(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 925 821 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
28.05.2008 Bulletin 2008/22

(51) Int Cl.:
F04B 27/18 *(2006.01)*

(21) Application number: **07119302.3**

(22) Date of filing: **25.10.2007**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK RS

(30) Priority: **15.11.2006 JP 2006309265**

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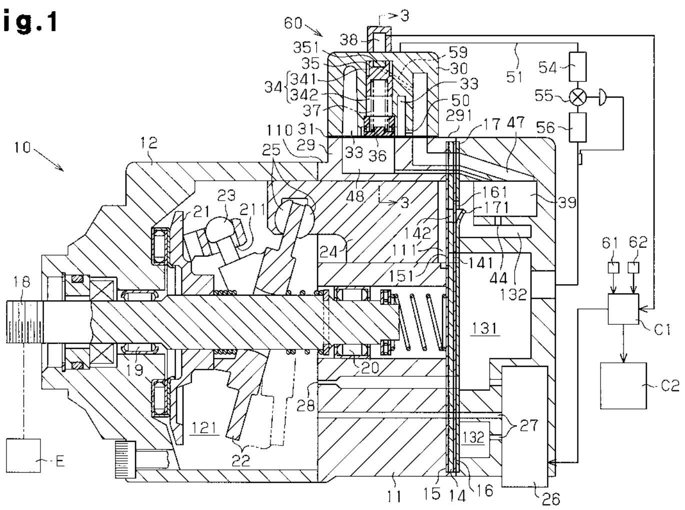
(54) Structure for sensing refrigerant flow rate in a compressor

(57) A compressor connected to an external refrigerant circuit is disclosed. The compressor is provided with a housing, a passage forming member coupled to an outer surface of the housing, and a differential pressure type flow rate detector provided in the passage forming member. The flow rate detector obtains the pressure in an upstream passage and the pressure in a downstream passage to detect a refrigerant flow rate within the refrigerant passage. The flow rate detector is provided with an accommodation chamber, a partition body, a compression spring, and a spring seat defining a maximum stroke amount of the partition body. The spring seat exists closer to the passage forming member side than a partition surface comparting the housing and the passage forming member, and is in contact with the partition surface.

Fig.1



EP 1 925 821 A2

Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a structure for sensing a flow rate of refrigerant in a compressor.

[0002] Among variable displacement compressors as disclosed in Japanese Laid-Open Patent Publication No. 2004-197679, there is a type having a displacement control valve the opening degree of which is controlled by detecting whether a refrigerant flow rate flowing through a passage provided within the compressor is proper. The opening degree of the displacement control valve is changed on the basis of a differential pressure between both sides of a restriction in a passage for the refrigerant in the compressor. In this displacement control valve, a force based on the differential pressure acts against an electromagnetic force generated by a current application to a solenoid within the displacement control valve via a valve body, and the opening degree of the valve is determined by arranging the valve body at a position where these two opposing forces are balanced.

[0003] The more the refrigerant flow rate increases, the higher the differential pressure between both sides of the restriction becomes. The differential pressure reflects the refrigerant flow rate, and the opening degree of the displacement control valve is increased when the differential pressure is increased. If the refrigerant flow rate becomes more than a proper flow rate, the opening degree of the displacement control valve is increased, and the amount of the refrigerant supplied to a crank chamber from a discharge chamber via a valve hole is increased. Accordingly, the pressure in the crank chamber is increased, the inclination angle of a swash plate is decreased, and the refrigerant flow rate is decreased to be converged into the proper flow rate. If the refrigerant flow rate becomes smaller than the proper flow rate, the opening degree becomes small, and the amount of the refrigerant supplied to the crank chamber from the discharge chamber via the valve hole is decreased. Accordingly, the pressure in the crank chamber is decreased, the inclination angle of the swash plate is increased, and the refrigerant flow rate is increased to be converged into the proper flow rate.

[0004] In the case that the compressor obtains a driving force from a vehicle engine, it is necessary to execute an output control of the engine to achieve an output capable of providing a necessary torque for driving the compressor. Since the refrigerant flow rate reflects the torque of the compressor, the torque of the compressor can be estimated by detecting the refrigerant flow rate. Although the differential pressure between both sides of the restriction reflects the refrigerant flow rate, the refrigerant flow rate is not actually detected. Accordingly, an estimation of the refrigerant flow rate (that is, the torque of the compressor) is executed on the basis of a magnitude of an electric current supplied to the solenoid of the displacement control valve.

[0005] At a time of starting the compressor, an operation control for setting the displacement to 100% is executed. However, since a liquid refrigerant in the crank chamber reserved during a stop of the operation of the compressor is vaporized with the start of the compressor, the pressure in the crank chamber becomes high, and the compressor maintains the operation while keeping the inclination angle of the swash plate small. A state in which the inclination angle of the swash plate is small corresponds to a state in which the torque of the compressor is small, that is, a state in which the refrigerant flow rate is small. On the other hand, the refrigerant flow rate estimated from the electric current supplied to the solenoid is large. Accordingly, even though the torque of the compressor is actually small, the operation of the vehicle engine is controlled on the assumption that the torque of the compressor is large. This causes an energy loss.

[0006] Accordingly, it is desirable to detect a refrigerant flow rate discharged from the compressor by using a differential pressure type flow rate detector as disclosed in Japanese Laid-Open Utility Model Publication No. 63-177715. The flow rate detector outputs an electric signal in correspondence to the differential pressures on both sides of a restriction. In Fig. 2 of the publication, the pressures on both sides of the restriction are opposed to each other via a bellofram (a partition body), and a force on the basis of the differential pressures opposes to a spring force of a coil spring. The bellofram is arranged at a position at which the differential pressures and the spring force are balanced, and an electric signal in correspondence to the position of a permanent magnet integrally displaced with the bellofram is output from a hall element.

[0007] It is desirable that the flow rate detector be provided not in a compressor housing, but in a passage forming member coupled to the compressor housing in such a manner as to form a part of the refrigerant passage. If the flow rate detector is provided in the passage forming member, it is possible to regulate and calibrate the flow rate detector in a state in which the passage forming member is detached from the compressor housing. Accordingly, it is possible to easily regulate and calibrate the flow rate detector in comparison with the case that the flow rate detector is provided within the compressor housing.

[0008] In the case that the passage forming member is detached from the compressor housing for regulating and calibrating the flow rate detector, it is necessary to prevent the partition body, the coil spring, the permanent magnet, which are components of the flow rate detector from falling off an accommodation chamber accommodating these components. The components are prevented from falling off, for example, by fastening a spring seat for the coil spring to the passage forming member by press fitting the spring seat for the coil spring to the accommodation chamber in such a manner as to confine the partition body, the coil spring, the permanent magnet or the like in the accommodation chamber.

[0009] In the case that a coil spring having a large wire diameter and a large spring constant is employed for the flow rate detector, the minimum length (a length which cannot be compressed any more) of the coil spring becomes enlarged. Accordingly, in order to secure a contraction and expansion amount (that is, the maximum stroke of the partition body and the permanent magnet) of the coil spring within the accommodation chamber large, it is necessary to enlarge the free length of the coil spring. In order to enlarge the free length of the coil spring, it is necessary to enlarge the length of an accommodating space accommodating the coil spring, the partition body and the permanent magnet, that is, the size of the accommodating space in a contracting and expanding direction of the coil spring. Therefore, it is preferable to make the thickness of the spring seat in the contracting and expanding direction of the coil spring small. However, in the case of reducing the thickness of the spring seat, a press fitting margin needs to be created between the spring seat and a wall surface of the accommodation chamber to obtain a necessary fastening force. If the press fitting margin is set large, the wall surface of the accommodation chamber may be largely deformed.

