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(54) FUEL INJECTION SYSTEM AND DAMPER USED IN THE FUEL INJECTION SYSTEM

KRAFTSTOFFEINSPRITZSYSTEM UND IN DEM KRAFTSTOFFEINSPRITZSYSTEM VERWENDETER DÄMPFER

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Description

[Technical Field]

[0001] The invention relates to a fuel injection system supplying fuel to an internal combustion engine by using a fuel line connecting a high pressure pump and a low pressure pump and to a damper used in the fuel injection system.

[Background Art]

[0002] A current diesel fuel injection system is equipped with a low pressure pump (feed pump) and a high pressure pump (supply pump). This low pressure pump feeds diesel fuel at about 0.5 MPa (about 5 bar) from a fuel tank through a fuel line to the high pressure pump, and the high pressure pump supplies the diesel fuel at 200 MPa (at a pressure over 200 MPa in the future) to a common rail and injectors. The generally-used high pressure pump is a plunger pump having plural plungers, and it generates a pressure peak with every stroke. Therefore, such diesel fuel injection system is configured that a magnetic valve (spill valve) between a high pressure circuit in which the plunger pump is located and a low pressure circuit is controlled in accordance with a target pressure at the fuel injection timing to allow the high pressure circuit and the low pressure circuit to be momentarily communicated to each other and that the pressure peak generated by the high pressure pump acts on the low pressure circuit (for example, the fuel line connecting the high pressure pump and the low pressure pump); therefore, a pulsation pressure involving the pressure peak is generated here.

[0003] DE 10 2006 006 887 A1 is directed to a fuel injection system comprising an assembly, which cushions pressure pulses in an automotive fuel supply to a piston engine. The assembly has a housing with an inner chamber in which a gas volume is defined by a membrane. The housing has two identical or similar horizontally opposed end-sections .

[Citation List]

[Patent Literature]

[0004]

[Patent Literature 1] JP2005-042554A (paragraph 0008 to 0037, Fig. 1)
[Patent Literature 2] DE 10 2006 006 887 A1

[Summary of Invention]

[Technical Problem]

[0005] The pulsation pressure in the low pressure circuit of such diesel fuel injection system generates structural issues, noise issues, or the like. In order to damp the pulsation pressure, a damper or the like needs to be installed.

[0006] In a gasoline fuel injection system, as illustrated in Fig. 7, a damper 110 is integrally installed in a housing of a high pressure pump 132 to reduce a pulsation pressure in the housing of the high pressure pump 132, thereby preventing the pulsation pressure from affecting a low pressure circuit 120 (for example, refer to Patent Literature 1).

[0007] In particular, gasoline (fuel) is discharged from a fuel tank 121 by a low pressure pump 122 and a pressure of the gasoline is regulated by a pressure regulator 123. Then, the gasoline is fed through a fuel line 124 to the high pressure pump 132 of an internal combustion engine 130, thereafter being pressurized by the high pressure pump 132 to be supplied to a common rail 135 and injectors 136. A pressure peak of the gasoline flowing through a magnetic valve 133 to the low pressure side when a plunger 134a moves in a reciprocating manner within a cylinder 134b is reduced by deformation of metal diaphragms 102, 102 sealed up gas therebetween and arranged in a damper chamber 101 adjacent to an inlet of the high pressure pump 132.

[0008] It is expected that a damper is installed in the high pressure pump in the diesel fuel injection system. However, an average pressure of the low pressure circuit is low at about 0.5 MPa but a pressure peak is very high at 1.5 MPa or higher; therefore, it is difficult to effectively reduce the pulsation pressure generated in the low pressure circuit at the low pressure side. In addition, in the event of installation of the damper in a housing of the high pressure pump, the structure of the high pressure pump cannot help being complicated.

[0009] As described above, the pressure peak in the diesel fuel injection system is high compared to that in the gasoline fuel injection system. In order to inhibit a pulsation pressure involving such high pressure peak, the diesel fuel injection system requires a damper having a large surface area and a high functionality and a damper chamber having a large capacity capable of accommodating the damper. Therefore, the high pressure pump and an internal combustion engine as well as a damper mechanism may grow in size. As a result, the layout flexibility of the internal combustion engine in an engine room may decrease.

[0010] Further, in the diesel fuel injection system, the average pressure of the low pressure circuit is about 0.5 MPa but the pressure peak is very high at 1.5 MPa or higher compared to that in the gasoline fuel injection system; therefore, it is difficult for the pulsation pressure to be reduced only in the housing of the high pressure pump 132 and an effect of the high pressure peak generated in the low pressure circuit cannot be eliminated at present.

[0011] The present invention is made in view of such drawbacks. The object of the present invention is to provide a fuel injection system which is simply configured so as to eliminate an effect of a high pressure peak generated in a low pressure circuit at a low pressure side and which inhibits a high pressure pump from being complicated and growing in size, and to provide a damper used in the fuel injection system.

[0012] In order to solve the above drawbacks, the fuel injection system of the present invention is characterized to include: a low pressure pump (22) feeding a fuel from a fuel tank (21); a high pressure pump (32) feeding the fuel to injectors (36) of an internal combustion engine (30); and a fuel line (24, 25) connecting the low pressure pump (22) and the high pressure pump (32), wherein a damper (10) is further arranged in and fixed to the fuel line (24, 25), the damper (10) including a fuel line portion (6, 7, 8) which has both ends provided with a pair of fuel line connecting portions (6a, 6b, 7a, 7b, 8a, 8b) connected to the fuel line (24, 25) and which has an inner portion allowing passage of the fuel; a cover portion (1, 2, 40, 42) forming an enclosed room (C) arranged to extend from the fuel line portion (6, 7, 8); and a pressure absorption body (3) extending in a direction which intersects with a passing direction (9) of the fuel and arranged in the enclosed room (C), wherein the cover portion (1, 2, 40, 42) is arranged at a circumferential side of the fuel line portion (6, 7, 8), such that the cover portion (1, 2, 40, 42) does not protrude all around the circumference of the fuel line portion (6, 7, 8).

[0013] According to this feature, the fuel line connecting portions at the both ends of the fuel line portion can be arranged by a plug-in connection (so-called in-line layout) in the fuel line making a connection between the fuel tank and the internal combustion engine; thereby, the layout flexibility, for example, in the direction in which the enclosed room (C) extends can be increased. In addition, the cover portion which accommodates the pressure absorption body can be formed at the outside of the high pressure pump; thereby, a high pressure pump housing can be downsized.

[0014] Further, the damper is arranged in the fuel line connecting the low pressure pump and the high pressure pump, therefore reducing an effect of a high pressure peak at a side closer to a low pressure circuit, i.e., in a wide area between the low pressure pump and the high pressure pump.

[0015] Furthermore, the pressure absorption body extends in the direction intersecting with the passing direction of the fuel; therefore, a length of the cover portion can be formed to be short in an axial direction.

[0016] The fuel injection system of the present invention is characterized in that the pressure absorption body (3) arranged in the enclosed room (C) is configured by a gas-filling chamber formed by a metal diaphragm member (4, 5) and a gas filled in the gas-filling chamber and being at a predetermined pressure.

[0017] According to this feature, when a pressure of the fuel has reached a pressure equal to or greater than the predetermined pressure, the filled gas is compressed and the pressure absorption body is configured that the metal diaphragm member is elastically deformed; therefore, the pressure absorption body can be easily arranged. Further, a damper function utilizing a gas pressure and the planar metal diaphragm member can restrain various pressure peaks at respective portions of the metal diaphragm member.

[0018] The fuel injection system of the present invention is characterized in that the cover portion (1, 2) has a flattened shape having a shorter length in the passing direction (9) of the fuel.

[0019] According to this feature, the cover portion has a shorter length in the passing direction of the fuel; therefore, a length occupied in an axial direction of the fuel line can be reduced. As a result, a structure less likely to be restricted in a length of the fuel line arranged between the internal combustion engine and the fuel tank or to be restricted in each layout can be offered.

[0020] The fuel injection system of the present invention is characterized in that the cover portion (40, 42) has a flattened shape having a shorter length in the direction intersecting with the passing direction (9) of the fuel.

[0021] According to this feature, the cover portion has a shorter length in the direction intersecting with the passing direction of the fuel; therefore, the length occupied in the direction intersecting with the fuel line and the cover portion can be reduced. As a result, the layout of the fuel line and the damper which are arranged between the internal combustion engine and the fuel tank is less likely to be restricted.

[0022] The fuel injection system of the present invention is characterized in that the metal diaphragm member (4, 5) is arranged to divide the enclosed room (C) into at least two chambers (C1, C2) and that at least the two chambers (C1, C2) are respectively communicated to the inner portion of the fuel line portion (6, 7).

