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(57)

ABSTRACT

A hydraulic damper includes: a cylinder containing liquid; a piston part configured to be connected to a rod moving in an axial direction and configured to move inside the cylinder; a channel forming part including a first channel in which the liquid flows along with movement of the piston part in one direction, and a second channel in which the liquid flows parallel to the first channel along with the movement of the piston part in the one direction; a valve part configured to control flow of the liquid in the first channel and the second channel; and a single advancing/retracting part configured to advance and retract the valve part to and from the first channel and the second channel.

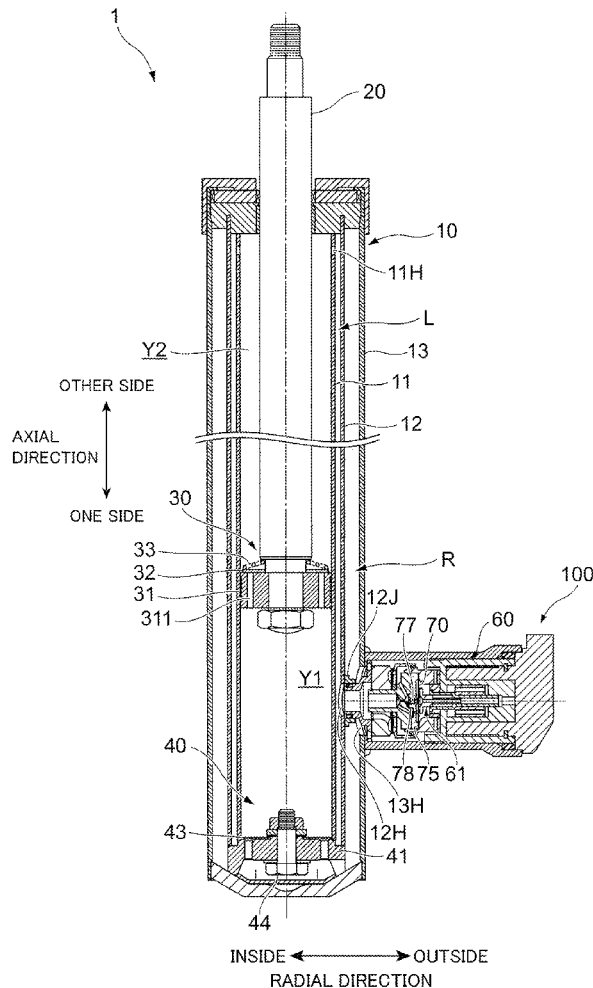


FIG.1

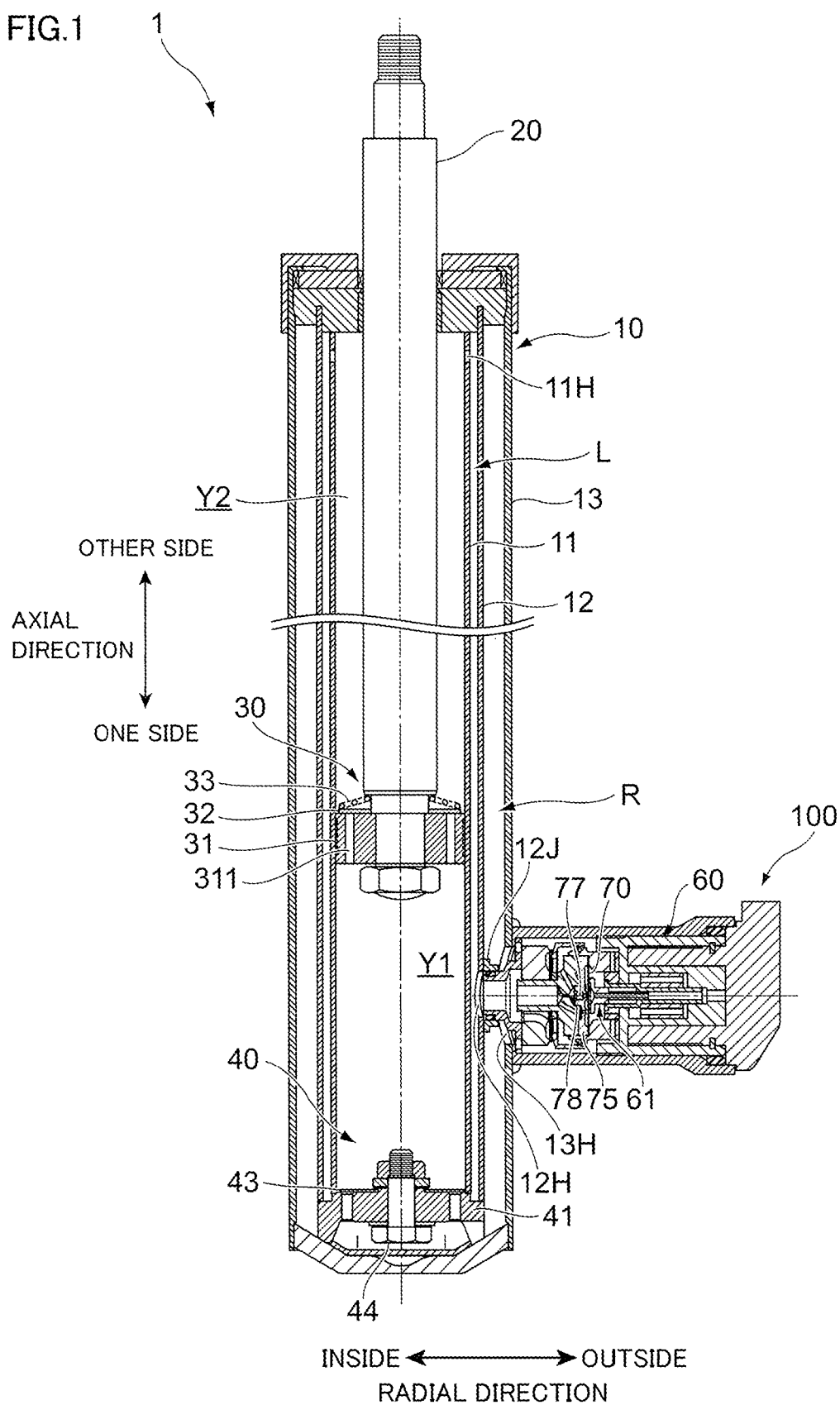


FIG.3A

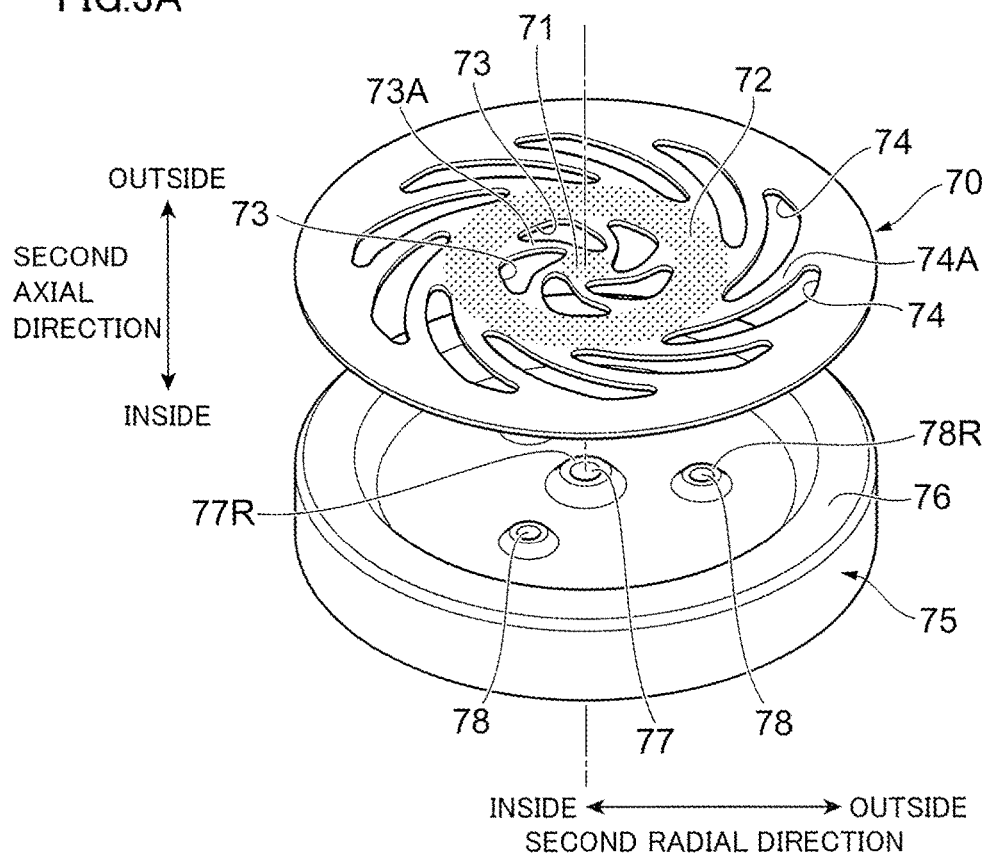
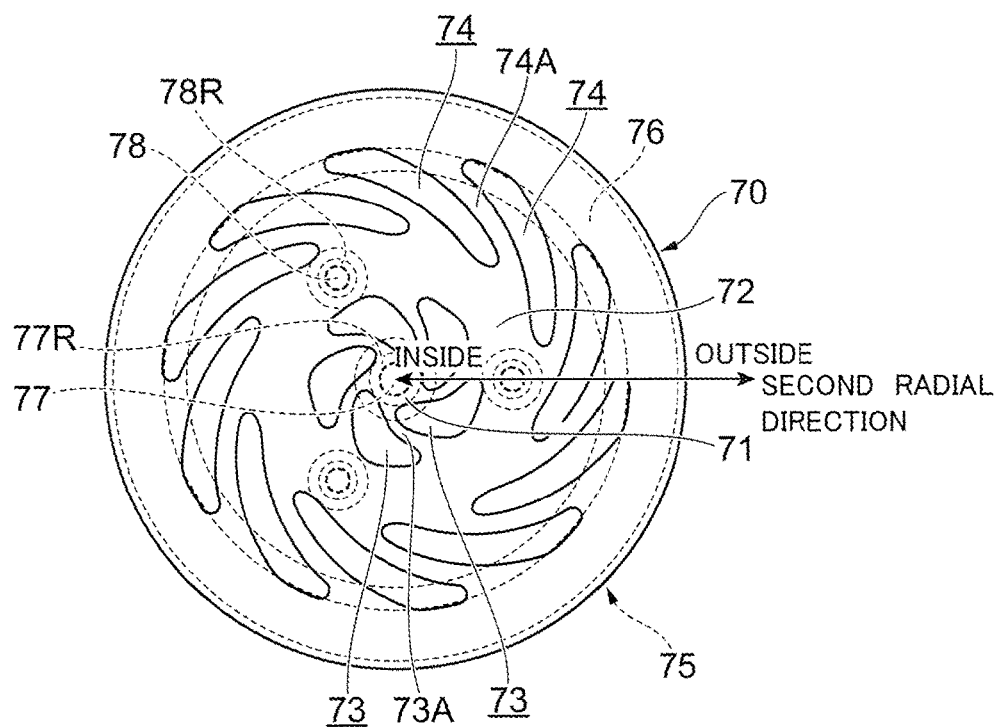