SUMMARY OF THE INVENTION

[0010] Accordingly, it is an objective of the present invention to enlarge the length of an accommodation space of a spring member without hindrance in a compressor provided with a differential pressure type flow rate detector in a passage forming body coupled to an outer surface of the compressor.

[0011] In order to achieve the object mentioned above, in accordance with an aspect of the present invention, a compressor connected to an external refrigerant circuit is provided. The compressor includes a housing, a passage forming member, and a differential pressure type flow rate detector. The passage forming member is coupled to an outer surface of the housing. The passage forming member forms a part of a refrigerant passage that connects the interior of the housing to the external refrigerant circuit. The refrigerant passage is comparted into an upstream passage having a high pressure and a downstream passage having a low pressure. The differential pressure type flow rate detector is provided in the passage forming member and obtains the pressure in the upstream passage and the pressure in the downstream passage to detect a refrigerant flow rate within the refrigerant passage. The detector is provided with an accommodation chamber, a partition body accommodated within the accommodation chamber such that the position of the partition body is displaceable, a spring member that urges the partition body, and a stroke defining body accommodated in the accommodation chamber in such a manner as to define a maximum stroke amount of the partition body. The partition body comparts the accommodation chamber into a high pressure chamber connected to the upstream passage and a low pressure chamber connected to the downstream passage. The spring member urges the partition body from the low pressure chamber toward the high pressure chamber. The stroke defining body exists closer to the passage forming member than a partition surface that partitions the housing and the passage forming member, and is in contact with the partition surface.

[0012] Other aspects and advantages of the present invention will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The invention, together with objects and advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments together with the accompanying drawings in which:

Fig. 1 is a cross-sectional side view of a whole of a variable displacement compressor in accordance with a first embodiment of the present invention;
Fig. 2A is a partially enlarged cross-sectional side view of the compressor in Fig. 1;
Fig. 2B is a view showing a portion surrounded by a circle 2B in Fig. 2A in a further enlarged manner;
Fig. 3 is a cross-sectional view taken along line 3-3 in Fig. 1;
Fig. 4 is a cross-sectional view taken along line 4-4 in Fig. 2A;
Fig. 5 is a cross-sectional view taken along line 5-5 in Fig. 2A;
Fig. 6 is a cross-sectional view taken along line 6-6 in Fig. 2A;
Fig. 7A is a partially cross-sectional side view of a compressor in accordance with a second embodiment of the present invention;
Fig. 7B is a partially enlarged cross-sectional side view of Fig. 7A; and
Fig. 8 is a partially cross-sectional side view of a compressor in accordance with a third embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0014] A description will be given of a first embodiment obtained by embodying the present invention with reference to Figs. 1 to 8.

[0015] As shown in Fig. 1, a housing of a variable displacement compressor 10 is provided with a cylinder block 11, a front housing member 12 connected to a front end of the cylinder block 11, and a rear housing member 13 connected to a rear end of the cylinder block 11 via a valve plate 14, valve forming plates 15 and 16 and a retainer forming plate 17. The cylinder block 11, the front housing member 12, and the rear housing member 13 construct the housing of the compressor 10.

[0016] The front housing member 12 and the cylinder block 11 form a control pressure chamber 121. A rotary shaft 18 is rotatably supported to the front housing member 12 and the cylinder block 11 respectively via radial bearings 19 and 20. The rotary shaft 18 protrudes to the outside from the control pressure chamber 121, and obtains a driving force from a vehicle engine E serving as an external driving source.

[0017] A rotary support 21 is fixed to the rotary shaft 18, and a swash plate 22 is supported thereto so as to be slidable in an axial direction and tiltable. A guide pin 23 provided in the swash plate 22 is slidably fitted to a guide hole 211 formed in the rotary support 21. The swash plate 22 is movable in the axial direction of the rotary shaft 18 while being tilted and is integrally rotatable with the rotary shaft 18, on the basis of the link between the guide hole 211 and the guide pin 23. The tilting motion of the swash plate 22 is generated by a sliding motion of the guide pin 23 with respect to the guide hole 211 and a sliding motion of the swash plate 22 with respect to the rotary shaft 18.

[0018] If a radial center of the swash plate 22 is moved toward the rotary support 21, the inclination angle of the swash plate 22 is increased. The maximum inclination angle of the swash plate 22 is regulated by contact between the rotary support 21 and the swash plate 22. The swash plate 22 shown by a solid line in Fig. 1 is under a state of the maximum inclination angle, and the swash plate 22 shown by a chain line is under a state of the minimum inclination angle.

[0019] A piston 24 is accommodated within each of a plurality of cylinder bores 111 formed through the cylinder block 11. Rotation of the swash plate 22 is converted into reciprocation of the pistons 24 by means of shoes 25, and the pistons 24 reciprocate within the cylinder bores 111.

[0020] A suction chamber 131 and a discharge chamber 132 are defined within the rear housing member 13. The suction chamber 131 corresponds to a suction pressure zone, and the discharge chamber 132 corresponds to a discharge pressure zone. Suction ports 141 are formed in the valve plate 14, the valve forming plate 16, and the retainer forming plate 17 in such a manner as to correspond to the respective cylinder bores 111. Discharge ports 142 are formed in the valve plate 14 and the valve forming plate 15 in such a manner as to correspond to the respective cylinder bores 111. Suction valve flaps 151 are formed in the valve forming plate 15 in such a manner as to correspond to the respective suction ports 141, and discharge valve flaps 161 are formed in the valve forming plate 16 in such a manner as to correspond to the respective discharge ports 142. Refrigerant within the suction chamber 131 pushes each suction valve flap 151 through the corresponding suction port 141 by a movement from the top dead center toward the bottom dead center of the associated piston 24 (the movement from right to left in Fig. 1), and flows into the cylinder bore 111. The refrigerant gas flowing into the cylinder bore 111 pushes each discharge valve flap 161 through the corresponding discharge port 142 by a movement from the bottom dead center toward the top dead center of the associated piston 24 (the movement from left to right in Fig. 1), and is discharged to the discharge chamber 132. The opening degree of each discharge valve flap 161 is regulated by contact of the discharge valve flap 161 with a retainer 171 on the retainer forming plate 17.

[0021] An electromagnetic type displacement control valve 26 is assembled in the rear housing member 13. The displacement control valve 26 is provided on a supply passage 27 connecting the discharge chamber 132 and the control pressure chamber 121. The opening degree of the displacement control valve 26 is adjusted in correspondence to the pressure of the suction chamber 131 and a duty ratio of a current applied to an electromagnetic solenoid (not shown) of the displacement control valve 26. When a valve hole of the displacement control valve 26 is closed, the refrigerant within the discharge chamber 132 is not fed to the control pressure chamber 121.

[0022] The control pressure chamber 121 is connected to the suction chamber 131 via a discharge passage 28, and the refrigerant within the control pressure chamber 121 flows out to the suction chamber 131 via the discharge passage 28. If the opening degree of the displacement control valve 26 becomes large, the amount of the refrigerant flowing into the control pressure chamber 121 from the discharge chamber 132 via the supply passage 27 is increased, and the pressure in the control pressure chamber 121 is increased. Accordingly, the inclination angle of the swash plate 22 is decreased, and the displacement of the compressor is decreased. If the opening degree of the displacement control valve 26 becomes small, the amount of the refrigerant flowing into the control pressure chamber 121 from the discharge chamber 132 via the supply passage 27 is decreased, and the pressure in the control pressure chamber 121 is decreased. Accordingly, the inclination angle of the swash plate 22 is increased, and the displacement of the compressor is increased.