[0023] According to this feature, a fuel pressure directly acts on of the respective chambers separated by the metal diaphragm member. Therefore, the metal diaphragm member of each chamber is deformed with respect to any of a differential pressure of the fuel and a pulsation pressure and can quickly respond to a pressure peak.

[0024] A damper of the present invention is characterized to include: a fuel line portion (6, 7, 8) provided with fuel line connecting portion (6a, 6b, 7a, 7b, 8a, 8b) at both ends and including an inner portion allowing passage of a fuel; a cover portion (1, 2, 40, 42) forming an enclosed room (C) arranged to extend from the fuel line portion (6, 7, 8); and a pressure absorption body (3) arranged in the enclosed room (C), wherein the cover portion (1, 2, 40, 42) and the pressure absorption body (3) are arranged to extend in a direction perpendicular to a passing direction (9) of the fuel, and wherein the cover portion (1, 2, 40, 42) is arranged at a circumferential side of the fuel line portion (6, 7, 8), such that the cover portion (1, 2, 40, 42) does not protrude all around the circumference of the fuel line portion (6, 7, 8).

[0025] According to this feature, a length of the cover portion is short in the axial direction; therefore, an equipment configuration can be downsized.

[0026] The damper of the present invention is characterized in that the pressure absorption body (3) arranged in the enclosed room (C) is configured by a gas-filling chamber formed by a metal diaphragm member (4, 5) and by a gas filled in the gas-filling chamber and being at a predetermined pressure.

[0027] According to this feature, when a pressure of the fuel has reached a pressure equal to or greater than the predetermined pressure, the filled gas is compressed and the pressure absorption body is configured that the metal diaphragm member is elastically deformed; therefore, the pressure absorption body can be easily arranged. Further, a damper function utilizing a gas pressure and the metal diaphragm member can restrain various pressure peaks at respective portions of the metal diaphragm member.

[0028] The damper of the present invention is characterized in that the cover portion (1, 2, 40, 42) is arranged at a portion at a circumferential side of the fuel line portion (6, 7, 8).

[0029] According to this feature, an area in which a protruding portion of the cover portion does not exist is provided at the circumferential side of the fuel line portion; therefore, restriction in the fuel line layout can be reduced.

[0030] The damper of the present invention is characterized in that the fuel line connecting portion (6a, 6b) is shaped to be connected to a metal fuel line by welding or brazing.

[0031] According to this feature, the damper can be applied to the metal fuel line and the fuel does not leak from a connected portion with the fuel line.

[0032] The damper of the present invention is characterized in that the fuel line connecting portion (7a, 7b, 8a, 8b) includes a connecting plug for inserting the fuel line connecting portion (7a, 7b) in a rubber fuel line.

[0033] According to this feature, the damper can be applied to the rubber fuel line and the damper can be easily attached to the fuel line.

[Brief Description of Drawings]

[0034]

Fig. 1 is a partially cutaway view of a diesel fuel injection system and a damper used in the diesel fuel injection system according to Example 1.

Fig. 2 is a view taken along the line II-II of the damper in Fig. 1.

Fig. 3 is a partially cutaway perspective view of the damper used in the diesel fuel injection system according to Example 2.

Fig. 4 is a partially cutaway perspective view of the damper used in the diesel fuel injection system according to Example 3.

Fig. 5 (a) is a front view of the damper used in the diesel fuel injection system according to Example 4 and Fig 5 (b) is a cross sectional view taken along the line V-V.

Fig. 6 is a front view of a holder of Fig 5.

Fig. 7 is a view illustrating a conventional gasoline fuel injection system.

[Description of Embodiments]

[0035] Embodiments of a fuel injection system and a damper used in the fuel injection system according to the present invention will be described on the basis of Examples.

[Example 1]

[0036] The diesel fuel injection system and the damper used in the diesel fuel injection system according to Example 1 will be described with reference to Figs. 1 to 2. Hereinafter, upper and lower sides presented on papers of Fig. 1 and Fig. 2 are explained as upper and lower sides.

[0037] A plug-in pulsation damper (damper) 10 is arranged between fuel lines 24, 25 of a common rail diesel fuel injection system. A low pressure circuit 20 is mainly configured by a fuel tank 21, a low pressure pump 22, a pressure regulator 23, the fuel line 24 at upstream side, the plug-in pulsation damper 10, and the fuel line 25 at downstream side. An internal combustion engine 30 is connected to the fuel line 25 at downstream side and is mainly configured by a high pressure pump (supply pump) 32, a common rail 35, injectors 36, and a combustion chamber and an output shaft which are not shown.

[0038] The high pressure pump 32 is a plunger pump in which a plunger 34a moves in a reciprocating manner within a cylinder 34b. A magnetic valve (spill valve) 33 is arranged at a low pressure side (suction side) of the high pressure pump 32. A discharge pressure of the high pressure pump 32 is 200 MPa and an opening of the magnetic valve 33 is controlled in accordance with a pressure requested by the common rail 35. The low pressure pump 22 feeds diesel fuel at an average fuel pressure of 0.5 MPa from the fuel tank 21 to the high pressure pump 32. In addition, the high pressure pump 32 operates to generate a pressure peak up to 1.5 MPa or higher at the low pressure side.

[0039] The plug-in pulsation damper 10 is mainly configured by a top cover 1 (cover portion), a lower cover 2 (cover portion), a pressure absorption body 3, and a fuel line portion 6. The top cover 1 is formed by pressing a stainless steel plate with a thickness of about 2 mm into a substantially half cylindrical shape having a cut surface in a radial direction (parallel to a passing direction 9). The lower cover 2 is formed by pressing a stainless steel plate with a thickness of about 2 mm into a substantially half cylindrical shape having a cut surface in a radial direction. A cut portion of the lower cover 2 is formed line-symmetrically with respect to a cut plane of Fig. 1.

[0040] Respective flange portions of the top cover 1 and the lower cover 2 are fixed liquid-tightly by welding or the like to form a substantially column-shaped enclosed room C inside the top cover 1 and the lower cover 2. The flange portions are welded to each other; therefore, the top cover 1 and the lower cover 2 can be easily connected liquid-tightly and the connection strength is high. Further, the cover portion is formed by two members of the top cover 1 and the lower cover 2; therefore, the number of components configuring the cover portion is small. Furthermore, the top cover 1, the lower cover 2, and the pressure absorption body 3 extend in a direction perpendicular to a passing direction 9 (direction indicated by an arrow in Fig. 1) of the diesel fuel so as to form a substantially flattened cylinder having a length short in the passing direction 9 of the diesel fuel. Moreover, the top cover 1, the lower cover 2, and the pressure absorption body 3 extend in a direction distant from the fuel line portion 6. In addition, main surfaces of the top cover 1, the lower cover 2, and the pressure absorption body 3 are perpendicular to the passing direction 9 of the diesel fuel.

[0041] The fuel line portion 6 is made of a stainless or steel material with a thickness of about 3 mm and is formed into a pipe shape including a fuel passage A at an inner portion. Fuel line connecting portions 6a, 6b to which the fuel lines 24, 25 of metal are connected by welding or brazing are arranged at both ends of the fuel line portion 6. Further, the fuel line portion 6 is integrally formed with the lower cover 2 and is arrange at the lower side of the lower cover 2. Furthermore, the fuel line portion 6 may be a separate body from the lower cover 2.

[0042] The pressure absorption body 3 is provided so as to divide the enclosed room C preferably equally into two portions of an upstream chamber C1 and a downstream chamber C2. The chamber C1 and the chamber C2 are respectively communicated through communication holes c1, c2 to the inner portion of the fuel line portion 6. The pressure absorption body 3 extends in the direction perpendicular to the passing direction 9 of the diesel fuel. A gas such as an argon gas or a helium gas is filled between a pair of metal diaphragm members 4, 5 of annular plate shapes; thereby, the pressure absorption body 3 is configured.

