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(71) Applicant: **HEWLETT-PACKARD DEVELOPMENT COMPANY, L.P.** [US/US]; 10300 Energy Drive, Spring, Texas 77389 (US).

(72) Inventor: **SUZUKAWA, Shinichiro**; 3-4-39, Tsurumi Chuo, Tsurumi-ku, Yokohama, Kanagawa 230-0051 (JP).

(74) Agent: **KO, Steve Sokbong** et al.; HP Inc., 3390 E. Harmony Road, Mailstop 35, Fort Collins, Colorado 80528 (US).

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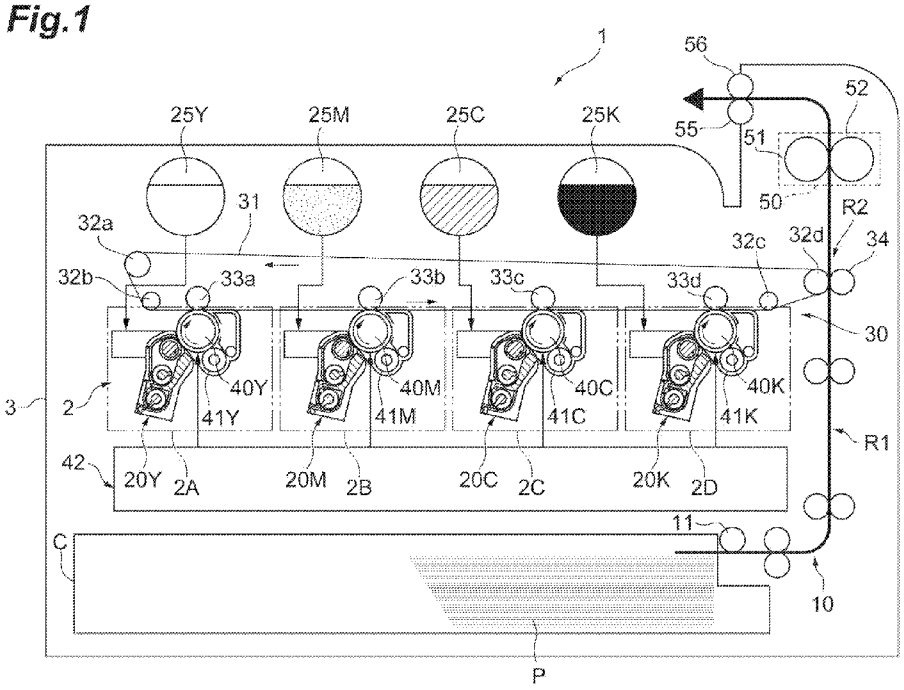
(54) Title: IMAGING SYSTEM WITH STOPPER FOR TONER CRUSHING DEVICE

Fig.1



(57) Abstract: A toner transfer device includes: a cylindrical body to supply a toner to a toner conveying device including a conveyor, in which the cylindrical body is detachably connected to the toner conveying device, a toner crushing member that is arranged inside the cylindrical body to crush the toner passing through the cylindrical body and to move in an axial direction of the cylindrical body, and a stopper that is positioned between the toner crushing member and the conveyor of the toner conveying device.

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Declarations under Rule 4.17:

— *as to the identity of the inventor (Rule 4.17(i))*
— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

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IMAGING SYSTEM WITH STOPPER FOR TONER CRUSHING DEVICE

BACKGROUND

[0001] Some imaging apparatuses include a toner cartridge, a developing device, and a toner transfer device that transfers a toner from the toner cartridge to the developing device. The toner transfer device includes a cylindrical body connected between the toner cartridge and the developing device and a toner crushing member arranged inside the cylindrical body. The toner crushing member is a coil spring inside the cylindrical body, that is expandable and contractable in an axial direction of the cylindrical body.

BRIEF DESCRIPTION OF DRAWINGS

[0002] FIG. 1 is a schematic view of an example imaging apparatus.

[0003] FIG. 2 is a cross-sectional view of an example toner transfer device, positioned between a toner cartridge and a developing device of the imaging apparatus of FIG. 1.

[0004] FIG. 3 is a partial view of FIG. 2, illustrating a portion of the developing device and a portion of the toner transfer device.

[0005] FIG. 4 is a partial cross-sectional perspective view of a second member of the toner transfer device illustrated in FIG. 3.

[0006] FIG. 5 is a perspective view illustrating a portion of the toner transfer device and a portion of the developing device of FIG. 3.

[0007] FIG. 6 is another perspective view of the toner transfer device and the developing device of FIG. 5, illustrating an example state where the second member is spaced away from the developing device.

[0008] FIG. 7 is a partial cross-sectional perspective view illustrating the toner transfer device and the developing device of FIG. 6, showing a toner crushing member in the toner transfer device.

[0009] FIG. 8 is a partial cross-sectional perspective view of the toner transfer device, illustrating an end of the example toner crushing member of FIG.

7 and a crank.

[0010] FIG. 9 is a side plan view illustrating an example toner crushing member.

[0011] FIG. 10 is a side plan view illustrating another example toner crushing member.

[0012] FIG. 11 is a side plan view illustrating another example toner crushing member.

[0013] FIG. 12 is a side plan view illustrating another example toner crushing member.

[0014] FIG. 13 is a side plan view illustrating another example toner crushing member.

[0015] FIG. 14 is a side plan view illustrating another example toner crushing member.

DETAILED DESCRIPTION

[0016] Hereinafter, various examples of a toner transfer device and an imaging apparatus will be described with reference to the drawings. In the following description, the same reference numbers are assigned to the same components or to similar components having the same function, and overlapping description is omitted. In addition, the drawings may be illustrated in a simplified or schematic manner, for ease of understanding.

[0017] An example imaging apparatus includes a toner cartridge that stores a toner, a toner conveying device that conveys the toner, and a toner transfer device that transfers the toner from the toner cartridge to the toner conveying device. The toner transfer device includes, for example, a cylindrical body, a toner crushing member (or toner crushing device) arranged inside the cylindrical body, and a stopper that prevents the toner crushing member from contacting a conveyor of the toner conveying device.

[0018] The toner crushing member crushes the toner passing through the cylindrical body, to suppress or inhibit aggregation of the toner. In some examples, the toner crushing member may move inside the cylindrical body in an axial

direction of the cylindrical body. The stopper is provided in an end portion on a toner conveying device side (an outlet end portion) of the cylindrical body and, for example, prevents the toner crushing member from contacting the conveyor in a position close to the toner conveying device, so that the toner crushing member can be brought closer to the toner conveyor.

[0019] With reference to FIG. 1, for example, an imaging apparatus 1 may uses yellow (Y), magenta (M), cyan (C), and black (K) colors to form a color image. The imaging apparatus 1 includes, for example, a recording medium conveying device 10, a transfer device 30, a fixing device 50, and first to fourth stations 2A, 2B, 2C, and 2D.

[0020] The example station 2A supplies a yellow toner, and includes a developing device 20Y and an image carrier 40Y. The example station 2B supplies a magenta toner, and includes a developing device 20M and an image carrier 40M. The example station 2C supplies a cyan toner, and includes a developing device 20C and an image carrier 40C. The example station 2D supplies a black toner, and includes a developing device 20K and an image carrier 40K. The image carriers 40Y, 40M, 40C, and 40K may be, for example, photoconductors (e.g., photoconductor drums).

[0021] The recording medium conveying device 10 may convey a print medium P. The recording medium conveying device 10 includes, for example, a paper feeding roller 11 that conveys the print medium P, on which an image is to be formed, along a conveying path R1. The print mediums P are stacked and accommodated in a cassette C and are picked up and conveyed by the paper feeding roller 11. The recording medium conveying device 10 conveys the print medium P to reach a secondary transfer region R2 along the conveying path R1 at a timing when the toner image to be transferred reaches the secondary transfer region R2.

[0022] The transfer device 30 transfers the toner image onto the print medium P. Subsequently, the fixing device 50 fixes the toner image onto the print medium P. The transfer device 30 includes, as one example, a transfer belt 31, suspension rollers 32a, 32b, 32c, and 32d, primary transfer rollers 33a, 33b, 33c, and 33d, and a secondary transfer roller 34. The transfer belt 31 may be

suspended or supported on the suspension rollers 32a to 32d. The primary transfer rollers 33a to 33d may be positioned to align with the stations 2A to 2D, respectively. The transfer belt 31 is interposed between the primary transfer rollers 33a to 33d and the image carriers 40Y, 40M, 40C, and 40K of the stations 2A to 2D. The transfer belt 31 is additionally interposed between the secondary transfer roller 34 and the suspension roller 32d.

[0023] According to an example, the first station 2A, the second station 2B, the third station 2C, and the fourth station 2D are process cartridges 2 that include the developing devices 20Y, 20M, 20C, and 20K, the image carriers 40Y, 40M, 40C, and 40K, and charging members 41Y, 41M, 41C, and 41K. For example, each of the

[0024] For example, the imaging apparatus 1 includes a housing 3 in which the first to fourth stations 2A to 2D are installed. For example, each of the first to fourth stations 2A to 2D is attachable to and removable from the housing 3. For example, a door of the housing 3 may be opened in order to insert or remove any of the first to fourth stations 2A to 2D, into or from the housing 3.

[0025] In the first to fourth stations 2A to 2D, the image carriers 40Y, 40M, 40C, and 40K form electrostatic latent images and the developing devices 20Y, 20M, 20C, and 20K develop the electrostatic latent images formed on the respective image carriers 40Y, 40M, 40C, and 40K. The charging members 41Y, 41M, 41C, and 41K face outer peripheral surfaces of the respective image carriers 40Y, 40M, 40C, and 40K.

[0026] The charging members 41Y, 41M, 41C, and 41K charge the outer peripheral surfaces of the respective image carriers 40Y, 40M, 40C, and 40K, to a predetermined electrostatic potential. Additionally, an exposure unit 42 exposes the outer peripheral surfaces of the image carriers 40Y, 40M, 40C, and 40K to laser light, according to an image to be formed on the print medium P, the outer peripheral surface is charged by the charging members 41Y, 41M, 41C, and 41K. The electrostatic potential of respective portions of the outer peripheral surfaces of the image carriers 40Y, 40M, 40C, and 40K are exposed to light by the exposure unit 42 according to the image to be formed on the print medium P, so that the electrostatic latent images are formed on the outer peripheral surfaces of

the respective image carriers 40Y, 40M, 40C, and 40K.

