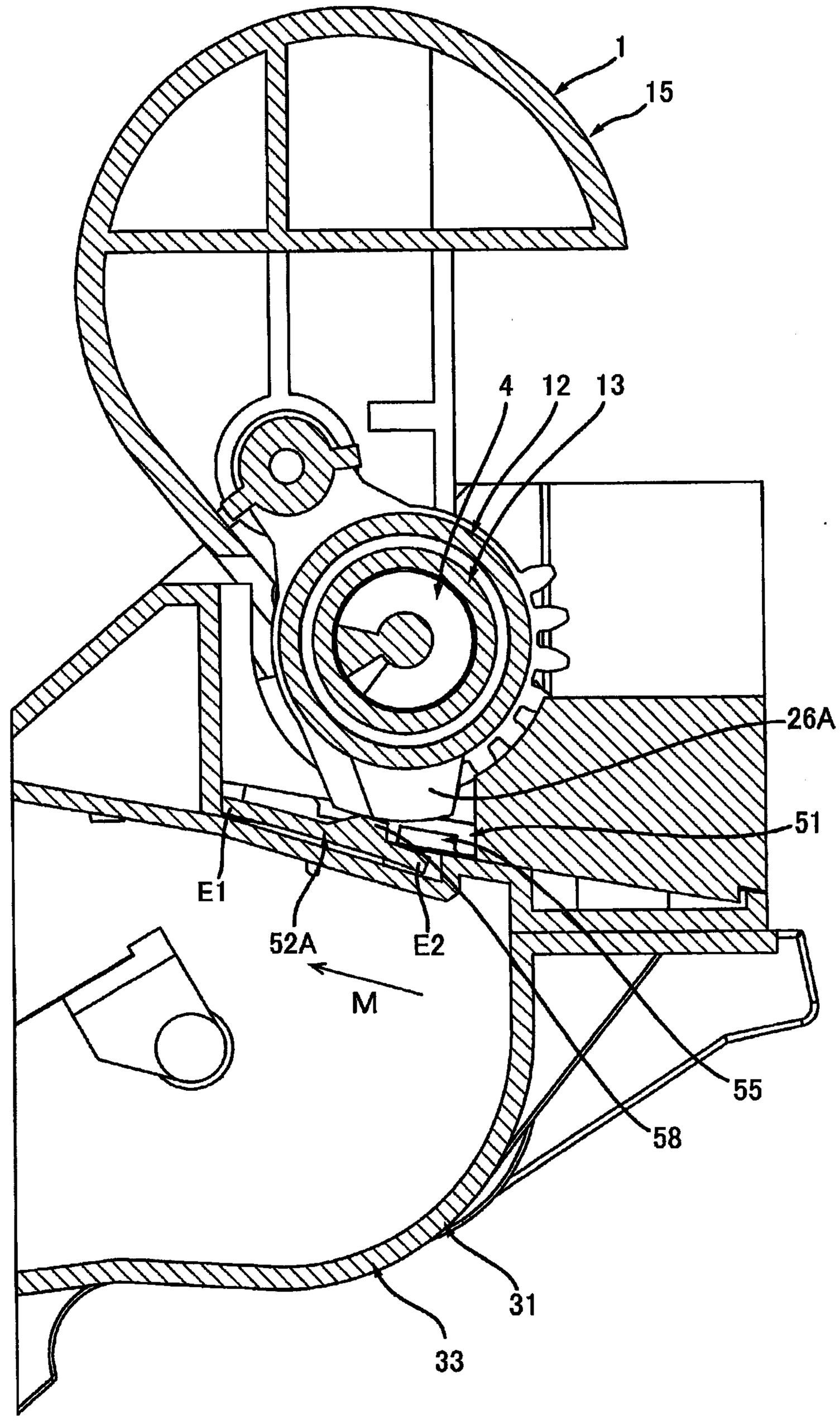


FIG. 18

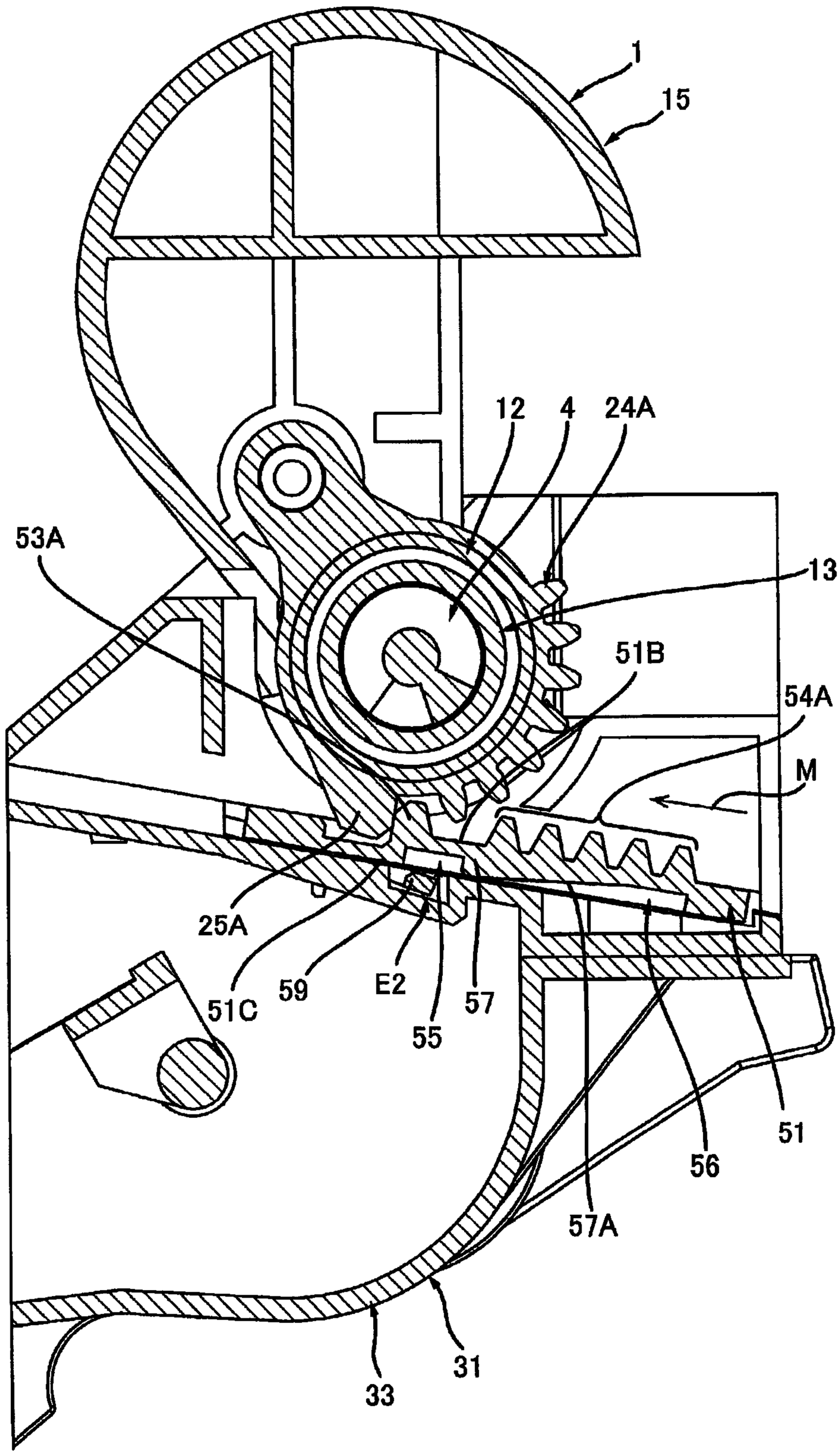