[0043] A stainless steel plate with a thickness of about 0.15 mm to 0.25 mm is pressed to form each of the metal diaphragm members 4, 5 into the annular plate shape. Flanges 4a, 5a of radial end portions of the metal diaphragm members 4, 5 are welded air-tightly in a circumferential direction. These flanges 4a, 5a of the metal diaphragm members 4, 5 are embedded in a recessed and grooved slit (not shown) of the top cover 1 and in a recessed and grooved slit 2a of the lower cover 2. The recessed and grooved slit of the top cover 1 and the recessed and grooved slit 2a of the lower cover 2 are substantially half circular recessed grooves, respectively, formed in an inner circumferential surface of the top cover 1 and an inner circumferential surface of the lower cover 2. A substantially circular recessed groove is formed in a state where the top cover 1 and the lower cover 2 are jointed to each other. The slit 2a is configured so that the width is substantially equal to the thickness of the total of the flanges 4a, 5a and that the depth is smaller (shorter) than a radial distance from radially outer ends of the flanges 4a, 5a to radially inner ends where a pressure receiving portion 4b start bulging therefrom. In addition, the width and depth of the slit of the top cover 1 are the same as those of the slit 2a of the lower cover 2. The flanges 4a, 5a are embedded in the slit of the top cover 1 and the slit 2a of the lower cover 2; thereby, the pressure absorption body 3 can be simply configured so as to be easily attached and fixed to the top cover 1 and the lower cover 2. Moreover, the flange portions of the top cover 1 and the lower cover 2 are in parallel with a diameter of the pressure absorption body 3, that is, the top cover 1 and the lower cover 2 are split at a portion of the maximum diameter of the pressure absorption body 3. Therefore, in a state where the pressure absorption body 3 is embedded in the slit 2a of the lower cover 2, an assembling operation for attaching the top cover 1 to the lower cover 2 is easy. The flanges 4a, 5a are embedded in the slit 2a; therefore, the pressure receiving portion 4b can be secured to be large. The pressure receiving portion may be flat. However, when plural recessed portions formed continuously in the circumferential direction are arranged at the pressure receiving portion 4b of each metal diaphragm member 4, 5 (a pressure receiving portion of the metal diaphragm member 5 is not shown), a mechanical strength of the pressure receiving portion 4b is increased.

[0044] When a fuel pressure equal to or greater than a predetermined pressure (for example, 0.7 MPa) acts on the pressure absorption body 3, the gas is compressed to elastically deform the metal diaphragm members 4, 5. This elastic deformation reduces the volume of the pressure absorption body 3 occupied by the enclosed room C; therefore, a large volume of the diesel fuel is accommodated in the enclosed room C. Thus, a pulsation involving a pressure peak can be reduced. The diaphragm thicknesses of the metal diaphragm members 4, 5 and a gas filling pressure can be determined so as not to plastically deform the metal diaphragm members 4, 5 when a maximum pressure peak generated from the high pressure pump 32 at downstream side acts on the pressure absorption body 3. In addition, the gas filling pressure is approximately equal to the predetermined pressure (for example, 0.7 MPa).

[0045] The fuel line connecting portions 6a, 6b at the both ends of the fuel line portion 6 can be arranged by a plug-in connection (so-called in-line layout) in the fuel lines 24, 25 making a connection between the fuel tank 21 and the internal combustion engine 30; thereby, the layout flexibility, for example, in the direction in which the enclosed room (C) extends can be increased. Additionally, the top cover 1 and the lower cover 2 which accommodate the metal diaphragm members 4, 5 can be formed at the outside of a high pressure pump housing

32a; therefore, the high pressure pump housing 32a can be downsized.

[0046] In addition, the plug-in pulsation damper 10 is arranged in the fuel lines 24, 25 connecting the low pressure pump 22 and the high pressure pump housing 32a, therefore reducing an effect of a high pressure peak at a side closer to the low pressure circuit 20, i.e., in a wide area between the low pressure pump 22 and the high pressure pump housing 32a.

[0047] Moreover, the plug-in pulsation damper 10 is an in-line type damper; therefore, the plug-in pulsation damper 10 can be utilized in various vehicle models and various models of internal combustion engines. For example, the plug-in pulsation damper 10 can be used in an internal combustion engine applied in two vehicle models and can be used in two different models of internal combustion engines applied in the same vehicle model.

[0048] Further, when a pressure of the diesel fuel has reached a pressure equal to or greater than the predetermined pressure, the gas filled between the metal diaphragm members 4, 5 is compressed to elastically deform the metal diaphragm members 4, 5. Accordingly, the metal diaphragm members are simply configured. In addition, a damper function utilizing a gas pressure and the planar metal diaphragm members 4, 5 can restrain various pressure peaks at respective portions of the metal diaphragm members 4, 5. In other words, the rigidity of the pressure absorption body 3 utilizing the gas pressure and the planar metal diaphragm members 4, 5 is changed in the radial direction; therefore, different portions of the pressure absorption body 3 are deformed depending on pressures and the following capability of the pressure absorption body 3 to pulsations involving pressure peaks continuously changing is high.

[0049] Furthermore, resistance to a high pressure peak can be obtained by the use of the metal diaphragm members 4, 5. In addition, the top cover 1 and the lower cover 2 which accommodate the metal diaphragm members 4, 5 can be formed at the outside of the high pressure pump 32; thereby, the high pressure pump housing 32a does not grow in size.

[0050] Moreover, the metal diaphragm members 4, 5 are accommodated in the top cover 1 and the lower cover 2. Therefore, the diesel fuel leaks outside can be inhibited even in a case where the metal diaphragm members 4, 5 burst. In this case, the top cover 1 and the lower cover 2 have rigidities higher than those of the metal diaphragm members 4, 5; thereby, the diesel fuel leaks outside can be surely inhibited.

[0051] Further, the top cover 1 and the lower cover 2 have the flattened shapes and the short lengths in the passing direction 9 of the diesel fuel; therefore, a length occupied in an axial direction of the fuel lines 24, 25 can be reduced. As a result, a structure less likely to be restricted in lengths of the fuel lines 24, 25 arranged between the internal combustion engine 30 and the fuel tank 21 or to be restricted in each layout can be offered.

[0052] Furthermore, a fuel pressure directly acts on of the respective chambers C1, C2 separated by the metal diaphragm members 4, 5. Therefore, the metal diaphragm members 4, 5 of the respective chambers C1, C2 are deformed with respect to any of a differential pressure of the fuel and a pulsation pressure and can quickly respond to a pressure peak.

[0053] The top cover 1, the lower cover 2, and the metal diaphragm members 4, 5 are arranged so as to extend in the direction in perpendicular to the passing direction 9 of the fuel; therefore, lengths of the top cover 1 and the lower cover 2 in an axial direction can be reduced.

[0054] In addition, the top cover 1 and the lower cover 2 are arranged above relative to a circumferential side of the fuel line portion 6, and an area in which protruding portions of the top cover 1 and the lower cover 2 do not exist is provided at the lower side of the top cover 1 and the lower cover 2. As a result, restriction in the fuel line layout can be reduced.

[0055] Further, the two metal diaphragm members 4, 5 are hermetically fixed to each other with the flanges 4a, 5a welded at the outer circumferential side of the metal diaphragm members 4, 5. Therefore, the pressure receiving portion 4b receiving pressure can be secured to be large.

[0056] Furthermore, the top cover 1, the lower cover 2, and the metal diaphragm members 4, 5 are formed of a stainless material, therefore being superior in corrosion resistance. In addition, an electrical potential difference is not generated between metals and electric corrosion is not easily generated.

[0057] Further, if pressure is low, the top cover 1, the lower cover 2, and the metal diaphragm members 4, 5 can be formed by a material such as resin.

[Example 2]

[0058] Next, the plug-in pulsation damper 10 according to Example 2 will be described with reference to Fig. 3. Plug connecting portions 7a, 7b are arranged at both ends of a fuel line portion 7. A rubber fuel line (not shown) is press-fitted and fixed to these plug connecting portions 7a, 7b. In addition, other configurations of Example 2 are the same as those of Example 1 and therefore will not be explained.

[Example 3]

[0059] Next, the plug-in pulsation damper 10 according to Example 3 will be described with reference to Fig. 4. Three pressure absorption bodies 3A, 3B, 3C are embedded in slits 2a1, 2a2, 2a3, respectively, so as to be positioned side by side to one another. Further, the pressure absorption bodies 3A, 3B, 3C and the slits 2a1, 2a2, 2a3 are configured in the same way as described in Example 1. In addition, other configurations of Example 3 are the same as those of Example 1 and therefore will not be explained.

[0060] Here, the three pressure absorption bodies 3A, 3B, 3C are provided. Therefore, when a fuel pressure greater than a predetermined pressure acts on the pressure absorption bodies 3A, 3B, 3C to deform the pressure absorption bodies 3A, 3B, 3C, a larger volume of the diesel fuel can be accommodated in the enclosed room C. Further, the pressure absorption bodies 3A, 3B, 3C are arranged in parallel with one another; thereby, the adjoining pressure absorption bodies 3A, 3B, 3C can be provided adjacent to one another. In addition, the number of plural pressure absorption bodies 3A, 3B, 3C to be arranged may be three or less or more than three. Moreover, the pressure absorption bodies 3A, 3B, 3C having the same structure are explained but may have different structures.

[Example 4]

[0061] Next, the plug-in pulsation damper 10 according to Example 4 will be described with reference to Fig. 5 and Fig. 6. The direction in which the pressure absorption body 3 is arranged and a method for fixing the pressure absorption body 3 are different from those of Example 1. Further, the same configurations as those in Example 1 will not be explained.