[0027] According to examples, the first to fourth stations 2A to 2D are arranged to face toner cartridges 25Y, 25M, 25C, and 25K, respectively. The toners of the four colors are transferred from the respective toner cartridges 25Y, 25M, 25C, and 25K to the developing devices 20Y, 20M, 20C, and 20K, respectively, of the first to fourth stations 2A to 2D.

[0028] Accordingly, developing devices 20Y, 20M, 20C, and 20K develop the respective electrostatic latent images on the outer peripheral surfaces of the image carriers 40Y, 40M, 40C, and 40K with the supplied toners to form the respective toner images. Subsequently, the toner images formed on the outer peripheral surfaces of the image carriers 40Y, 40M, 40C, and 40K are primarily transferred onto the transfer belt 31. Additionally, the toner images are layered on the transfer belt 31 to form a single composite toner image, which is secondarily transferred from the transfer belt 31 to the print medium at the secondary transfer region R2.

[0029] According to examples, the fixing device 50 fuses and fixes the composite toner image onto the print medium P. The fixing device 50 may include a heating belt 51 that heats the print medium P and fixes the toner image onto the print medium P, and a pressure roller 52 that presses the heating belt 51. A nip portion that is a fixing region is provided between the heating belt 51 and the pressure roller 52. As one example, the imaging apparatus 1 may include output rollers 55 and 56 positioned downstream of the fixing device 50 in the conveying path of the print medium P, to convey the print medium P including the fixed toner image, to the outside the imaging apparatus 1.

[0030] FIG. 2 is a cross-sectional view of an example toner transfer device 60 that connects the toner cartridges 25Y, 25M, 25C, and 25K and the developing devices 20Y, 20M, 20C, and 20K, respectively. In the following description, a toner cartridge 25 refers to any one of the toner cartridges 25Y, 25M, 25C, and 25K when describing features that are common to each of the toner cartridges 25Y, 25M, 25C, and 25Kand a developing device 20 refers to a corresponding one of the developing devices 20Y, 20M, 20C, and 20K when describing features that are common to each of the developing devices 20Y, 20M, 20C, and 20K.

[0031] The toner cartridge 25 is provided, for example, above (e.g., directly above, in a vertical direction) the developing device 20, and the toner transfer device 60 extends between the toner cartridge 25 and the developing device 20 in an upward and downward direction (e.g., in the vertical direction). However, the position of the toner cartridge 25 with respect to the developing device 20 and the extending direction of the toner transfer device 60 are not limited to the above-described example. For example, the toner cartridge 25 and the developing device 20 may be positioned such that the toner transfer device 60 extends therebetween, obliquely in some examples, or in a horizontal direction in other examples.

[0032] The developing device 20 is one type of a toner conveying device including a conveyor 21 that conveys a toner. According to the present disclosure, the toner transfer device may be positioned adjacent a conveyor that is in device different from a developing device. Namely, the toner conveying device may refer to a toner conveying device that convey a waste toner scraped off from the image carrier such as a photoconductor according to some examples, or to a waste toner conveying device that conveys a toner having fallen from the transfer device according to other examples, and may include various other devices to convey a toner.

[0033] The developing device 20 includes, for example, the conveyor 21 and a housing 22 that accommodates the conveyor 21. As one example, the conveyor 21 includes a conveying auger that supplies the toner as a developer to a developing roller of the developing device 20. The example conveyor 21 includes a rotary shaft 21b and a helical blade 21c that protrudes helically from the rotary shaft 21b.

[0034] In some examples, the conveyor 21 conveys the toner inside the housing 22, which is supplied from the toner transfer device 60, in a direction D1. The direction D1 may define an axial direction (longitudinal direction) of the conveyor 21. The rotary shaft 21b may be rotated by a drive device so as to convey the toner in the direction D1 by the rotation of the helical blade 21c.

[0035] According to examples, the housing 22 accommodates the conveyor 21 and the toner. As one example, the housing 22 includes a protrusion

portion 22b to which the toner transfer device 60 is connected. The example protrusion portion 22b has a cylindrical shape that protrudes toward the toner cartridge 25 (for example, at an upper side of the developing device 20 in FIG. 2). A part of the toner transfer device 60 is inserted into the portion 22b, so that the toner transfer device 60 is connected to the developing device 20.

[0036] The toner transfer device 60 is provided, for example, between the toner cartridge 25 and the developing device 20 to convey the toner from the toner cartridge 25 to the developing device 20. The example toner transfer device 60 includes a cylindrical body 61 that supplies the toner to the developing device 20, a toner crushing member (or toner crushing device) 62 including a spring 62b that is arranged inside the cylindrical body 61 to crush the toner passing through the cylindrical body 61, and a crank 63 that moves the toner crushing member 62 inside the cylindrical body 61 along an axial direction D2 of the cylindrical body 61. As one example, the spring 62b may be a coil spring having helical windings.

[0037] The cylindrical body 61 is molded by, for example, resin molding. As one example, the cylindrical body 61 is a rigid body. The cylindrical body 61 includes a first member 71 positioned upstream of the conveying path of the toner in the toner transfer device 60, and a second member 72 positioned downstream of the conveying path of the toner in the toner transfer device 60. In some examples, the second member 72 is movably connected to the first member 71 and is detachably connected (or detachably coupled) to the developing device 20. In some examples, the first member 71 includes an accommodating portion 71b that accommodates the crank 63, and a cylindrical portion 71c that extends from the accommodating portion 71b toward the second member 72.

[0038] The accommodating portion 71b may be fixed to the toner cartridge 25. The accommodating portion 71b forms a widening arc shaped cross-section above the cylindrical portion 71c, and the crank 63 that rotates along a circumferential direction D3 is accommodated in the accommodating portion 71b. The crank 63 includes a body portion 63b that rotates along the circumferential direction D3, and a support portion 63c that supports the toner crushing member (or device) 62. The support portion 63c is a projection on the body portion 63b and the toner crushing member 62 is hooked and supported on the projection.

[0039] FIG. 3 illustrates a portion of the cross-section view of FIG. 2, including a lower end of the cylindrical portion 71c of the first member 71 of the cylindrical body 61, the second member 72 of the cylindrical body 61, the toner transfer device 60, and a portion of the developing device 20. As illustrated in FIGS. 2 and 3, the second member 72 includes, for example, a connection portion 72b connected to the developing device 20 and a cylindrical portion 72c extending from the connection portion 72b to a first member 71 side.

[0040] For example, the connection portion 72b includes an insertion portion 72d that is inserted into the protrusion portion 22b of the housing 22 of the developing device 20, a flange portion 72f placed on a protrusion end 22d of the protrusion portion 22b, and a stopper 80 that prevents the toner crushing member 62 from contacting the conveyor 21 (helical blade 21c). The insertion portion 72d has, for example, a cylindrical shape and the stopper 80 has a hole 85 that supplies the toner to the developing device 20.

[0041] The inner diameter of the protrusion portion 22b of the housing 22 is larger than the outer diameter of the insertion portion 72d and is additionally, smaller than the outer diameter of the flange portion 72f. Accordingly, the insertion portion 72d is inserted into the inside of the protrusion portion 22b and the flange portion 72f is placed on the protrusion end 22d of the protrusion portion 22b. The insertion portion 72d is movable with respect to the first member 71 along the axial direction D2, and thus the second member 72 is attachable to and removable from the developing device 20.

[0042] FIG. 4 illustrates a portion of the second member 72, including the insertion portion 72d, the flange portion 72f, and the stopper 80 of the second member 72. As illustrated in FIGS. 3 and 4, the stopper 80 protrudes radially inwardly from the cylindrical body 61 at an end portion (outlet end portion) 72g of the second member 72 adjacent the conveyor 21. For example, the stopper 80 is positioned between the toner crushing member 62 and the conveyor 21 of the developing device 20, and is mounted on the second member 72.

[0043] The stopper 80 is formed, for example, at a lower end of the cylindrical body 61 (insertion portion 72d of the second member 72). As one example, the stopper 80 has a surface 81 that faces the developing device 20

and that is in the same plane as (is flush with) an inner surface 22f of the developing device 20. The surface 81 forms an outer surface of the cylindrical body 61, and the stopper 80 further includes a surface 82 that forms an inner surface on the inside of the cylindrical body 61.

[0044] As one example, a tapered surface 72j is formed in an end portion (or outlet end portion) of the second member 72 adjacent the developing device 20 on an outer peripheral surface of the second member 72, and the surface 81 of the stopper 80 extends radially inwardly, from a lower end (outlet end portion 72g) of the tapered surface 72j of the second member 72. The surface (outer surface) 81 may extend for example, along a plane orthogonal to the axial direction D2.

[0045] The surface (inner surface) 82 of the example stopper 80 extends radially inwardly, from a lower end of an inner peripheral surface 72k of the second member 72 of the second member 72. The inner surface 82 may be inclined (e.g., extend obliquely downwardly) with respect to the outer surface 81, so as to approach the surface 81 toward the hole 85 (radially inwardly relative to the second member 72). Accordingly, the stopper 80 has a thickness that tapers radially inwardly, considering that the thickness is defined by a distance between the outer surface 81 and the inner surface 82, taken in a longitudinal direction of the second member 72. Consequently, the example stopper 80 is an annular plate portion of which the thickness is reduced toward the inside in the radial direction. The hole 85 of the stopper 80 has, for example, a circular shape and the inner diameter of the hole 85 is smaller than the outer diameter of the toner crushing member (or device) 62. Accordingly, the toner crushing member 62 is prevented from contacting the conveyor 21.

[0046] Since a distance K1 from a surface on a stopper 80 side of the flange portion 72f to the surface 81 coincides with a distance K2 (cf. FIG. 3) from the inner surface 22f of the housing 22 to the protrusion end 22d, the surface 81 is positioned in substantially the same plane as the inner surface 22f, in the cross-section illustrated in FIG. 3. Namely, the surface 81 is aligned with the inner surface 22f in the cross-section. Accordingly, a first end 62c of the toner crushing member 62 can be brought close to an internal space 22g of the developing

device 20.

[0047] In the absence of the stopper 80, in order to prevent the toner crushing member 62 from interfering with the conveyor 21, the toner crushing member would 62 have to be positioned away from the conveyor 21, and a free-falling space of the toner may be formed between the toner crushing member 62 and the conveyor 21. When the free-falling space is formed, the effect of crushing the toner obtained by the toner crushing member 62 is weakened, and the toner may clog inside the conveying path of the toner.

