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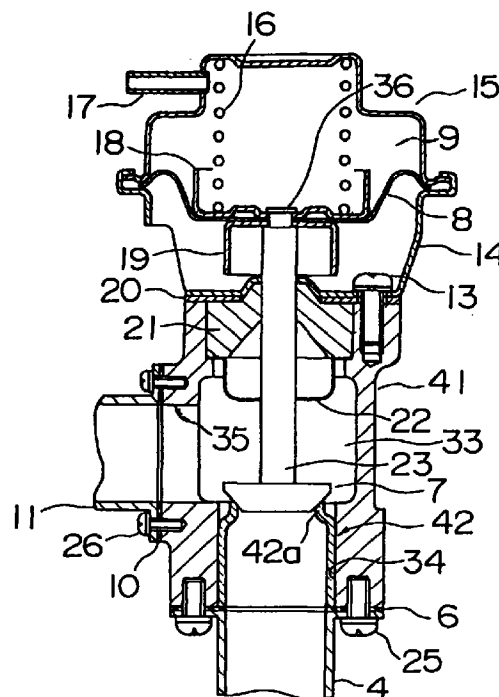
(54) EXHAUST GAS RECIRCULATION CONTROL VALVE DEVICE

(57) According to the present invention, there is provided a less expensive EGR controlling valve device which enhances corrosion resistance of a wall surface of a passage inlet of an exhaust gas passage against exhaust gas to suppress adhesion of fine particles, may considerably reduce a frequency of maintenance, and is superior in assembling property.

This EGR controlling valve device is provided with a housing having an exhaust gas passage therein; an adjusting valve provided in this housing for adjusting an amount of exhaust gas to be recirculated into an intake pipe of an engine from an exhaust pipe of the engine through the exhaust gas passage; a shielding member formed into a cylinder having a valve seat at its front end, and made of material that is more excellent than the housing in corrosion resistance against the exhaust gas, the shielding member being mounted on a passage inlet of the exhaust gas passage so as to bring the valve seat into contact with the adjusting valve and cover an inner wall surface of the passage inlet of the exhaust gas passage; a stem portion integrally formed with the adjusting valve and disposed to be slidable relative to a sliding member press-fitted in the housing; a diaphragm mounted at an end portion of this stem portion for opening/closing the adjusting valve in accordance with differential pressure; and a vacuum pressure case mounted on the sliding member for generating the differential pressure through the diaphragm.

FIG. 1

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Description

TECHNICAL FIELD

[0001] The present invention relates to an exhaust gas recirculation control valve device (hereinafter referred to as an EGR control valve device) used in an exhaust gas recirculation system of an internal combustion engine of an automotive vehicle or the like.

BACKGROUND ART

[0002] Fig. 7 is a schematic structural view showing a conventional EGR controlling device described in, for example, Examined Japanese Utility Model Publication No. Sho 63-1104.

[0003] In Fig. 7, a combustion chamber 2 is provided in an interior of an engine 1. Then, an intake pipe 3a is connected to the engine 1 for feeding fuel gas to the combustion chamber 2, whereas an exhaust pipe 3b is connected to the engine 1 for discharging the exhaust gas from the combustion chamber 2.

[0004] An EGR pipe 4 is provided for communication between the exhaust pipe 3b and an EGR valve 5. An exhaust gas return pipe 11 is provided for communication between the EGR valve 5 and the intake pipe 3a. The EGR valve device 5 functions to intake, through the EGR pipe 4, a part of the exhaust gas that passes through the exhaust pipe 3b and to adjust a recirculation amount of the exhaust gas to return the exhaust gas through the exhaust gas return pipe 11 back to the intake pipe 3a.

[0005] The EGR valve device 5 is provided with a packing 6 for preventing a leakage of the exhaust gas from a joint interface with the EGR pipe 4, an adjusting valve 7 for adjusting an opening degree of an exhaust gas passage in response to a vacuum pressure signal transmitted from an intake system of the engine, a diaphragm 8 made of rubber and having a vacuum pressure chamber 9 formed in an upper portion thereof to thereby operate the adjusting valve 7 in accordance with a differential pressure, and a packing 10 for preventing a leakage of the exhaust gas from a joint interface with the exhaust gas return pipe 11.

[0006] Here, the structure of the EGR valve device 5 will be described with reference to Fig. 8.

[0007] A housing 12 is formed by aluminum die-cast molding so that an exhaust gas passage 33 is formed for communication between a passage inlet 34 and a passage outlet 35. Then, an annular valve seat 24 is fitted in the midway of the exhaust gas passage 33 and the adjusting valve 7 is brought into contact with this valve seat 24. This adjusting valve 7 is fixed to a lower end portion of a stem portion 23 which is arranged so as to slidably move up and down within an interior of a sliding member 21 mounted on the housing 12. A holder 22 having a U-shaped cross-section is provided on the lower portion of the sliding member 21, i.e., on the side

facing the exhaust gas passage 33, thereby preventing carbon or the like contained in the exhaust gas from entering into the sliding portion between the stem portion 23 and the sliding member 21.