[0062] The plug-in pulsation damper 10 is mainly configured by a cover 40 (cover portion), a plate 42 (cover portion), the pressure absorption body 3, and a fuel line portion 8. The cover 40 is formed by pressing a stainless steel plate with a thickness of about 2 mm into a substantially cup shape. A circumferential portion of the cover 40 is partially cut out to be provided with a flat portion 40a (Fig. 5 (a)). A through hole 40b is formed in this flat portion 40a. The plate 42 is formed by pressing a stainless steel plate into a substantially cross-sectional convex shape to have a small-diameter convex portion 42a in the center, thereby forming a substantially circular plate shape.

[0063] A circumferential end portion 40c of the cover 40 and a flange 42b of the plate 42 are fixed liquid-tightly by welding 48 or the like to form a substantially column-shaped enclosed room C inside thereof. Further, the cover 40 and the plate 42 extend in the direction perpendicular to the passing direction 9 (direction indicated by an arrow in Fig. 5) of the diesel fuel so as to form a substantially flattened cylinder shape having a length long in the passing direction 9 of the diesel fuel. Furthermore, the top cover 1, the lower cover 2, and the pressure absorption body 3 extend in a direction distant from the fuel line portion 8. In addition, the top cover 1, the lower cover 2, and the pressure absorption body 3 extend along the passing direction 9 of the diesel fuel, that is, the main surfaces of the top cover 1, the lower cover 2, and the pressure absorption body 3 are perpendicular to a circular arc around the passing direction 9 of the diesel fuel.

[0064] The fuel line portion 8 is made of a stainless or steel material with a thickness of about 3 mm and is formed into a pipe shape including the fuel passage A at an inner portion. Plug connecting portions 8a, 8b are arranged at both ends of the fuel line portion 8. An intermediate portion 8c between the plug connecting portions 8a, 8b of the fuel line portion 8 is formed to have a cross-sectional rectangular shape. A through hole 8e is formed in a portion of a cylindrical surface portion 8d of the intermediate portion 8c.

[0065] The flat portion 40a of the cover 40 and the cylindrical surface portion 8d of the fuel line portion 8 are fixed to each other by brazing; therefore, the through hole 40b and the through hole 8e are communicated with each other. That is, the enclosed room C is formed so as to extend from the fuel line portion 8.

[0066] The pressure absorption body 3 is positioned by a wave spring 44 (fixation spring) for fixation and a holder 46 in the enclosed room C so as to be fixed therein. The holder 46 is configured by a retaining portion 46a having a ring shape and seven leg portions 46b (Fig. 6). A tongue-shaped section 46b' (only one tongue-shaped section shown in Fig. 6) extending radially inward from the retaining portion 46a is bent, thereby configuring the leg portion 46b. It is preferable that the wave spring 44 and the leg portions 46b of the holder 46 are fixed by spot welding to the flange 4a and the flange 5a, respectively of the pressure absorption body 3. One end of the wave spring 44 is inserted to an outer side of the small-diameter convex portion 42a of the plate 42 so as to be positioned at the plate 42. The leg portions 46b of the holder 46 are arranged at a circumferential corner portion of an inner circumference of the cover 40 so as to be positioned thereat. Thus, the pressure absorption body 3 is attached between the cover 40 and the plate 42 without loosening or rattling to be generated therbetween. When a fuel pressure larger than a predetermined pressure acts on the pressure absorption body 3, the gas is compressed and therefore the metal diaphragm members 4, 5 are elastically deformed. Further, the wave spring may be arranged so as to be in contact with the cover and the leg portions of the holder may be arranged so as to be in contact with the plate.

[0067] As describe above, Examples of the present invention are described with reference to the drawings but the specific configuration is not limited to these Examples, and even modifications and alternations of the invention may be made without departing from the scope the invention.

[0068] For example, the configuration where the gas is filled between the metal diaphragm members 4, 5 is explained. Alternatively, a configuration where metal diaphragm members are arranged at both sides of a rigid metal plate and a gas is filled between the metal plate and the metal diaphragm members may be applied.

[0069] Further, the metal diaphragm members 4, 5 may have different diaphragm thicknesses and shapes from each other. In this case, one of the metal diaphragm members 4, 5 that has a lower rigidity than that of the other starts being deformed; therefore, an initial elastic deformation at a low pressure proceeds smoothly.

[0070] Furthermore, in addition to the plug-in pulsation damper 10, an additional damper may be arranged in the high pressure pump housing 32a.

[0071] Moreover, the pressure absorption body 3 utilizing the metal diaphragm members 4, 5 and the gas is explained as an example but another member which can absorb a pressure of the diesel fuel may be applied.

[0072] Further, through holes may be formed in the top cover 1, the lower cover 2, the cover 40, and the cover portion of the plate 42 so that a pressure sensor for measuring a fuel pressure is attached in the through holes.

[0073] Furthermore, the diesel fuel injection system and the damper used in the diesel fuel injection system are explained as an example in the foregoing Examples. Alternatively, the present invention can be applied to, for example, a gasoline injection system other than a diesel fuel injection system.

[Reference Signs List]

[0074]

1	top cover (cover portion)
2	lower cover (cover portion)
3	pressure absorption body
4	metal diaphragm member
5	metal diaphragm member
6	fuel line portion
6a, 6b	fuel line connecting portion
7	fuel line portion
7a, 7b	fuel line connecting portion
8	fuel line portion
8a, 8b	fuel line connecting portion
9	passing direction of fuel
10	plug-in pulsation damper (damper)
20	low pressure circuit
21	fuel tank
22	low pressure pump
24, 25	fuel line
30	internal combustion engine
32	high pressure pump
32a	high pressure pump housing
36	injectors
40	cover (cover portion)
42	plate (cover portion)
A	fuel passage
C	enclosed room
C1, C2	chamber
c1, c2	communication hole

Claims

1. A fuel injection system, comprising:

a low pressure pump (22) feeding a fuel from a fuel tank (21);

a high pressure pump (32) feeding the fuel to injectors (36) of an internal combustion engine (30); and

a fuel line (24, 25) connecting the low pressure pump (22) and the high pressure pump (32),

wherein a damper (10) is further arranged in and fixed to the fuel line (24, 25), the damper (10) including a fuel line portion (6, 7, 8) which has both ends provided with a pair of fuel line connecting portions (6a, 6b, 7a, 7b, 8a, 8b) connected to the fuel line (24, 25) and which has an inner portion allowing passage of the fuel; a cover portion (1, 2, 40, 42) forming an enclosed room (C) arranged to extend from the fuel line portion (6, 7, 8); and a pressure absorption body (3) extending in a direction which intersects with a passing direction (9) of the fuel and arranged in the enclosed room (C), **characterized in that** the cover portion (1, 2, 40, 42) is arranged at a circumferential side of the fuel line portion (6, 7, 8), such that the cover portion (1, 2, 40, 42) does not protrude all around the circumference of the fuel line portion (6, 7, 8).

2. The fuel injection system according to claim 1, wherein the pressure absorption body (3) arranged in the enclosed room (C) is configured by a gas-filling chamber formed by a metal diaphragm member (4, 5) and a gas filled in the gas-filling chamber and being at a predetermined pressure.

3. The fuel injection system according to claim 1 or 2, wherein the cover portion (1, 2) has a flattened shape having a shorter length in the passing direction (9) of the fuel.

4. The fuel injection system according to claim 1 or 2, wherein the cover portion (40, 42) has a flattened shape having a shorter length in the direction intersecting with the passing direction (9) of the fuel.

5. The fuel injection system according to one of claims 1 to 4, wherein the metal diaphragm member (4, 5) is arranged to divide the enclosed room (C) into at least two chambers (C1, C2), and

wherein at least the two chambers (C1, C2) is respectively communicated to the inner portion of the fuel line portion (6, 7).

6. A damper (10) comprising:

a fuel line portion (6, 7, 8) provided with fuel line connecting portion (6a, 6b, 7a, 7b, 8a, 8b) at both ends and including an inner portion allowing passage of a fuel;

a cover portion (1, 2, 40, 42) forming an enclosed room (C) arranged to extend from the fuel line portion (6, 7, 8); and

a pressure absorption body (3) arranged in the

enclosed room (C),
wherein the cover portion (1, 2, 40, 42) and the pressure absorption body (3) are arranged to extend in a direction perpendicular to a passing direction (9) of the fuel,
characterized in that the cover portion (1, 2, 40, 42) is arranged at a circumferential side of the fuel line portion (6, 7, 8), such that the cover portion (1, 2, 40, 42) does not protrude all around the circumference of the fuel line portion (6, 7, 8).

7. The damper (10) according to claim 6, wherein the pressure absorption body (3) arranged in the enclosed room (C) is configured by a gas-filling chamber formed by a metal diaphragm member (4, 5) and a gas filled in the gas-filling chamber and being at a predetermined pressure.