[0048] With reference to the illustrated example, when the stopper 80 is provided, while the toner crushing member 62 can be prevented from interfering with the conveyor 21, the toner crushing member 62 can be brought close to the conveyor 21, thereby eliminating or reducing the free-falling space, so as to increase the effect of crushing the toner obtained by the toner crushing member 62, and reduce or prevent clogging of the toner.

[0049] With reference to FIGS. 5 and 6, the second member 72 can move with respect to the first member 71, away from the developing device 20 (e.g., upwardly). The first member 71 and the second member 72 may include a position fixing mechanism 75 that maintains a state in which the second member 72 is spaced away from the developing device 20.

[0050] The example position fixing mechanism 75 may include a projection 71d formed on an outer peripheral surface of the first member 71, and a groove 72p formed in an L shape in the second member 72 to guide the projection 71d. As one example, the projection 71d has a cylindrical shape, and the diameter of the projection 71d is narrower than the width of the groove 72p. The second member 72 has a surface 72q located at an end (e.g., upper end) of the second member 72 that is opposite the developing device. The groove 72p includes, for example, a first groove 72r that extends from the end surface 72q, toward the developing device 20, and a second groove 72s that extends from an end portion (e.g., lower end) of the first groove 72r that is closest to the developing device 20, in a circumferential direction of the second member 72.

[0051] With reference to FIGS. 5 to 7, according to examples, when the second member 72 is raised with respect to the first member 71, the projection

71d enters the first groove 72r. At this time, as the second member 72 is raised, the stopper 80 pushes the toner crushing member 62 upward, thereby compressing (or contracting) the toner crushing member 62. Then, the second member 72 is rotated with respect to the first member 71 in a state where the projection 71d reaches the lower end of the first groove 72r, so that the projection 71d is hooked into the second groove 72s, which fixes the position of the second member 72 with respect to the first member 71. Accordingly, the second member 72 may move between a first position in which the second member 72 contacts the toner conveying device (cf. FIG. 5), and a second position in which the second member 72 is spaced away from the toner conveying device (cf. FIG. 6).

[0052] In the above-described example, the second member 72 is separated from the developing device 20 and the projection 71d is hooked into the groove 72p of the position fixing mechanism 75, so as to fix the position of the second member 72 that is spaced away from the developing device 20. A position fixing mechanism may be achieved by other configurations, depending on examples. For example, the position fixing mechanism may be configured such that the second member 72 is screw-joined to the first member 71.

[0053] With reference to FIGS. 2 and 8, the example toner crushing member 62 includes the spring 62b having an axis L extending along the axial direction D2 of the cylindrical body 61. The spring 62b includes, for example, the first end 62c adjacent to the stopper 80, and a second end 62d opposite the first end 62c.

[0054] For example, the first end 62c (cf. FIG. 2) is a portion in contact with the surface 82 that is the inner surface of the stopper 80, and is prevented from interfering with (contacting) the conveyor 21 by the stopper 80. In some examples, the second end 62d engages the support portion 63c of the crank 63 that rotates to move the spring 62b along the axial direction D2.

[0055] The second end 62d of the example toner crushing member 62 forms a loop 62f that is partially open and engages the support portion 63c of the crank 63. For example, the loop 62f has an opening 62g facing the support 63c in a direction (direction other than the axial direction D2) different from the axis L of the spring 62b, such that the opening 62g is offset relative to the axis L. For

example, the loop 62f includes a first extending portion 62h that is positioned below the support portion 63c, a curved portion 62j that has a U shape and is curved from the first extending portion 62h to partially surround the support portion 63c, a second extending portion 62k that extends from the curved portion 62j adjacent an upper outer periphery of the support portion 63c, and a bent portion 62m that is bent in an end portion of the second extending portion 62k.

[0056] According to examples, the first extending portion 62h is positioned below the support portion 63c and extends in a lateral direction that is substantially orthogonal to the axis L (e.g., from one side (left side) toward the other side (right side) in a rightward and leftward direction), the curved portion 62j partially surrounds the support portion 63c on the right side, and the second extending portion 62k extends above the support portion 63c in the lateral direction. As described above, in the loop 62f, the first extending portion 62h, the curved portion 62j, and the second extending portion 62k surround a part of an outer periphery of the support portion 63c to be hooked on the support portion 63c, so as to maintain the crushing member 62 hooked with the crank 63, even as the toner crushing member 62 is stretched (expanded) and compressed (contracted) along the axial direction D2.

[0057] The opening 62g of the loop 62f corresponds to the remaining portion of the outer periphery of the support portion 63c, which is not surrounded by the loop 62f, and as one example, the opening 62g is located obliquely downward, relative to the support portion 63c. As described above, the opening 62g is positioned in a direction other than the axial direction D2, relative to the support portion, as to prevent the toner crushing member 62 from disengaging the crank 63. According to some examples, the opening 62g may be positioned in a lateral direction (e.g., rightward and leftward direction) from the support portion 63c. In other examples, the opening 62g may be positioned in an obliquely upward direction relative to the support portion 63c, or the like other than the obliquely downward direction.

[0058] FIG. 9 is a side view illustrating a spring 91 of the toner crushing member (or device) 62 according to a modified example. The spring 91 includes a first portion 91b and a second portion 91c having different intervals (pitches) P1

and P2 between adjacent windings, in the axial direction D2. The interval P1 between the windings in the first portion 91b is wider than the interval P2 between the windings in the second portion 91c.

[0059] The first portion 91b and the second portion 91c are arranged along the axial direction D2. The first portion 91b is formed with a wider pitch to be positioned closer to the toner cartridge 25 in the cylindrical body 61 (cf. FIG. 2), and the second portion 91c is formed with a narrower pitch to be positioned closer to the developing device 20, in the cylindrical body 61 (cf. FIG. 2). In this case, since the second portion 91c with a narrow pitch is positioned adjacent the developing device 20 (in the second member 72 of the cylindrical body 61), the operation force to move the second member 72 upward can be reduced. Namely, the second member 72 can be more easily lifted.

[0060] FIG. 10 is a side view illustrating a spring 92 according to another modified example. In the spring 92, a first portion 92b and a second portion 92c are formed differently than those in the spring 91. Namely, the first portion 92b is formed with a wide pitch to be positioned adjacent the developing device 20, and the second portion 92c is formed with a narrow pitch to be positioned adjacent the toner cartridge 25.

[0061] FIG. 11 is a side view illustrating a spring 93 according to another modified example. The spring 93 includes one first portion 93b and a plurality of second portions 93c, for example, two second portions 93c. The second portions 93c are provided on respective ends of the spring 93, and the first portion 93b is provided between the two second portions 93c.

[0062] FIG. 12 is a side view illustrating a spring 94 according to yet another modified example. The spring 94 includes a plurality of first portions 94b, for example two first portions 94b, and one second portion 94c. The two first portions 94b are provided on respective ends of the spring 94, and the second portion 94c is provided between the two first portions 94b.

[0063] Various examples of the spring including the first portion and the second portion having different pitches have been described above. The length and the number of each of the first portions and the second portions are not limited to the above-described examples and can be suitably modified.

Furthermore, the spring may include three or more portions having different pitches.

[0064] FIG. 13 is a side view illustrating a spring 95 according to another modified example. The spring 95 includes a conical portion (also referred to herein as a third portion or variable-diameter portion) 95b in which the diameter of the windings varies from the second end 62d toward the first end 62c. FIG. 13 illustrates an example where the conical portion 95b extends substantially over the entire length of the spring 95. In other examples, the conical portion 95b may extend along a portion of the length of the spring 95. Namely, the diameter of the windings of the spring 95 may be varied in a portion of the spring 95.

[0065] In the conical portion 95b of the spring 95, the diameter of the windings is increased toward the first end 62c that is positioned to be adjacent the developing device 20. Namely, in a side view of the conical portion 95b, the windings are widened to form a conical shape (e.g., the shape of a truncated cone) in a side view.

[0066] A larger-diameter portion of the windings is positioned to be adjacent the developing device 20 (e.g., in the second member 72 of the cylindrical body 61), so as to reduce the operation force to move the second member 72 upward.

[0067] FIG. 14 is a side view illustrating a spring 96 according to another modified example. The spring 96 includes another conical portion (also referred to herein as a third portion or a variable-diameter portion) 96b in which the diameter of the windings varies from the second end 62d toward the first end 62c, so that the diameter of the windings is reduced toward the first end 62c. For example, in a side view, the windings in the conical portion 96b form a conical shape that is inverted relative to the shape of the conical portion 95b illustrated in FIG. 13. Consequently, while the toner is crushed by the spring 96, the toner can be collected inside the spring 96, to increase the fluidity of the toner.

[0068] In the above description, the example toner transfer device 60 illustrated in FIGS. 2 and 3 is positioned between the toner crushing member (or device) 62 and the conveyor 21 of the developing device 20, and includes the stopper 80 mounted on the second member 72 of the cylindrical body 61.

Consequently, the stopper 80 is interposed between the toner crushing member 62 and the conveyor 21, and thus the toner crushing member 62 can be brought as close to the conveyor 21 as possible.

[0069] Consequently, the stopper 80 partitions a region of the toner crushing member 62 off from a region of the conveyor 21, so as to eliminate the free-falling space of the toner, and thereby maximize or increase the efficiency of the toner crushing member 62. Consequently, the toner inside the cylindrical body 61 is more reliably crushed by the toner crushing member 62, so as to increase the efficiency of conveying the toner from the toner cartridge 25 to the developing device 20.

[0070] In the toner crushing member 62, the loop 62f of the second end 62d may have the opening 62g that is offset from the axis L of the spring 62b. Accordingly, the toner crushing member 62 is prevented from disengaging the crank 63, even if an upward load is applied to the toner crushing member 62.

[0071] The stopper 80 may protrude radially inwardly from the cylindrical body 61, at the end portion (or outlet end portion) of the second member 72 that is adjacent the developing device 20, so as to simplify the shape of the stopper 80. The shape of the stopper 80 is not limited to the above-described example, and can be modified to adopt other suitable arrangements that prevent the toner crushing member 62 from extending out of the cylindrical body 61.