[0023] A protruding pedestal 29 is integrally formed in an upper portion of an outer circumferential surface 110 of the cylinder block 11. As shown in Fig. 2A, an upper end 291 of the pedestal 29, that is, an outer surface of the cylinder block 11 is flat, and a muffler forming member 30 serving as a passage forming member is coupled to the upper end 291 of the pedestal 29 with a tabular sealing gasket 31. The gasket 31 is structured by rubber layers 312 and 313 baked on both surfaces of a metal plate 311, which is a core material (refer to Fig. 2B). The gasket 31 prevents refrigerant leakage from a portion between the pedestal 29 and the muffler forming member 30. As shown in Fig. 3, the muffler forming member 30 and the gasket 31 are both fixed to the pedestal 29 by a screw 32.

[0024] A muffler chamber 33 and an accommodation chamber 34 are formed in the muffler forming member 30, and a partition body 35 is slidably accommodated in the accommodation chamber 34, which is open toward the pedestal 29. That is, the position of the partition body 35 is displaceable within the accommodation chamber 34. The partition body 35 comparts the accommodation chamber 34 into a high pressure chamber 341 and a low pressure chamber 342. A spring seat 36 made of a synthetic resin is fitted to an opening of the accommodation chamber 34, and a coil spring 37 serving as a spring member is arranged between the partition body 35 and the ring-shaped spring seat 36. The coil spring 37 urges the partition body 35 from the low pressure chamber 342 toward the high pressure chamber 341.

[0025] The spring seat 36 serving as a stroke defining body is provided with a disc-shaped base portion 45 and a cylindrical portion 46, and a fixed end 371 of the coil spring 37 comes into contact with the base portion 45. A back surface 451 of the base portion 45 comes into contact with a surface of the rubber layer 312, that is, a seal surface 310. Introduction ports 461 are formed in the cylindrical portion 46. An annular communication groove 343 is formed in a peripheral wall surface 344 of the accommodation chamber 34. The introduction port 461 connects an internal space of the cylindrical portion 46, specifically the low pressure chamber 342, with the communication groove 343. The introduction port 461 is covered by an annular filter 53 surrounding an outer peripheral portion of the cylindrical portion 46. The spring seat 36 is insert-molded in a state in which the filter 53 is put into the mold.

[0026] The low pressure chamber 342 communicates with the muffler chamber 33 via the introduction port 461 and the communication groove 343. The pressure within the muffler chamber 33 is applied to the low pressure chamber 342.

[0027] A permanent magnet 351 is fixed to the partition body 35, and a magnetic detector 38 is provided on an outer surface of the muffler forming member 30. The magnetic detector 38 detects a magnetic flux density of the permanent magnet 351. Information about the magnetic flux density detected by the magnetic detector 38 is transmitted to a displacement control computer C1 shown in Fig. 1.

[0028] As shown in Fig. 2A, an oil separator 39 is installed in the rear housing member 13. The oil separator 39 is provided with a housing 40. A refrigerant swirling cylinder 41 is fitted into the housing 40 and fixed inside the housing 40. The cylinder 41 comparts the housing 40 into an oil separating chamber 42 and a passing chamber 43, and the oil separating chamber 42 is connected to the discharge chamber 132 via an introduction passage 44. The refrigerant within the discharge chamber 132 flows into the oil separating chamber 42 via the introduction passage 44. The refrigerant flowing into the oil separating chamber 42 from the introduction passage 44 is swirled along an outer circumferential surface of the cylinder 41 around the cylinder 41. The refrigerant swirling around the cylinder 41 flows out to the passing chamber 43 via an internal space 411 of the cylinder 41.

[0029] A passage 47 passing through the valve plate 14 and the gasket 31 is formed in the muffler forming member 30, the cylinder block 11, and the rear housing member 13. The muffler chamber 33 is connected to the passage 47 within the muffler forming member 30 via the restriction passage 50, and the passage 47 is connected to the passing chamber 43. Fig. 4 shows the passage 47 formed in the cylinder block 11, Fig. 5 shows the passage 47 provided in a penetrating manner in the gasket 31, and Fig. 6 shows the passage 47 and the restriction passage 50 formed in the muffler forming member 30.

[0030] As shown in Figs. 2A and 3, an oil reservoir chamber 48 is formed within the pedestal 29. The oil reservoir chamber 48 is isolated from the muffler chamber 33 and an accommodation chamber 34 by the gasket 31. As shown in Fig. 2A, the oil reservoir chamber 48 is connected to the oil separating chamber 42 via a passage 49 formed in the cylinder block 11, the valve plate 14 and the rear housing member 13.

[0031] The refrigerant within the discharge chamber 132 shown in Fig. 1 flows out to an external refrigerant circuit 51 via the introduction passage 44, the interior of the oil separator 39, the passage 47, restriction passage 50, and the muffler chamber 33. The refrigerant flowing out to the external refrigerant circuit 51 is circulated to the suction chamber 131. On the external refrigerant circuit 51, there are provided a heat exchanger 54 for absorbing heat from the refrigerant, an expansion valve 55, and a heat exchanger 56 for transferring the surrounding heat to the refrigerant. The expansion valve 55 controls a refrigerant flow rate in correspondence to fluctuations of the gas temperature in an outlet side of the heat exchanger 56. Oil exists in a circuit comprising the variable displacement compressor 10 and the external refrigerant circuit 51, and the oil flows with the refrigerant.

[0032] The refrigerant flowing into the oil separating chamber 42 from the discharge chamber 132 via the introduction passage 44 shown in Fig. 2A swirls along the outer circumferential surface of the cylinder 41 around the cylinder 41. Accordingly, mist-like oil contained in the refrigerant is separated from the refrigerant within the oil separating chamber 42. The refrigerant swirling around the cylinder 41 flows into an internal space 411 of the cylinder 41, and the oil separated from the refrigerant flows into the oil reservoir chamber 48 via the passage 49. The oil within the oil reservoir chamber 48 flows out to the control pressure chamber 121 via a return passage 57 open to a bottom portion of the oil reservoir chamber 48. The oil within the control pressure chamber 121 is used for lubricating a sliding portion within the control pressure chamber 121.

[0033] The restriction passage 50 generates a difference between the pressure within the passage 47 and the pressure within the muffler chamber 33. The pressure within the muffler chamber 33 is lower than the pressure within the passage 47. The introduction passage.44, the oil separating chamber 42, the passing chamber 43, the passage 47, the restriction passage 50, and the muffler chamber 33 construct a refrigerant passage 52 through which the refrigerant discharged out of the housing from the interior of the housing of the variable displacement compressor 10 passes. The refrigerant passage 52 is comparted into an upstream passage 58 including the introduction passage 44, the oil separating chamber 42, the passing chamber 43 and the passage 47, and the muffler chamber 33 serving as a downstream passage, by the restriction passage 50.

[0034] The pressure within the upstream passage 58 is applied to the high pressure chamber 341 via a high pressure introduction passage 59 formed in the muffler forming member 30, and the pressure within the muffler chamber 33 serving as the downstream passage is applied to the low pressure chamber 342 via the communication groove 343 and an introduction port 461. The pressure within the high pressure chamber 341 and the pressure within the low pressure chamber 342 oppose to each other with the partition body 35 in between. The differential pressure between the pressure within the high pressure chamber 341 and the pressure within the low pressure chamber 342 acts against the spring force of the coil spring 37, and the partition body 35 is arranged at a position at which the force based on the differential pressure and the spring force of the coil spring 37 are balanced. The permanent magnet 351 fixed to the partition body 35 is separated away from the magnetic detector 38 as the differential pressure between the pressure within the high pressure chamber 341 and the pressure within the low pressure chamber 342 increases. In the case that the differential pressure does not exist between the high pressure chamber 341 and the low pressure chamber 342, the coil spring 37 is in a state close to the free length, and the partition body 35 comes into contact with the bottom 340 of the accommodation chamber 34.