FIG. 19

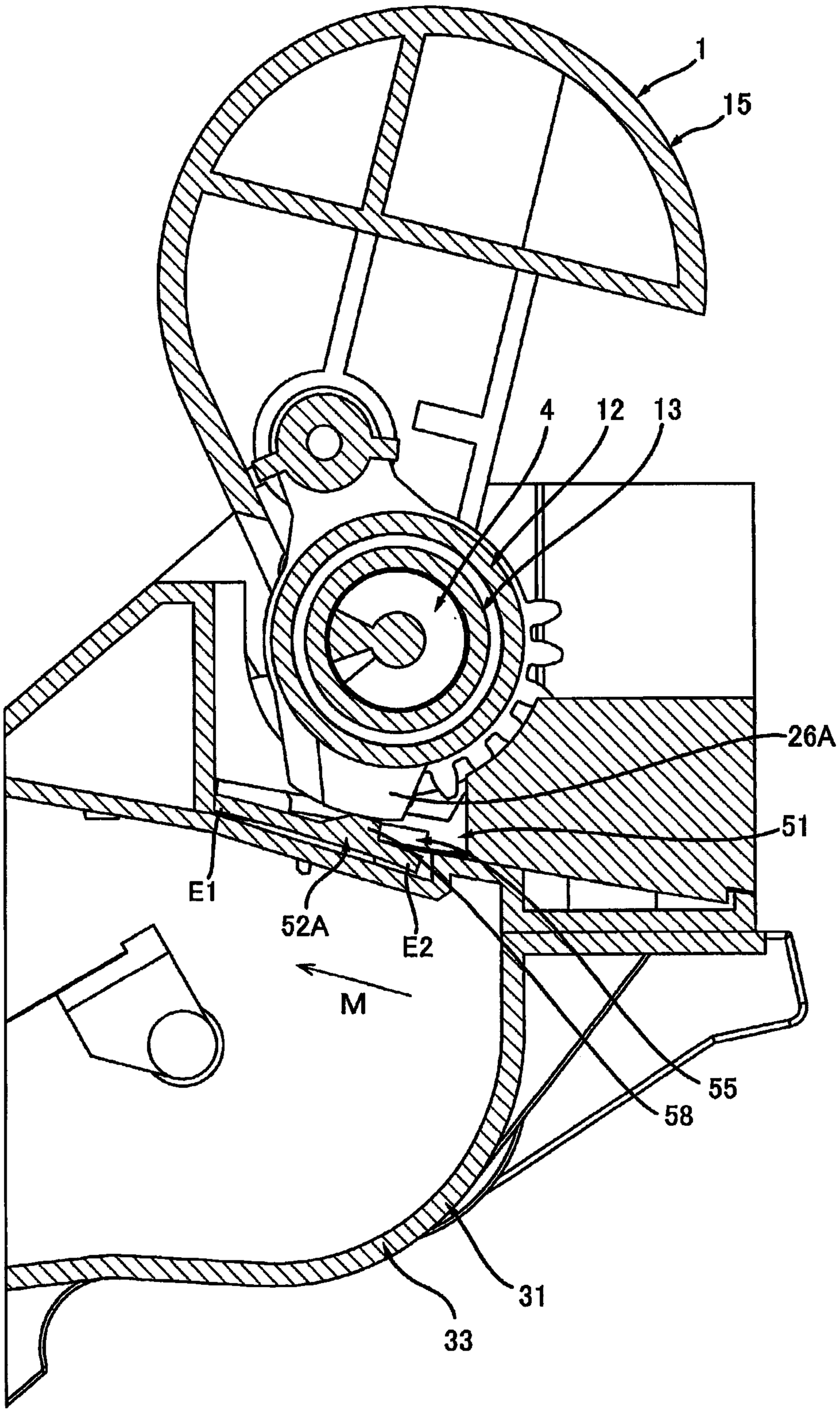


FIG. 20

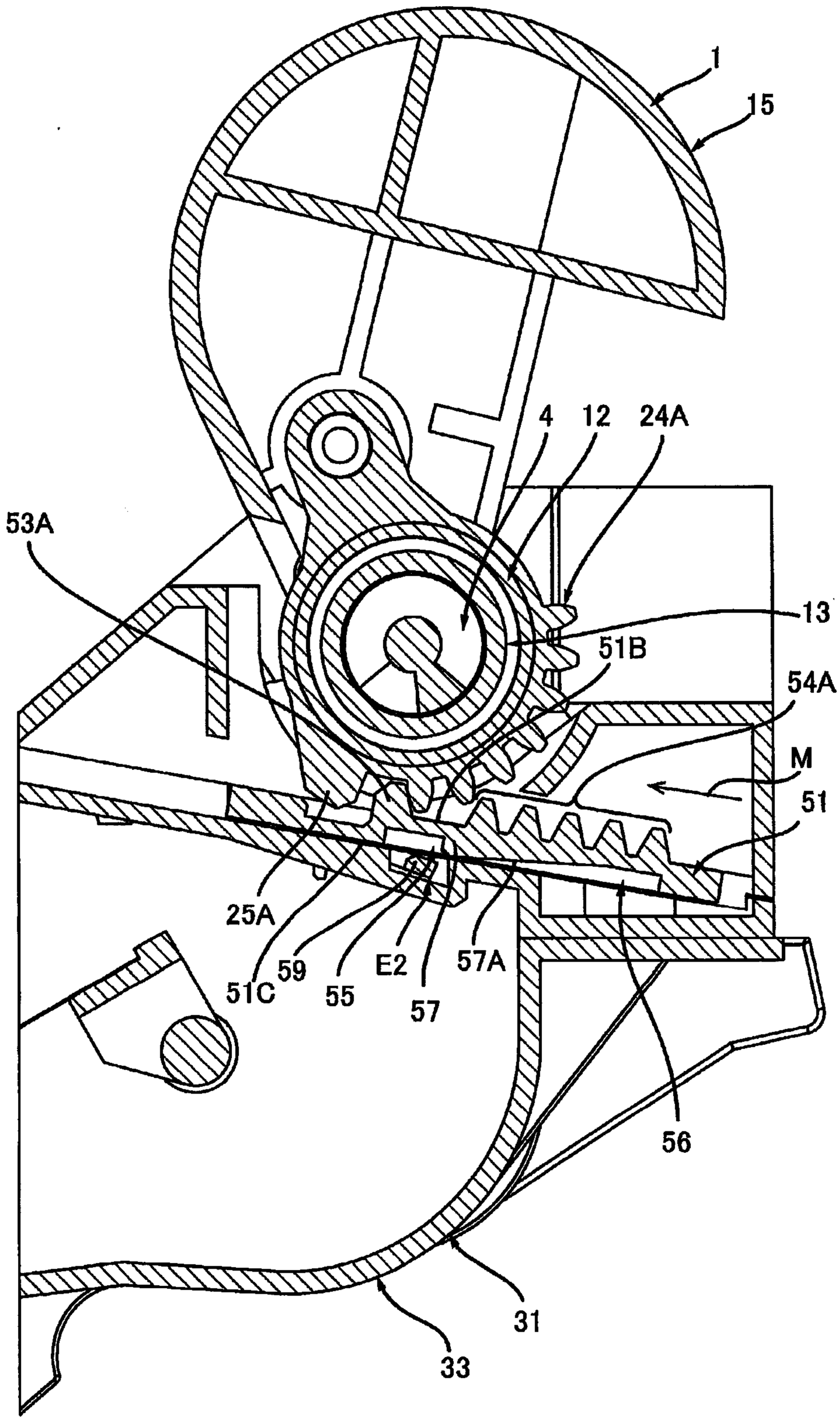