[0008] The diaphragm 8 is clamped between first and second disc-like retainer plates 18 and 19 mounted on an upper end portion 36 of the stem portion 23 and is mounted on the upper end portion 36 of the stem portion 23.

[0009] A lower vacuum pressure case 14 has retainer holes formed in the bottom portion and is fitted and fixed to the upper portion of the housing 12 by screws 13, retaining a convex portion of the sliding member 21 by the retainer holes. An upper vacuum pressure case 15 is mounted on the upper portion of the lower vacuum pressure case 14 for clamping a circumferential edge portion of the diaphragm 8 in cooperation with the lower vacuum pressure case 14. Then, the vacuum pressure chamber 9 is defined by the upper vacuum pressure case 15 and the diaphragm 8. A compression spring 16 is compressed between the upper vacuum pressure case 15 and the first retainer plate 18 to thereby depress the first retainer plate 18 downwardly. A vacuum pressure introduction pipe 17 for introducing the vacuum pressure from the intake pipe 3a is mounted on the upper vacuum pressure case 15. Furthermore, a packing 20 made of non-metal material is interposed between the lower vacuum pressure case 14 and the housing 12 for interrupting heat that is to be introduced into the lower vacuum pressure case 14 from the housing 12.

[0010] This EGR valve device 5 is assembled into the EGR controlling device in such a manner that the EGR pipe 4 branched from the exhaust pipe 3b is fitted and fixed to the housing 12 through the packing 6 by bolts 25 so as to be coupled with the passage inlet 34, the exhaust gas return pipe 11 is fitted and fixed to the housing 12 through the packing 10 by bolts 26 so as to be coupled with the passage outlet 35, and the vacuum pressure introduction pipe 17 is coupled with the intake pipe 3a.

[0011] The operation of this EGR controlling device will now be described.

[0012] The gas that has been burnt within the combustion chamber 2 is discharged through the exhaust pipe 3b as the exhaust gas. Then, a part of the exhaust gas that passes through the exhaust pipe 3b is introduced into the exhaust gas passage 33 of the EGR valve device 5 through the EGR pipe 4.

[0013] The diaphragm 8 operates in response to the differential pressure between the pressure within the vacuum pressure chamber 9 and the exhaust gas that has been introduced through the EGR pipe 4, thereby moving the stem portion 23 up and down while being guided by the sliding member 21. As a result, the opening degree of the adjusting valve 7 is adjusted by the up-and-down movement of the stem portion 23.

[0014] Therefore, the exhaust gas that has been intro-

duced through the EGR pipe 4 is returned back to the intake pipe 3a through the passage outlet 35 and the exhaust gas return pipe 11 in response to a magnitude of the vacuum pressure that has been introduced into the vacuum pressure chamber 9 through the vacuum pressure introduction pipe 17. Then, the exhaust gas is mixed with mixture of the fuel and air passing through the intake pipe 3a and introduced into the combustion chamber 2 to be burnt. As a result, an amount of nitrogen oxides which are harmful substances contained in the exhaust gas may be reduced.

[0015] This conventional EGR valve device 5 suffers from a problem that fine particles such as carbon or the like contained in the exhaust gas would adhere to a wall surface of the exhaust gas passage 33 to thereby adversely affect the flow rate control function of the EGR valve device 5.

[0016] As a result of deliberate and vigorous studies, the present applicant has found out that the more the wall surface of the exhaust gas passage 33 is corroded and roughened by acid components contained in the exhaust gas, the more the adhesion amount of the fine particles such as carbon or the like to the wall surface will be increased, and has also found out that the adhesion of the fine particles to the wall surface of the passage inlet 34 of the exhaust gas passage 33 is one of the largest factors to deteriorate the flow rate controlling function of the EGR valve device. Namely, the exhaust gas is always introduced from the EGR pipe 4 to the passage inlet 34 of the exhaust gas passage 33 so that the corrosion of the wall surface of the passage inlet 34 is particularly remarkable. Then, the fine particles such as carbon or the like adhere to this roughened wall surface so that a diameter of the passage inlet 34 is reduced, resulting in the deterioration of the flow rate controlling function of the EGR valve device.

[0017] However, in this conventional EGR valve device 5, since the exhaust gas passage 33 is formed in the housing 12 formed by aluminum die-cast molding, the wall surface of the exhaust gas passage 33, in particular, the wall surface of the passage inlet 34 is not protected against the corrosion due to the exhaust gas. In order to maintain the flow rate controlling function, it is therefore necessary to frequently perform the operation to remove the adhering fine particles. Thus, there is a problem that the maintenance property is remarkably low.

[0018] Also, since the valve seat 24 is press-fitted and fixed from the inside to the outside of the housing 12, the assembling workability is wrong.