FIG.3B



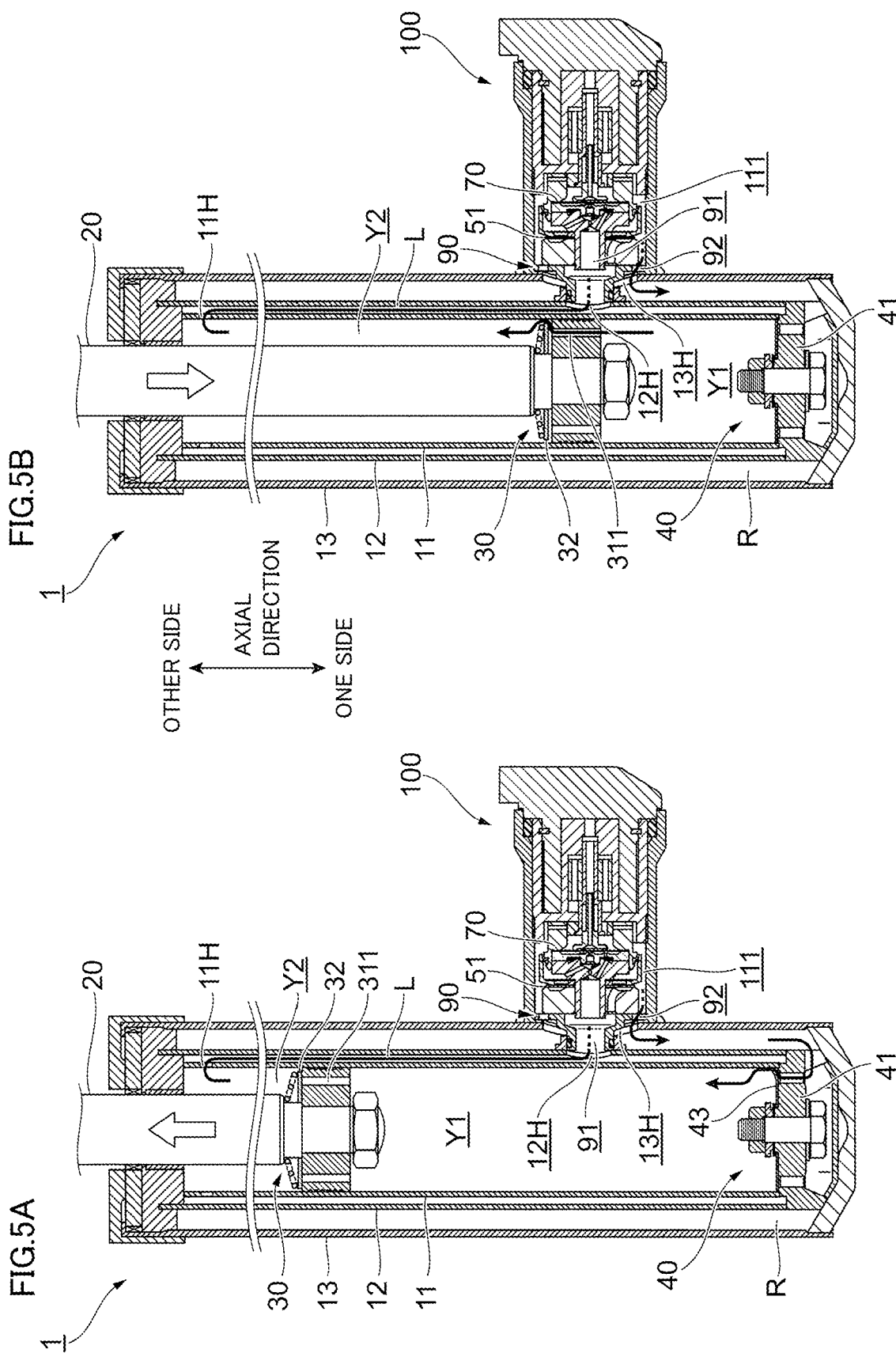


FIG.6A

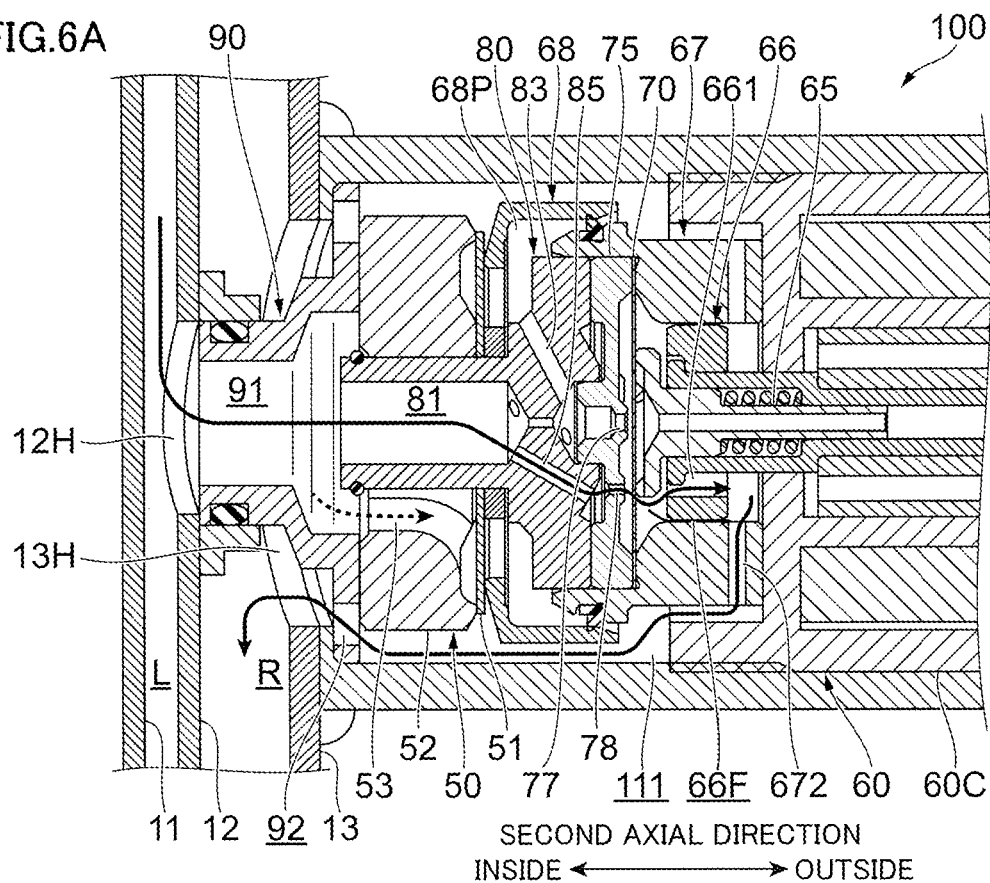
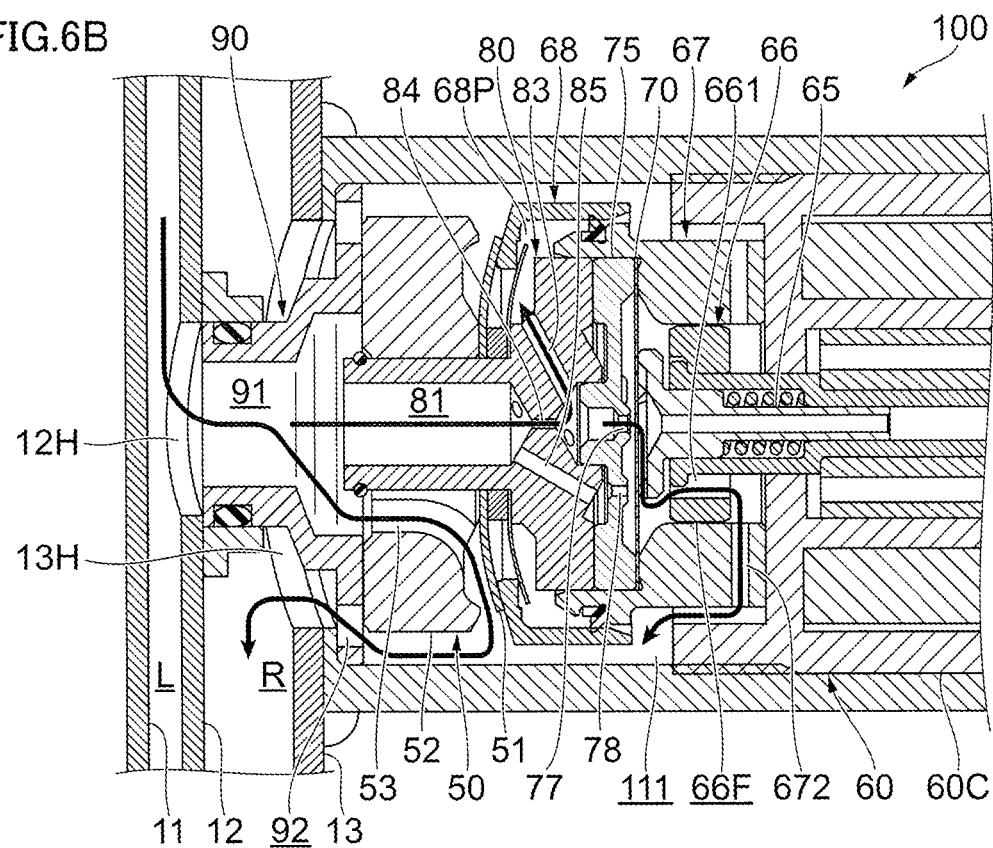
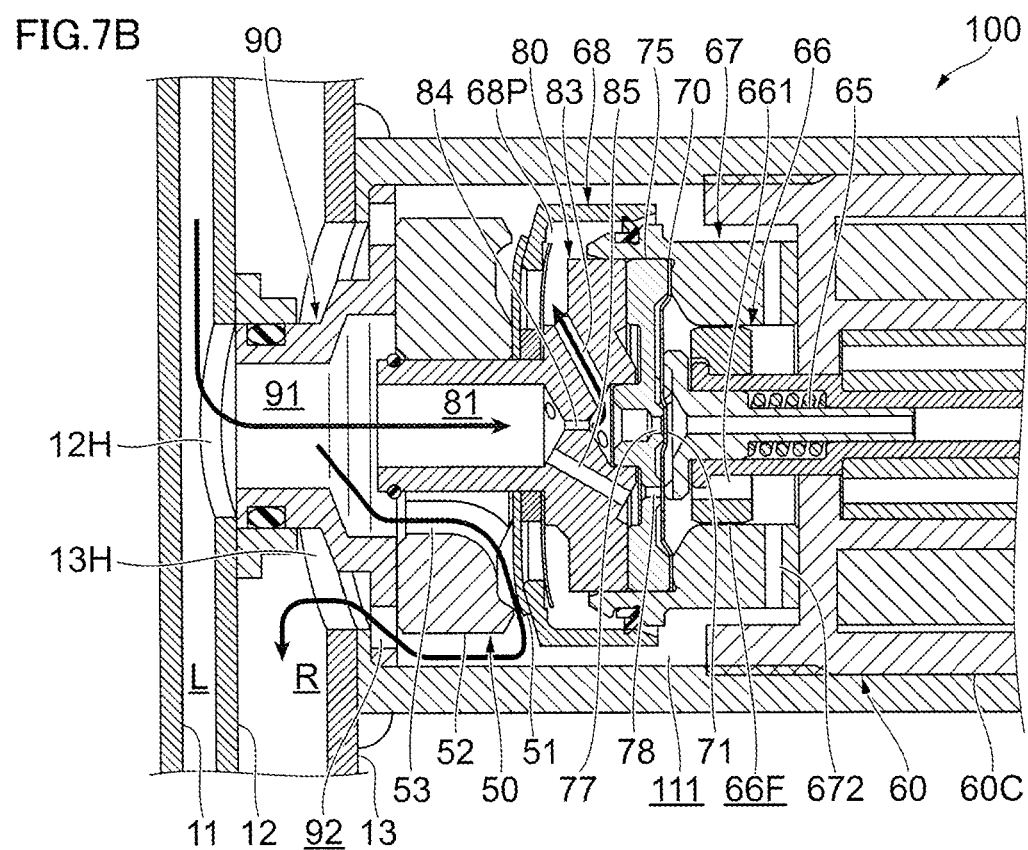
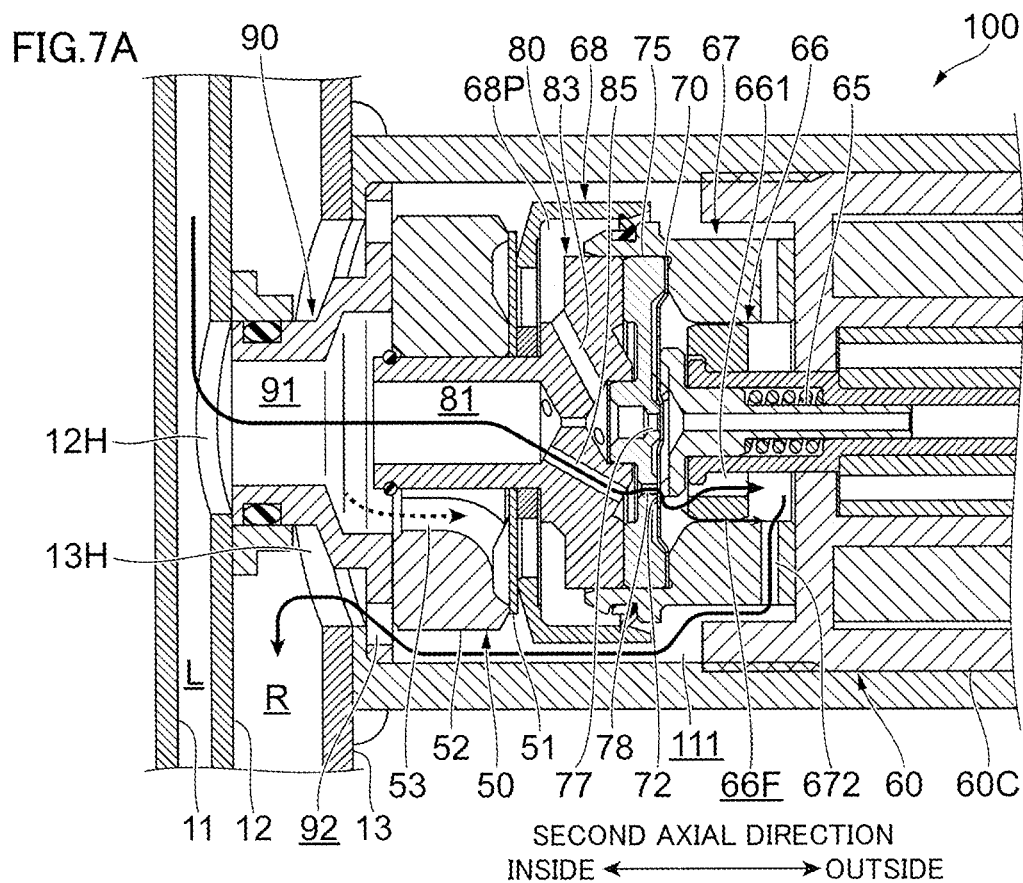


FIG.6B





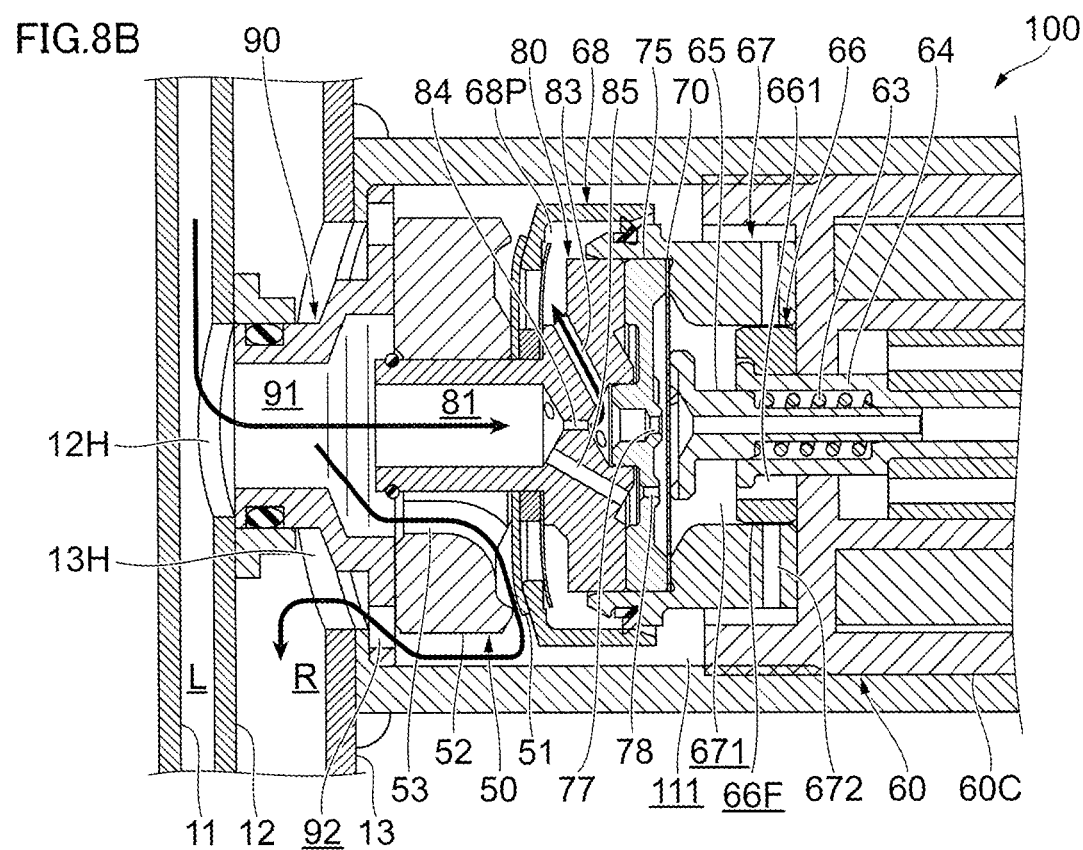
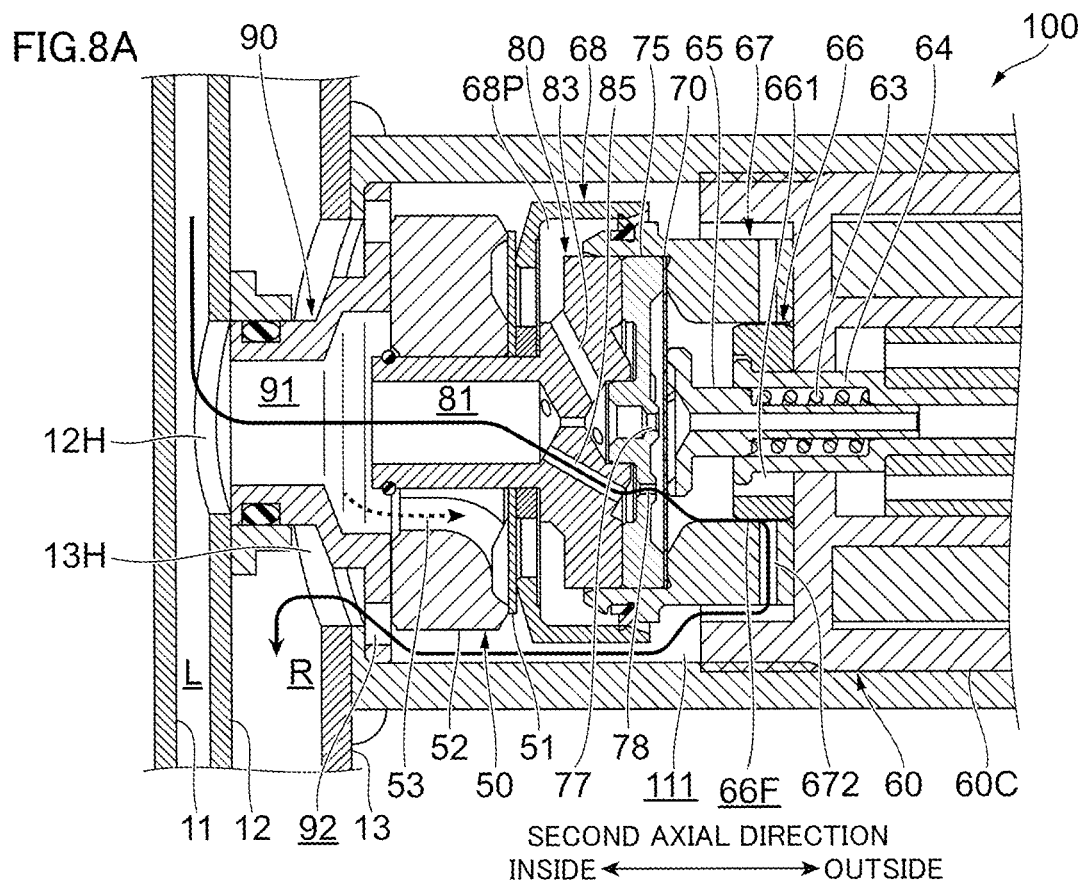
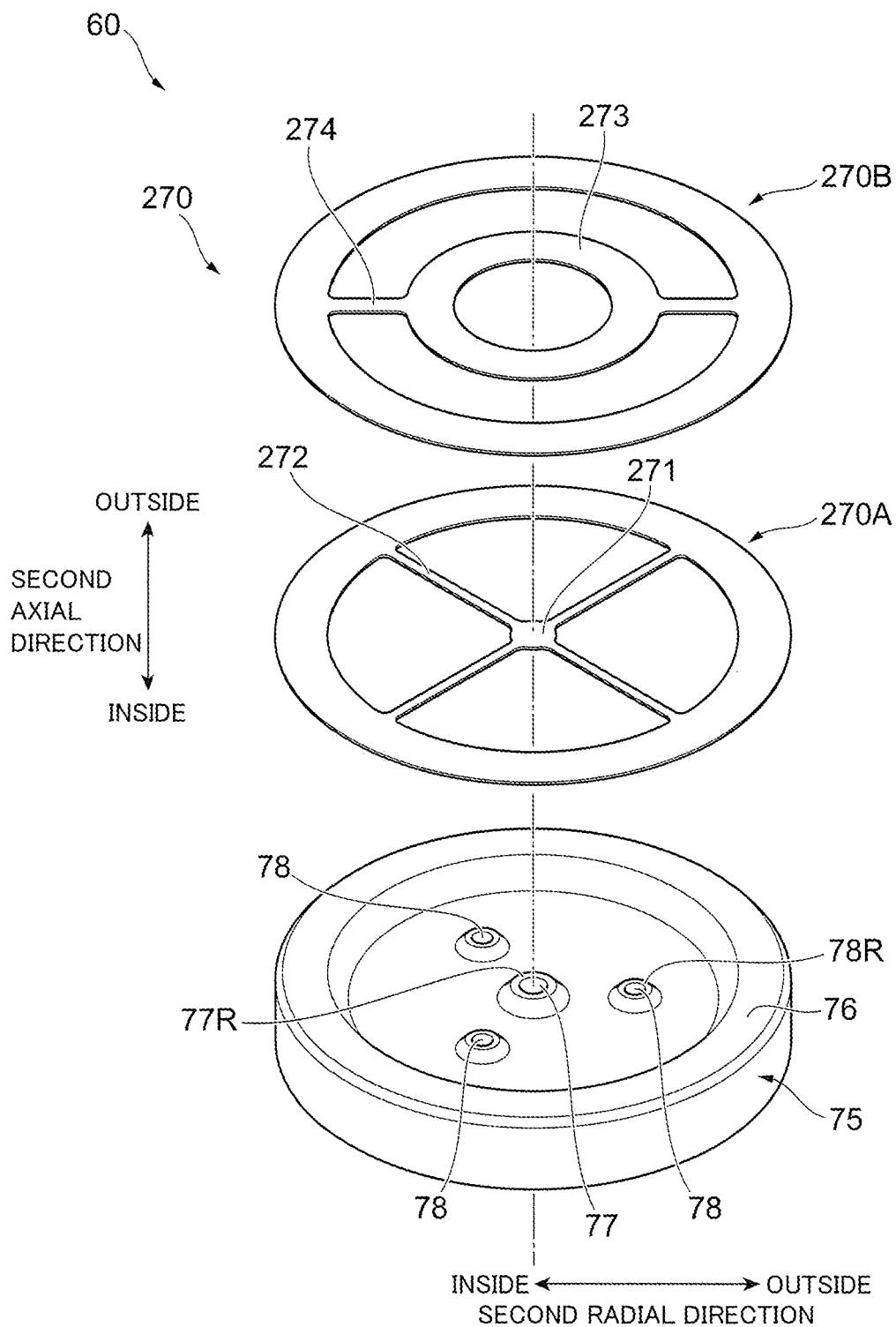