[0072] The stopper 80 may be provided in a position where the outer surface 81 facing the developing device 20 substantially aligns with the inner surface 22f of the developing device 20 (e.g., extends substantially along a plane intersecting the inner surface 22f of the developing device 20, in the longitudinal cross-section). In this case, since the outer surface 81 of the stopper 80, which forms the outer surface of the cylindrical body 61, is flush with the inner surface 22f of the developing device 20, the stopper 80 may be formed to be relatively thin, so as to bring the toner crushing member 62 as close as possible to the developing device 20, and thereby reduce the free-falling space for the toner.

[0073] The second member 72 of the cylindrical body 61 may be movable with respect to the first member 71 in the axial direction D2, so as to move away from the developing device 20. In this case, the developing device 20 can be

easily removed from the toner transfer device 60, to facilitate the replacement or maintenance of the developing device 20.

[0074] At least one of the first member 71 and the second member 72 may include the position fixing mechanism 75 that maintains a state where the second member 72 is spaced apart from the developing device 20, so as to more easily access or remove the developing device 20.

[0075] As illustrated as an example in FIG. 9, the toner crushing member (or device) 62 may include the spring 91 which may include the first portion 91b and the second portion 91c having the different space intervals P1 and P2 between adjacent windings, in the axial direction D2, so as to increase the fluidity of the toner in the toner crushing member 62.

[0076] With reference to FIGS. 11 and 12, the spring 93, 94 may include a plurality of the first portions 93b, 94b and/or a plurality of the second portions 93c, 94c. For example, given the first portion 93b, 94b of the spring in which the windings are spaced apart by a first space interval, and the second portion 93c, 94c in which the windings are spaced apart by a second space interval, the spring may include at least one additional portion in which the windings are spaced apart by the first space interval or the second space interval. Accordingly, the fluidity of the toner in the toner crushing member 62 can be further increased.

[0077] With reference to FIGS. 13 and 14, the springs 95, 96 may include the conical portion 95b, 96b, respectively in which the diameter of the windings varies from the second end 62d toward the first end 62c, so as to reduce the operation force to move the second member 72 and to increase the fluidity of the toner.

[0078] In the conical portion 95b, the diameter of the windings may be increased from the second end 62d toward the first end 62c. In this case, the toner crushing member 62 is more easily contractable (more easily compressed) at the first end 62c, so as to reduce the operation force to push the second member 72 upward to contract the toner crushing member 62.

[0079] In the conical portion 96b, the diameter of the windings may be reduced from the second end 62d toward the first end 62c. In this case, the diameter of the windings is gradually reduced toward the first end 62c, thereby

forming the conveying path of the toner toward the center at the first end 62c, so as to increase the fluidity of the toner.

[0080] The cylindrical body 61 may be molded by resin molding. Consequently, the toner crushing member 62 may move in a more stable manner along the axial direction D2 inside the cylindrical body 61, as the cylindrical body 61 is formed as a rigid body. Therefore, the toner may be crushed in a more stable manner, by the toner crushing member 62, and thus increasing the fluidity of the toner, so as to achieve a more efficient transfer of the toner. Furthermore, when the imaging apparatus 1 described above includes the toner transfer device 60, the same effects as the above-described effects of the toner transfer device 60 can be obtained from the imaging apparatus 1.

[0081] It is to be understood that not all aspects, advantages and features described herein may necessarily be achieved by, or included in, any one particular example. Indeed, having described and illustrated various examples herein, it should be apparent that other examples may be modified in arrangement and detail is omitted.

CLAIMS

1. A toner transfer device comprising:

a cylindrical body to supply a toner to a toner conveying device having a conveyor, wherein the cylindrical body includes:

a first member; and

a second member that is coupled to the first member and that is detachably coupled to the toner conveying device;

a toner crushing device that is arranged inside the cylindrical body to crush the toner passing through the cylindrical body and to move in an axial direction of the cylindrical body; and

a stopper that extends from the second member and is positioned between the toner crushing device and the conveyor of the toner conveying device.

2. The toner transfer device according to claim 1,

wherein the toner crushing device includes a spring having an axis extending along the axial direction of the cylindrical body,

wherein the spring includes a first end adjacent the stopper, and a second end opposite the first end,

wherein the second end of the spring forms a partially-open loop which engages a support portion that is rotatable to move the spring in the axial direction, and

wherein the partially-open loop forms an opening that is offset from the axis of the spring.

3. The toner transfer device according to claim 1,

wherein the second member of the cylindrical body has an outlet end portion located adjacent the toner conveying device,

wherein the stopper extends radially inwardly from the outlet end portion of the second member, and

wherein the spring extends longitudinally in the cylinder body and includes an end located adjacent to the stopper.

4. The toner transfer device according to claim 1,

wherein the second member of the cylindrical body has an outlet end portion located adjacent the toner conveying device,

wherein the stopper extends radially inwardly from the outlet end portion of the second member, and

wherein the stopper includes an outer surface that faces the conveyor of the toner conveying device, the outer surface of the stopper to extend along a plane that intersects an inner surface of the toner conveying device, that faces the conveyor.

5. The toner transfer device according to claim 1, wherein the second member is movable with respect to the first member in the axial direction, to move away from the toner conveying device.

6. The toner transfer device according to claim 5, wherein at least one of the first member and the second member of the cylindrical body includes a position fixing mechanism to maintain a state in which the second member is spaced away from the toner conveying device.

7. The toner transfer device according to claim 1,

wherein the toner crushing device includes a spring that forms helical windings and has an axis extending along the axial direction of the cylindrical body,

wherein the spring includes a first portion in which the windings are spaced apart by a first space interval, and a second portion in which the windings are spaced apart by a second space interval,

wherein the first space interval associated with the windings in the first portion is greater than the second space interval associated with the windings in the second portion, and

wherein the first portion and the second portion are arranged along the axial direction.

8. The toner transfer device according to claim 7, wherein the spring includes at least one additional portion in which the windings are spaced apart by the first space interval or the second space interval.

9. The toner transfer device according to claim 1,

wherein the toner crushing device includes a spring that is formed of helical windings and has an axis extending along the axial direction of the cylindrical body,

wherein the spring includes a first end adjacent the stopper, and a second end opposite the first end, and

wherein the spring includes a variable-diameter portion in which a diameter of the windings varies from the first end to the second end.

10. The toner transfer device according to claim 9, wherein in the variable-diameter portion, the diameter of the windings decreases from the first end to the second end.

11. The toner transfer device according to claim 9, wherein in the variable-diameter portion, the diameter of the windings increases from the second end to the first end.

12. The toner transfer device according to claim 1, wherein the cylindrical body is formed by resin molding.

13. An imaging apparatus comprising:

a cartridge compartment to accommodate a toner cartridge;

a toner conveying device including a conveyor to convey toner; and

a toner transfer device to transfer the toner from the toner cartridge to the toner conveying device, wherein the toner transfer device includes:

a cylindrical body that is detachably coupled to the toner conveying device;

a toner crushing device located inside the cylindrical body to crush the toner supplied through the cylindrical body; and

a stopper that is positioned between the toner crushing device and the conveyor of the toner conveying device to prevent the toner crushing device from contacting the conveyor of the toner conveying device.

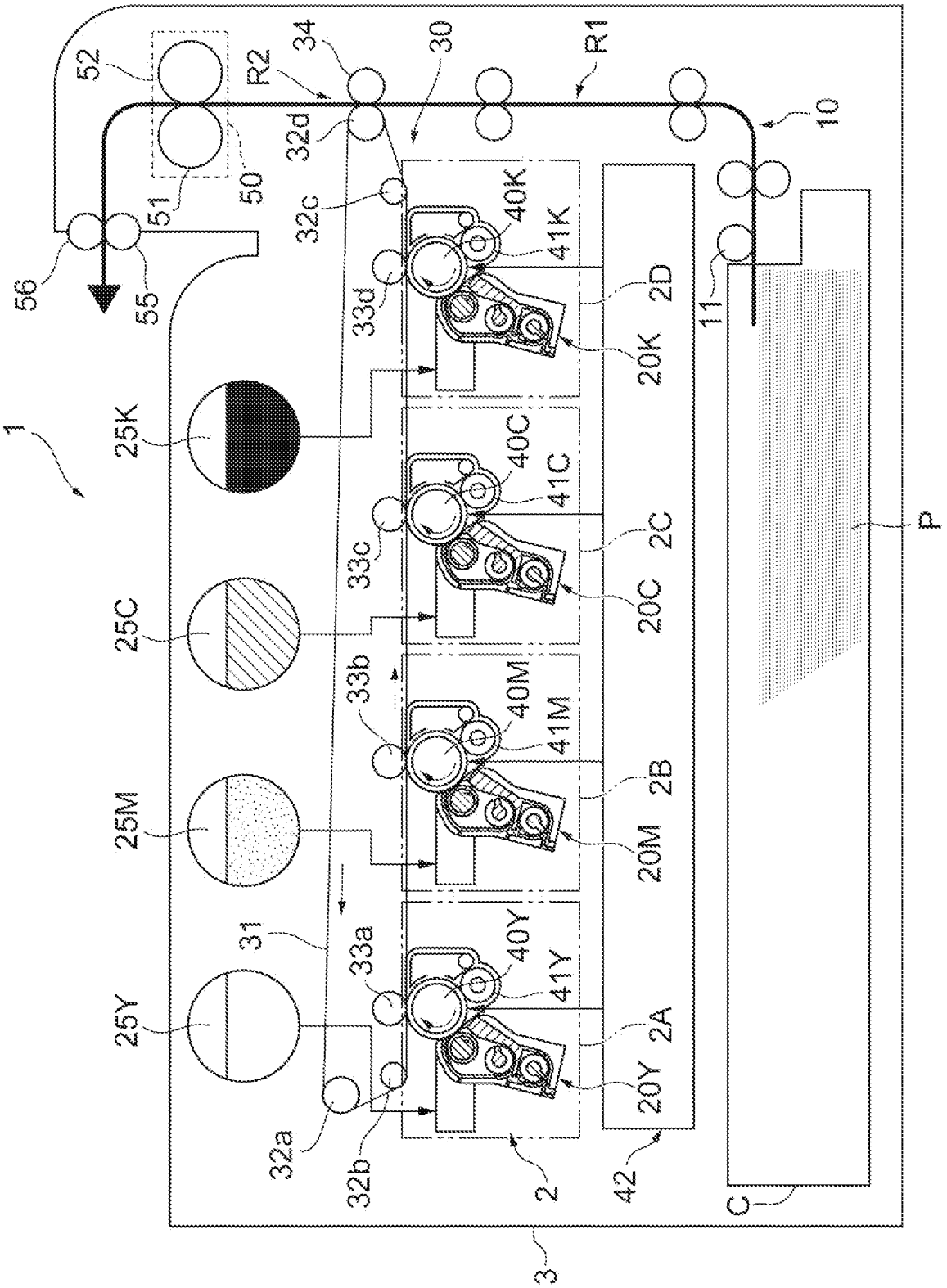
14. The imaging apparatus according to claim 13,

wherein the cylindrical body extends along an axial direction, and

wherein the toner crushing device includes a spring that is movable in the axial direction.