8. The damper (10) according to claim 6 or 7, wherein the cover portion (1, 2, 40, 42) is arranged at a portion at a circumferential side of the fuel line portion (6, 7, 8).

9. The damper (10) according to one of claims 6 to 8, wherein the fuel line connecting portion (6a, 6b) is shaped to be connected to a metal fuel line by welding or brazing.

10. The damper (10) according to one of claims 6 to 8, wherein the fuel line connecting portion (7a, 7b, 8a, 8b) includes a connecting plug for inserting the fuel line connecting portion (7a, 7b, 8a, 8b) in a rubber fuel line.

Patentansprüche

1. Kraftstoffeinspritzsystem, welches aufweist:

eine Niederdruckpumpe (22), welche einen Kraftstoff von einem Kraftstofftank (21) einspeist,
eine Hochdruckpumpe (32), welche den Kraftstoff Injektoren (36) eines Verbrennungsmotors (30) zuführt, und
eine Kraftstoffleitung (24, 25), welche die Niederdruckpumpe (22) und die Hochdruckpumpe (32) miteinander verbindet,
wobei ein Dämpfer (10) weiterhin in der Kraftstoffleitung (24, 25) angeordnet und daran befestigt ist, wobei der Dämpfer (10) einen Kraftstoffleitungsabschnitt (6, 7, 8) aufweist, welcher an beiden Enden ein Paar von Kraftstoffleitungsverbindungsabschnitten (6a, 6b, 7a, 7b, 8a, 8b) aufweist, welche mit der Kraftstoffleitung (24, 25) verbunden sind, und einen inneren Abschnitt aufweist, durch welchen der Kraftstoff hindurchfließen kann, wobei ein Abdeckungsabschnitt (1, 2, 40, 42), welcher einen geschlossen Raum (C) bildet, so angeordnet ist, dass er sich von dem Kraftstoffleitungsabschnitt (6, 7, 8) erstreckt, und wobei ein Druckaufnahmekörper (3) sich von einer Richtung aus erstreckt, welche eine Durchflussrichtung (9) des Kraftstoffes schneidet und in dem geschlossenen Raum (C) angeordnet ist, **dadurch gekennzeichnet, dass** der Abdeckungsabschnitt (1, 2, 40, 42) an einer Umfangsseite des Kraftstoffleitungsabschnitts (6, 7, 8) angeordnet ist, sodass sich der Abdeckungsabschnitt (1, 2, 40, 42) nicht vollständig über den Umfang des Kraftstoffleitungsabschnitts (6, 7, 8) erstreckt.

2. Kraftstoffeinspritzsystem nach Anspruch 1, wobei der Druckaufnahmekörper (3), welcher in dem geschlossen Raum (C) angeordnet ist, durch eine Gasabfüllkammer, welche durch ein Metallmembranelement (4, 5) gebildet ist, und ein Gas, welches in die Gasabfüllkammer gefüllt wird und bei einer vorbestimmten Temperatur vorliegt, gebildet ist.

3. Kraftstoffeinspritzsystem nach Anspruch 1 oder 2, wobei der Abdeckungsabschnitt (1, 2) eine abgeflachte Form hat, welche eine kürzere Länge in der Durchflussrichtung (9) des Kraftstoffes aufweist.

4. Kraftstoffeinspritzsystem nach Anspruch 1 oder 2, wobei der Abdeckungsabschnitt (40, 42) eine abgeflachte Form hat, welche eine kürzere Länge in der Richtung, welche die Durchflussrichtung (9) des Kraftstoffes schneidet, aufweist.

5. Kraftstoffeinspritzsystem nach einem der Ansprüche 1 bis 4, wobei das Metallmembranelement (4, 5) angeordnet ist, um den geschlossen Raum (C) in mindestens zwei Kammern (C1, C2) zu trennen, und wobei mindestens die beiden Kammern (C1, C2) jeweils mit dem inneren Abschnitt des Kraftstoffleitungsabschnitts (6, 7) verbunden sind.

6. Dämpfer (10), welcher aufweist:

einen Kraftstoffleitungsabschnitt (6, 7, 8), welcher einen Kraftstoffleitungsverbindungsabschnitt (6a, 6b, 7a, 7b, 8a, 8b) an beiden Enden aufweist und einen inneren Abschnitt aufweist, durch welchen ein Kraftstoff hindurchfließen kann,
einen Abdeckungsabschnitt (1, 2, 40, 42), welcher einen geschlossenen Raum (C) bildet, welcher so angeordnet ist, dass er sich von dem Kraftstoffleitungsabschnitt (6, 7, 8) erstreckt, und
einen Druckaufnahmekörper (3), welcher in dem geschlossenen Raum (C) angeordnet ist,
wobei der Abdeckungsabschnitt (1, 2, 40, 42)

und der Druckaufnahmekörper (3) so angeordnet sind, dass sie sich in einer Richtung senkrecht zu einer Durchflussrichtung (9) des Kraftstoffes erstrecken,
dadurch gekennzeichnet, dass der Abdeckungsabschnitt (1, 2, 40, 42) an einer Umfangsseite des Kraftstoffleitungsabschnitts (6, 7, 8) angeordnet ist, sodass sich der Abdeckungsabschnitt (1, 2, 40, 42) nicht vollständig über den Umfang des Kraftstoffleitungsabschnitts (6, 7, 8) erstreckt.

7. Dämpfer (10) nach Anspruch 6, wobei der Druckaufnahmekörper (3), welcher in dem geschlossen Raum (C) angeordnet ist, durch eine Gasabfüllkammer, welche durch ein Metallmembranelement (4, 5) gebildet ist, und ein Gas, welches in die Gasabfüllkammer gefüllt wird und bei einer vorbestimmten Temperatur vorliegt, gebildet ist.

8. Dämpfer (10) nach Anspruch 6 oder 7, wobei der Abdeckungsabschnitt (1, 2, 40, 42) an einem Abschnitt an einer Umfangsseite des Kraftstoffleitungsabschnitts (6, 7, 8) angeordnet ist.

9. Dämpfer (10) nach einem der Ansprüche 6 bis 8, wobei der Kraftstoffleitungsverbindungsabschnitt (6a, 6b) geformt ist, um an einer Metallkraftstoffleitung durch Schweißen oder Löten befestigt zu werden.

10. Dämpfer (10) nach einem der Ansprüche 6 bis 8, wobei der Kraftstoffleitungsverbindungsabschnitt (7a, 7b, 8a, 8b) einen Verbindungsstecker zum Einführen des Kraftstoffleitungsverbindungsabschnitts (7a, 7b, 8a, 8b) in eine Kautschukkraftstoffleitung aufweist.

Revendications

1. Système d'injection de carburant, comprenant :

une pompe basse pression (22) délivrant un carburant à partir d'un réservoir de carburant (21) ;
une pompe haute pression (32) délivrant le carburant à des injecteurs (36) d'un moteur à combustion interne (30) ; et
une ligne de carburant (24, 25) reliant la pompe basse pression (22) et la pompe haute pression (32),
dans lequel un registre (10) est de plus disposé dans la ligne de carburant (24, 25) et fixé à celle-ci, le registre (10) comprenant une partie de ligne de carburant (6, 7, 8) dont les deux extrémités sont munies d'une paire de parties de liaison de ligne de carburant (6a, 6b, 7a, 7b, 8a, 8b) reliées à la ligne de carburant (24, 25), et qui comporte une partie intérieure permettant le passage du carburant ; une partie couvrante (1, 2, 40, 42) formant une chambre close (C) agencée de façon à s'étendre à partir de la partie de ligne de carburant (6, 7, 8) ; et un corps d'absorption de pression (3) s'étendant dans une direction croisant une direction de passage (9) du carburant et disposé dans la chambre close (C),
caractérisé en ce que la partie couvrante (1, 2, 40, 42) est disposée sur un côté circonférentiel de la partie de ligne de carburant (6, 7, 8), de telle sorte que la partie couvrante (1, 2, 40, 42) ne fasse pas saillie tout autour de la circonférence de la partie de ligne de carburant (6, 7, 8).

2. Système d'injection de carburant selon la revendication 1, dans lequel le corps d'absorption de pression (3) disposé dans la chambre close (C) est formé d'une chambre de remplissage de gaz formée par un élément de diaphragme métallique (4, 5) et un gaz remplissant la chambre de remplissage de gaz, et qui est à une pression prédéterminée.

3. Système d'injection de carburant selon la revendication 1 ou 2, dans lequel la partie couvrante (1, 2) a une forme aplatie ayant une longueur plus courte dans la direction de passage (9) du carburant.

4. Système d'injection de carburant selon la revendication 1 ou 2, dans lequel la partie couvrante (40, 42) a une forme aplatie ayant une longueur plus courte dans la direction croisant la direction de passage (9) du carburant.