FIG. 9



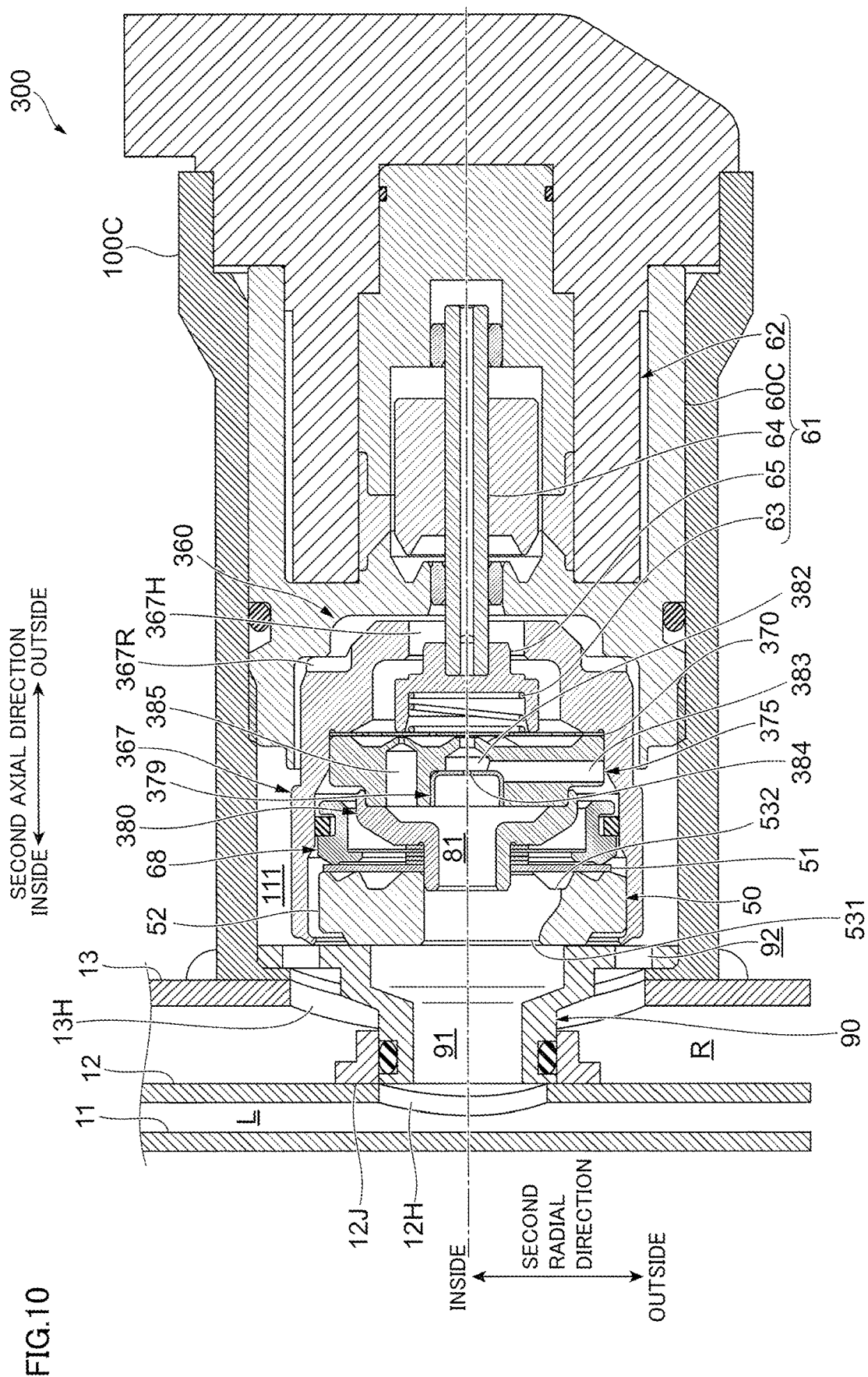


FIG. 11

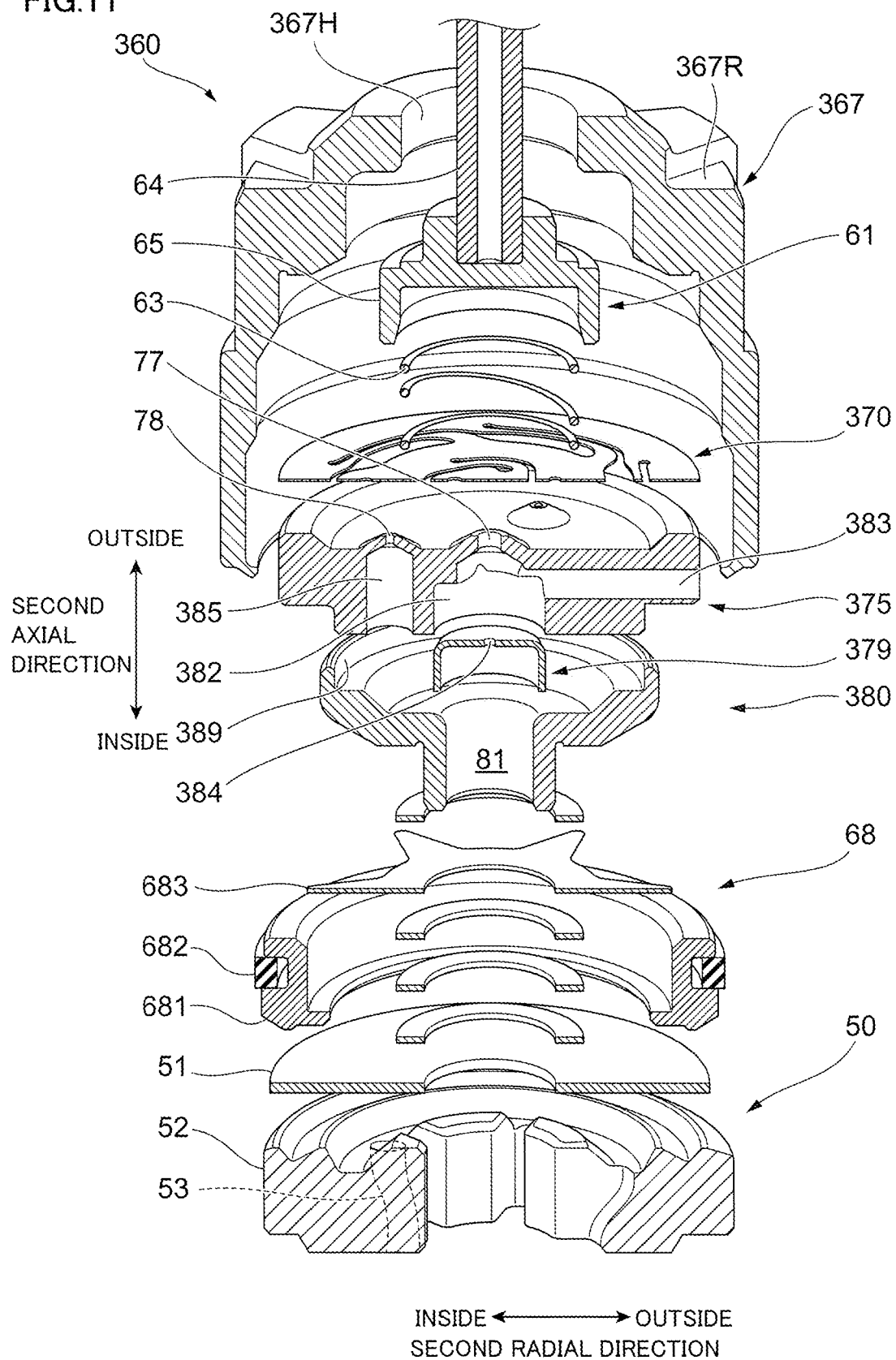


FIG.13A

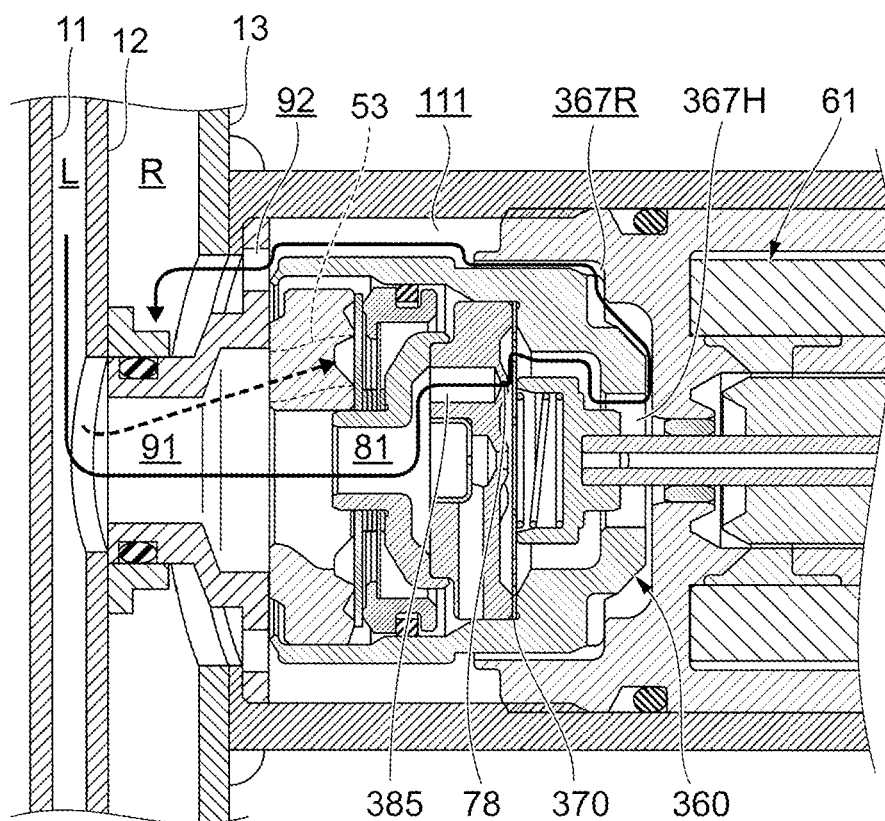


FIG.13B

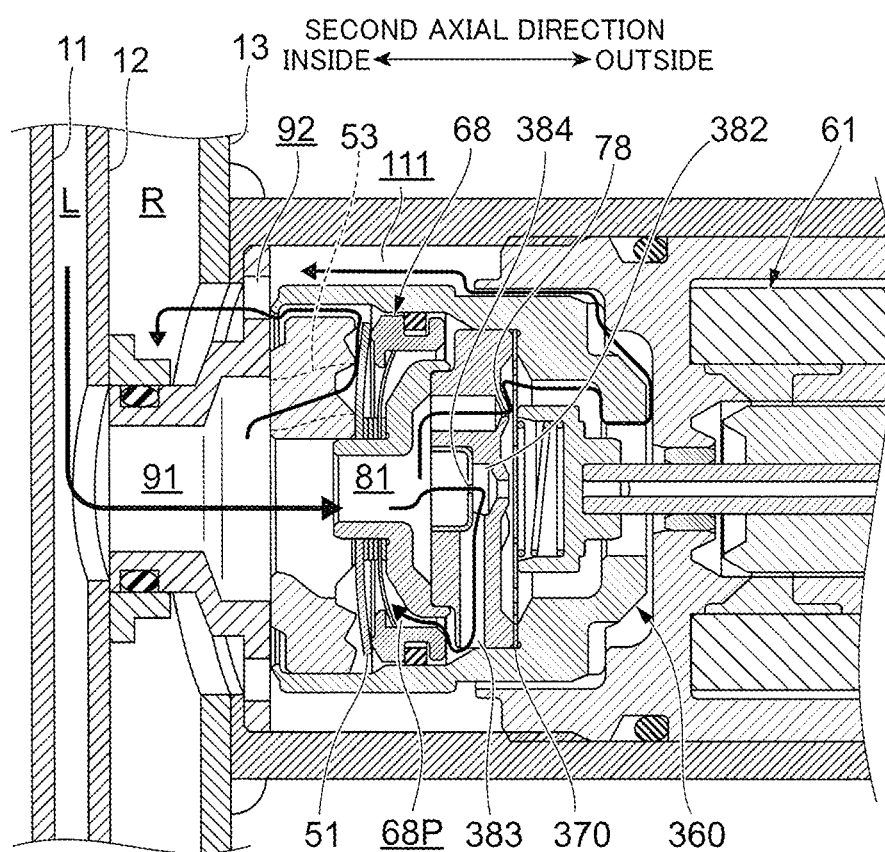


FIG.15A

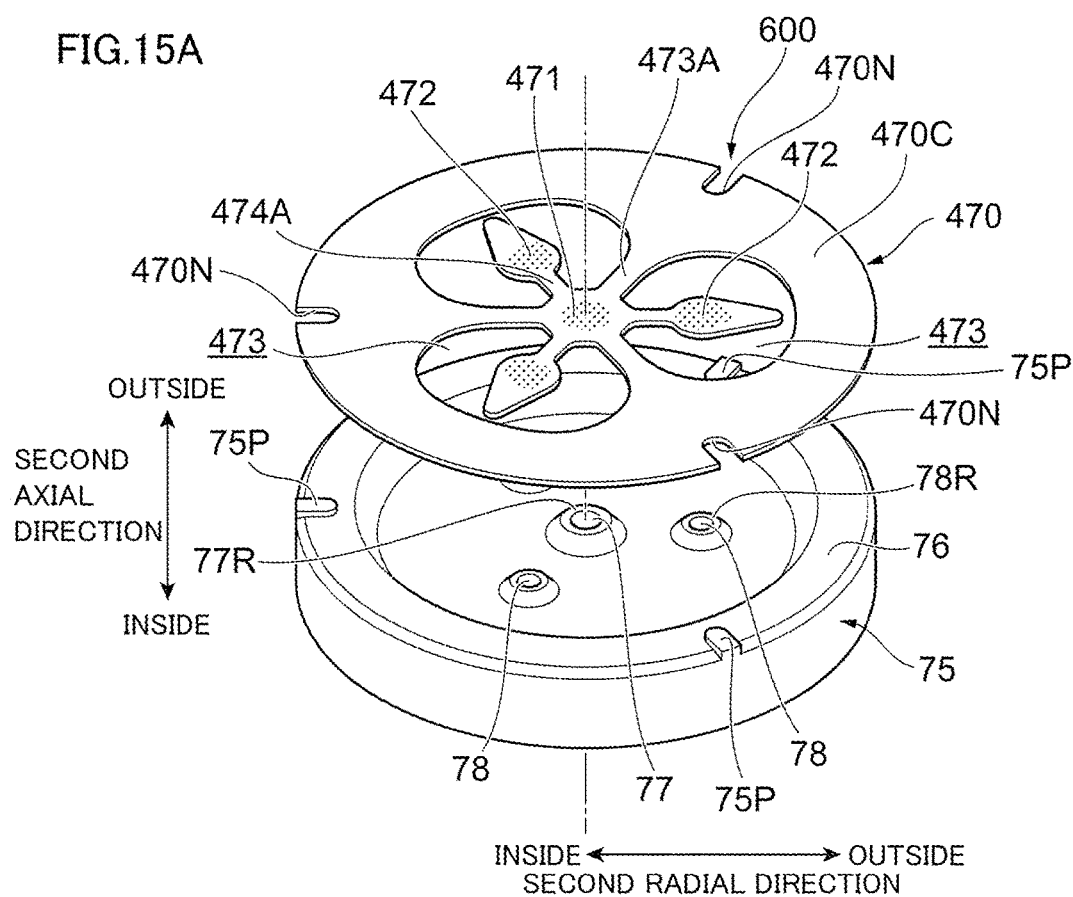
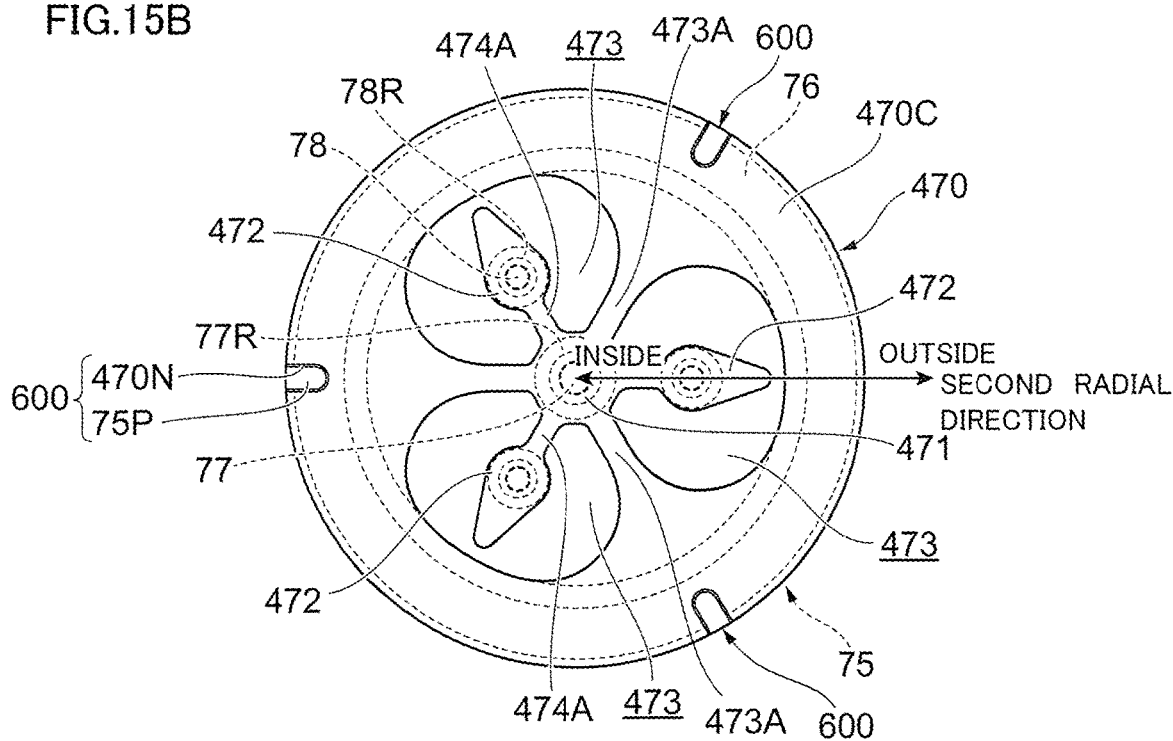


FIG.15B



HYDRAULIC DAMPER

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of International Application No. PCT/JP2019/016969 filed on Apr. 22, 2019, which claims the benefit of priority to International Application No. PCT/JP2018/022582 filed Jun. 13, 2018, the contents of which are incorporated herein by reference in their entireties. The International Application No. PCT/JP2019/016969 was published in Japanese on Dec. 19, 2019 as International Publication No. WO/2019/239721 under PCT Article 21(2).

FIELD OF THE INVENTION

[0002] The present invention relates to a hydraulic damper.

BACKGROUND OF THE INVENTION

[0003] For example, Japanese Patent Application Laid-Open Publication No. 07-091476 discloses an adjustable damper including, on a base side, a compression-side damping valve that generates a damping force by restrictively permitting liquid in the amount equal to the volume of a piston rod entering a cylinder during a compression stroke to flow out toward a reservoir chamber, and a solenoid that is capable of varying and controlling generated damping force characteristics by varying a set load on the compression-side damping valve.

Technical Problem

[0004] A hydraulic damper may be formed with multiple channels for generating a damping force, and a need exists for individually adjusting the damping force in each of the multiple channels. However, providing a damping force adjusting mechanism individually for each of the multiple channels leads to complicating the damper.

[0005] An object of the present invention is to adjust the damping force in multiple channels while avoiding complicating the damper.

SUMMARY OF THE INVENTION

Solution to Problem

[0006] With the above object in view, an aspect of the present invention relates to a hydraulic damper including: a cylinder containing liquid; a piston part configured to be connected to a rod moving in an axial direction and configured to move inside the cylinder; a channel forming part including a first channel in which the liquid flows along with movement of the piston part in one direction, and a second channel in which the liquid flows parallel to the first channel along with the movement of the piston part in the one direction; a valve part configured to control flow of the liquid in the first channel and the second channel; and a single advancing/retracting part configured to advance and retract the valve part to and from the first channel and the second channel.

[0007] With the above object in view, another aspect of the present invention relates to a hydraulic damper including: a cylinder containing liquid; a piston part configured to be connected to a rod moving in an axial direction and config-

ured to move inside the cylinder; a first valve part configured to throttle a first channel in which the oil flows along with movement of the piston part; a pressing part including an accommodation chamber for accommodating the liquid and configured to press the first valve part against the first channel by pressure of the liquid in the accommodation chamber; a second valve part configured to throttle flow of the liquid in a second channel parallel to the first channel; and an adjustment mechanism part configured to adjust an amount by which the second valve part throttles the second channel, along with adjusting the pressure of the liquid in the accommodation chamber.

Advantageous Effects of Invention

[0008] The present invention allows to adjust the damping force in multiple channels while avoiding complicating the damper.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 is an entire view of a hydraulic damper of the first embodiment.

[0010] FIG. 2 is a sectional view of an external damping unit of the first embodiment.

[0011] FIGS. 3A and 3B are explanatory diagrams of a control valve and a control valve seat of the first embodiment.

[0012] FIG. 4 is an explanatory diagram of how the control valve, the control valve seat, and an advancing/retracting member operate.

[0013] FIGS. 5A and 5B are explanatory diagrams of how the hydraulic damper of the first embodiment operates.

[0014] FIGS. 6A and 6B are explanatory diagrams of how oil flows in the external damping unit.

[0015] FIGS. 7A and 7B are explanatory diagrams of how oil flows in the external damping unit.

[0016] FIGS. 8A and 8B are explanatory diagrams of how oil flows in the external damping unit.

[0017] FIG. 9 is an explanatory diagram of a damping force adjusting part of the second embodiment.

[0018] FIG. 10 is a sectional view of an external damping unit of the third embodiment.

[0019] FIG. 11 is a perspective sectional view of the external damping unit of the third embodiment.

[0020] FIGS. 12A and 12B are explanatory diagrams of a control valve and a control valve seat of the third embodiment.

[0021] FIGS. 13A and 13B are explanatory diagrams of how oil flows in the external damping unit of the third embodiment.

[0022] FIGS. 14A and 14B are explanatory diagrams of how oil flows in the external damping unit of the third embodiment.

[0023] FIGS. 15A and 15B are explanatory diagrams of a damping force adjusting part of the fourth embodiment.

DETAILED DESCRIPTION OF THE INVENTION

[0024] Embodiments of the present invention will be described below in detail with reference to the attached drawings.

First Embodiment

[Configuration and Functions of the Hydraulic Damper 1]

[0025] FIG. 1 is an entire view of the hydraulic damper 1 of the first embodiment.

[0026] As shown in FIG. 1, the hydraulic damper 1 includes a cylinder part 10 and a rod 20. The cylinder part 10 stores oil. One end of the rod 20 is inserted into the cylinder part 10 such that the rod 20 can slide within the cylinder part 10, and the other end of the rod 20 protrudes from the cylinder part 10. The hydraulic damper 1 further includes a piston part 30 disposed at the one end of the rod 20, and a bottom piston part 40 disposed at one end of the cylinder part 10. The hydraulic damper 1 further includes an external damping unit 100 disposed outside (radially outside) of the cylinder part 10 and generating a damping force.

[0027] Below a description will be given of an overall configuration of the hydraulic damper 1 of the first embodiment.