[0035] If the flow rate of the refrigerant flowing through the refrigerant passage 52 is increased, the differential pressure is increased, and the partition body 35 is displaced from the high pressure chamber 341 toward the low pressure chamber 342. If the flow rate of the refrigerant flowing through the refrigerant passage 52 is decreased, the differential pressure is decreased, and the partition body 35 is displaced from the low pressure chamber 342 toward the high pressure chamber 341. The position of the partition body 35 is reflected to the magnetic flux density detected by the magnetic detector 38. The magnetic flux density detected by the magnetic detector 38 reflects the position of the partition body 35, that is, the flow rate of the refrigerant flowing through the refrigerant passage 52.

[0036] The accommodation chamber 34, the partition body 35, the coil spring 37, the spring seat 36, and the magnetic detector 38 form a differential pressure type flow rate detector 60 that obtains the pressure in the upstream passage 58 and the pressure in the downstream passage (the muffler chamber 33), thereby detecting the flow rate of the refrigerant within the refrigerant passage 52.

[0037] As shown in Fig. 1, a room temperature setting device 61 and a room temperature detector 62 are connected to the displacement control computer C1. The displacement control computer C1 controls a current supplied to the electromagnetic solenoid of the displacement control valve 26 on the basis of the magnetic flux density information obtained by the magnetic detector 38 in such a manner that the room temperature detected by the room temperature detector 62 is converged into a target room temperature set by the room temperature setting device 61. That is, the displacement control computer C1 executes a feedback control for controlling the flow rate of the refrigerant to achieve a proper value on the basis of the magnetic flux density information obtained by the magnetic detector 38.

[0038] The displacement control computer C1 transmits the torque information of the variable displacement compressor 10 to an engine control computer C2 on the basis of the magnetic flux density information obtained from the magnetic detector 38. The engine control computer C2 executes a proper control of the speed of the vehicle engine E on the basis of the torque information obtained from the displacement control computer C1.

[0039] The present embodiment in detail mentioned above has the following advantages.

(1) It is possible to regulate and calibrate the differential pressure type flow rate detector 60 assembled in the muffler forming member 30 in a state in which the muffler forming member 30 is detached from the housing (specifically, from the cylinder block 11) of the variable displacement compressor 10. In this case, the structure is made such as to prevent the position of the spring seat 36 from being changed by using a jig.

In the case of moving the muffler forming member 30 detached form the cylinder block 11 to a place for regulating and calibrating, it is necessary to prevent the spring seat 36, the partition body 35 and the coil spring 37 from falling off the accommodation chamber 34. In a state in which the partition body 35 is in contact with the bottom 340 of the accommodation chamber 34, the coil spring 37 is in a state close to the free length, and the spring force of the coil spring 37 applied to the spring seat 36 is small. Accordingly, in a state in which the muffler forming member 30 is away from the cylinder block 11, it is possible to make the fastening force to the spring seat 36 necessary for preventing the spring seat 36 from falling off the muffler forming member 30, (that is, the force for fastening and holding the spring seat 36 at a time of fitting the spring seat 36 to the accommodation chamber 34) small.

In the state in which the muffler forming member 30 is fastened to the cylinder block 11, the spring seat

36 exists at the position of being in contact with the gasket 31. Accordingly, it is possible to utilize the space within the accommodation chamber 34 as an accommodation space for the partition body 35 and the coil spring 37 to the maximum. In other words, it is possible to enlarge without hindrance the length of the accommodation space for the coil spring 37, that is, the size of the accommodation space in the contracting and expanding direction of the coil spring 37, without employing the structure for strongly press fitting the spring seat 36 to the accommodation chamber 34 so as to cause a deformation of the peripheral wall surface 344 of the accommodation chamber 34. In other words, it is possible to enlarge the maximum stroke amount of the partition body 35 without hindrance.

(2) Since the spring seat 36 is in contact with the gasket 31, the spring seat 36 is hardly deformed by the pressure of the refrigerant and the spring force of the coil spring 37. Accordingly, it is possible to reduce the thickness of the base portion 45 of the spring seat 36, and it is possible to utilize the space within the accommodation chamber 34 as the accommodation space for the partition body 35 and the coil spring 37 to the maximum.

(3) The gasket 31 partitions the cylinder block 11 and the muffler forming member 30, and the seal surface 310 of the gasket 31 is a partition surface partitioning the cylinder block 11 and the muffler forming member 30. The gasket 31, which ensures a sealing performance between the cylinder block 11 and the muffler forming member 30 and partitions the cylinder block 11 and the muffler forming member 30, is a suitable member for receiving and holding the spring seat 36 so as to secure the length of the accommodation space of the coil spring 37.

(4) The fastening force utilizing the elastic deforming force of the synthetic resin is suitable for generating a weak fastening force which does not generate deformation of the peripheral wall surface 344 of the accommodation chamber 34. In other words, it is preferable for obtaining the weak fastening force to form the spring seat 36 by the synthetic resin, and it is preferable for saving weight of the spring seat 36.

(5) Since the spring seat 36 is not displaced on the basis of the contact with the gasket 31, the detection accuracy is not lowered due to the displacement of the spring seat 36.

(6) If foreign matter enters a portion between the partition body 35 and the peripheral wall surface 344 of the accommodation chamber 34, a portion between the partition body 35 and the peripheral wall surface 344 of the accommodation chamber 34 is damaged. The filter 53, which removes such foreign matter can be easily provided in the spring seat 36 by insert molding the spring seat 36 made of the synthetic resin.

(7) The pressure in the muffler chamber 33 is introduced to the low pressure chamber 342 connected to the muffler chamber 33. The passage structure for connecting the low pressure chamber 342 to the muffler chamber 33 is simple, and the structure in which the muffler chamber 33 is formed as the downstream passage of the refrigerant passage 52 simplifies the passage structure for introducing the pressure in the downstream passage to the differential pressure type flow rate detector 60 provided in the muffler forming member 30.

[0040] Next, a description will be given of a second embodiment according to the present invention with reference to Fig. 7. Some of the reference numerals used in the previous description will be used below, and a description of the common structure will be omitted. Description will be given only of the modified portions.

[0041] In the second embodiment, the oil separator 39 and the oil reservoir chamber 48 in the first embodiment are not provided. Further, the spring seat 36 made of the synthetic resin is in contact with an upper end 291 of the pedestal 29. A retainer projection 462 is integrally formed in an outer circumferential surface of the cylindrical portion 46 of the spring seat 36, and a retainer recess 345 is formed in the peripheral wall surface 344 of the accommodation chamber 34. At a time when the spring seat 36 is fitted to the accommodation chamber 34, the retainer projection 462 enters into a position of the retainer recess 345 while being elastically deformed, and the retainer projection 462 is retained to the retainer recess 345.

[0042] Since the retainer projection 462 can be molded at the same time of molding the spring seat 36 made of the synthetic resin which can be molded into a complex shape, it is possible to easily mold the retainer projection 462. The force required for elastically deforming the retainer projection 462 is comparatively small, and does not deform the peripheral wall surface 344 of the accommodation chamber 34.

[0043] The base portion 45 of the spring seat 36 is in contact with the cylinder block 11, and the outer surface of the cylinder block 11 (the upper end 291 of the pedestal 29) serves as a partition surface partitioning the cylinder block 11 and the muffler forming member 30. In the structure in which the outer surface of the cylinder block 11 is formed as the partition surface, it is possible to elongate the length of the accommodation space of the coil spring 37 by the amount corresponding to the thickness of the gasket 31, in comparison with the structure in which the seal surface 310 of the gasket 31 is formed as the partition surface.

[0044] Next, a description will be given of a third embodiment according to the present invention with reference to Fig. 8. Some of the reference numerals used in the previous description will be used below, and a description of the common structure will be omitted. Description will be given only of the modified portions.