FIG. 21

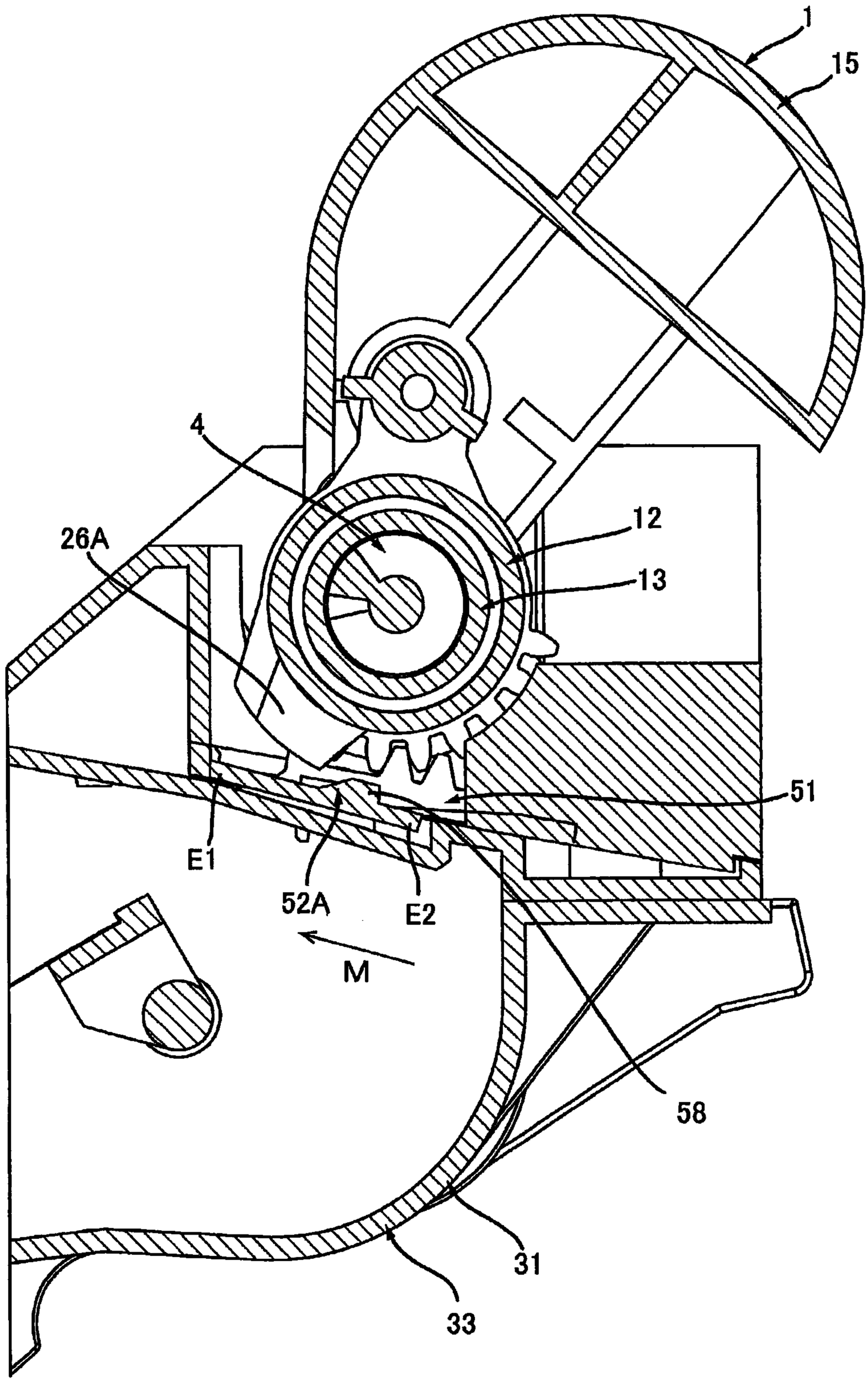


FIG. 22