[0028] As shown in FIG. 1, the hydraulic damper 1 of the first embodiment includes: the cylinder part 10 (an example of the cylinder) that stores oil (an example of the liquid); a piston part 30 (an example of the piston part) that is connected to the rod 20 moving in an axial direction and moves within the cylinder part 10; a back pressure channel 77 (an example of the first channel) in which oil flows along with the movement of the piston part 30 in one direction; a control valve seat 75 (an example of the channel forming part) including low-speed channels 78 (an example of the second channel) in which oil flows in parallel to the back pressure channel 77 along with the movement of the piston part 30 in the one direction; a control valve 70 (valve part) that controls oil flow in the back pressure channel 77 and the low-speed channels 78; and a single advancing/retracting part 61 (an example of the advancing/retracting part) that advances and retracts the control valve 70 to and from the back pressure channel 77 and the low-speed channels 78.

[0029] Below a detailed description will be given of these components.

[0030] In the following description, the longitudinal direction of the cylinder part 10 shown in FIG. 1 may be referred to as an “axial direction”. Also, the lower side of the cylinder part 10 in the axial direction may be referred to as “one side”, and the upper side of the cylinder part 10 in the axial direction may be referred to as the “other side”.

[0031] Also, the left-right direction of the cylinder part 10 shown in FIG. 1 may be referred to as a “radial direction”. The side closer to the axis in the radial direction may be referred to as an “inside in the radial direction”, and the side away from the axis in the radial direction may be referred to as an “outside in the radial direction”.

[Configuration and Functions of the Cylinder Part 10]

[0032] The cylinder part 10 includes a cylinder 11 storing oil, an outer cylinder body 12 disposed outside of the cylinder 11 in the radial direction, and a damper case 13 disposed outside of the cylinder 11 and also outside of the outer cylinder body 12 in the radial direction.

[0033] The cylinder 11 has a cylindrical shape and includes a cylinder opening 11H at the other side.

[0034] The outer cylinder body 12 has a cylindrical shape. The outer cylinder body 12 forms a communication path L between the outer cylinder body 12 and the cylinder 11. The

outer cylinder body 12 includes an outer cylinder opening 12H and an external connection part 12J at a position facing the external damping unit 100. The external connection part 12J has an oil channel, and protrudes to the outside in the radial direction to form a connection point with the external damping unit 100.

[0035] The damper case 13 has a cylindrical shape. The damper case 13 forms a reservoir chamber R for retention of oil between the damper case 13 and the outer cylinder body 12. Along with the movement of the rod 20 relative to the cylinder 11, the reservoir chamber R absorbs oil in the cylinder 11 (a first oil chamber Y1) or supplies oil into the cylinder 11 (the first oil chamber Y1). Further, the reservoir chamber R retains oil flowing out of the external damping unit 100. The damper case 13 includes a case opening 13H at a position facing the external damping unit 100.

[Configuration and Functions of the Rod 20]

[0036] The rod 20 is a rod-like member extending in the axial direction. The rod 20 connects to the piston part 30 at the one side. Also, the rod 20 connects to a vehicle body at the other side via a coupling member or the like (not shown in the figure). The rod 20 may have either a hollow body or a solid body.

[Configuration and Functions of the Piston Part 30]

[0037] The piston part 30 includes a piston body 31 having multiple piston oil ports 311, a piston valve 32 opening and closing the other side of the piston oil ports 311, and a spring 33 interposed between the piston valve 32 and the one side end of the rod 20. The piston part 30 partitions the oil chamber within the cylinder 11 into the first oil chamber Y1 and a second oil chamber Y2.

[Configuration and Functions of the Bottom Piston Part 40]

[0038] The bottom piston part 40 includes a valve seat 41, a check valve part 43 at the other side of the valve seat 41, and a fixing member 44 provided in the axial direction. The bottom piston part 40 provides partition between the first oil chamber Y1 and the reservoir chamber R.

[Configuration and Functions of the External Damping Unit 100]

[0039] FIG. 2 is sectional view of the external damping unit 100 of the first embodiment.

[0040] FIGS. 3A and 3B are explanatory diagrams of the control valve 70 and the control valve seat 75 of the first embodiment.

[0041] FIG. 3A is a perspective view of the control valve 70 and the control valve seat 75, and FIG. 3B is a top view of the control valve 70 and the control valve seat 75.

[0042] In the following description, the longitudinal direction of the external damping unit 100 shown in FIG. 2 (the direction intersecting (substantially perpendicular to) the axial direction of the cylinder part 10) may be referred to as a “second axial direction”. The left side of the external damping unit 100 in the second axial direction may be referred to as an “inside in the second axial direction”, and the right side of the external damping unit 100 in the second axial direction may be referred to as an “outside in the second axial direction”.

[0043] Also, the vertical direction of the external damping unit 100 shown in FIG. 2 (the direction intersecting the

second axial direction) may be referred to as a “second radial direction”. In the second radial direction, the side closer to the second axis may be referred to as an “inside in the second radial direction”, and the side away from the second axis may be referred to as an “outside in the second radial direction”.

[0044] As shown in FIG. 2, the external damping unit 100 includes a main valve part 50 that mainly generates a damping force in the hydraulic damper 1 of the first embodiment, and a damping force adjusting part 60 that adjusts the magnitude of the damping force generated in the external damping unit 100. The external damping unit 100 further includes a communication part 80 that forms channels parallel to the main valve part 50, and a connecting channel part 90 that forms an oil channel from the communication path L to the main valve part 50 and the communication part 80. The external damping unit 100 further includes an external housing 100C accommodating the components of the external damping unit 100.

(Main Valve Part 50)

[0045] The main valve part 50 includes a main valve 51 (an example of another valve part and the first valve part) that generates a damping force by controlling the oil flow so as to throttle it, and a main valve seat 52 (an example of the second channel forming part) that faces the main valve 51 and that the main valve 51 contacts.