15. The imaging apparatus according to claim 13,

wherein the cylindrical body includes a first member, and a second member that is movably connected to the first member, the second member to move between a first position wherein the second member contacts the toner conveying device, and a second position wherein the second member is spaced away from the toner conveying device.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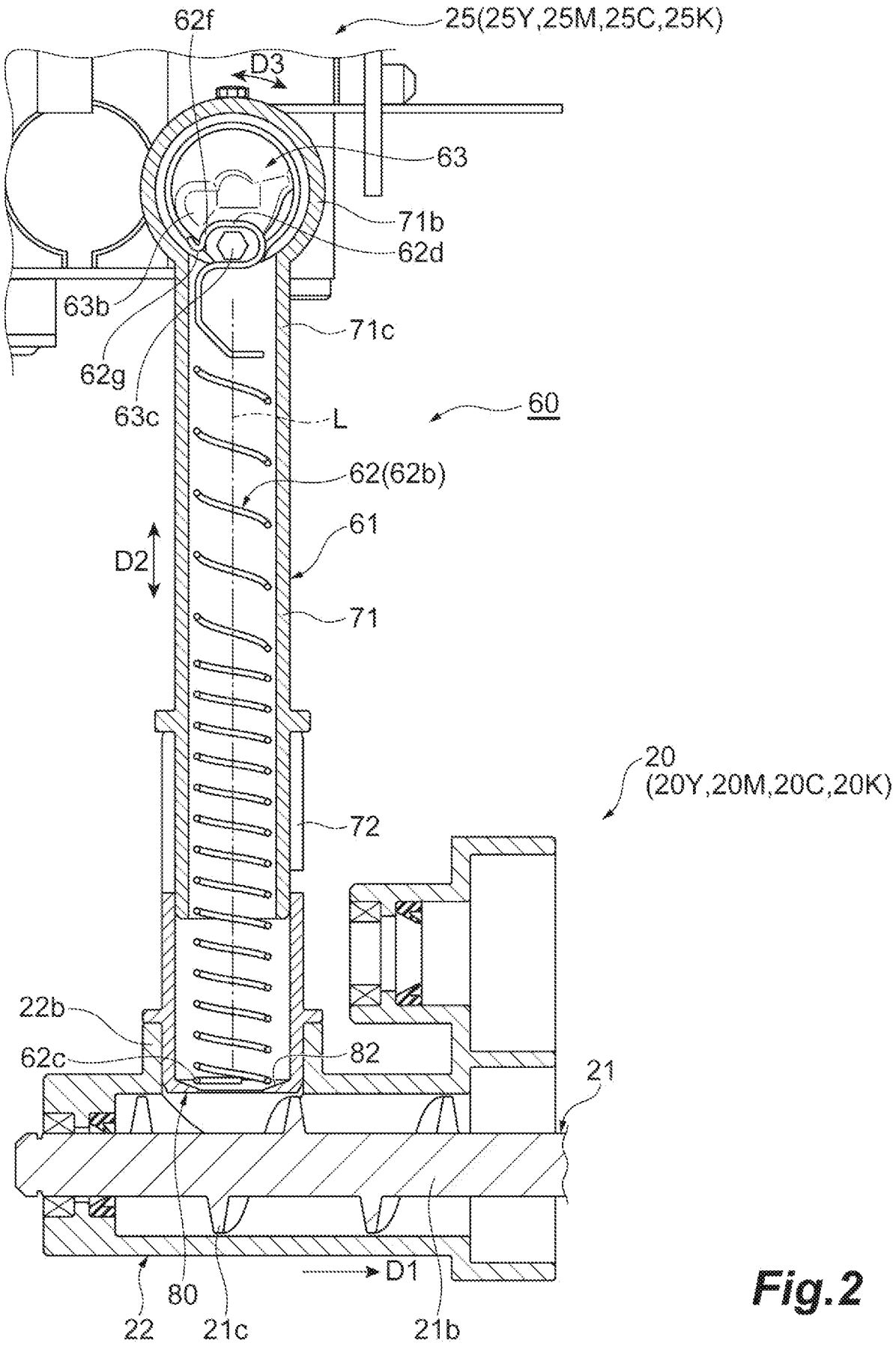
56
C
P
R1
R2

Fig.1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71
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21b

Fig.2

Fig.3

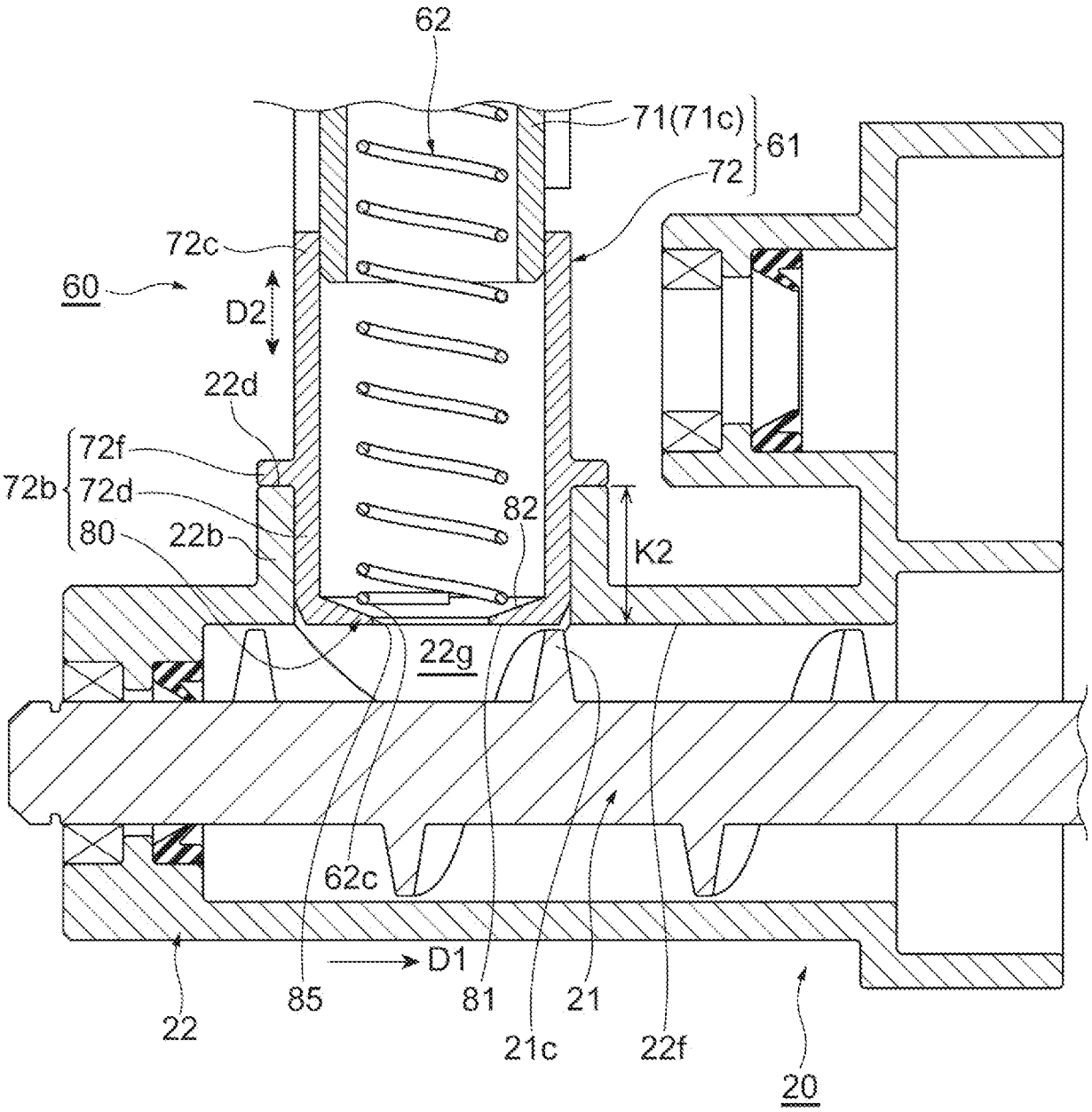
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Fig.4