[0045] A partition body 35B of a differential pressure type flow rate detector 60B comparts an accommodation chamber 34B into a high pressure chamber 341B and a low pressure chamber 342B, and a coil spring 37B serving as a spring member is accommodated in the low pressure chamber 342B. A positioning seat 63 serving as the stroke defining body is fitted to the accommodation chamber 34B, and the coil spring 37B urges the partition body 35B toward the positioning seat 63. The positioning seat 63 made of the synthetic resin is fitted to the accommodation chamber 34B and is in contact with the gasket 31.

[0046] The high pressure chamber 341B is connected to a passage 47B via an introduction port 631 formed in the positioning seat 63, the communication groove 343, the muffler forming member 30, and the passage 64 formed in the gasket 31. The low pressure chamber 342B is connected to the muffler chamber 33 via the low pressure introduction passage 301 formed in the muffler forming member 30. The muffler chamber 33 is connected to the passage 47B via the restriction 65 formed in the gasket 31. The introduction port 631 is covered by the filter 53.

[0047] The restriction 65 comparts the refrigerant passage 52B into the upstream passage and the downstream passage, and generates a differential pressure between the pressure within the passage 47B and the pressure within the muffler chamber 33. The pressure within the passage 47B is applied to the high pressure chamber 341B, and the pressure within the muffler chamber 33 is applied to the low pressure chamber 342B. The permanent magnet 351 fastened to the partition body 35B comes closer to the magnetic detector 38 as the differential pressure between the pressure within the high pressure chamber 341B and the pressure within the low pressure chamber 342B increases. In the case that the differential pressure does not exist between the high pressure chamber 341B and the low pressure chamber 342B, the partition body 35B comes into contact with the positioning seat 63.

[0048] In accordance with the third embodiment mentioned above, it is possible to obtain the same advantages as the advantages (1) to (7) of the first embodiment mentioned above.

[0049] Each of the embodiments mentioned above may be modified as follows.

[0050] In the first to third embodiments mentioned above, the muffler forming member 30 is coupled to the pedestal 29 of the cylinder block 11 via the gasket 31. However, the muffler forming member 30 may be coupled to the outer circumferential surface of the front housing member 12 or the outer circumferential surface of the rear housing member 13. Alternatively, the muffler forming member 30 may be coupled to an outer circumferential surface which is astride two members or more in the cylinder block 11, the front housing member 12 and the rear housing member 13.

[0051] A bellows may be used as the partition body in the differential pressure type flow rate detector.

[0052] A diaphragm may be used as the partition body in the differential pressure type flow rate detector.

[0053] The structure may be made such that a passage forming member is provided between the external refrigerant circuit 51 and the suction chamber 131, a gasket is provided between the housing of the variable displacement compressor and the passage forming member, and a differential pressure type flow rate detector is provided in the passage forming member. The differential pressure type flow rate detector in this case detects the refrigerant flow rate flowing into the suction chamber 131 from the external refrigerant circuit 51.

[0054] The present invention may be applied to a fixed displacement type compressor.

[0055] It should be apparent to those skilled in the art that the present invention may be embodied in many other specific forms without departing from the spirit or scope of the invention. Particularly, it should be understood that the invention may be embodied in the following forms.

[0056] The present examples and embodiments are to be considered as illustrative and not restrictive and the invention is not to be limited to the details given herein, but may be modified within the scope and equivalence of the appended claims.

[0057] A compressor connected to an external refrigerant circuit is disclosed. The compressor is provided with a housing, a passage forming member coupled to an outer surface of the housing, and a differential pressure type flow rate detector provided in the passage forming member. The flow rate detector obtains the pressure in an upstream passage and the pressure in a downstream passage to detect a refrigerant flow rate within the refrigerant passage. The flow rate detector is provided with an accommodation chamber, a partition body, a compression spring, and a spring seat defining a maximum stroke amount of the partition body. The spring seat exists closer to the passage forming member side than a partition surface comparting the housing and the passage forming member, and is in contact with the partition surface.

Claims

1. A compressor connected to an external refrigerant circuit (51), the compressor comprising:

a housing (11, 12, 13);

a passage forming member (30) coupled to an outer surface of the housing (11, 12, 13), the passage forming member (30) forming a part of a refrigerant passage (52) connecting the inte-

rior of the housing (11, 12, 13) to the external refrigerant circuit (51), the refrigerant passage (52) being comparted into an upstream passage (58) having a high pressure and a downstream passage (33) having a low pressure; and
a differential pressure type flow rate detector (60) provided in the passage forming member (30) and obtaining the pressure in the upstream passage (58) and the pressure in the downstream passage (33) to detect a refrigerant flow rate within the refrigerant passage (52), the detector (60) being provided with an accommodation chamber (34), a partition body (35) accommodated within the accommodation chamber (34) such that the position of the partition body (35) is displaceable, a spring member (37) urging the partition body (35), and a stroke defining body (36) accommodated in the accommodation chamber (34) in such a manner as to define a maximum stroke amount of the partition body (35), wherein the partition body (35) comparts the accommodation chamber (34) into a high pressure chamber (341) connected to the upstream passage (58) and a low pressure chamber (342) connected to the downstream passage (33), the spring member (37) urging the partition body (35) from the low pressure chamber (342) toward the high pressure chamber (341),

characterized in that the stroke defining body (36) exists closer to the passage forming member (30) than a partition surface (291, 310) partitioning the housing (11) and the passage forming member (30), and is in contact with the partition surface (291, 310).

2. The compressor according to claim 1, **characterized in that** a gasket (31) is provided between the housing (11) and the passage forming member (30), and the partition surface (310) is a seal surface (310) of the gasket (31) opposing to the passage forming member (30).

3. The compressor according to claim 1, **characterized in that** the partition surface (291) is an outer surface of the housing (11).

4. The compressor according to any one of claims 1 to 3, **characterized in that** the stroke defining body (36) is made of a synthetic resin, and is fitted to the accommodation chamber (34).

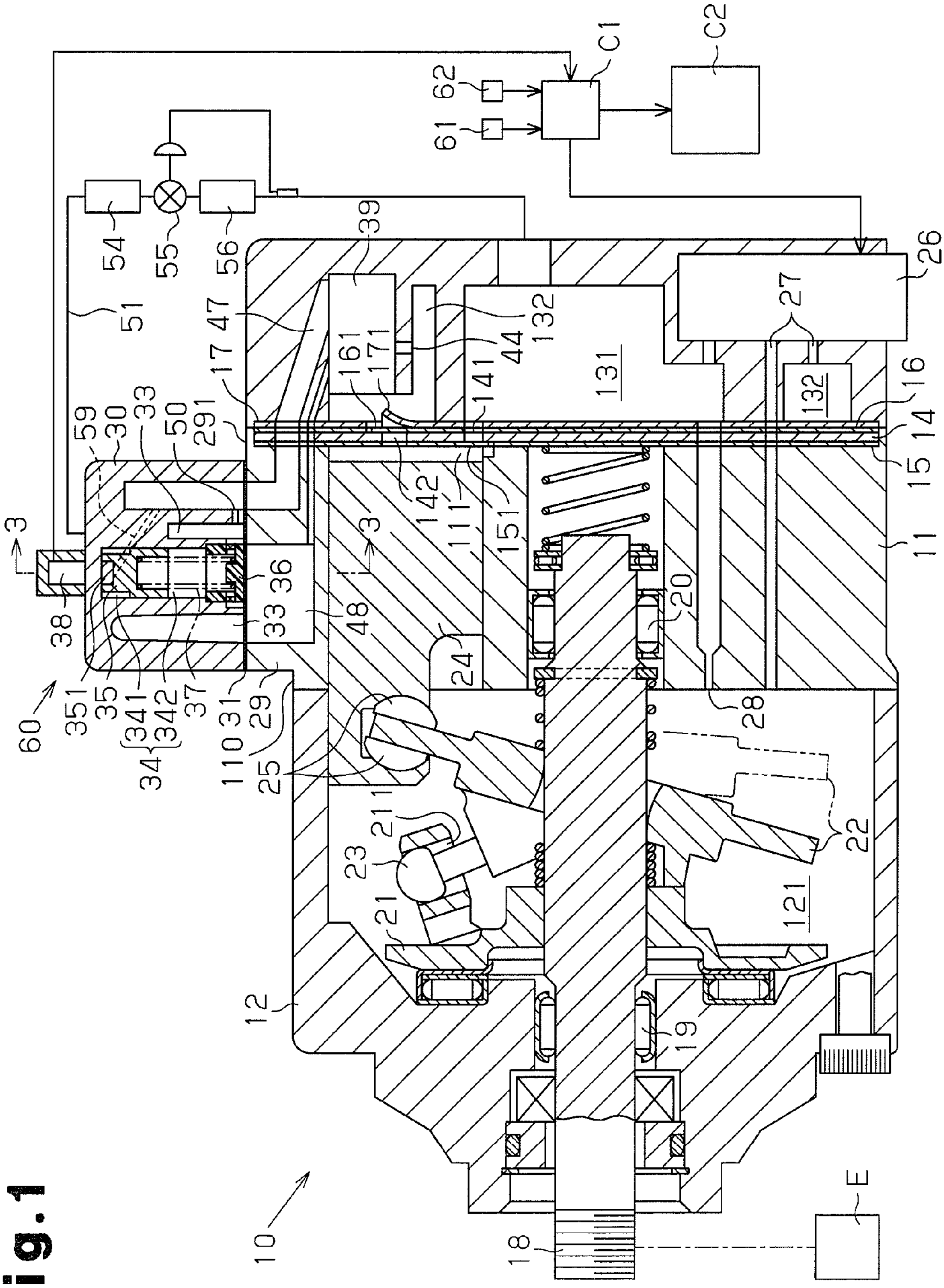
5. The compressor according to any one of claims 1 to 3, **characterized in that** the passage forming member (30) has a retainer recess (345), and the stroke defining body (36) is made of a synthetic resin, and has a retainer projection (462) retained to the retainer recess (345).