[0046] The main valve 51 is an elastically deformable disk-like member including an opening 51H at the inside in the second radial direction. The main valve 51 may be made of metal such as iron. The communication part 80 penetrates the opening 51H of the main valve 51. At the inside in the second radial direction, the main valve 51 is interposed between the main valve seat 52 and a spacer member 684 (described later). The main valve 51 faces the outside in the second axial direction of the main valve seat 52.

[0047] The main valve 51 is restricted by the communication part 80 from moving in the second radial direction. Also, the inside in the second radial direction of the main valve 51 is restricted by the main valve seat 52 and the spacer member 684 (described later) from moving in the second axial direction. Meanwhile, the outside in the second radial direction of the main valve 51 can move in the second axial direction by deforming. The main valve 51 throttles the oil flow in main channels 53 (described later) of the main valve seat 52 to thereby generate a damping force.

[0048] The main valve seat 52 is a columnar member including an opening 52H at the inside in the second radial direction. The communication part 80 penetrates the opening 52H of the main valve seat 52.

[0049] The main valve seat 52 includes, on its side facing the main valve 51 (on the outside in the second axial direction), an inner round 521 provided at the inside in the second radial direction and an outer round 522 provided at the outside in the second radial direction. The main valve seat 52 further includes the main channels 53 penetrating in the second axial direction.

[0050] The inner round 521 annularly protrudes toward the main valve 51 (toward the outside in the second axial direction). In the first embodiment, the protrusion height of the inner round 521 is lower than that of the outer round 522. The outer round 522 annularly protrudes toward the main valve 51 (toward the outside in the second axial direction).

Each of the inner round 521 and the outer round 522 forms a contact point with the main valve 51.

[0051] The main channels 53 (an example of the third channel and the one channel) each form a channel parallel to the back pressure channel 77 and the low-speed channels 78 (described later). In the first embodiment, multiple main channels 53 are provided. A channel port 531 on the inside in the second axial direction of each main channel 53 faces the connecting channel part 90. A channel port 532 on the outside in the second axial direction of each main channel 53 has its outside in the second axial direction positioned between the inner round 521 and the outer round 522.

(Damping Force Adjusting Part 60)

[0052] The damping force adjusting part 60 includes the control valve 70 that throttles and controls oil flow in the communication part 80, and the control valve seat 75 that faces the control valve 70 and that the control valve 70 contacts. The damping force adjusting part 60 further includes the advancing/retracting part 61 (an example of the adjustment mechanism part) that advances and retracts the control valve 70 to and from the control valve seat 75, and a cap part 67 that covers the outside in the second axial direction of the control valve 70 and the control valve seat 75. The damping force adjusting part 60 further includes a back pressure forming part 68 that changes deformability of the main valve 51 against the main valve seat 52.

Control Valve 70

[0053] As shown in FIG. 3A, the control valve 70 (an example of the valve part and the second valve part) is an elastically deformable, substantially round planar member. The control valve 70 may be made of metal such as iron. The control valve 70 faces the outside in the second axial direction of the control valve seat 75.

[0054] As shown in FIG. 3B, the control valve 70 includes a back pressure channel facing portion 71 facing the back pressure channel 77 (described later), and a low-speed channel facing portion 72 facing the low-speed channels 78 (described later). The control valve 70 further includes an inner openings 73 provided at the inside in the second radial direction of the control valve 70 and making the control valve 70 easily deformable in the second axial direction, and outer openings 74 provided at the outside in the second radial direction relative to the inner openings 73 and making the control valve 70 easily deformable in the second axial direction.

[0055] The back pressure channel facing portion 71 is formed in a round and planar shape. The back pressure channel facing portion 71 is formed larger than an inner diameter of the back pressure channel 77 and able to cover a back pressure channel round 77R. In the first embodiment, the back pressure channel facing portion 71 is formed at the center (inside in the second radial direction) of the control valve 70.

[0056] The low-speed channel facing portion 72 is formed in a round and planar shape. The low-speed channel facing portion 72 is formed larger than an inner diameter of each low-speed channel 78 and able to cover each low-speed channel round 78R. The low-speed channel facing portion 72 is formed on the outside in the second radial direction of the back pressure channel facing portion 71. The low-speed channel facing portion 72 is formed as an annular area in the

control valve 70. In the first embodiment, this allows the low-speed channel facing portion 72 to always face the low-speed channels 78 regardless of the position of the control valve 70 in the circumferential direction relative to the control valve seat 75.

[0057] Each inner opening 73 is formed in a substantially arc shape. In the first embodiment, multiple inner openings 73 are provided at substantially equal intervals in the circumferential direction. In the following description, a portion between each two adjacent inner openings 73 is referred to as an inner arm portion 73A. In the control valve 70, the inner openings 73 are provided on the outside in the second radial direction of the back pressure channel facing portion 71 and on the inside in the second radial direction of the low-speed channel facing portion 72. In other words, the inner openings 73 are formed between the back pressure channel facing portion 71 and the low-speed channel facing portion 72 in the second radial direction.

[0058] The multiple inner openings 73 are formed in a spiral shape as a whole. Specifically, each inner opening 73 is formed such that a distance from the center (inside in the second radial direction) becomes longer as the inner opening 73 goes in the circumferential direction. The multiple inner arm portions 73A are formed in a spiral shape as a whole.

[0059] Each outer opening 74 is formed in a substantially arc shape. In the first embodiment, multiple outer openings 74 are provided at substantially equal intervals in the circumferential direction. In the following description, a portion between each two adjacent outer openings 74 is referred to as an outer arm portion 74A.

[0060] The multiple outer openings 74 are formed in a spiral shape as a whole. Specifically, each outer opening 74 is formed such that a distance from the center (inside in the second radial direction) becomes longer as the outer opening 74 goes in the circumferential direction. The multiple outer arm portions 74A are formed in a spiral shape as a whole.

[0061] As shown in FIG. 3B, the outer openings 74 are formed on the outside in the second radial direction of the back pressure channel facing portion 71 and the low-speed channel facing portion 72 and on the inside in the second radial direction of a portion facing an outer round 76 (described later) of the control valve seat 75.

[0062] The control valve 70 of the first embodiment is itself thicker than a certain thickness, which increases the durability of the control valve 70. Meanwhile, the control valve 70 of the first embodiment has its rigidity reduced at its portions where the inner arm portions 73A are formed, making these portions where the inner arm portions 73A are formed easily deformable. Also, the control valve 70 of the first embodiment has its rigidity reduced at its portions where the outer arm portions 74A are formed, making these portions where the outer arm portions 74A are formed easily deformable.

[0063] In the hydraulic damper 1 of the first embodiment, the back pressure channel facing portion 71 and the low-speed channel facing portion 72 are integrally formed in the control valve 70 which is a single member.

[0064] As the control valve 70 is composed of a single member in the first embodiment, damping force can be easily set by, for example, adjusting a spring rate by changing the plate thickness of the control valve 70.

Control Valve Seat 75

[0065] The control valve seat 75 includes the outer round 76 holding the control valve 70, the back pressure channel 77 (an example of the first channel) defining an oil channel for adjusting oil pressure in a back pressure chamber 68P (an example of the accommodation chamber; described later), and the low-speed channels 78 (an example of the second channel and another channel) each defining an oil channel in a low-speed stroke.

[0066] The outer round 76 annularly protrudes toward the control valve 70 (toward the outside in the second axial direction) at the outside in the second radial direction. The outer round 76 forms an area where the control valve 70 is held on its outside in the second radial direction between the outer round 76 and the cap part 67.

[0067] The back pressure channel 77 penetrates the control valve seat 75 in the second axial direction. The back pressure channel 77 communicates with a communication chamber 82 of the communication part 80 at the inside in the second axial direction and faces the control valve 70 at the outside in the second axial direction.

[0068] The back pressure channel 77 further includes the back pressure channel round 77R annularly protruding toward the control valve 70 (toward the outside in the second axial direction).

[0069] In the hydraulic damper 1 of the first embodiment, the back pressure channel 77 is a channel for controlling oil pressure in the back pressure chamber 68P that adjusts how easily the main valve 51 opens the main channels 53.

[0070] The low-speed channels 78 penetrate the control valve seat 75 in the second axial direction. Multiple low-speed channels 78 are provided on the outside in the second radial direction of the back pressure channel 77. Each of the low-speed channels 78 communicates with a low-speed communication path 85 of the communication part 80 at the inside in the second axial direction and faces the control valve 70 at the outside in the second axial direction.

[0071] Each of the low-speed channels 78 includes the low-speed channel round 78R annularly protruding toward the control valve 70 (toward the outside in the second axial direction).

[0072] The protrusion height of the outer round 76 is larger than that of the back pressure channel round 77R and the low-speed channel round 78R. The protrusion height of the back pressure channel round 77R is larger than that of the low-speed channel round 78R.

[0073] Note that, in the first embodiment, it is only required that the protrusion height of the back pressure channel round 77R be larger than that of the low-speed channel round 78R, and thus the low-speed channel round 78R does not need to protrude from its surroundings.

[0074] In the hydraulic damper 1 of the first embodiment, each of the low-speed channels 78 is a channel that allows for oil flow in the damping force adjusting part 60 when the piston part 30 is moving at a speed slower than its moving speed at which oil opens the main valve 51 and flows through the main channels 53.

[0075] In the hydraulic damper 1 of the first embodiment, the back pressure channel 77 and the low-speed channels 78 are integrally formed in the control valve seat 75 which is a single member. The back pressure channel 77 and the low-speed channels 78 in the control valve seat 75 are separated from each other and form parallel channels.

Advancing/Retracting Part 61

[0076] The advancing/retracting part 61 includes a solenoid part 62 advancing and retracting a plunger 64 (described later) by using an electromagnet, a compression coil spring 63 provided between the plunger 64 and an advancing/retracting member 65, and the plunger 64 advanced and retracted in the second axial direction. The advancing/retracting part 61 further includes the advancing/retracting member 65 pressing the control valve 70 against the control valve seat 75, and a controlling part 66 for increasing the pressure of oil in the back pressure chamber 68P when the solenoid part 62 is not energized. The advancing/retracting part 61 further includes a solenoid case 60C accommodating and supporting the components of the advancing/retracting part 61.

[0077] When the electromagnet is energized, the solenoid part 62 pushes the plunger 64 toward the advancing/retracting member 65.

[0078] The compression coil spring 63 contacts the advancing/retracting member 65 at the inside in the second axial direction and connects to the plunger 64 at the outside in the second axial direction. The compression coil spring 63 imparts force to each of the advancing/retracting member 65 and the plunger 64 in opposite directions away from each other.

[0079] The plunger 64 is pushed toward the advancing/retracting member 65 when the solenoid part 62 is energized, and pulled back by the compression coil spring 63 when the solenoid part 62 is not energized.

[0080] The advancing/retracting member 65 includes valve contacting portions 651 protruding toward the control valve 70 (toward the inside in the second axial direction). Multiple valve contacting portions 651 are provided at substantially equal intervals in the circumferential direction. The valve contacting portions 651 are formed at positions facing the low-speed channel facing portion 72. The valve contacting portions 651 contact the low-speed channel facing portion 72 of the control valve 70.

[0081] Also, an opening 652 is formed between each adjacent two of the valve contacting portions 651. The opening 652 permits oil flow from the inside in the second radial direction of the advancing/retracting member 65 to the outside in the second radial direction thereof.

[0082] The controlling part 66 is fixed to an end at the inside in the second axial direction of the plunger 64. Accordingly, the controlling part 66 moves along with the movement of the plunger 64. When moved to the outside in the second axial direction, the controlling part 66 faces radial channels 672 (described later) of the cap part 67 and, when moved to the inside in the second axial direction, comes away from the radial channels 672.

[0083] The controlling part 66 also forms an orifice channel 66F that permits oil flow between the controlling part 66 and the cap part 67. The orifice channel 66F is always formed regardless of the position of the controlling part 66 in the second axial direction.

[0084] The controlling part 66 further includes a penetrating channel 661 penetrating in the second axial direction. The channel cross-sectional area of the penetrating channel 661 is larger than that of the above orifice channel 66F.

[0085] When the solenoid part 62 is not energized, the controlling part 66 (an example of the restricting part) of the first embodiment faces the radial channels 672 (described later) of the cap part 67 so that only the orifice channel 66F,

not the penetrating channel 661, provides an oil channel to the radial channels 672. Thus, the controlling part 66 restricts oil from flowing out from the back pressure chamber 68P through the back pressure channel 77 (described later) when the solenoid part 62 is not energized.

Cap Part 67

[0086] The cap part 67 includes an intra-cap oil chamber 671 formed at the inside in the second radial direction, the radial channels 672 penetrating the cap part 67 in the second radial direction, and a holding part 673 holding the control valve 70, the control valve seat 75, and the communication part 80.

[0087] The intra-cap oil chamber 671 is formed on the outside in the second axial direction of the control valve 70. The intra-cap oil chamber 671 forms a space in which the plunger 64, the advancing/retracting member 65, and the controlling part 66 can move in the second axial direction.

[0088] Each radial channel 672 communicates with the intra-cap oil chamber 671 at the inside in the second radial direction and communicates with an intra-housing channel 111 (described later) at the outside in the second radial direction.

[0089] The control valve 70, the control valve seat 75, and the communication part 80 are press-fitted into the inside in the second radial direction of the holding part 673, whereby the holding part 673 holds these members.

Back Pressure Forming Part 68

[0090] The back pressure forming part 68 (an example of the pressing part) includes a case part 681 and a sealing part 682. The case part 681 forms the back pressure chamber 68P on an opposite side (outside in the second axial direction) of the main valve 51 from the main valve seat 52. The sealing part 682 maintains liquid tightness between the cap part 67 and the case part 681. The back pressure forming part 68 further includes a case return spring 683 and a spacer member 684. The case return spring 683 applies a pressing force to the case part 681 by which the case part 681 is pressed against the main valve 51. The spacer member 684 is interposed between the case return spring 683 and the main valve 51.

[0091] The case part 681 includes, at the inside in the second axial direction, a main valve contacting portion 681T contacting the main valve 51. The case part 681 is movable in the second axial direction. Under the pressure of oil in the back pressure chamber 68P, the case part 681 presses the main valve 51 against the main channels 53. According to the pressure of oil in the back pressure chamber 68P, the pressing force applied from the case part 681 to the main valve 51 changes.

[0092] The sealing part 682 may be made of an elastically deformable resin material such as rubber. The sealing part 682 restrains oil from flowing out from the back pressure chamber 68P to the outside and also holds the case part 681 such that the case part 681 is movable in the second axial direction.

Communication Part 80

[0093] The communication part 80 includes an inflow channel 81 into which oil flows from the communication path L, a communication chamber 82 communicating with the back pressure channel 77 of the control valve seat 75,

and back pressure communication paths **83** connecting the communication chamber **82** and the back pressure chamber **68P**. The communication part **80** further includes a back pressure orifice channel **84** connecting the inflow channel **81** and the communication chamber **82**, and low-speed communication paths **85** connecting the low-speed channels **78** of the control valve seat **75** and the communication chamber **82**.

[0094] The inflow channel **81** is formed along the second axial direction.

[0095] The communication chamber **82** communicates with the back pressure orifice channel **84** at the inside in the second axial direction, communicates with the back pressure channel **77** at the outside in the second axial direction, and faces the back pressure communication paths **83** in the second radial direction.

[0096] Each back pressure communication path **83** communicates with the communication chamber **82** at the inside in the second radial direction and communicates with the back pressure chamber **68P** at the outside in the second radial direction.

[0097] The channel cross-sectional area of the back pressure orifice channel **84** is smaller than that of the back pressure communication path **83** and the back pressure channel **77**. Thus, the back pressure orifice channel **84** hardly allows oil in the back pressure chamber **68P** to return to the inflow channel **81** through the back pressure orifice channel **84**.

[0098] The channel cross-sectional area of the low-speed communication path **85** is larger than that of the low-speed channel **78**. In the first embodiment, oil flow during a low-speed stroke (described later) is adjusted by the low-speed channels **78** of the control valve seat **75**. Accordingly, the oil flow is not throttled on the upstream side of the low-speed channels **78** in the oil flow.

Connecting Channel Part 90

[0099] The connecting channel part **90** includes an inner channel **91** at the inside in the second radial direction and outer channels **92** at the outside in the second radial direction.

[0100] The inner channel **91** communicates with the outer cylinder opening **12H** at the inside in the second axial direction and communicates with the inflow channel **81** of the communication part **80** and the main channels **53** of the main valve seat **52** at the outside in the second axial direction.