5. Système d'injection de carburant selon l'une des revendications 1 à 4, dans lequel l'élément de diaphragme métallique (4, 5) est agencé de façon à diviser la chambre close (C) en au moins deux chambres (C1, C2), et
dans lequel au moins les deux chambres (C1, C2) communiquent respectivement avec la partie intérieure de la partie de ligne de carburant (6, 7).

6. Registre (10), comprenant :

une partie de ligne de carburant (6, 7, 8) munie d'une partie de liaison de ligne de carburant (6a, 6b, 7a, 7b, 8a, 8b) aux deux extrémités, et comprenant une partie intérieure permettant le passage d'un carburant ;
une partie couvrante (1, 2, 40, 42) formant une chambre close (C) agencée de façon à s'étendre à partir de la partie de ligne de carburant (6, 7, 8) ; et
un corps d'absorption de pression (3) disposé dans la chambre close (C),
dans lequel la partie couvrante (1, 2, 40, 42) et

le corps d'absorption de pression (3) sont agencés de façon à s'étendre dans une direction perpendiculaire à une direction de passage (9) du carburant,
caractérisé en ce que la partie couvrante (1, 2, 40, 42) est disposée sur un côté circonférentiel de la partie de ligne de carburant (6, 7, 8), de telle sorte que la partie couvrante (1, 2, 40, 42) ne fasse pas saillie tout autour de la circonférence de la partie de ligne de carburant (6, 7, 8).

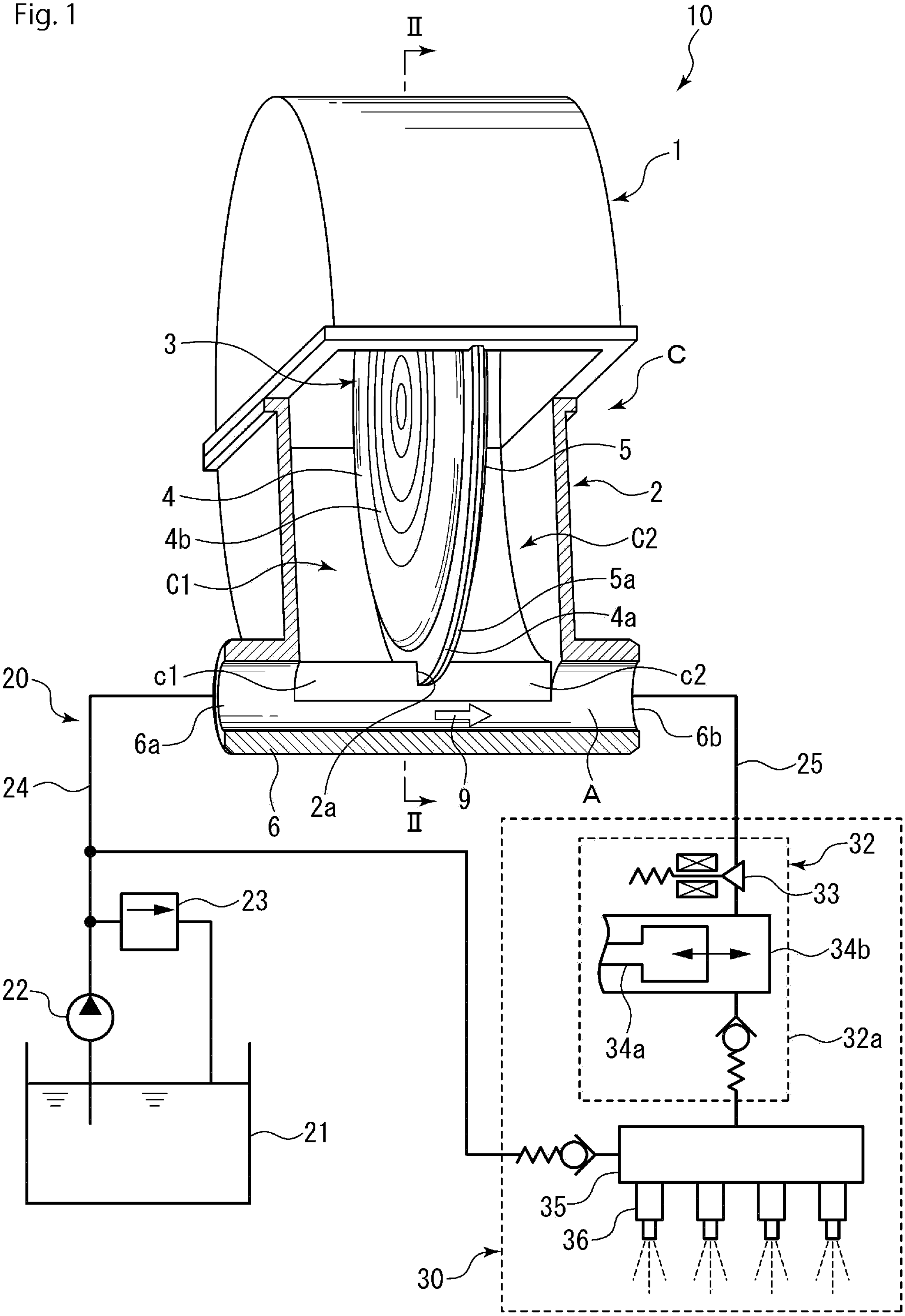
7. Registre (10) selon la revendication 6, dans lequel le corps d'absorption de pression (3) disposé dans la chambre close (C) est formé d'une chambre de remplissage de gaz formée par un élément de diaphragme métallique (4, 5) et un gaz remplissant la chambre de remplissage de gaz, et qui est à une pression prédéterminée.

8. Registre (10) selon la revendication 6 ou 7, dans lequel la partie couvrante (1, 2, 40, 42) est disposée dans une partie sur un côté circonférentiel de la partie de ligne de carburant (6, 7, 8).

9. Registre (10) selon l'une des revendications 6 à 8, dans lequel la partie de liaison de ligne de carburant (6a, 6b) est formée de façon à être reliée à une ligne de carburant métallique par soudage ou brasage.

10. Registre (10) selon l'une des revendications 6 à 8, dans lequel la partie de liaison de ligne de carburant (7a, 7b, 8a, 8b) comprend un bouchon de liaison pour insérer la partie de liaison de ligne de carburant (7a, 7b, 8a, 8b) dans une ligne de carburant en caoutchouc.

Fig. 1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10
1
3
C
5
2
4
4b
C2
C1
5a
4a
20
c1
c2
6a
6b
25
24
9
A
2a
II
6
32
33
23
34b
22
34a
32a
21
35
36
30