6. The compressor according to any one of claims 1 to 5, **characterized in that** the stroke defining body (36) is made of a synthetic resin, and has an introduction port (461) passing through the stroke defining body (36) in such a manner as to connect the low pressure chamber (342) to the downstream passage (33), and wherein a filter (53) is provided in the introduction port (461).

7. The compressor according to any one of claims 1 to 6, **characterized in that** the stroke defining body (36) is a spring seat receiving a fixed end (371) of the spring member (37) .

8. The compressor according to any one of claims 1 to 7, **characterized in that** the compressor being a variable displacement compressor that is provided with the discharge pressure zone(132), the suction pressure zone (131), a control pressure chamber (121), a supply passage (27) supplying the refrigerant from the discharge pressure zone (132) to the control pressure chamber (121), and a discharge passage (28) discharging the refrigerant from the control pressure chamber (121) to the suction pressure zone (131), wherein a displacement of the compressor is controlled in correspondence to the pressure within the control pressure chamber (121).

9. The compressor according to any one of claims 1 to 8, **characterized in that** the passage forming member (30) has a restriction passage (50) comparting the refrigerant passage (52) into the upstream passage (58) and the downstream passage (33).


C1
C2
61
62
54
55
56
51
59
30
33
50
291
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47
39
161
171
44
132
131
141
142
111
151
26
27
132
16
14
15
11
3
38
36
33
48
24
20
28
60
351
35
341
342
37
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34
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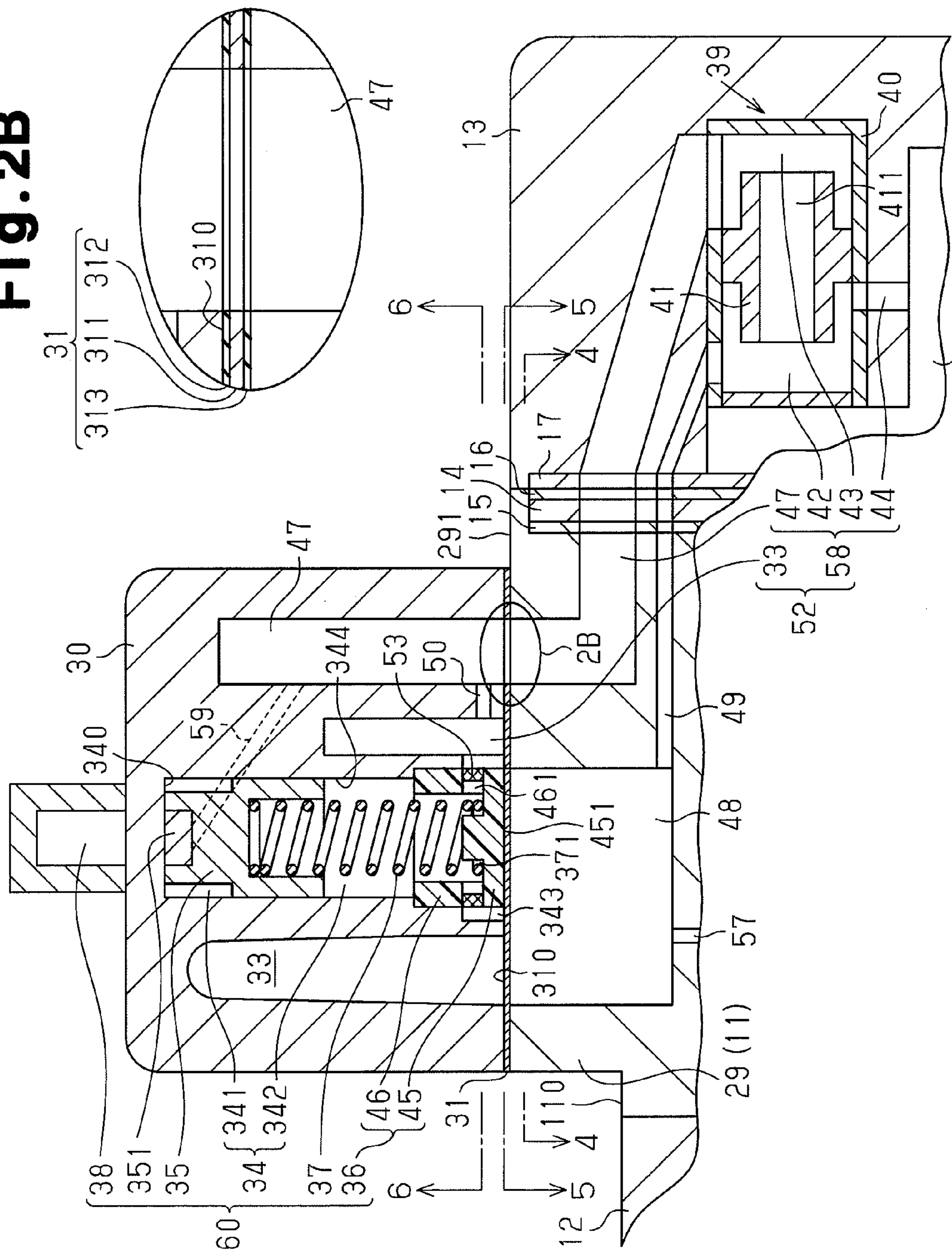
23
21
22
121
12
19
10
18
E