[0101] Multiple outer channels **92** are provided in the first embodiment. The outer channels **92** each communicate with the case opening **13H** at the inside in the second axial direction and communicate with the intra-housing channel **111** at the outside in the second axial direction.

(External Housing 100c)

[0102] The external housing **100c** is a substantially cylindrical member. At the inside in the second axial direction, the external housing **100c** is fixed to the damper case **13** by welding and the like.

[0103] The external housing **100c** is formed with the intra-housing channel **111** at the outside in the second radial direction of the main valve part **50** and the damping force adjusting part **60**. The intra-housing channel **111** defines an oil channel in the external housing **100c**.

[0104] Oil flowing out from the radial channels **672** of the cap part **67** and oil flowing out from the main channels **53** of the main valve seat **52** by opening the main valve **51** flow into the intra-housing channel **111**.

[Adjustment Operation of the Damping Force Adjusting Part 60]

[0105] Now a description will be given of an adjustment operation of the damping force adjusting part **60**.

[0106] FIG. 4 is an explanatory diagram of how the control valve **70**, the control valve seat **75**, and the advancing/retracting member **65** operate.

[0107] As shown in FIG. 4, pushing the advancing/retracting member **65** toward the inside in the second axial direction causes the control valve **70** to be pressed against the control valve seat **75**. The pressing force of the advancing/retracting member **65** changes according to an amount of current supplied to the solenoid part **62** (see FIG. 2).

[0108] For example, in the damping force adjusting part **60**, a state is formed in which the advancing/retracting member **65** is imparted with the largest pressing force. In the damping force adjusting part **60**, this causes the control valve **70** to be most strongly pressed against the control valve seat **75**. Specifically, as shown in FIG. 4, the valve contacting portion **651** of the advancing/retracting member **65** moves the low-speed channel facing portion **72** closer to the low-speed channels **78** and presses the low-speed channel facing portion **72** against the low-speed channels **78** (the low-speed channel rounds **78R**).

[0109] Further, the low-speed channel facing portion **72** of the first embodiment connects to the back pressure channel facing portion **71** via the inner arm portions **73A**. Accordingly, as the valve contacting portion **651** of the advancing/retracting member **65** moves the low-speed channel facing portion **72**, the back pressure channel facing portion **71** also approaches the back pressure channel **77**. Thus, the back pressure channel facing portion **71** is pressed against the back pressure channel **77** (the back pressure channel round **77R**). In the first embodiment, the back pressure channel **77** protrudes more than the low-speed channels **78**. In the first embodiment, this ensures that the back pressure channel **77** is surely pressed against by the back pressure channel facing portion **71**.

[0110] As such, the back pressure channel facing portion **71** contacts the back pressure channel round **77R**, closing the back pressure channel **77**. Simultaneously, the low-speed channel facing portion **72** contacts the low-speed channel rounds **78R**, closing the low-speed channels **78**.

[0111] Also for example, in the damping force adjusting part **60**, a state is formed in which the advancing/retracting member **65** is imparted with the smallest pressing force. In the damping force adjusting part **60**, this causes the back pressure channel facing portion **71** to go away from the back pressure channel round **77R**, opening the back pressure channel **77**. Simultaneously, the low-speed channel facing portion **72** goes away from the low-speed channel rounds **78R**, opening the low-speed channels **78**.

[0112] Also for example, in the damping force adjusting part **60**, a state is formed in which the advancing/retracting member **65** is imparted with an intermediate pressing force between the largest pressing force and the smallest pressing force. In the damping force adjusting part **60**, this causes the back pressure channel facing portion **71** to go away from the back pressure channel round **77R** as compared to when the

advancing/retracting member **65** exerts the largest pressing force but to come closer to the back pressure channel round **77R** as compared to when the advancing/retracting member **65** exerts the smallest pressing force. Simultaneously, the low-speed channel facing portion **72** goes away from the low-speed channel rounds **78R** as compared to when the advancing/retracting member **65** exerts the largest pressing force but comes closer to the low-speed channel rounds **78R** as compared to when the advancing/retracting member **65** exerts the smallest pressing force.

[0113] In the above first embodiment, the low-speed channels **78** protrude less than the back pressure channel **77**, and the low-speed channel facing portion **72** facing these lower low-speed channels **78** is pushed by the advancing/retracting member **65**. When, conversely, the back pressure channel **77** is made to protrude less than the low-speed channels **78**, the back pressure channel facing portion **71** facing this lower back pressure channel **77** may be pushed by the advancing/retracting member **65**.

[0114] Alternatively, the valve contacting portion **651** of the advancing/retracting member **65** may be made to contact both of the back pressure channel facing portion **71** and the low-speed channel facing portion **72**, so that the valve contacting portion **651** is advanced and retracted to and from the low-speed channels **78** and the back pressure channel **77**.

[Operation of the Hydraulic Damper 1]

[0115] FIGS. **5A** and **5B** are explanatory diagrams of how the hydraulic damper **1** of the first embodiment operates. FIG. **5A** shows an oil flow during a tension stroke, and FIG. **5B** shows an oil flow during a compression stroke.

[0116] First, a description will be given of how the hydraulic damper **1** operates in a tension stroke.

[0117] As shown in FIG. **5A**, during a tension stroke, the rod **20** moves to the other side relative to the cylinder **11**. At this time, the piston valve **32** keeps the piston oil ports **311** closed. Further, the movement of the piston part **30** to the other side reduces the volume of the second oil chamber **Y2**. Thus, the oil in the second oil chamber **Y2** flows out from the cylinder opening **11H** into the communication path **L**.

[0118] The oil then flows through the communication path **L** and the outer cylinder opening **12H** into the external damping unit **100**. In the external damping unit **100**, the oil first flows into the inner channel **91** of the connecting channel part **90**. Then, a damping force is generated at the main valve **51** or the control valve **70** in the external damping unit **100**. An oil flow at that time will be detailed later.

[0119] Having flowed through the main valve **51** or the control valve **70**, the oil flows out into the intra-housing channel **111**. The oil then flows through the outer channels **92** of the connecting channel part **90** before flowing into the reservoir chamber **R** through the case opening **13H**.

[0120] The pressure in the first oil chamber **Y1** is relatively lower than the pressure in the reservoir chamber **R**. For this reason, the oil in the reservoir chamber **R** flows through the bottom piston part **40** into the first oil chamber **Y1**.

[0121] Now a description will be given of an operation of the hydraulic damper **1** during a compression stroke.

[0122] As shown in FIG. **5B**, during a compression stroke of the hydraulic damper **1**, the rod **20** moves to the one side relative to the cylinder **11**. In the piston part **30**, pressure difference between the first oil chamber **Y1** and the second

oil chamber **Y2** causes the piston valve **32** to open the piston oil ports **311**. Thus, the oil within the first oil chamber **Y1** flows out through the piston oil ports **311** into the second oil chamber **Y2**. Here, the rod **20** is present within the second oil chamber **Y2**. For this reason, the oil flowing from the first oil chamber **Y1** into the second oil chamber **Y2** is excessive in the amount equal to the volume of the rod **20** within the second oil chamber **Y2**. Accordingly, the oil in the amount equal to the volume of the rod **20** within the second oil chamber **Y2** flows out through the cylinder opening **11H** into the communication path **L**.

[0123] The oil then flows through the communication path **L** and the outer cylinder opening **12H** into the external damping unit **100**. The oil flow within the external damping unit **100** is the same as that during a tension stroke described above. In other words, in the hydraulic damper **1** of the first embodiment, oil flows in the same direction within the external damping unit **100** during both of the compression and tension strokes.

[0124] Also, as a result of the rod **20** moving to the one side relative to the cylinder **11**, the oil within the first oil chamber **Y1** flows into the channel in the valve seat **41** of the bottom piston part **40**.

[0125] As described above, the hydraulic damper **1** of the first embodiment generates a damping force by the external damping unit **100** in both of the compression and tension strokes.

[0126] Now a detailed description will be given of an oil flow in the external damping unit **100**.

[0127] First, a description will be given of an oil flow when the pressing force of the advancing/retracting member **65** is relatively small. The following description uses an example where the control valve **70** is positioned away from the back pressure channel round **77R** and the low-speed channel rounds **78R**.

[0128] FIGS. **6A** and **6B** are explanatory diagrams of how oil flows in the external damping unit **100**. FIG. **6A** shows an oil flow during a low-speed stroke and when the pressing force of the advancing/retracting member **65** is relatively small, and FIG. **6B** shows an oil flow during a high-speed stroke and when the pressing force of the advancing/retracting member **65** is relatively small.

(During a Low-Speed Stroke)

[0129] As shown in FIG. **6A**, when the piston part **30** is moving at a low speed, oil having flowed into the inner channel **91** flows into the inflow channel **81** and the main channels **53**. As the piston part **30** is moving at a low speed, no oil flow occurs in the main channels **53** that opens the main valve **51**.

[0130] Meanwhile, the oil having flowed into the inflow channel **81** flows through the low-speed communication paths **85**, the low-speed channels **78**, the inner openings **73** or the outer openings **74** (see FIGS. **3A** and **3B**), the penetrating channel **661** or the orifice channel **66F**, and the radial channels **672** in this order. Then, the oil flows out into the intra-housing channel **111**.

[0131] As such, when the piston part **30** is moving at a low speed, the damping force is generated by the oil flow in the low-speed channels **78** in the control valve seat **75**.

(During a High-Speed Stroke)

[0132] As shown in FIG. 6B, when the piston part 30 is moving at a high speed, oil having flowed into the inner channel 91 flows into the inflow channel 81 and the main channels 53. Here, in the above-described oil path in a low-speed stroke, the low-speed channels 78 with a relatively small channel cross-sectional area are present, which makes it difficult for the oil to flow therethrough. Meanwhile, the oil having flowed into the main channels 53 opens the main valve 51 to flow into the intra-housing channel 111.

[0133] As such, when the piston part 30 is moving at a high speed, the damping force is generated by the oil flow in the main channels 53 of the main valve seat 52.

[0134] Also, the oil having flowed into the inflow channel 81 flows through the back pressure orifice channel 84 and the back pressure communication paths 83 into the back pressure chamber 68P. However, the back pressure channel 77 communicating with the back pressure chamber 68P is left open by the control valve 70. Thus, the pressure in the back pressure chamber 68P is low as compared to when the control valve 70 is pressed against the back pressure channel 77. And the main valve 51 in contact with the case part 681 (see FIG. 2) relatively easily opens the main channels 53. Hence, when the pressing force of the advancing/retracting member 65 is relatively small, the damping force generated by the oil flow in the main channels 53 opening the main valve 51 is relatively small.

[0135] Now a description will be given of an oil flow when the pressing force of the advancing/retracting member 65 is relatively large.

[0136] The following description uses an example where the control valve 70 is pressed against the back pressure channel round 77R and the low-speed channel rounds 78R.

[0137] FIGS. 7A and 7B are explanatory diagrams of how oil flows in the external damping unit 100. FIG. 7A shows an oil flow during a low-speed stroke and when the pressing force of the advancing/retracting member 65 is relatively large, and FIG. 7B shows an oil flow during a high-speed stroke and when the pressing force of the advancing/retracting member 65 is relatively large.

(During a Low-Speed Stroke)

[0138] As shown in FIG. 7A, when the piston part 30 is moving at a low speed, oil having flowed into the inner channel 91 flows into the inflow channel 81 and the main channels 53. As the piston part 30 is moving at a low speed, no oil flow occurs in the main channels 53 by opening the main valve 51.

[0139] Meanwhile, the oil having flowed into the inflow channel 81 flows through the low-speed communication paths 85 into the low-speed channels 78. The oil then flows through the low-speed channels 78 while opening the control valve 70. The oil further flows through the inner openings 73 or the outer openings 74 (see FIG. 3A and 3B), the penetrating channel 661 or the orifice channel 66F, and the radial channels 672 in this order. Then, the oil flows into the intra-housing channel 111.

[0140] As such, when the piston part 30 is moving at a low speed, the damping force is generated by the oil flow in the low-speed channels 78 in the control valve seat 75. This damping force from the oil flow in the low-speed channels 78 is large as compared to when the control valve 70 is positioned away from the low-speed channels 78.

(During a High-Speed Stroke)

[0141] As shown in FIG. 7B, when the piston part 30 is moving at a high speed, oil having flowed into the inner channel 91 flows into the inflow channel 81 and the main channels 53. Here, in the above-described oil path in a low-speed stroke, the low-speed channels 78 with a relatively small channel cross-sectional area are present, which makes it difficult for the oil to flow therethrough. Meanwhile, the oil having flowed into the main channels 53 opens the main valve 51 to flow into the intra-housing channel 111.

[0142] As such, when the piston part 30 is moving at a high speed, the damping force is generated by the oil flow in the main channels 53 of the main valve seat 52.

[0143] Also, the oil having flowed into the inflow channel 81 flows through the back pressure orifice channel 84 and the back pressure communication paths 83 into the back pressure chamber 68P. The back pressure channel 77 communicating with the back pressure chamber 68P is pressed against by the control valve 70. Thus, the pressure in the back pressure chamber 68P is high as compared to when the back pressure channel 77 is left open. And the main valve 51 in contact with the case part 681 relatively hardly opens the main channels 53. Hence, when the pressing force of the advancing/retracting member 65 is relatively large, the damping force generated by the oil flow in the main channels 53 opening the main valve 51 is relatively large.

[0144] As described above, in the hydraulic damper 1 of the first embodiment, both of the damping force during a low-speed stroke and the damping force during a high-speed stroke are adjusted by operating the advancing/retracting member 65. In other words, both of the flow area of the low-speed channels 78, which are oil channels in a low-speed stroke, and the flow area of the back pressure channel 77, which adjusts the pressure in the back pressure chamber 68P related to the oil flow area in a high-speed stroke, are adjusted by changing the pressing force by which the control valve 70 is pressed against the control valve seat 75 by the advancing/retracting member 65.

[0145] Further, the hydraulic damper 1 of the first embodiment allows both of the oil flow in the back pressure channel 77 and the oil flow in the low-speed channels 78 to be simultaneously controlled by the single control valve 70. In particular, the hydraulic damper 1 of the first embodiment allows for control of the oil flow in the low-speed channels 78 during a low-speed stroke and thus allows for adjustment to conditions upon which the main valve 51 opens the main channels 53 (a so-called blow point). This allows for finer control of the damping force than conventional art.

[0146] It should be noted that, while the two operational patterns have been described in the above example, one of which is when the pressing force of the advancing/retracting member 65 is relatively large and the other of which is when the pressing force is relatively small, these patterns are not the sole ones. The pressing force of the advancing/retracting member 65 may be set in any ways within an adjustable range according to the amount of electric current to the solenoid part 62. Along with this setting, multi-stage adjustment to the damping force during both low-speed and high-speed strokes by the damping force adjusting part 60 of the first embodiment is possible.

[0147] Now a description will be given of an oil flow when the solenoid part 62 is not energized.

[0148] FIGS. 8A and 8B are explanatory diagrams of how oil flows in the external damping unit 100. FIG. 8A shows

an oil flow during a low-speed stroke and when the solenoid part 62 is not energized, and FIG. 8B shows an oil flow during a high-speed stroke and when the solenoid part 62 is not energized.

[0149] As shown in FIGS. 8A and 8B, when the solenoid part 62 is not energized, the plunger 64 is pushed back toward the outside in the second axial direction by the compression coil spring 63. This results in the controlling part 66 fixed to the plunger 64 being pressed against the solenoid case 60C. Thus, the controlling part 66 faces the radial channels 672 of the cap part 67. Also, an end of the penetrating channel 661 of the controlling part 66 on the outside in the second axial direction gets closed by the solenoid case 60C.

(During a Low-Speed Stroke)

[0150] As shown in FIG. 8A, when the piston part 30 is moving at a low speed, oil having flowed into the inflow channel 81 flows through the low-speed communication paths 85, the low-speed channels 78, the inner openings 73 and the outer openings 74, the orifice channel 66F, and the radial channels 672 in this order, similarly to the oil flow as explained with reference to FIG. 6A. The oil then flows out into the intra-housing channel 111.

[0151] When the piston part 30 is moving at a low speed, the damping force is generated by the oil flow in the orifice channel 66F. In the first embodiment, the channel cross-sectional area of the orifice channel 66F is smaller than that of each low-speed channel 78. Accordingly, the damping force generated by the oil flow in the orifice channel 66F is larger than that generated by, for example, the oil flow in the low-speed channels 78.