Fig. 2

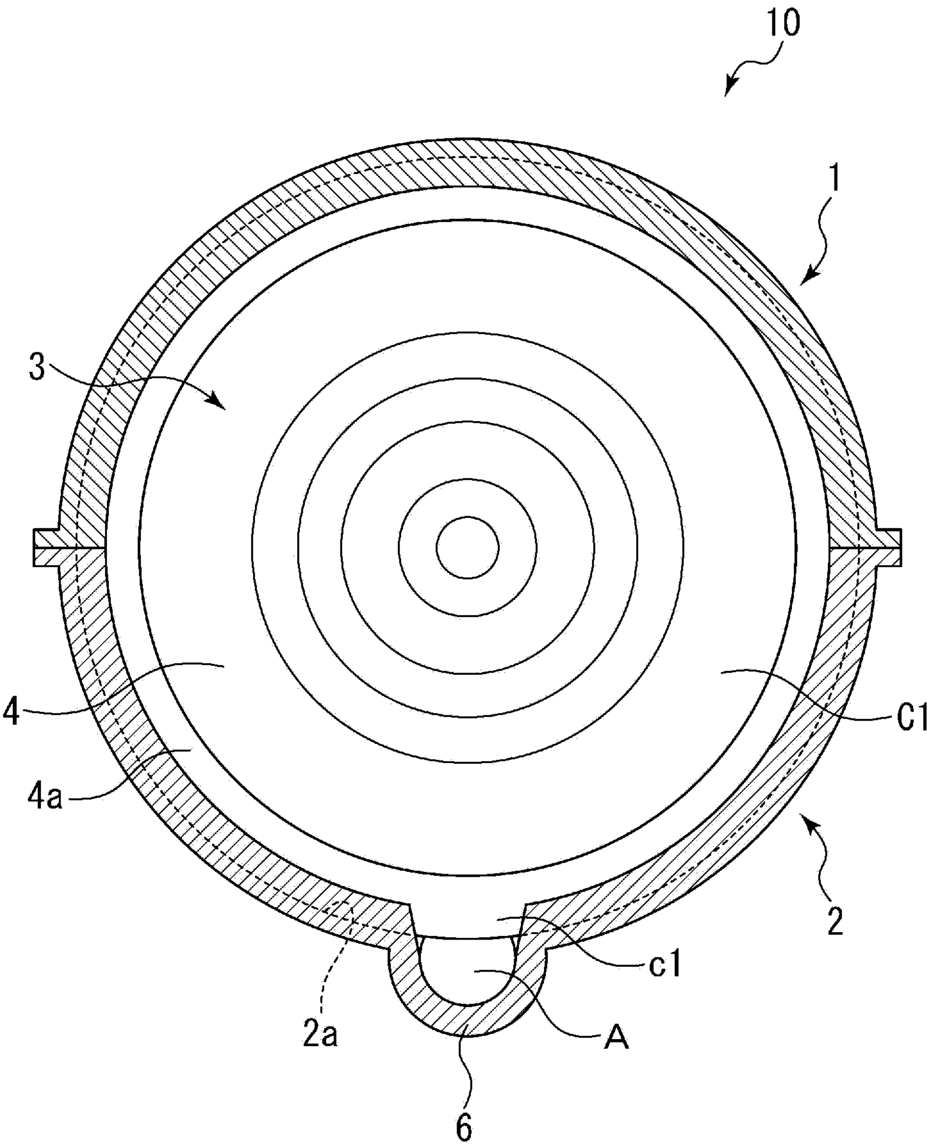


Fig. 3

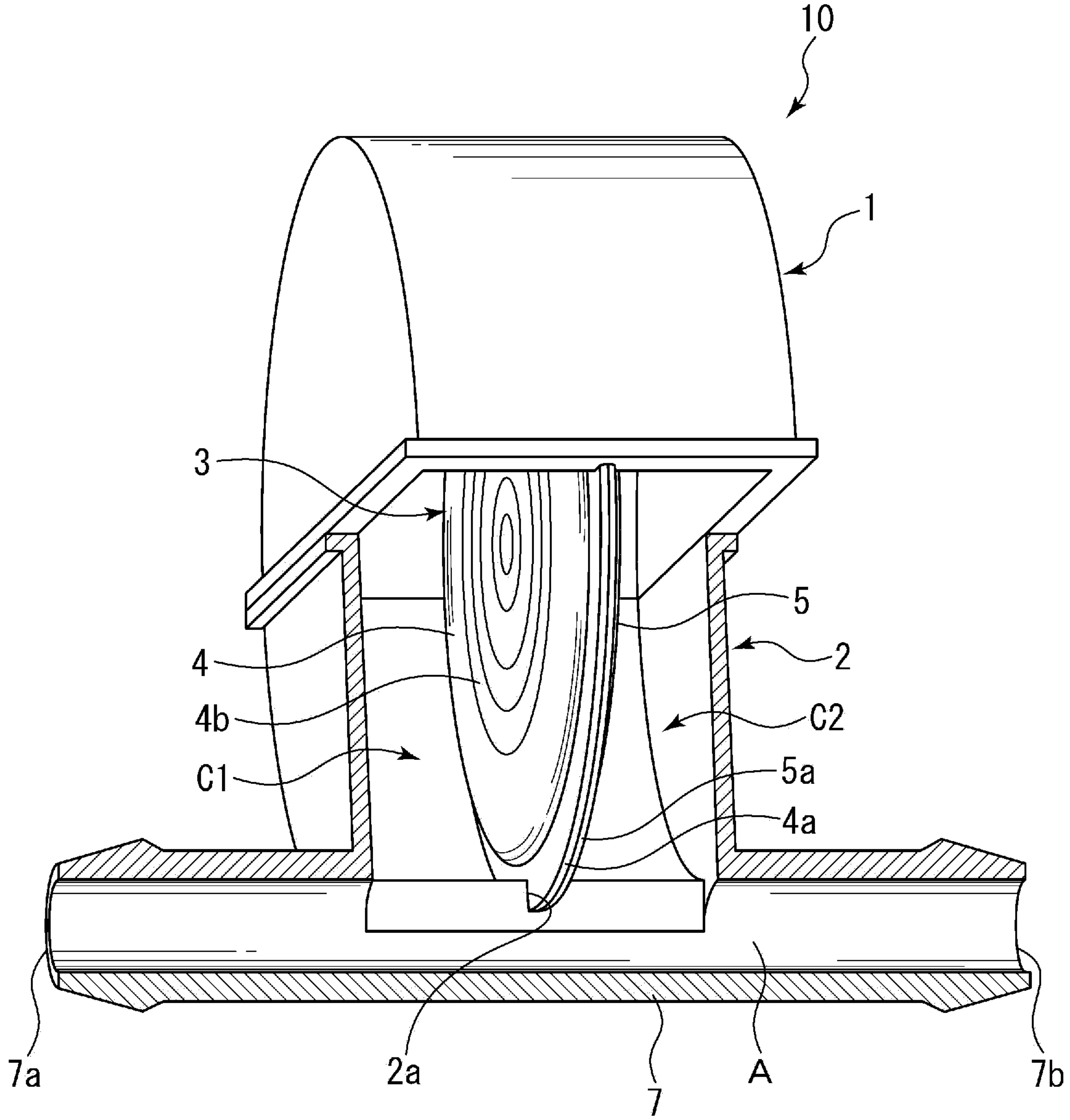


Fig. 4

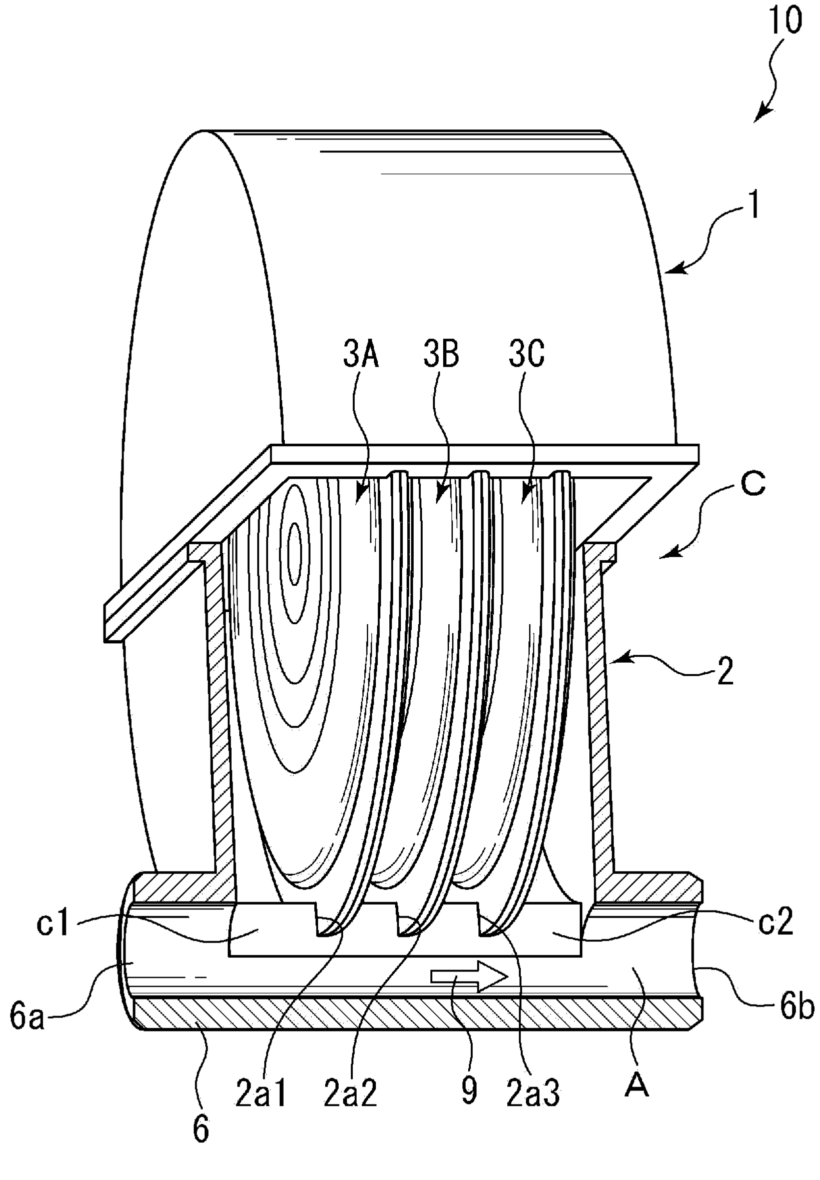
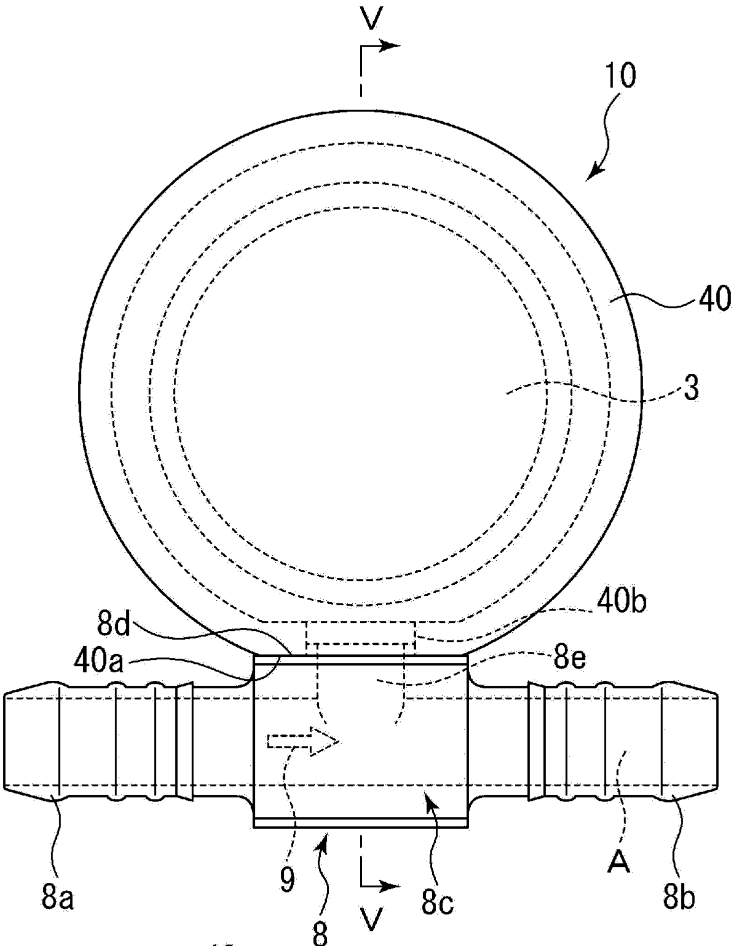