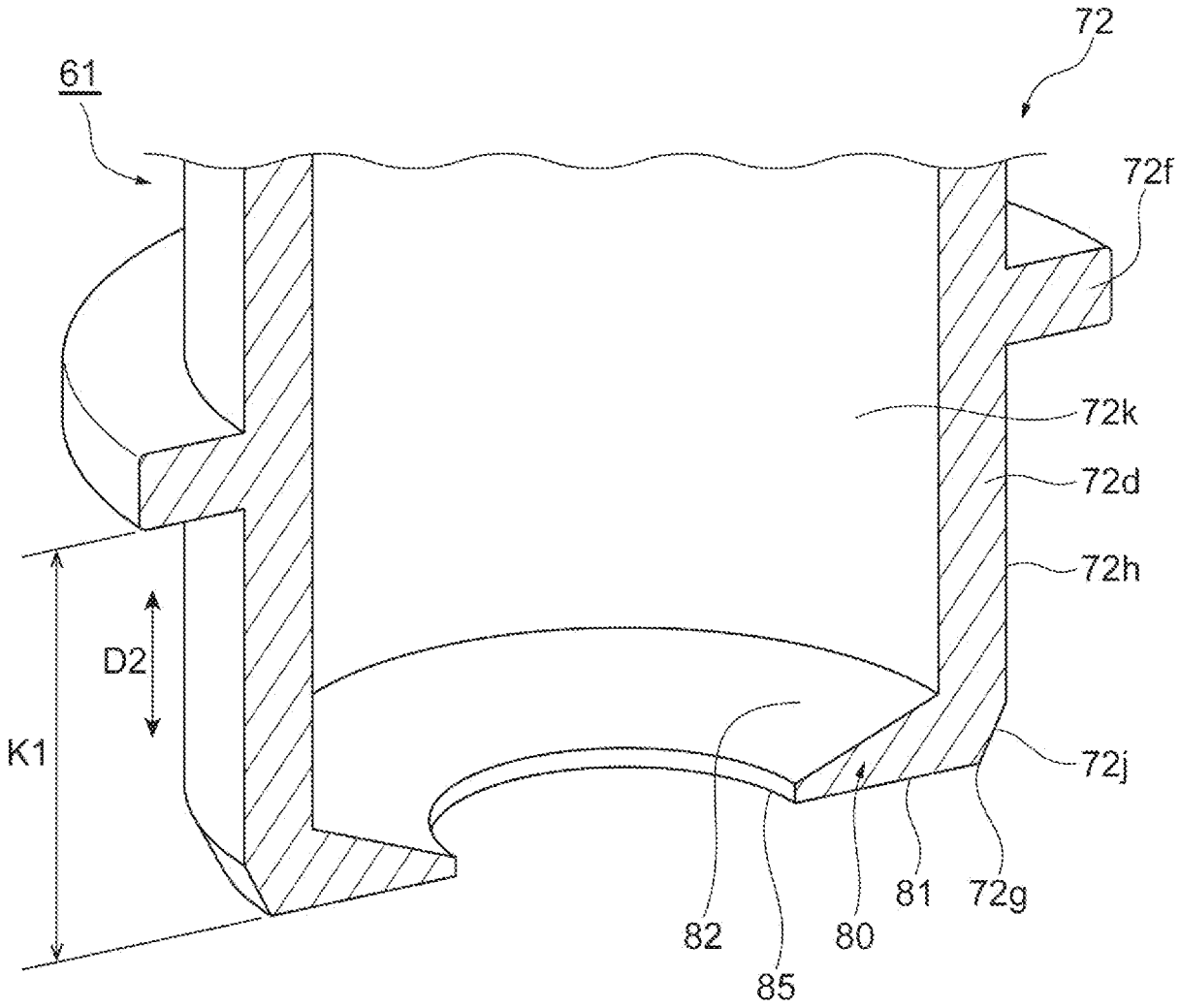


Fig.5

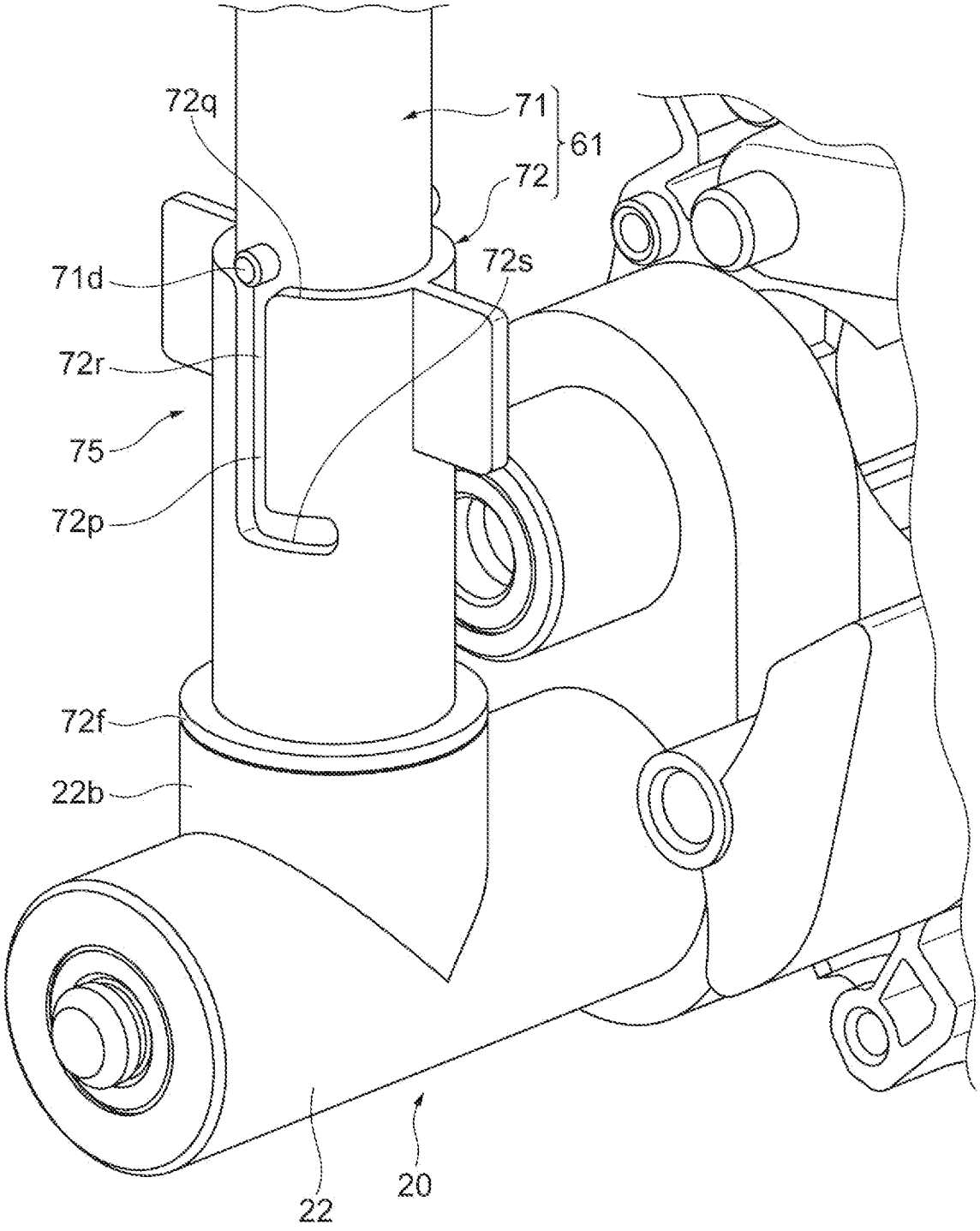


Fig.6

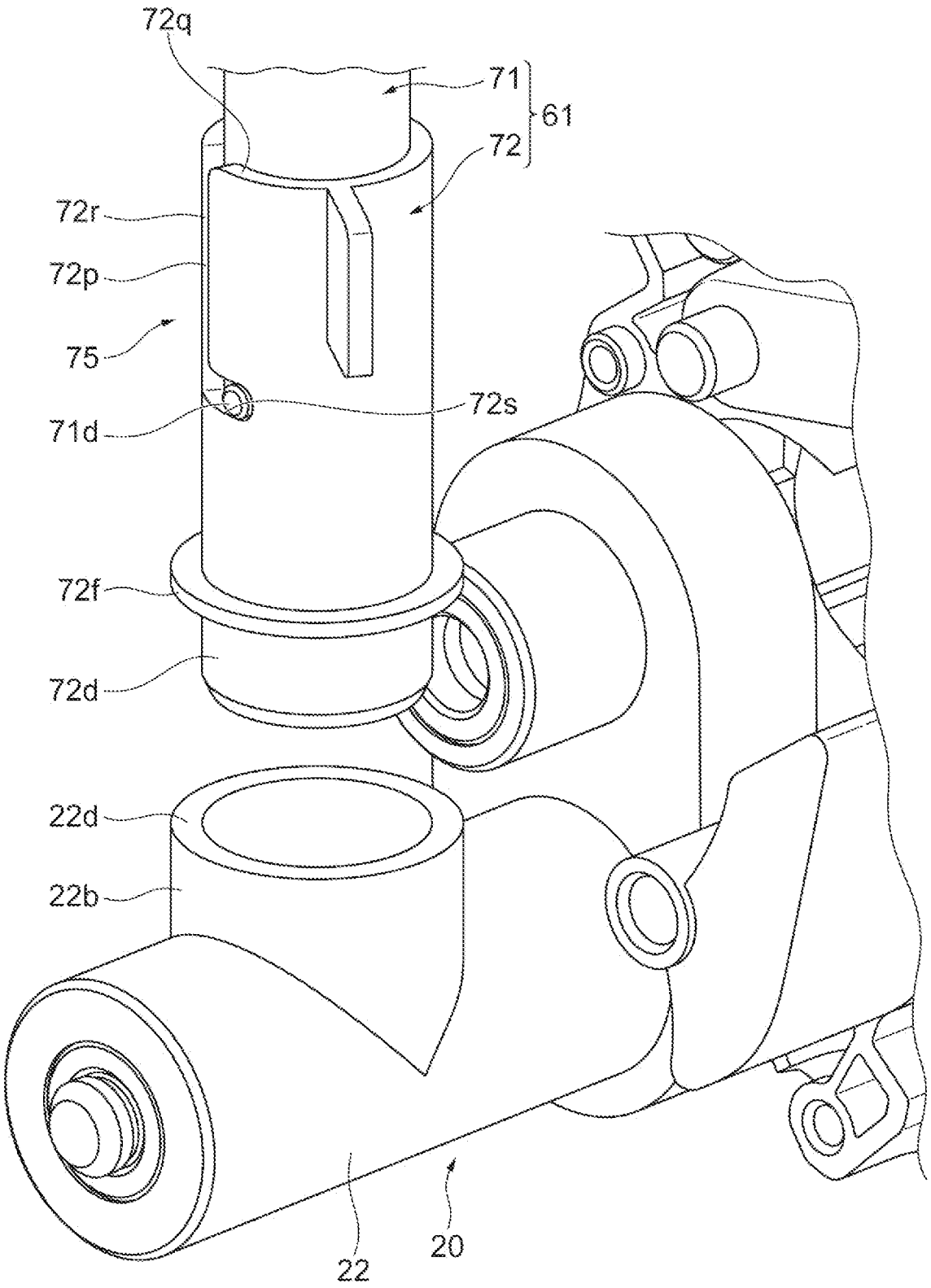


Fig.7

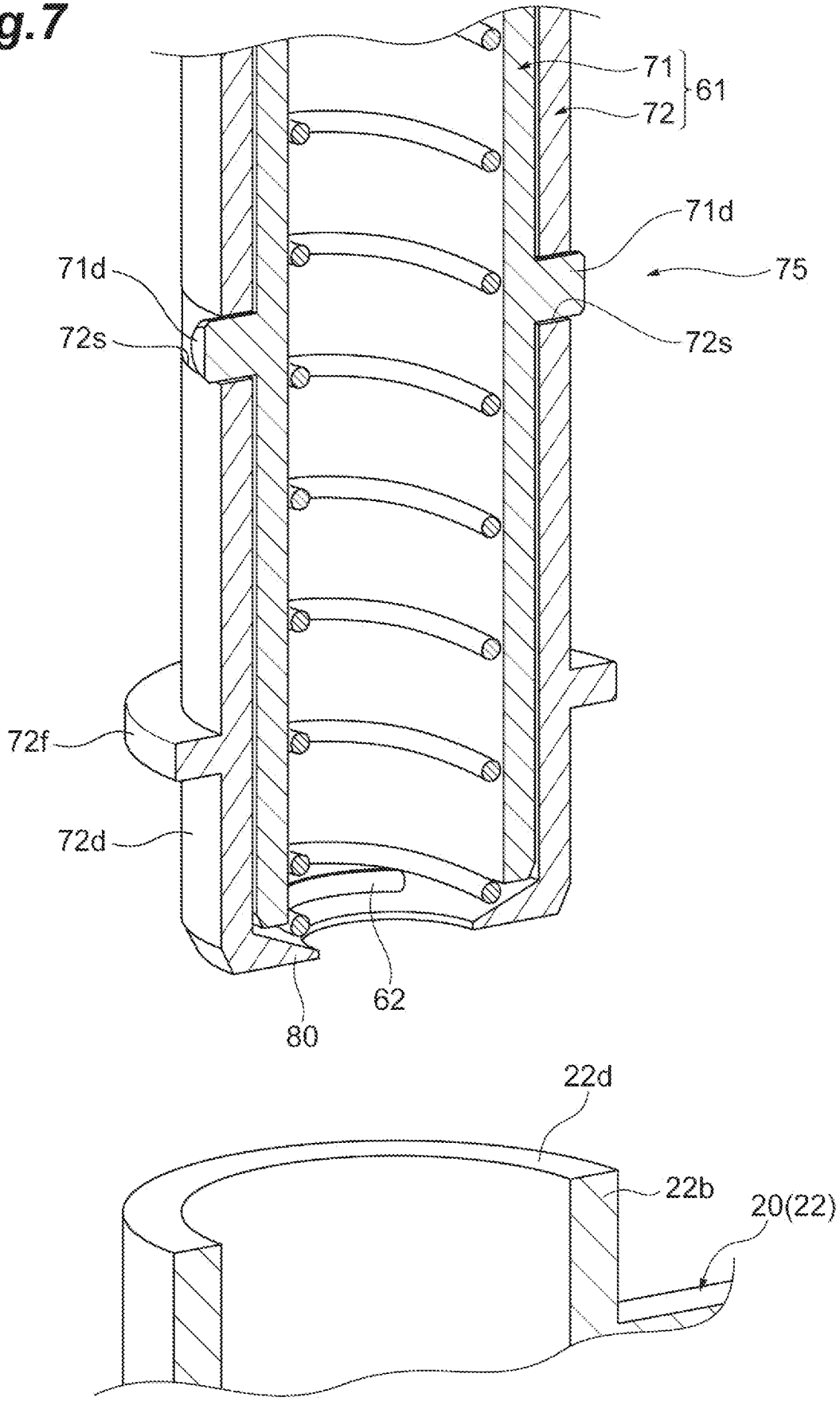


Fig.8

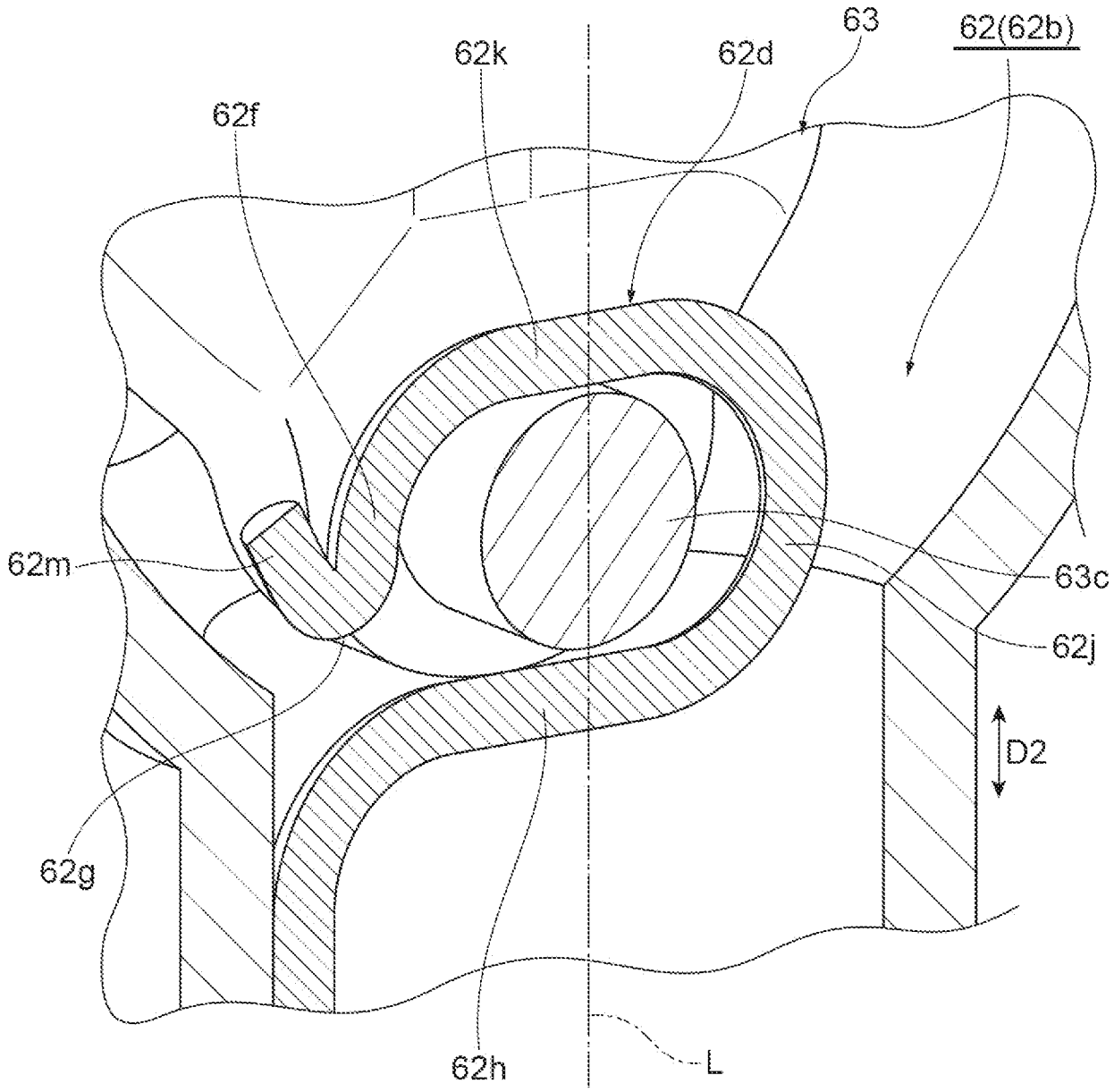


Fig.9

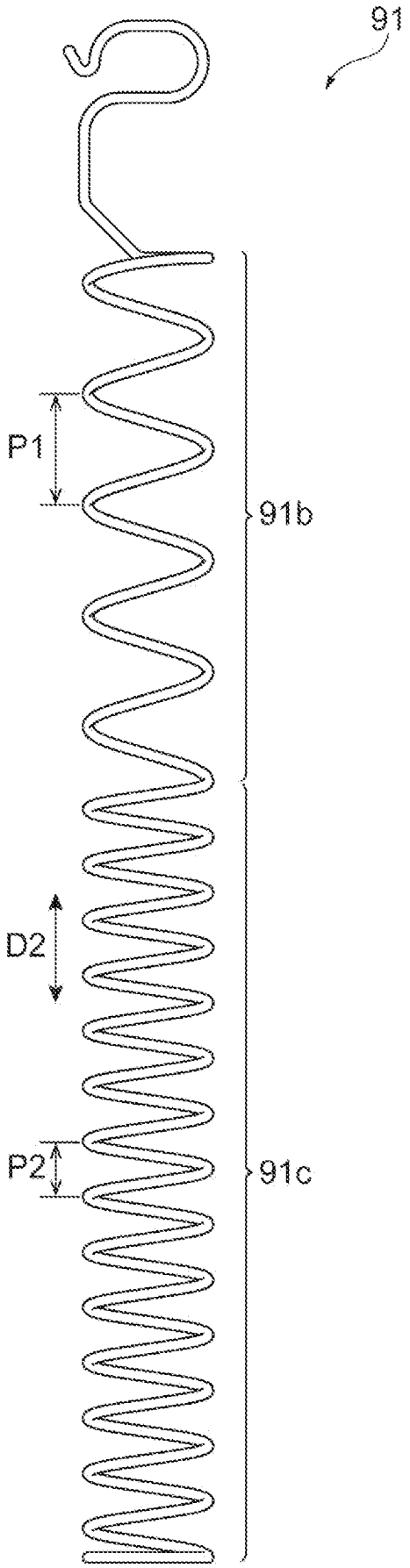


Fig.10

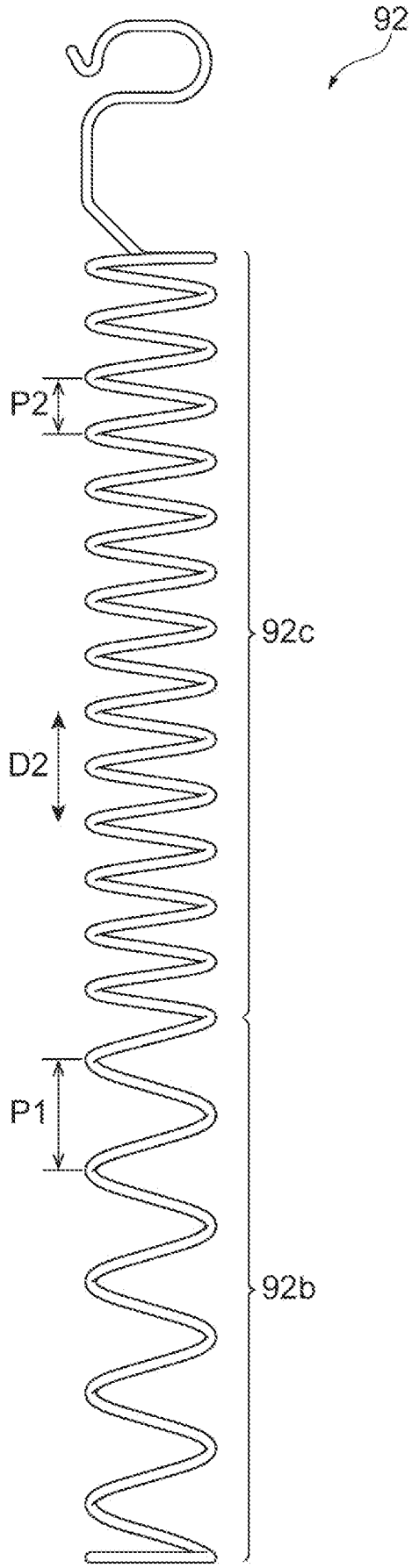


Fig.11

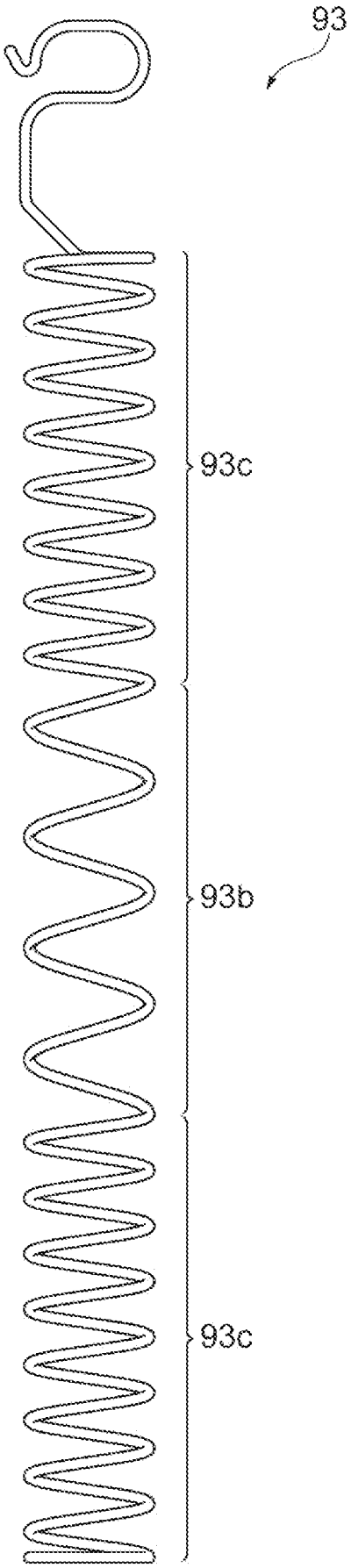


Fig.12

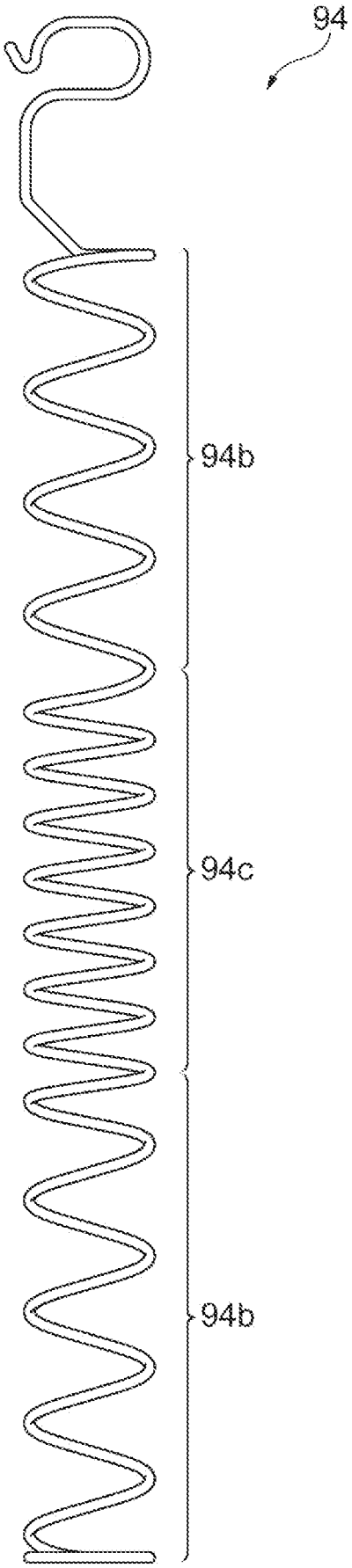


Fig.13

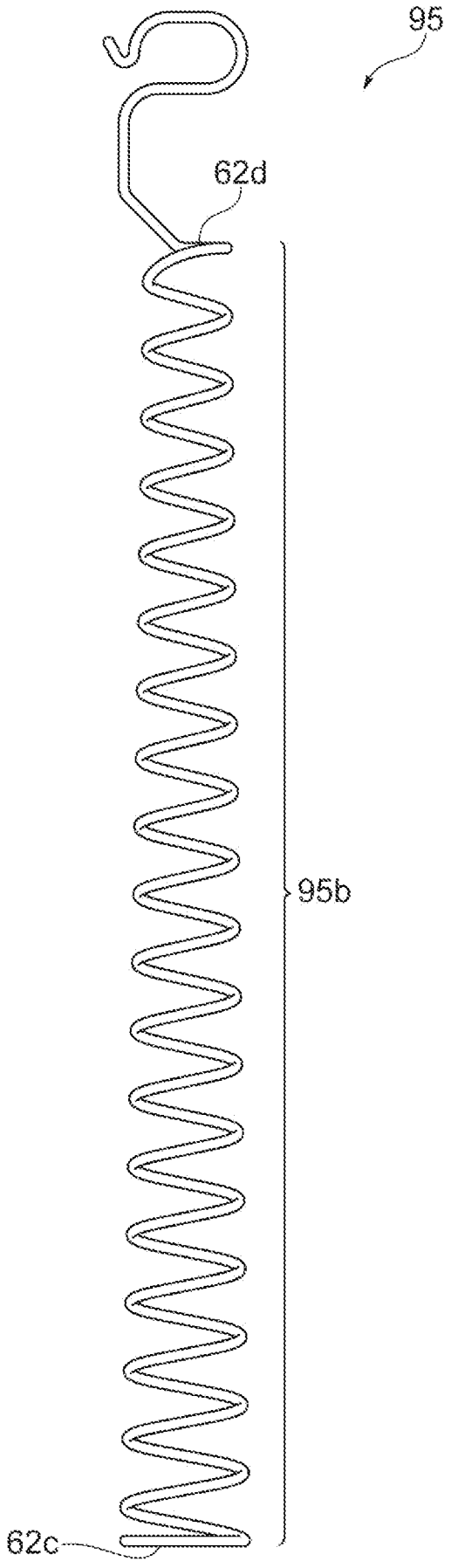
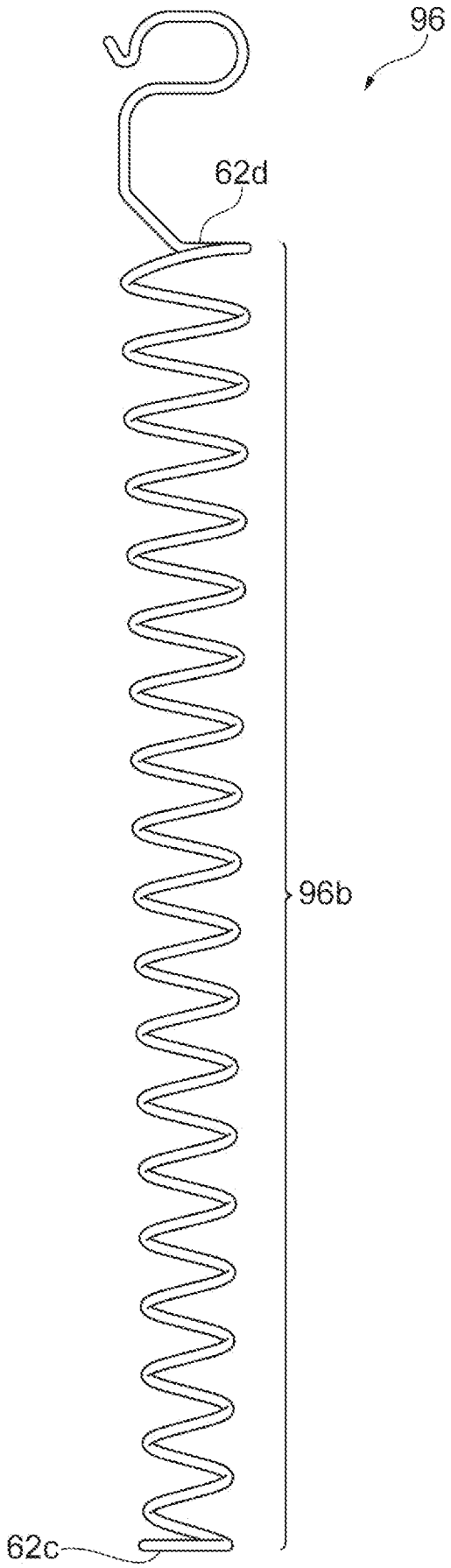


Fig.14



INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 2021/033824

A. CLASSIFICATION OF SUBJECT MATTER

G03G 15/16 *(2006.01)*
G03G 21/10 *(2006.01)*

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G03G 15/00, 15/08-15/16, 21/00, 21/10

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PatSearch (RUPTO Internal), USPTO, PAJ, Espacenet, Information Retrieval System of FIPS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6014541 A (MITA INDUSTRIAL CO., LTD) 11.01.2000, column 4, line 60-column 5, line 56, figures 3-6	1-15
A	US 5715501 A (CANON KABUSHIKI KAISHA) 03.02.1998, abstract	1-15
A	US 2007/0065196 A1 (LEXMARK INTERNATIONAL, INC) 22.03.2007, abstract	1-15
A	US 4011835 A (XEROX CORPORATION) 15.03.1977, abstract	1-15

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 July 2021 (12.07.2021)	05 August 2021 (05.08.2021)

Name and mailing address of the ISA/RU:
Federal Institute of Industrial Property,
Berezhkovskaya nab., 30-1, Moscow, G-59,
GSP-3, Russia, 125993
Facsimile No: (8-495) 531-63-18, (8-499) 243-33-37

Authorized officer

A. Grigoryan

Telephone No. 8(495)531-64-81