(During a High-Speed Stroke)

[0152] As shown in FIG. 8B, when the piston part 30 is moving at a high speed, oil having flowed into the inner channel 91 flows into the inflow channel 81 and the main channels 53, similarly to the oil flow as explained with reference to FIG. 7B. Here, in the above-described oil path in a low-speed stroke, the low-speed channels 78 with a relatively small channel cross-sectional area are present, which makes it difficult for the oil to flow therethrough. Accordingly, the oil having flowed into the main channels 53 opens the main valve 51 to flow into the intra-housing channel 111.

[0153] As such, when the piston part 30 is moving at a high speed, the damping force is generated by the oil flow in the main channels 53 of the main valve seat 52.

[0154] Also, the oil having flowed into the inflow channel 81 flows through the back pressure orifice channel 84 and the back pressure communication paths 83 into the back pressure chamber 68P. Here, the back pressure chamber 68P communicates with the intra-cap oil chamber 671 via the back pressure channel 77, and the oil in the intra-cap oil chamber 671 needs to go through the orifice channel 66F before flowing into the intra-housing channel 111. This restrains the oil from flowing out of the back pressure chamber 68P, keeping the pressure in the back pressure chamber 68P relatively high. And the main valve 51 in contact with the case part 681 relatively hardly opens the main channels 53. Thus, when the solenoid part 62 is not

energized, the damping force generated by the oil flow in the main channels 53 opening the main valve 51 is relatively large.

[0155] As described above, even when the solenoid part 62 is not energized, the hydraulic damper 1 of the first embodiment generates a relatively large damping force in both of low-speed and high-speed strokes.

Second Embodiment

[0156] Now a description will be given of the damping force adjusting part 60 of the external damping unit 100 of the second embodiment.

[0157] FIG. 9 is an explanatory diagram of the damping force adjusting part 60 of the second embodiment.

[0158] The damping force adjusting part 60 of the second embodiment differs in its control valve 270 from the control valve 70 of the first embodiment.

[0159] The control valve 270 includes a first control valve 270A and a second control valve 270B. In the external damping unit 100 of the second embodiment, the first control valve 270A and the second control valve 270B are provided on the control valve seat 75 in this order from the inside to the outside in the second axial direction.

[0160] The first control valve 270A is an elastically deformable, generally round planar member. The first control valve 270A includes a round back pressure channel facing portion 271 facing the back pressure channel 77, and multiple (four in the second embodiment) arm portions 272 supporting the back pressure channel facing portion 271.

[0161] The second control valve 270B is an elastically deformable, generally round planar member. The second control valve 270B includes an annular low-speed channel facing portion 273 facing the low-speed channels 78 and multiple (two in the second embodiment) arm portions 274 supporting the low-speed channel facing portion 273.

[0162] In the above-configured damping force adjusting part 60 of the second embodiment, the valve contacting portions 651 of the advancing/retracting member 65 are made to contact the second control valve 270B to advance and retract the second control valve 270B and the first control valve 270A to and from the control valve seat 75. In the external damping unit 100 of the second embodiment, control of the oil flow in the back pressure channel 77 by the back pressure channel facing portion 271 of the first control valve 270A and control of the oil flow in the low-speed channels 78 by the low-speed channel facing portion 273 of the second control valve 270B are simultaneously made possible by the single advancing/retracting member 65.

Third Embodiment

[0163] An external damping unit 300 of the third embodiment will be described below. In the description of the third embodiment, similar components to those in the above embodiments are denoted by the same reference numerals, and detailed description thereof has been omitted.

[0164] FIG. 10 is a sectional view of the external damping unit 300 of the third embodiment.

[0165] FIG. 11 is a perspective sectional view of the external damping unit 300 of the third embodiment.

[0166] FIGS. 12A and 12B are explanatory diagrams of a control valve 370 and a control valve seat 375 of the third embodiment.

[0167] FIG. 12A is a perspective view of the control valve 370 and the control valve seat 375, and FIG. 12B is a top view of the control valve 370 and the control valve seat 375.

[Configuration and Functions of the External Damping Unit 300]

[0168] As shown in FIG. 10, the external damping unit 300 includes the main valve part 50 that mainly generates a damping force in the hydraulic damper 1 of the third embodiment, and a damping force adjusting part 360 that adjusts the magnitude of the damping force generated in the external damping unit 300. The external damping unit 300 further includes a communication part 380 that forms channels parallel to the main valve part 50, and includes the connecting channel part 90 and the external housing 100c.

(Damping Force Adjusting Part 360)

[0169] As shown in FIG. 11, the damping force adjusting part 360 of the third embodiment includes an advancing/retracting part 61, a cap part 367 covering components including the main valve part 50, and the back pressure forming part 68. The damping force adjusting part 360 further includes a control valve 370 that throttles and controls oil flow in the communication part 380, a control valve seat 375 that faces the control valve 370 and that the control valve 370 contacts, and a throttle member 379 for throttling oil flow.

[0170] As shown in FIG. 10, the cap part 367 accommodates therein the main valve part 50, the control valve 370, the control valve seat 375, the throttle member 379, the inside in the second axial direction of the plunger 64, and the advancing/retracting member 65. The cap part 367 is fixed by being interposed between the solenoid case 60C and the connecting channel part 90.

[0171] The cap part 367 forms a cap channel 367R between the cap part 367 and the solenoid case 60C for flow of oil. The cap channel 367R communicates with an opening 367H (described later) and with the intra-housing channel 111.

[0172] The cap part 367 includes, at its end on the outside in the second axial direction, the opening 367H that the plunger 64 penetrates. The advancing/retracting member 65 advances and retracts to and from the opening 367H. With the advancing/retracting member 65 being away from the opening 367H, the opening 367H permits oil flow between the cap channel 367R and the channel on the control valve 370 side. With the advancing/retracting member 65 being in contact with the opening 367H, the opening 367H restricts oil flow between the cap channel 367R and the channel on the control valve 370 side.

Control Valve 370

[0173] As shown in FIG. 12A, the control valve 370 is an elastically deformable, substantially round planar member. The control valve 370 may be made of metal such as iron. The control valve 370 faces the outside in the second axial direction of the control valve seat 375.

[0174] As shown in FIG. 12B, the control valve 370 includes an outer annular portion 370C (an example of the held portion) formed in an annular shape, a back pressure channel facing portion 371 (an example of the second controlling portion) facing the back pressure channel 77, and a low-speed channel facing portion 372 (an example of the

first controlling portion) facing the low-speed channels 78. The control valve 370 further includes an inner openings 373 provided at the inside in the second radial direction of the control valve 370 and making the control valve 370 easily deformable in the second axial direction, and outer openings 374 provided on the outside in the second radial direction of the inner openings 373 and making the control valve 370 easily deformable in the second axial direction.

[0175] The outer annular portion 370C is provided at the outside in the second radial direction. The outer annular portion 370C serves as a portion that is interposed between the cap part 367 and the control valve seat 375. The control valve 370 of the third embodiment is held by the control valve seat 375 by having its outer annular portion 370C interposed between the cap part 367 and the control valve seat 375 (see FIG. 10).

[0176] The back pressure channel facing portion 371 is formed in a round and planar shape. The back pressure channel facing portion 371 is formed larger than the inner diameter of the back pressure channel 77 and able to cover the back pressure channel round 77R. In the third embodiment, the back pressure channel facing portion 371 is formed at the center (inside in the second radial direction) of the control valve 370.

[0177] The low-speed channel facing portion 372 is formed in an annular and planar shape. The low-speed channel facing portion 372 is formed larger than an inner diameter of each low-speed channel 78 and able to cover each low-speed channel round 78R. The low-speed channel facing portion 372 is formed on the outside in the second radial direction of the back pressure channel facing portion 371. The low-speed channel facing portion 372 is formed as an annular area in the control valve 370. This allows the low-speed channel facing portion 372 to always face the low-speed channels 78 regardless of the position of the control valve 370 in the circumferential direction relative to the control valve seat 375.

[0178] The inner openings 373 are elongated along the circumferential direction of the control valve 370. Multiple inner openings 373 are provided. An inner arm portion 373A (an example of the second supporting portion) is formed between each two adjacent inner openings 373. The inner arm portion 373A at least partially extends along the circumferential direction. In the third embodiment, the multiple inner arm portions 373A are formed in a spiral shape as a whole. In the control valve 370, the inner arm portions 373A are provided on the outside in the second radial direction of the back pressure channel facing portion 371 and on the inside in the second radial direction of the low-speed channel facing portion 372. In other words, the inner arm portions 373A are formed between the back pressure channel facing portion 371 and the low-speed channel facing portion 372 in the second radial direction.

[0179] Also, a width B11 of the inner arm portion 373A near the back pressure channel facing portion 371 is larger than a width B12 thereof farther from the back pressure channel facing portion 371. And a width B13 of the inner arm portion 373A near the low-speed channel facing portion 372 is larger than the width B12 thereof farther from the low-speed channel facing portion 372.

[0180] As shown in FIG. 12A, the outer openings 374 extend in the circumferential direction of the control valve 370. The multiple outer openings 374 are provided at substantially equal intervals in the circumferential direction.

In the control valve 370 of the third embodiment, two different outer openings 374 overlap each other in the second radial direction.

[0181] As shown in FIG. 12B, the outer openings 374 are formed on the outside in the second radial direction of the low-speed channel facing portion 372 and on the inside in the second radial direction of the outer annular portion 370C.

[0182] An outer arm portion 374A (an example of the first supporting portion) is formed between each two adjacent outer openings 374. The outer arm portion 374A at least partially extends along the circumferential direction. In the third embodiment, the multiple outer arm portions 374A are formed in a spiral shape as a whole. In the control valve 370, the outer arm portions 374A are provided on the outside in the second radial direction of the low-speed channel facing portion 372 and on the inside in the second radial direction of the outer annular portion 370C. In other words, the outer arm portions 374A are formed between the low-speed channel facing portion 372 and the outer annular portion 370C in the second radial direction.

[0183] As shown in FIG. 12A, each outer opening 374 is formed such that a width H1 of an inner region 3741 formed on the inside in the second radial direction of the outer arm portion 374A is larger than a width H2 of an outer region 3742 formed on the outside in the second radial direction of the outer arm portion 374A. The opening area of each outer opening 374 is larger than that of any other opening formed in the control valve 370. In the third embodiment, the inner regions 3741 of the respective outer openings 374 define main channels for oil flow penetrating the control valve 370.

[0184] In the control valve 370 of the third embodiment, the outer arm portion 374A is disposed on the outside in the second radial direction of the inner region 3741 of the outer opening 374, which has a larger opening area. In the control valve 370 of the third embodiment, when oil flows in the manner described below, a flow velocity at the outside in the second radial direction is slower than that at the inside in the second radial direction. In view of this, in the third embodiment, the outer arm portion 374A is disposed on the outside in the second radial direction of the inner region 3741 of the outer opening 374 so that the outer arm portion 374A with a lower rigidity is less affected by the dynamic pressure of oil flowing through the outer opening 374.

[0185] Also, as shown in FIG. 12B, a width B21 of the outer arm portion 374A near the low-speed channel facing portion 372 is larger than a width B22 thereof farther from the low-speed channel facing portion 372. And a width B23 of the outer arm portion 374A near the outer annular portion 370C is larger than the width B22 thereof farther from the outer annular portion 370C.

[0186] The control valve 370 of the third embodiment is itself thicker than a certain thickness, which increases the durability of the control valve 370. Meanwhile, the control valve 370 of the third embodiment has its rigidity reduced at its portions where the inner arm portions 373A and the outer arm portions 374A are formed, making these portions where the inner arm portions 373A and the outer arm portions 374A are formed easily deformable. In particular, in the third embodiment, the inner arm portions 373A and the outer arm portions 374A are formed so to extend along the circumferential direction, and this ensures a deformable arm length to enable easier deformation.

Control Valve Seat 375

[0187] As shown in FIG. 12A, the control valve seat 375 includes the outer round 76 holding the control valve 370, the back pressure channel 77 forming an oil channel for adjusting oil pressure in the back pressure chamber 68P, and the low-speed channels 78 each forming an oil channel in a low-speed stroke. As shown in FIG. 10, the control valve seat 375 further includes a communication chamber 382 communicating with the back pressure channel 77, back pressure communication paths 383 connecting the communication chamber 382 and the back pressure chamber 68P, and low-speed communication paths 385 connecting the low-speed channels 78 and the communication chamber 382.

[0188] As shown in FIG. 11, the communication chamber 382 communicates with a back pressure orifice channel 384 at the inside in the second axial direction, communicates with the back pressure channel 77 at the outside in the second axial direction, and faces the back pressure communication paths 383 in the second radial direction.

[0189] Each back pressure communication path 383 communicates with the communication chamber 382 at the inside in the second radial direction and communicates with the back pressure chamber 68P at the outside in the second radial direction.

[0190] The channel cross-sectional area of the low-speed communication path 385 is larger than that of the low-speed channel 78. In the third embodiment, oil flow during a low-speed stroke (described later) is adjusted by the low-speed channels 78. Accordingly, the oil flow is not throttled on the upstream side of the low-speed channels 78 in the oil flow.

Throttle Member 379

[0191] As shown in FIG. 11, the throttle member 379 includes the back pressure orifice channel 384 connecting the inflow channel 81 and the communication chamber 382. The channel cross-sectional area of the back pressure orifice channel 384 is smaller than that of the back pressure communication path 383 and the back pressure channel 77. Thus, the back pressure orifice channel 384 hardly allows oil in the back pressure chamber 68P to return to the inflow channel 81 through the back pressure orifice channel 384.

Communication Part 380

[0192] The communication part 380 of the third embodiment includes the inflow channel 81 into which oil flows from the communication path L, and a connecting portion 389 connecting to the control valve seat 375.

[0193] The inner diameter of the connecting portion 389 is substantially equal to the outer diameter of the inside in the second axial direction of the control valve seat 375. An end of the control valve seat 375 at the inside in the second axial direction is press-fitted into the connecting portion 389.

[0194] Alternatively, the communication part 380 may be press-fitted into the control valve seat 375.

[0195] The adjustment operation of the above-configured damping force adjusting part 360 of the third embodiment is similar to that in the first embodiment. Specifically, pushing the advancing/retracting member 65 toward the inside in the second axial direction causes the control valve 370 to be pressed against the control valve seat 375. The pressing

force of the advancing/retracting member 65 changes according to an amount of current supplied to the solenoid part 62 (see FIG. 10).

[0196] Also, the operation of the hydraulic damper 1 of the third embodiment is similar to that of the hydraulic damper 1 of the first embodiment. Specifically, during a tension stroke of the hydraulic damper 1, the damping force is generated at the main valve 51 or the control valve 370 in the external damping unit 300. During a compression stroke of the hydraulic damper 1, the damping force is generated at the main valve 51 or the control valve 370 in the external damping unit 300.

[0197] Now a detailed description will be given of an oil flow in the external damping unit 300 of the third embodiment.

[0198] First, a description will be given of an oil flow when the pressing force of the advancing/retracting member 65 is relatively small. The following description uses an example where the control valve 370 is positioned away from the back pressure channel round 77R and the low-speed channel rounds 78R.

[0199] FIGS. 13A and 13B are explanatory diagrams of how oil flows in the external damping unit 300 of the third embodiment. FIG. 13A shows an oil flow during a low-speed stroke and when the pressing force of the advancing/retracting member 65 is relatively small, and FIG. 13B shows an oil flow during a high-speed stroke and when the pressing force of the advancing/retracting member 65 is relatively small.

(During a Low-Speed Stroke)

[0200] As shown in FIG. 13A, when the piston part 30 (see FIG. 1) is moving at a low speed, oil having flowed into the inner channel 91 flows into the inflow channel 81 and the main channels 53. As the piston part 30 is moving at a low speed, no oil flow occurs in the main channels 53 that opens the main valve 51.

[0201] Meanwhile, the oil having flowed into the inflow channel 81 flows through the low-speed communication paths 385, the low-speed channels 78, the low-speed channel rounds 78R, the outer openings 374 (see FIGS. 12A and 12B) in particular, the opening 367H, and the cap channel 367R in this order. Then, the oil flows out into the reservoir chamber R via the intra-housing channel 111.

[0202] As such, when the piston part 30 is moving at a low speed, the damping force is generated by the oil flow being throttled by the gap between the low-speed channel round 78R of the low-speed channel 78 and the control valve 370.