Fig.1

Fig.2B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311
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310
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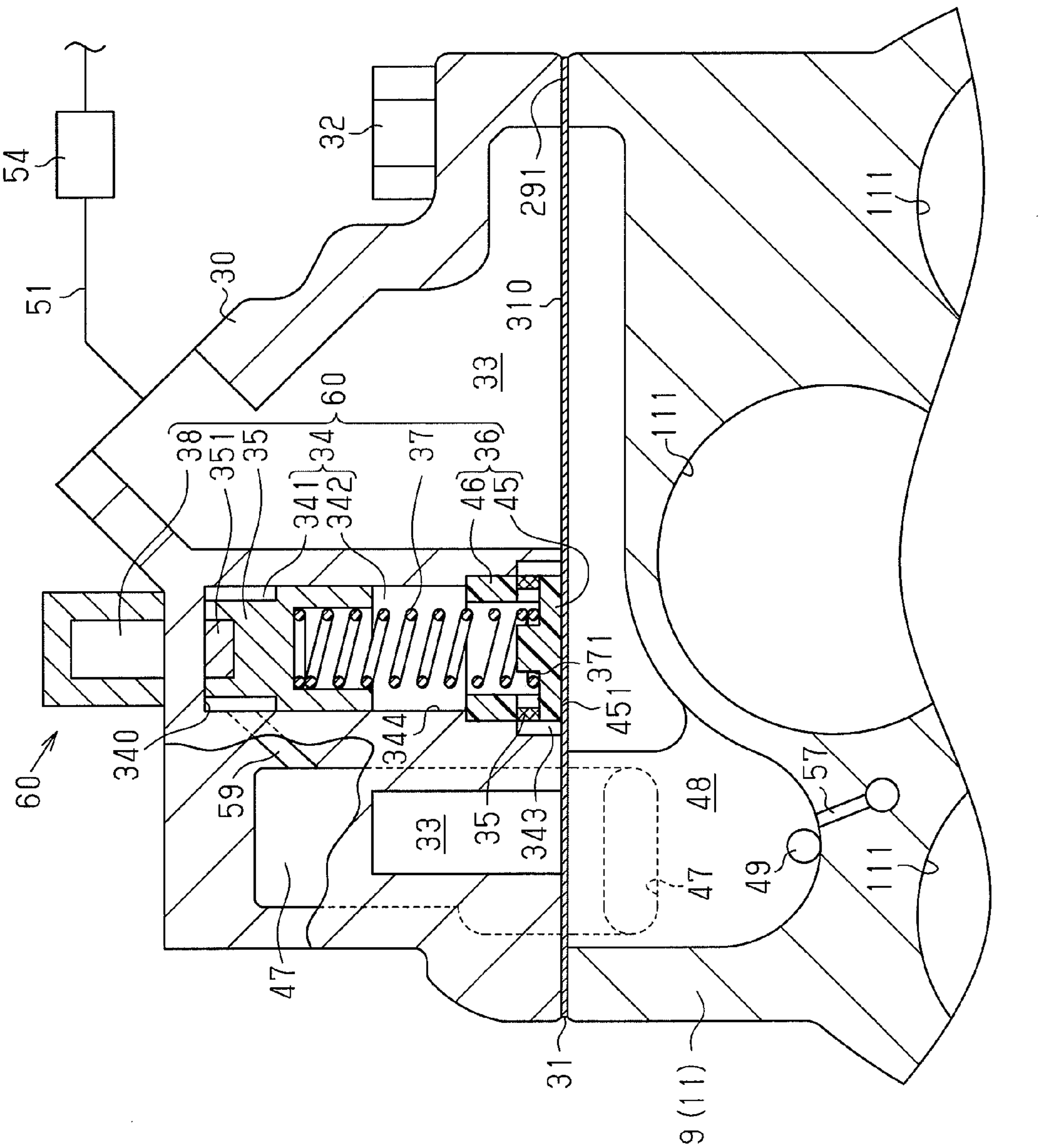
411
41
132
42
43
44
17
14
16
15
291
47
33
58
52
2B
49
48
57
29 (11)
110
4
5
6
12
30
340
59
344
53
50
461
451
371
343
310
31
38
351
35
341
342
34
37
46
45
36
60
33

Fig.2A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51
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291
310
33
60
38
351
35
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341
342
37
36
46
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111
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344
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343
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47
49
60
31
29 (11)