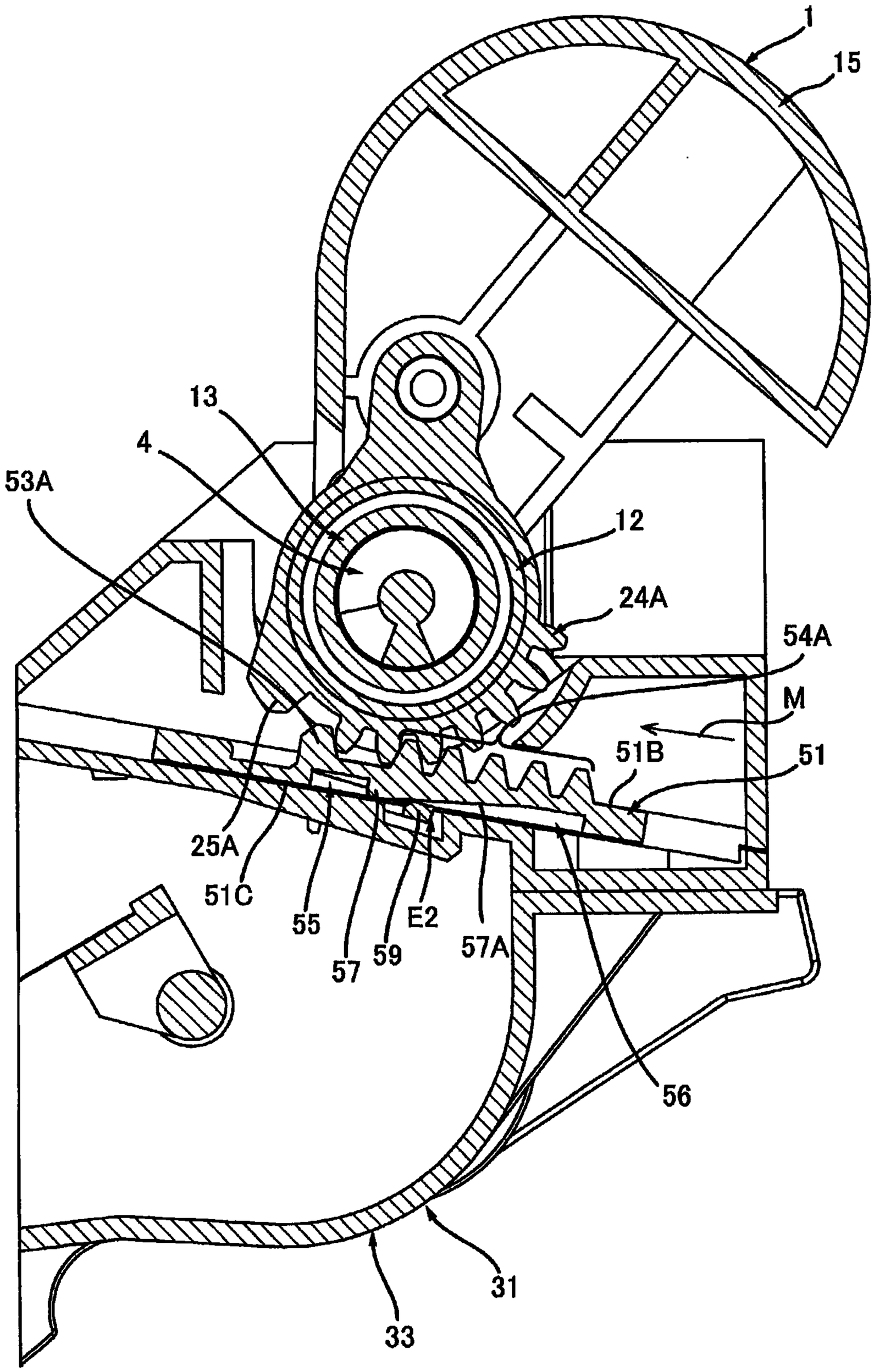


FIG. 23

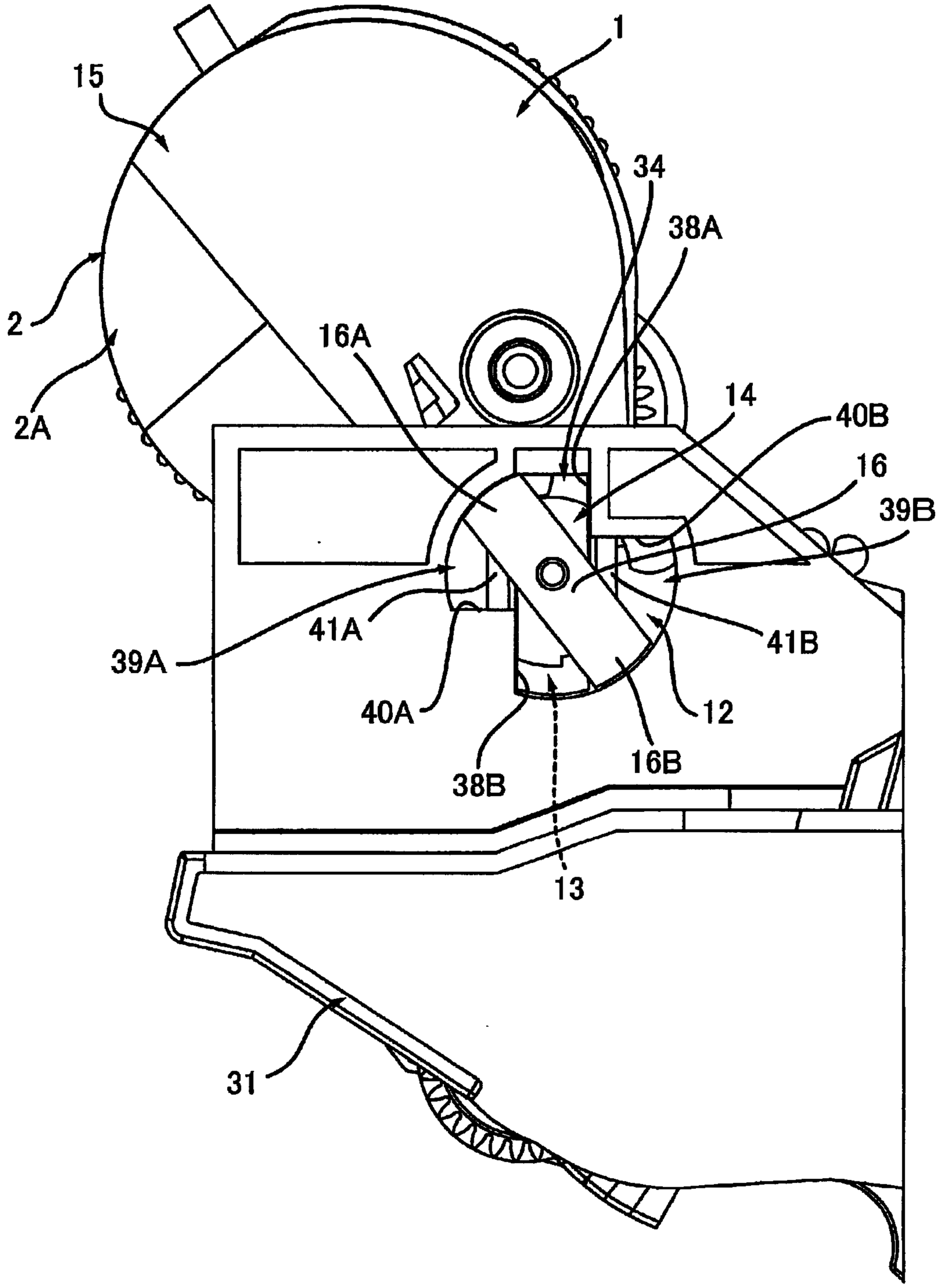


FIG. 24