(During a High-Speed Stroke)

[0203] As shown in FIG. 13B, when the piston part 30 (see FIG. 1) is moving at a high speed, oil having flowed into the inner channel 91 flows into the inflow channel 81 and the main channels 53. When the piston part 30 is moving at a high speed too, the oil having flowed into the inflow channel 81 flows into the intra-housing channel 111 while generating a differential pressure by having its flow rate throttled by the gap between the low-speed channel round 78R and the control valve 370, and then flows out into the reservoir chamber R, similarly to during a low-speed stroke. Meanwhile, the oil having flowed into the main channels 53 opens the main valve 51 to flow into the reservoir chamber R.

[0204] As such, when the piston part 30 is moving at a high speed, the damping force is generated by the oil flow in the main channels 53 of the main valve seat 52.

[0205] Also, the oil having flowed into the inflow channel 81 transmits pressure to the back pressure chamber 68P via the back pressure orifice channel 384 and the back pressure communication paths 383. However, the back pressure channel 77 communicating with the back pressure chamber 68P is left open by the control valve 370. Accordingly, the pressure in the back pressure chamber 68P is low as compared to when the control valve 370 is pressed against the back pressure channel 77. And the main valve 51 in contact with the back pressure forming part 68 relatively easily opens the main channels 53. Hence, when the pressing force of the advancing/retracting member 65 is relatively small, the damping force generated by the oil flow in the main channels 53 opening the main valve 51 is relatively small.

[0206] Now a description will be given of an oil flow when the pressing force of the advancing/retracting member 65 is relatively large.

[0207] The following description uses an example where the control valve 370 is pressed against the back pressure channel round 77R and the low-speed channel rounds 78R.

[0208] FIGS. 14A and 14B are explanatory diagrams of how oil flows in the external damping unit 300. FIG. 14A shows an oil flow during a low-speed stroke and when the pressing force of the advancing/retracting member 65 is relatively large, and FIG. 14B shows an oil flow during a high-speed stroke and when the pressing force of the advancing/retracting member 65 is relatively large.

(During a Low-Speed Stroke)

[0209] As shown in FIG. 14A, when the piston part 30 is moving at a low speed, oil having flowed into the inner channel 91 flows into the inflow channel 81 and the main channels 53. As the piston part 30 is moving at a low speed, no oil flow occurs in the main channels 53 by opening the main valve 51.

[0210] Meanwhile, the oil having flowed into the inflow channel 81 flows through the low-speed communication paths 385 into the low-speed channels 78 and the low-speed channel rounds 78R (see FIGS. 12A and 12B). The oil then flows through the low-speed channels 78 while opening the control valve 370. The oil then flows through the outer openings 374 (see FIGS. 12A and 12B) in particular, the opening 367H, and the cap channel 367R. Then, the oil flows through the intra-housing channel 111 into the reservoir chamber R.

[0211] As such, when the piston part 30 (see FIG. 1) is moving at a low speed, the damping force is generated at the low-speed channel rounds 78R of the control valve seat 375 as the oil flows therethrough while opening the control valve 370. This damping force from the oil flow at the low-speed channel rounds 78R is large as compared to when the control valve 370 is positioned away from the low-speed channel rounds 78R.

(During a High-Speed Stroke)

[0212] As shown in FIG. 14B, when the piston part 30 is moving at a high speed, oil having flowed into the inner channel 91 flows into the inflow channel 81 and the main channels 53. When the piston part 30 is moving at a high speed too, the oil having flowed into the inflow channel 81

flows into the intra-housing channel 111 while generating a differential pressure by having its flow rate throttled by the gap between the low-speed channel round 78R and the control valve 370, and then flows into the reservoir chamber R, similarly to when the pressing force of the advancing/retracting member 65 is relatively small. Meanwhile, the oil having flowed into the main channels 53 opens the main valve 51 to flow into the reservoir chamber R.

[0213] As such, when the piston part 30 is moving at a high speed, the damping force is generated by the oil flow in the main channels 53 of the main valve seat 52.

[0214] Also, the oil having flowed into the inflow channel 81 transmits pressure to the back pressure chamber 68P via the back pressure orifice channel 384 and the back pressure communication paths 383. The back pressure channel 77 communicating with the back pressure chamber 68P is pressed against by the control valve 370. Accordingly, the pressure in the back pressure chamber 68P is high as compared to when the back pressure channel 77 is left open. And the main valve 51 in contact with the back pressure forming part 68 relatively hardly opens the main channels 53. Hence, when the pressing force of the advancing/retracting member 65 is relatively large, the damping force generated by the oil flow in the main channels 53 opening the main valve 51 is relatively large.

[0215] As described above, in the hydraulic damper 1 of the third embodiment, both of the damping force during a low-speed stroke and the damping force during a high-speed stroke are adjusted by operating the advancing/retracting member 65. In other words, both of the flow area of the low-speed channels 78, which are oil channels in a low-speed stroke, and the flow area of the back pressure channel 77, which adjusts the pressure in the back pressure chamber 68P related to the oil flow area in a high-speed stroke, are adjusted by changing the pressing force by which the control valve 370 is pressed against the control valve seat 375 by the advancing/retracting member 65.

[0216] Further, the hydraulic damper 1 of the third embodiment allows both of the oil flow in the back pressure channel 77 and the oil flow in the low-speed channels 78 to be simultaneously controlled by the single control valve 370. In particular, the hydraulic damper 1 of the third embodiment allows for control of the oil flow in the low-speed channels 78 during a low-speed stroke and thus allows for adjustment to conditions upon which the main valve 51 opens the main channels 53 (a so-called blow point). This allows for finer control of the damping force than conventional art.

[0217] The oil flow when the solenoid part 62 (see FIG. 10) is not energized is similar to that in the first embodiment. Specifically, when the solenoid part 62 is not energized, the plunger 64 is pushed back toward the outside in the second axial direction by the compression coil spring 63. This results in the advancing/retracting member 65 fixed to the plunger 64 being pressed against the cap part 367. Thus, the advancing/retracting member 65 faces the opening 367H of the cap part 367. The advancing/retracting member 65 is formed with a cutout on its position facing the opening 367H, permitting only a certain amount of oil to flow into the cap channel 367R.

[0218] Thus, even when the solenoid part 62 is not energized, the hydraulic damper 1 of the third embodiment generates a relatively large damping force in both of low-speed and high-speed strokes.

Fourth Embodiment

[0219] Now a description will be given of the damping force adjusting part 60 of the external damping unit 100 of the fourth embodiment.

[0220] FIG. 15 is an explanatory diagram of the damping force adjusting part 60 of the fourth embodiment.

[0221] The damping force adjusting part 60 of the fourth embodiment differs in its control valve 470 from the control valve 70 of the first embodiment.

Control Valve 470

[0222] As shown in FIG. 15A, the control valve 470 is an elastically deformable, substantially round planar member. The control valve 470 may be made of metal such as iron. The control valve 470 faces the outside in the second axial direction of the control valve seat 75.

[0223] As shown in FIG. 15B, the control valve 470 includes an outer annular portion 470C (an example of the held portion) formed in an annular shape, a back pressure channel facing portion 471 (an example of the first controlling portion) facing the back pressure channel 77, openings 473 for making the control valve 470 easily deformable in the second axial direction, and low-speed channel facing portions 472 (an example of the second controlling portion) respectively facing the low-speed channels 78.

[0224] The outer annular portion 470C is provided at the outside in the second radial direction. The outer annular portion 470C serves as a portion that is interposed between the cap part 67 and the control valve seat 75. The control valve 470 of the fourth embodiment is held by the control valve seat 75 by having its outer annular portion 470C interposed between the cap part 67 and the control valve seat 75 and is also positioned using engaging portions 600. By way of example, the engaging portions 600 include recesses 470N formed in the control valve 470 and protrusions 75P formed in the control valve seat 75 for engagement with the respective recesses 470N. It should be noted that the engaging portions 600 are only required to be capable of positioning the control valve 470 and the control valve seat 75 in the circumferential direction, and thus the recesses and the protrusions may be provided in a vice versa manner.

[0225] The back pressure channel facing portion 471 is formed in a round and planar shape. The back pressure channel facing portion 471 is formed larger than the inner diameter of the back pressure channel 77 and able to cover the back pressure channel round 77R. In the fourth embodiment, the back pressure channel facing portion 471 is formed at the center (inside in the second radial direction) of the control valve 470.

[0226] Each opening 473 is formed in an elliptical shape. In the fourth embodiment, multiple openings 473 are provided at substantially equal intervals in the circumferential direction. The opening area of each opening 473 is largest in the control valve 470. In the fourth embodiment, the openings 473 define main channels for oil flow penetrating the control valve 470.

[0227] A back pressure arm portion 473A (an example of the first supporting portion) is formed between each two adjacent openings 473. The back pressure arm portion 473A extends along the second radial direction. The back pressure arm portion 473A connects the back pressure channel facing portion 471 and the outer annular portion 470C.

[0228] Each low-speed channel facing portion 472 is formed in a leaf shape with its inside in the second radial direction being round and with its outside in the second radial direction being triangular. The low-speed channel facing portion 472 is formed larger than the inner diameter of the low-speed channel 78 and able to cover the low-speed channel round 78R. The low-speed channel facing portion 472 is formed on the outside in the second radial direction of the back pressure channel facing portion 471. The low-speed channel facing portion 472 faces the corresponding low-speed channel 78.

[0229] The valve contacting portions 651 (see FIG. 2) of the advancing/retracting member 65 contact distal ends of the respective low-speed channel facing portions 472 (in this example, triangular portions thereof). This gives a nonlinear relationship between the opening degree of the low-speed channels 78 and the pressing force of the advancing/retracting member 65 in the fourth embodiment.

[0230] A low-pressure arm portion 474A (an example of the second supporting portion) is formed at the center of each opening 473. The low-pressure arm portion 474A extends in the second radial direction. The low-pressure arm portion 474A connects the low-speed channel facing portion 472 and the back pressure channel facing portion 471. In other words, the low-pressure arm portion 474A is supported, at its inside in the second radial direction, by the back pressure channel facing portion 471 and supports, at its outside in the second radial direction, the low-speed channel facing portion 472; the low-speed channel facing portion 472 is cantilevered by the low-pressure arm portion 474A in the fourth embodiment.

[0231] In the above-configured damping force adjusting part 60 of the fourth embodiment, the advancing/retracting member 65 is brought into contact with the control valve 470 to thereby advance and retract the control valve 470 to and from the control valve seat 75. In the external damping unit 100 of the fourth embodiment, control of the oil flow in the back pressure channel 77 by the back pressure channel facing portion 471 of the control valve 470 and control of the oil flow in the low-speed channels 78 by the low-speed channel facing portions 472 are simultaneously made possible by the single advancing/retracting member 65. In particular, in the damping force adjusting part 60 of the fourth embodiment, the opening degree of the low-speed channel facing portions 472 controlling the low-speed channels 78 is nonlinear, which gives linear characteristics to variable steps of the damping force.

[0232] In the first to fourth embodiments, the structures of the piston part 30 and the bottom piston part 40 are not limited to those in the above embodiments and may be of any other shape or structure that allows the piston part 30 and the bottom piston part 40 to function as a damping mechanism.

[0233] For example, the function of the external damping unit 100 or the external damping unit 300 provided outside of the cylinder 11 may be incorporated in the piston part 30 and the like inside the cylinder 11. Likewise, the function of the external damping unit 100 or the external damping unit 300 provided outside of the cylinder 11 may be incorporated in the bottom piston part 40. The hydraulic damper 1 of the first to fourth embodiments is not limited to a so-called triple-tube structure composed of the cylindrical members of the cylinder 11, the outer cylinder body 12, and the damper

case 13, and may have a so-called dual-tube structure composed of the cylinder 11 and the damper case 13.

REFERENCE SIGNS LIST

- [0234] 1 Hydraulic damper
 - [0235] 10 Cylinder part
 - [0236] 30 Piston part
 - [0237] 50 Main valve part
 - [0238] 51 Main valve
 - [0239] 52 Main valve seat
 - [0240] 53 Main channel
 - [0241] 60 Damping force adjusting part
 - [0242] 61 Advancing/retracting part
 - [0243] 70 Control valve
 - [0244] 71 Back pressure channel facing portion
 - [0245] 72 Low-speed channel facing portion
 - [0246] 76 Control valve seat
 - [0247] 77 Back pressure channel
 - [0248] 78 Low-speed channel
1. A hydraulic damper comprising:
 - a cylinder containing liquid;
 - a piston part configured to be connected to a rod moving in an axial direction and configured to move inside the cylinder;
 - a channel forming part including a first channel in which the liquid flows along with movement of the piston part in one direction, and a second channel in which the liquid flows parallel to the first channel along with the movement of the piston part in the one direction;
 - a valve part configured to control flow of the liquid in the first channel and the second channel; and
 - a single advancing/retracting part configured to advance and retract the valve part to and from the first channel and the second channel.
 2. The hydraulic damper according to claim 1, wherein the valve part includes a first channel facing portion and a second channel facing portion, the first channel facing portion being of a planar shape and facing the first channel, the second channel facing portion being of a planar shape and facing the second channel.
 3. The hydraulic damper according to claim 2, wherein the valve part includes a planar member integrally formed with the first channel facing portion and the second channel facing portion.
 4. The hydraulic damper according to claim 3, wherein the planar member at least includes an opening between the first channel facing portion and the second channel facing portion.
 5. The hydraulic damper according to claim 2, wherein the first channel protrudes more than the second channel toward the valve part, and the advancing/retracting part is configured to bring the valve part close to the first channel and the second channel by contacting the second channel facing portion of the valve part.
 6. The hydraulic damper according to claim 1, wherein the channel forming part is integrally formed with the first channel and the second channel.
 7. The hydraulic damper according to claim 1, further comprising:
 - a second channel forming part configured to form a third channel in which the liquid flows parallel to the first channel and the second channel along with the movement of the piston part in the one direction;

another valve part configured to control flow of the liquid in the third channel; and

a pressing part including an accommodation chamber for accommodating the liquid and configured to press the another valve part against the third channel by pressure of the liquid in the accommodation chamber, wherein the first channel is a channel configured to adjust the pressure of the liquid in the accommodation chamber.

8. The hydraulic damper according to claim 7, wherein the advancing/retracting part is configured to advance and retract the valve part to and from the first channel and the second channel according to an energization state of the advancing/retracting part, and

the advancing/retracting part includes a restricting part, the restricting part being configured to restrict the liquid from flowing out from the accommodation chamber through the first channel when the advancing/retracting part is not energized.

9. The hydraulic damper according to claim 1, wherein the valve part includes:

- a held portion configured to be held by the channel forming part;
- a first supporting portion configured to be connected to the held portion and to support a first controlling portion, the first controlling portion being configured to control flow of the liquid in the first channel; and
- a second supporting portion configured to be connected to the first controlling portion and to support a second controlling portion, the second controlling portion being configured to control flow of the liquid in the second channel.

10. The hydraulic damper according to claim 9, wherein at least one of the first supporting portion and the second supporting portion includes a portion extending along a circumferential direction.

11. The hydraulic damper according to claim 9, wherein a width of the first supporting portion is larger at a portion thereof near the held portion than at a portion thereof farther from the held portion, and

the width of the first supporting portion is larger at a portion thereof near the first controlling portion than at a portion thereof farther from the first controlling portion.

12. The hydraulic damper according to claim 9, wherein a width of the second supporting portion is larger at a portion thereof near the first controlling portion than at a portion thereof farther from the first controlling portion, and

the width of the second supporting portion is larger at a portion thereof near the second controlling portion than at a portion thereof farther from the second controlling portion.

13. The hydraulic damper according to claim 9, wherein the first supporting portion is provided at an outside in a radial direction of an opening formed in the valve part and having a largest opening area.

14. The hydraulic damper according to claim 9, wherein the first controlling portion is provided at a center of the valve part, and

the second controlling portion is supported by an end of the second supporting portion extending from the first controlling portion toward an outside in a radial direction.

15. A hydraulic damper comprising:

- a cylinder containing liquid;
- a piston part configured to be connected to a rod moving in an axial direction and configured to move inside the cylinder;
- a first valve part configured to throttle one channel in which the liquid flows along with movement of the piston part;
- a pressing part including an accommodation chamber for accommodating the liquid and configured to press the first valve part against the one channel by pressure of the liquid in the accommodation chamber; and
- a second valve part configured to throttle another channel provided parallel to the one channel and in which the liquid flows along with movement of the piston part, and to throttle a pressure channel provided separately from the another channel and configured to change the pressure of the liquid in the accommodation chamber.

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