Fig. 5

(a)


V
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40
3
40b
8d
40a
8e
8a
9
8
8c
V
A
8b

(b)

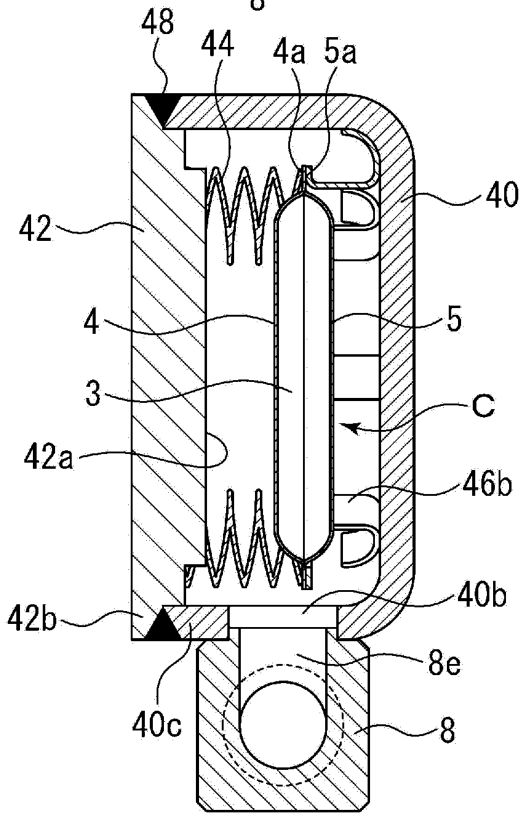

48
44
4a
5a
40
42
4
5
3
C
42a
46b
40b
42b
8e
40c
8

Fig. 6

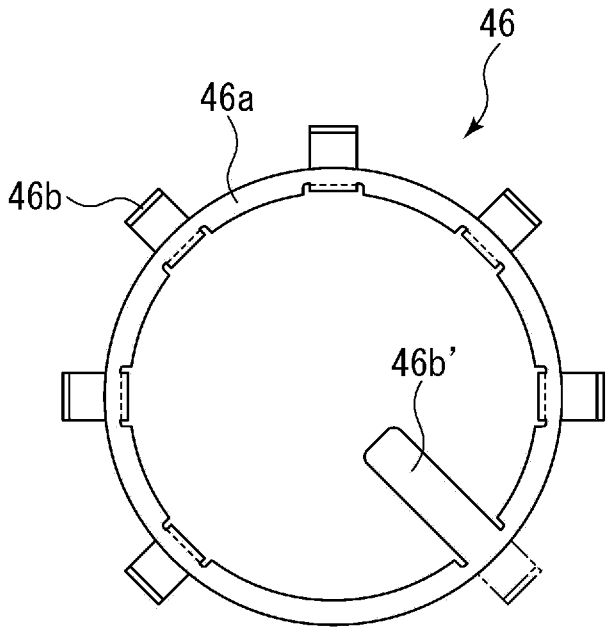
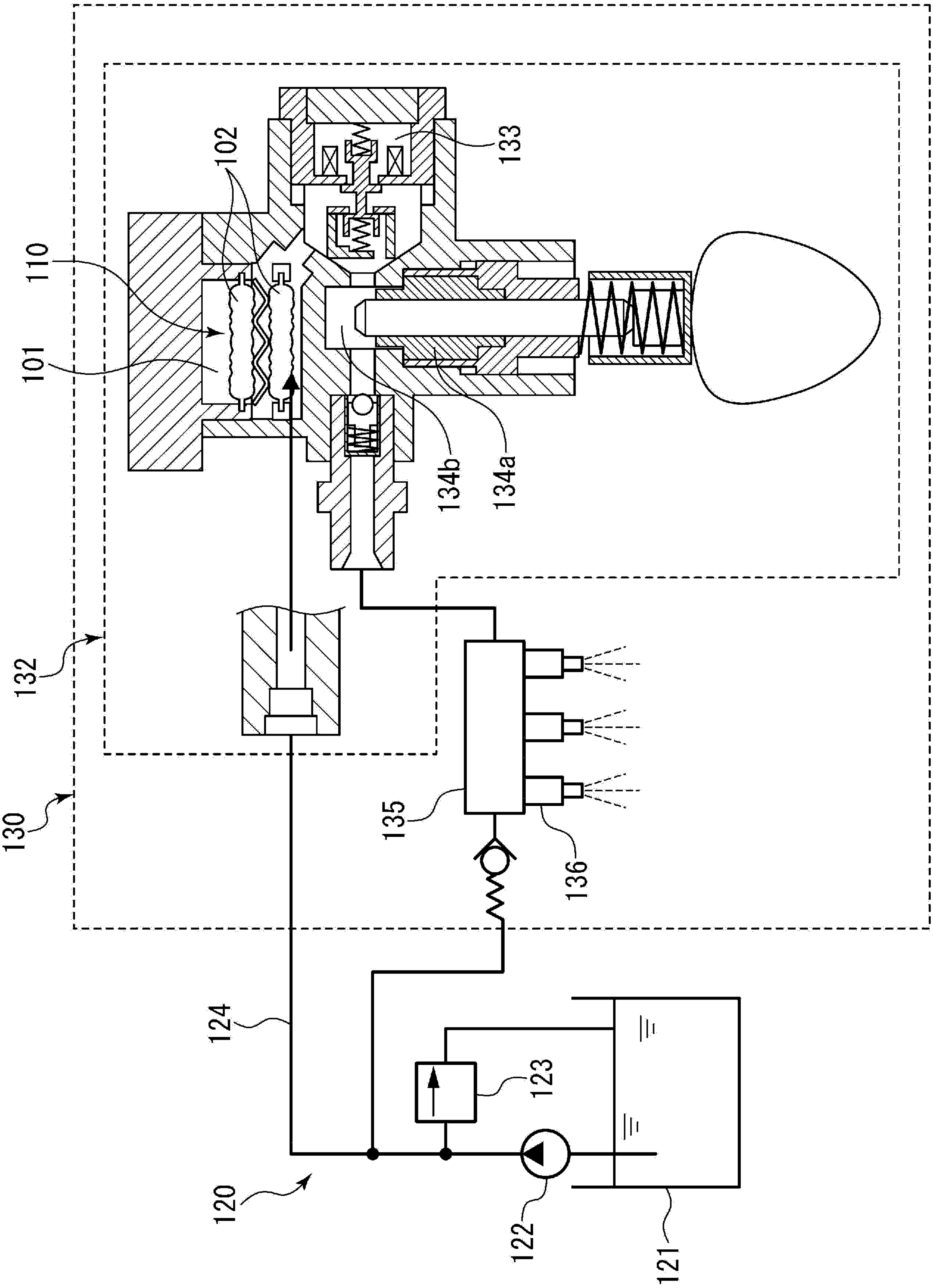


Fig. 7



REFERENCES CITED IN THE DESCRIPTION

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