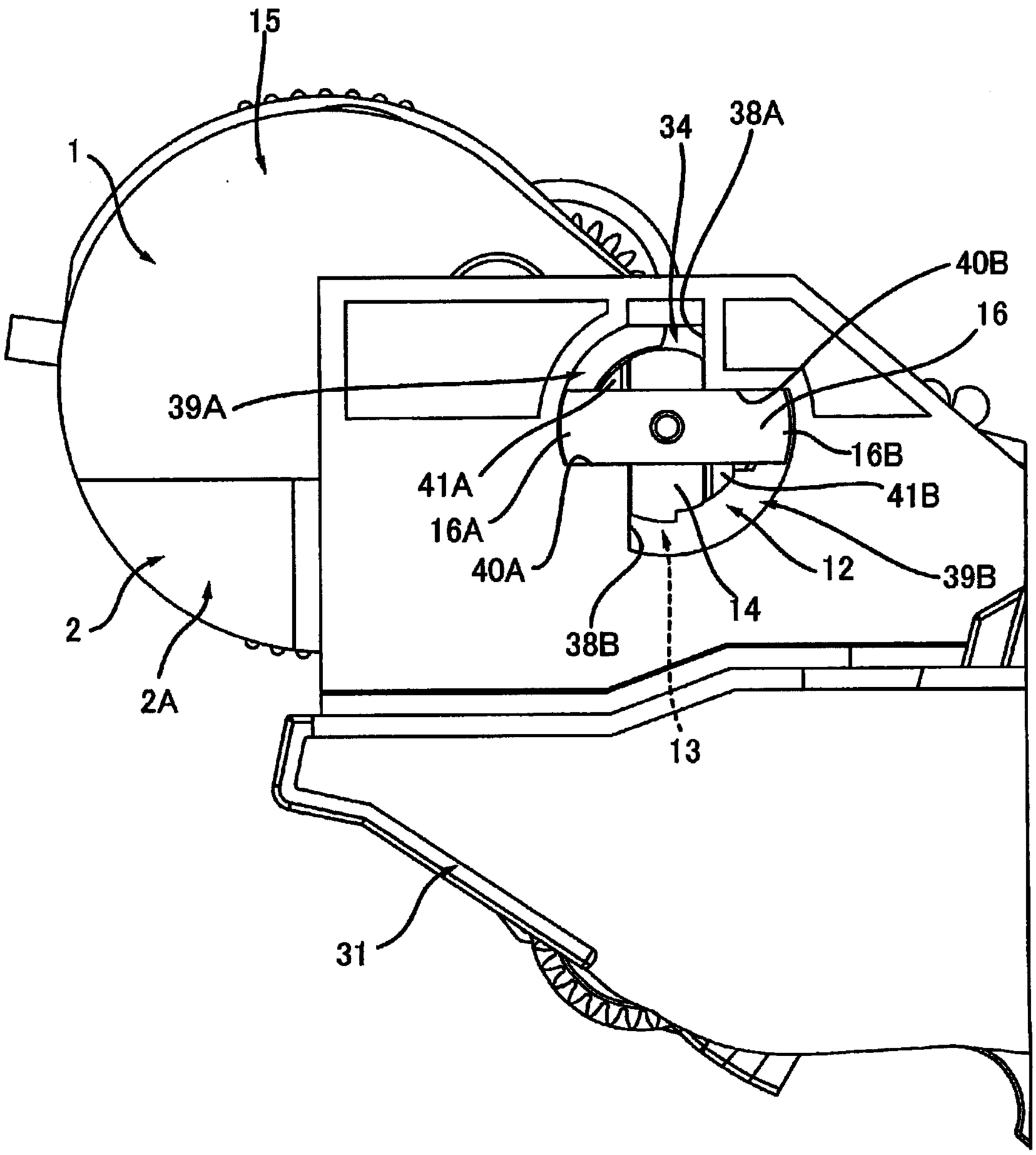


FIG. 25

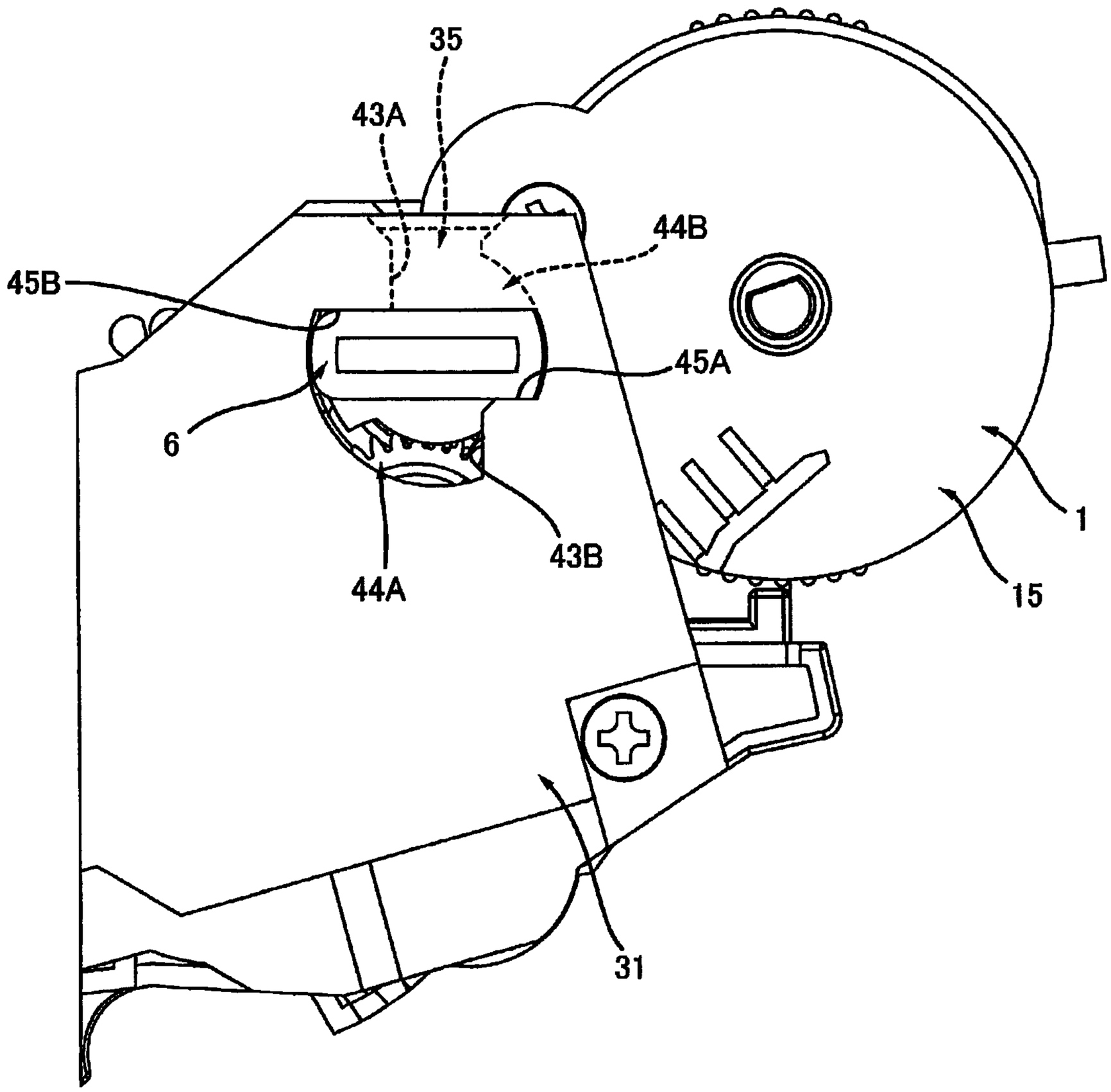