Fig.3

Fig.6

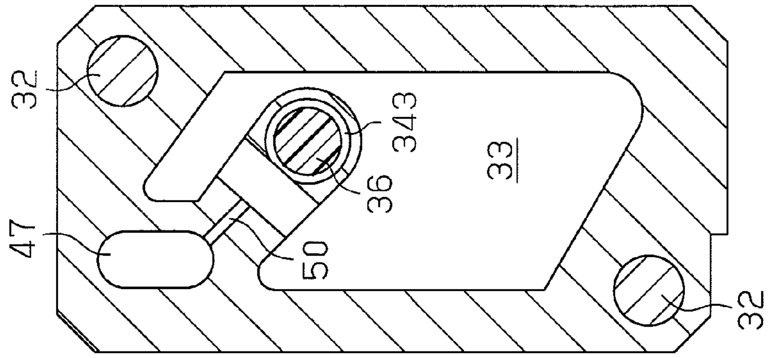


Fig.5

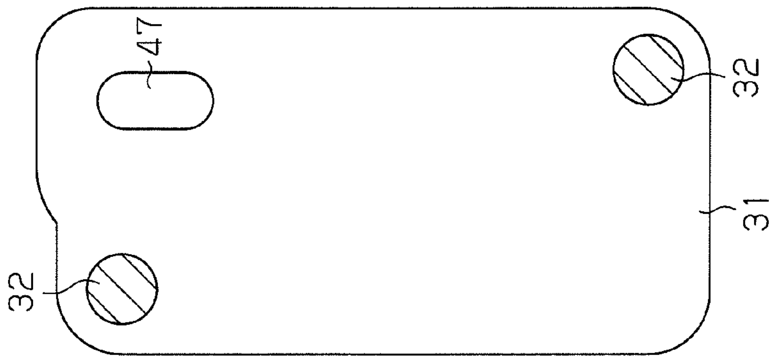
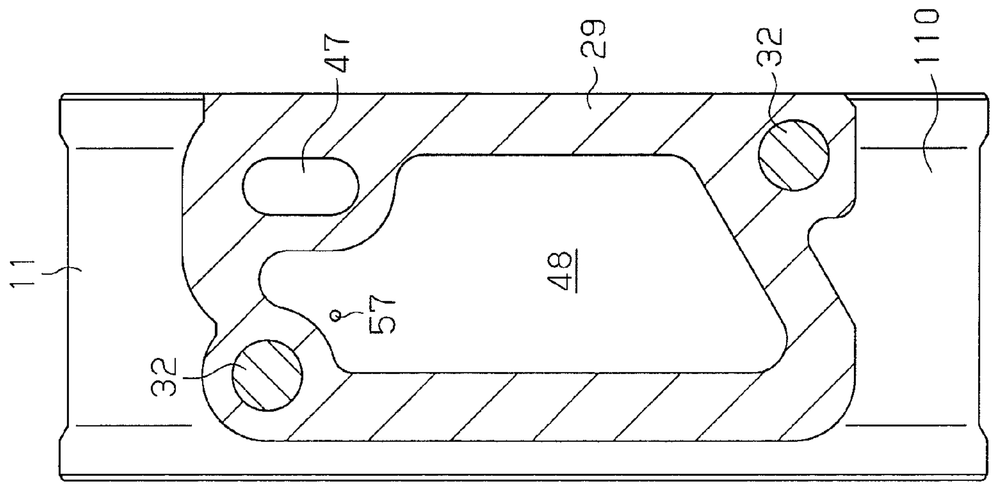
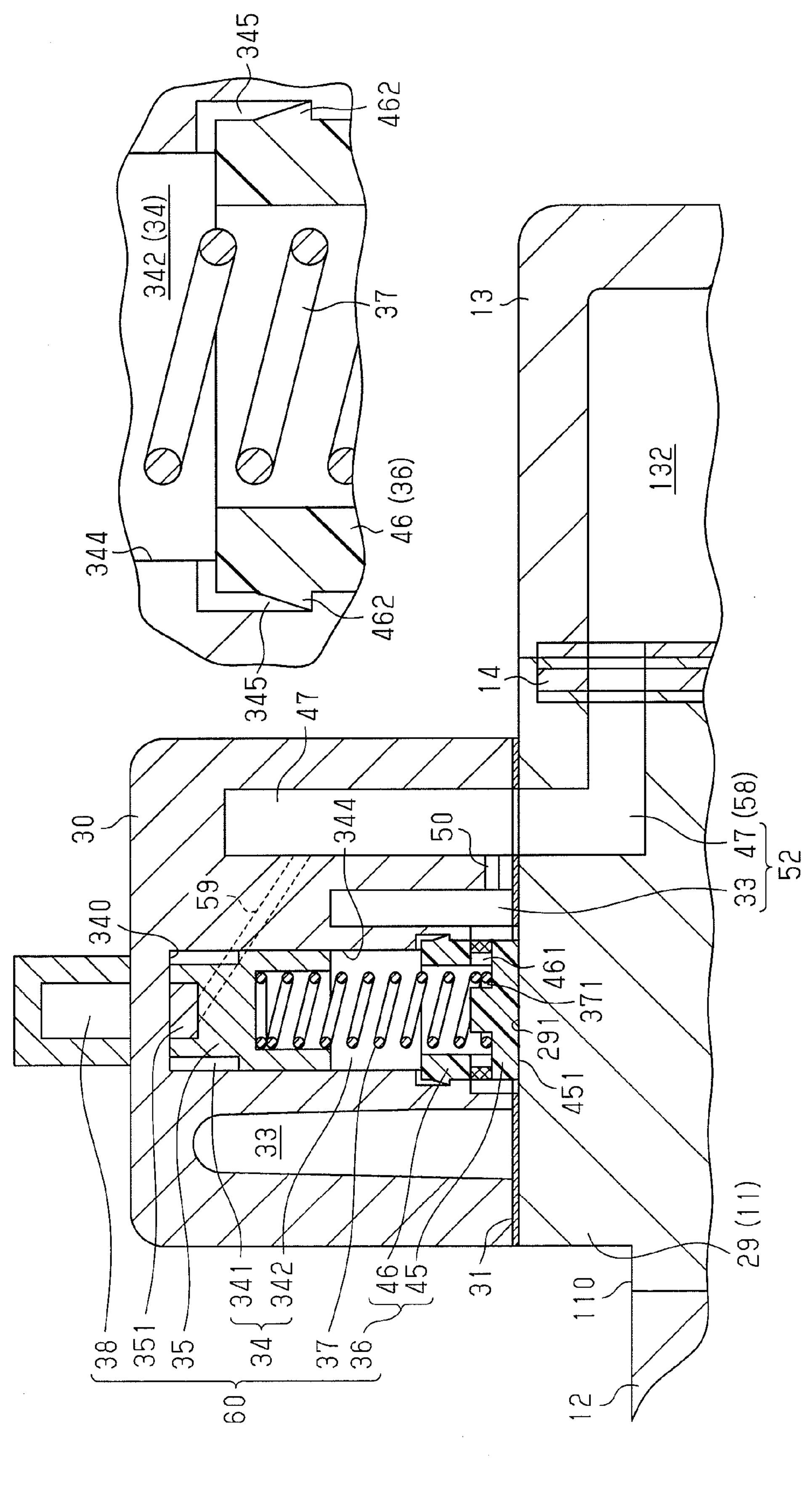


Fig.4




345
462
342 (34)
37
46 (36)
344
462
345
13
132
14
47
30
344
50
340
59
47 (58)
33 47
52
33
461
371
291
451
33
29 (11)
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110
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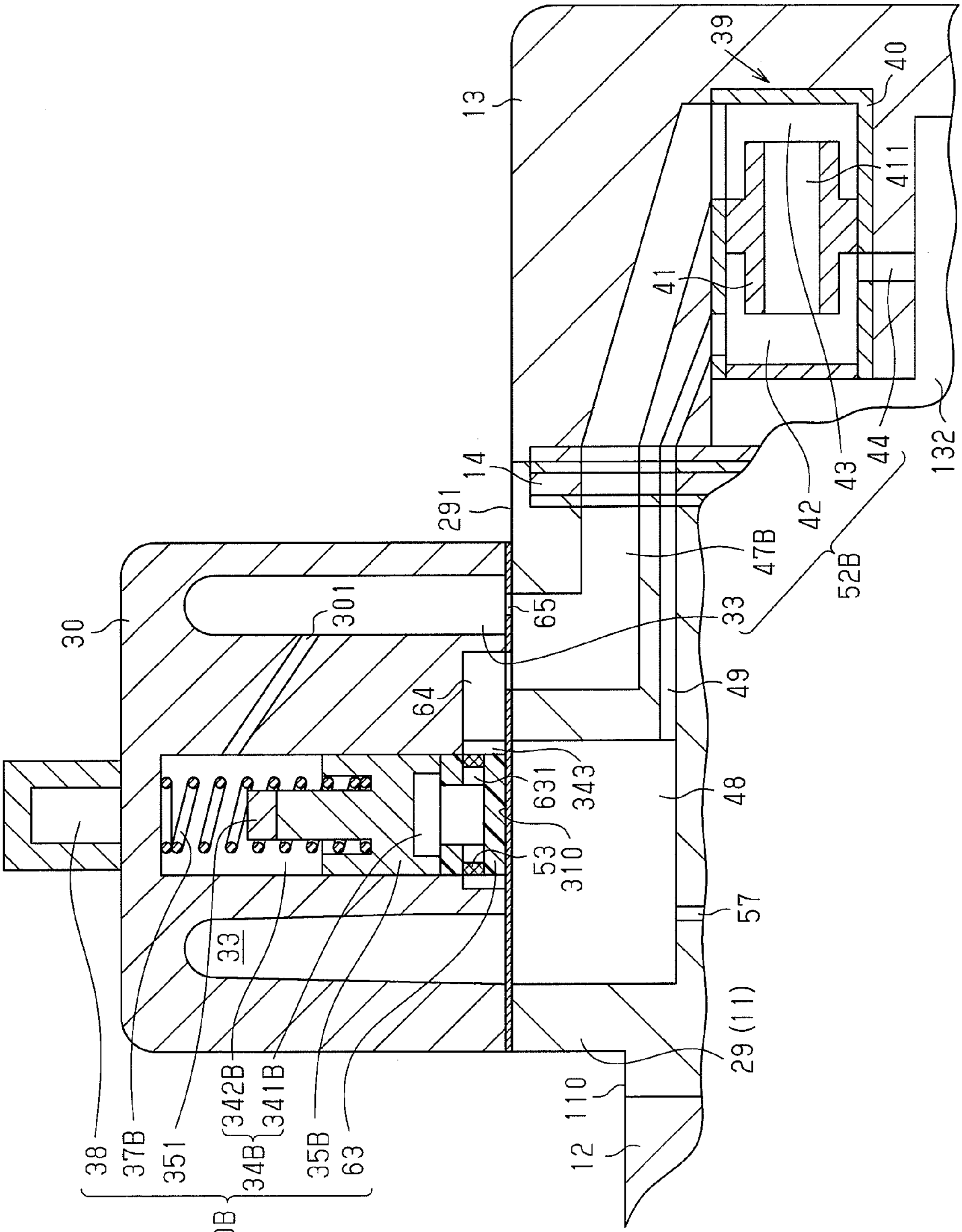
351
35
341
342
34
37
46
45
36
60

Fig.7A

Fig.7B


13
39
40
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43
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132
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291
47B
52B
33
65
30
301
64
49
343
631
48
53
310
57
29 (11)
110
12
38
37B
351
342B
34B
341B
35B
63
60B

Fig.8

REFERENCES CITED IN THE DESCRIPTION

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- JP 63177715 U **[0006]**