FIG. 26

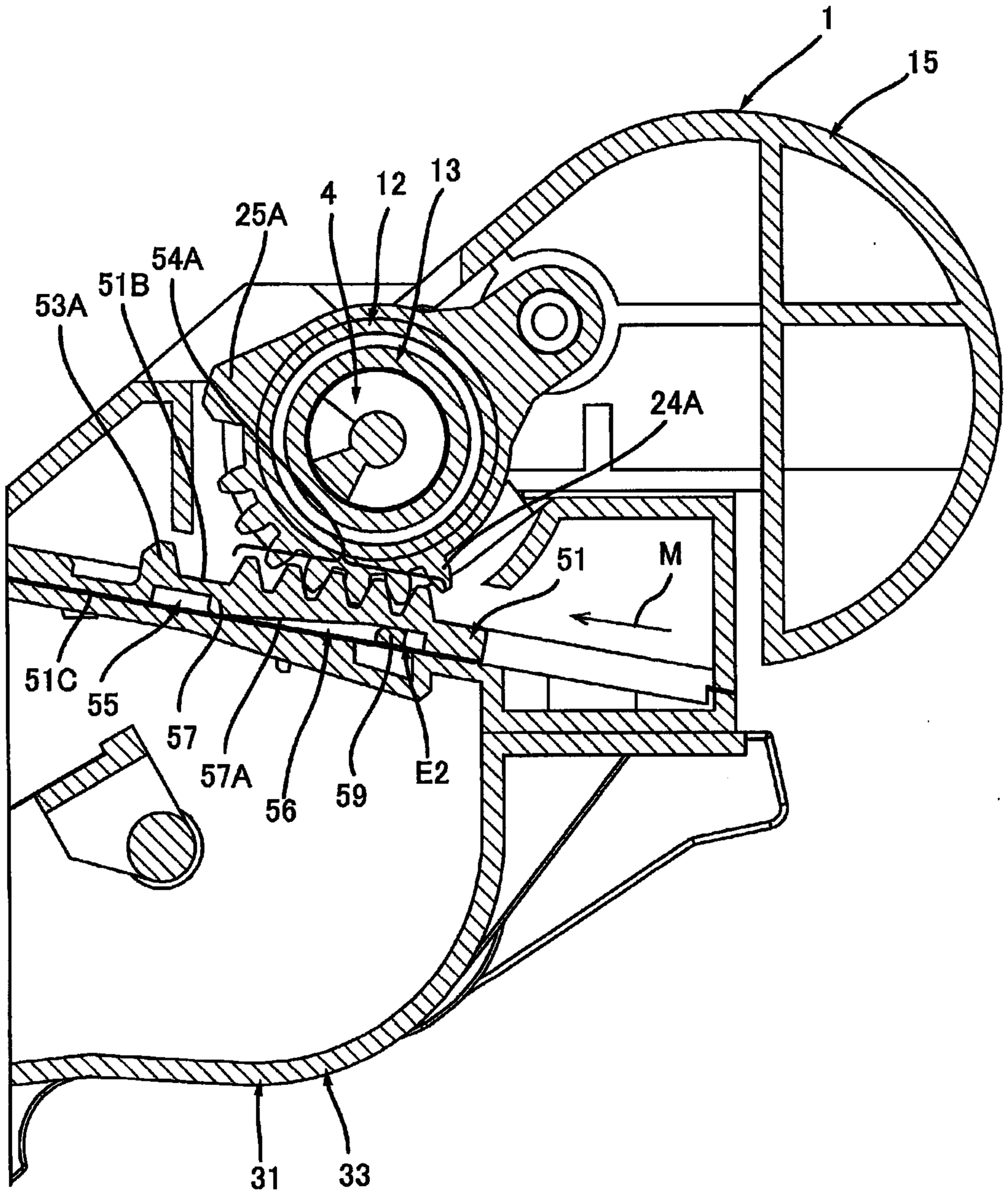
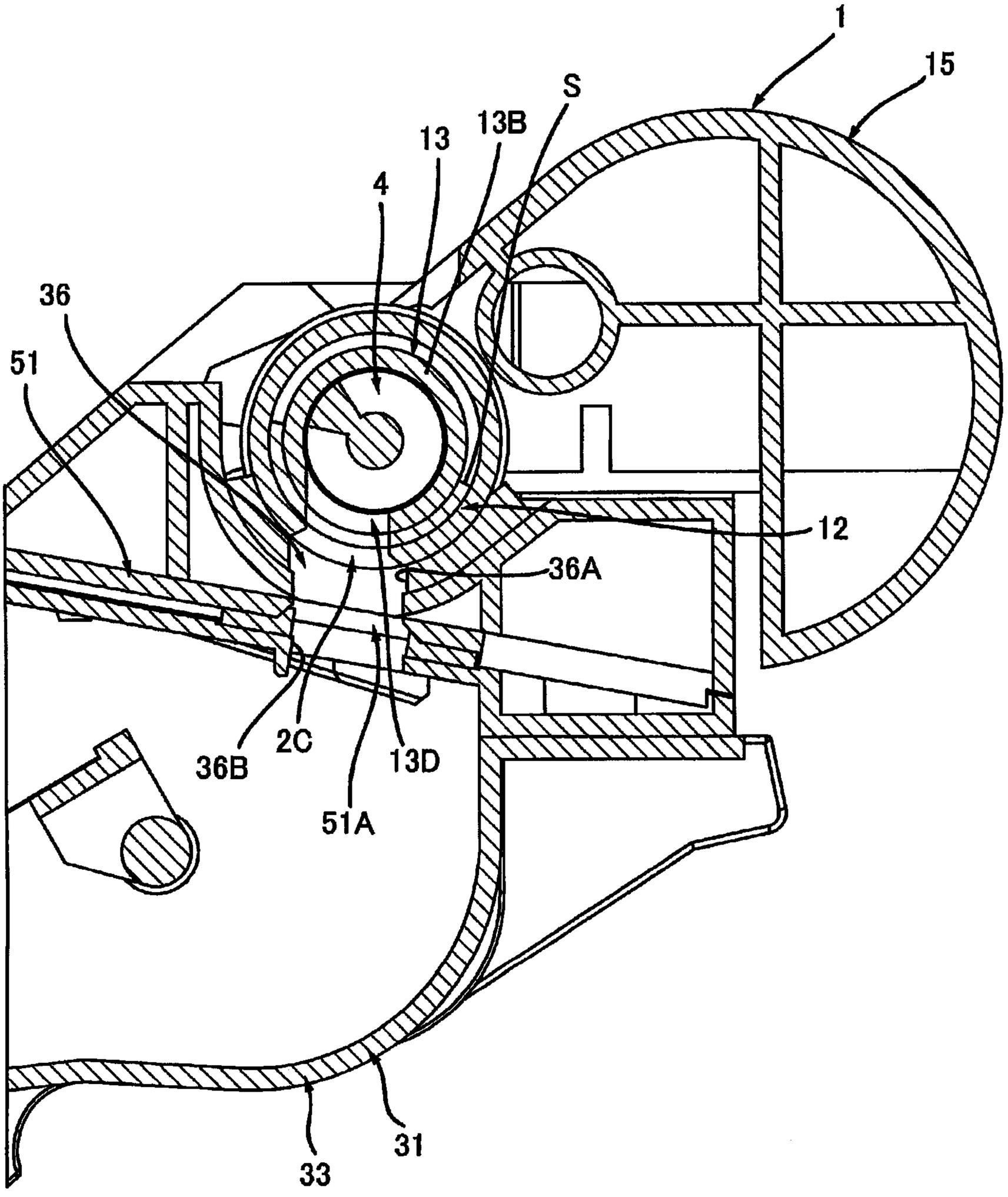
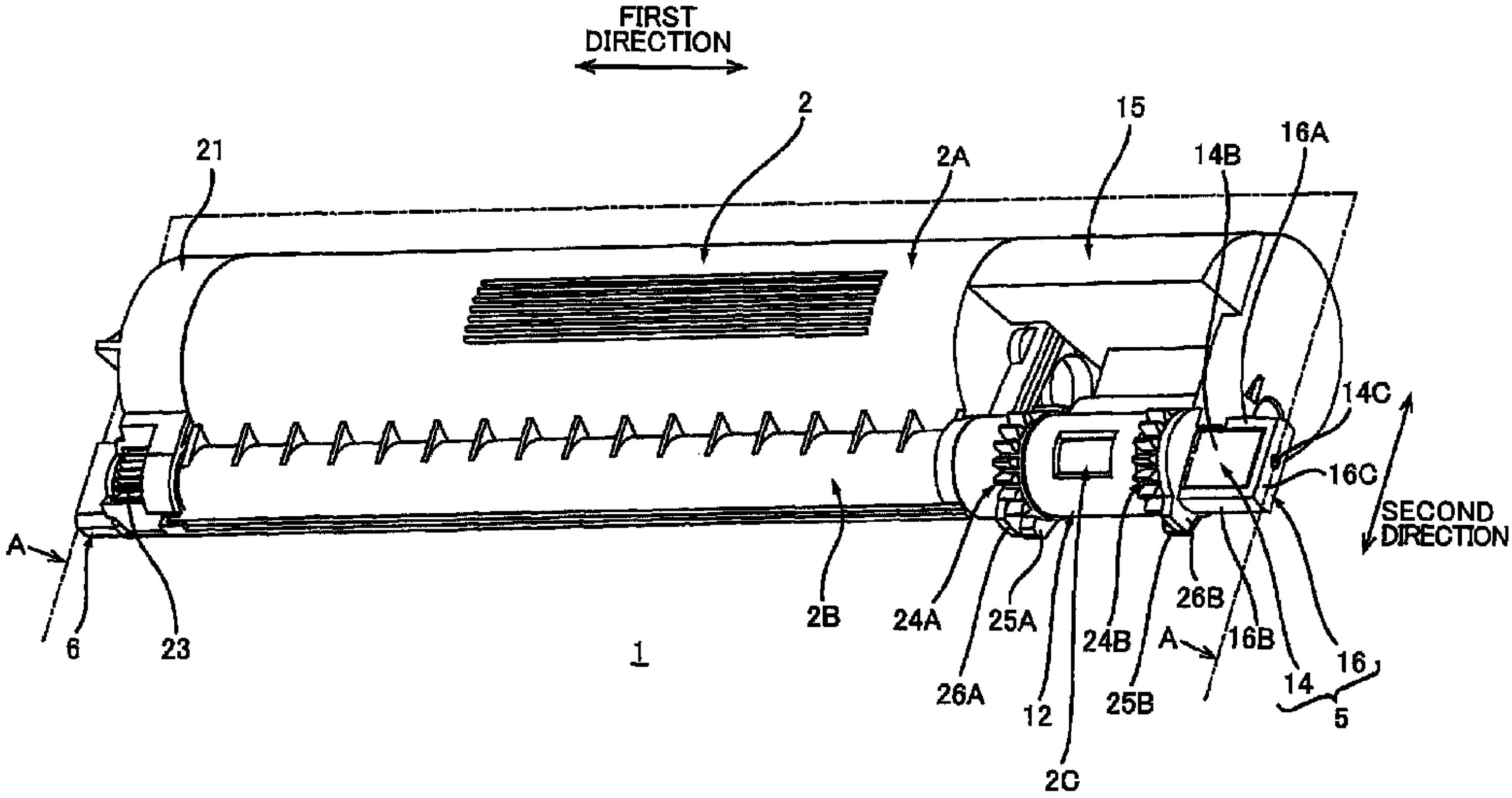


FIG. 27




FIRST
DIRECTION
2
15
21
2A
14B
16A
14C
16C
SECOND
DIRECTION
A
2B
24A
25A
26B
6
23
24B
A
16B
26A
12
25B
14
16
5
2C

1