[0019] Also, the EGR pipe 4 is fitted and fixed to the housing 12 through the packing 6 by the bolts 25 so that the leakage of the exhaust gas from the joint interface between the EGR pipe 4 and the housing 12 is prevented. It is therefore necessary to perform a complicated alignment work to align the bolt hole positions of the EGR pipe 4, the packing 6 and the housing 12 with each other. Thus, there is a problem that the assembling

workability is worse and the working time is prolonged.

[0020] Also, since the valve seat 24 is manufactured by the cutting operation, there is a problem that the manufacturing cost is increased.

[0021] Also, Japanese Utility Model Application Laid-Open No. Sho 55-12067 describes an EGR valve which may be applied to an EGR controlling device of this kind.

[0022] This conventional EGR valve device 5A is provided with a plate member 27 which is a discrete member from the housing 12 as shown in Fig. 9. A valve seat, a passage inlet and a passage outlet are formed in this plate member 27. Then, in the EGR valve device 5A, a packing 29, the plate member 27, a packing 28 and the housing 12 are overlapped on a base on which the EGR pipe 4 and the exhaust gas return pipe 11 are formed integrally and are fitted and fixed integrally by the bolts 25. Incidentally, the other structure is the same as that of the conventional EGR valve device 5 shown in Fig. 8.

[0023] In this EGR valve device 5A, since the plate member 27 which is the discrete member from the housing 12 is provided, in order to prevent the leakage of the exhaust gas, it is necessary to provide two packings 28 and 29, resulting in the increase of the number of structural components. This causes the alignment work for the bolt holes to be further intricate. And hence there is a problem that the assembling workability is wrong, and working time is prolonged.

[0024] Also, the purpose of this EGR valve device 5A is to enhance the disassembling and assembling property to readily remove the fine particles adhering to the wall surface of the exhaust gas passage 33. However, there is no consideration to suppress the adhesion of the fine particles at all.

[0025] Furthermore, Japanese Patent Application Laid-Open No. Hei 2-185657 describes an EGR valve which may be applied to an EGR controlling device of this kind.

[0026] This conventional EGR valve device 5B is provided with an annular valve seat 30 composed of a thin plate as shown in Fig. 10. Then, this valve seat 30 is fitted and fixed to the housing 12 by a spring action possessed by the thin plate shape. Incidentally, the other structure is the same as that of the conventional EGR valve device 5 shown in Fig. 8.

[0027] In this EGR valve device 5B, since the exhaust gas passage 33 is formed by the housing 12 formed by aluminum die-cast molding in the same manner as in the EGR valve device 5, the wall surface of the exhaust gas passage 33, in particular, the passage inlet 34 is not protected against the corrosion due to the exhaust gas at all. It is therefore necessary to frequently perform the operation to remove the adhering fine particles. Thus, there is a problem that the maintenance property is remarkably low.

[0028] Also, since the valve seat 30 is press-fitted and fixed from the inside to the outside of the housing 12,

the assembling workability is wrong.

[0029] Also, in the same manner as in the above-described EGR valve device 5, the packing 6 is required for coupling the EGR pipe 4 and the housing 12 with each other. Thus, there is a problem that the assembling workability is wrong and the working time is prolonged.

DISCLOSURE OF THE INVENTION

[0030] The present invention has been made to solve the above problems, and therefore has an object of this invention to provide an EGR controlling valve device which enhances corrosion resistance of a wall surface of a passage inlet of an exhaust gas passage against exhaust gas to suppress adhesion of fine particles, and may considerably reduce a frequency of maintenance.

[0031] Furthermore, an object is to provide a less expensive EGR valve device which is superior in assembling property while maintaining an effect capable of considerably reducing a frequency of maintenance.

[0032] According to the this invention, an exhaust gas recirculation controlling valve device is provided with a housing having an exhaust gas passage therein; an adjusting valve provided in this housing for adjusting an amount of exhaust gas to be recirculated into an intake pipe of an engine from an exhaust pipe of the engine through the exhaust gas passage; a shielding member formed into a cylinder having a valve seat at its front end, and made of material that is more excellent than the housing in corrosion resistance against the exhaust gas, the shielding member being mounted on a passage inlet of the exhaust gas passage so as to bring the valve seat into contact with the adjusting valve and cover an inner wall surface of the passage inlet of the exhaust gas passage; a stem portion integrally formed with the adjusting valve and disposed to be slidable relative to a sliding member press-fitted in the housing; a diaphragm mounted at an end portion of this stem portion for opening/closing the adjusting valve in accordance with differential pressure; and a vacuum pressure case mounted on the sliding member for generating the differential pressure through the diaphragm.

BRIEF DESCRIPTION OF THE DRAWINGS

[0033]

Fig. 1 is a cross-sectional view showing an EGR controlling valve device according to Embodiment 1 of this invention;

Fig. 2 is a cross-sectional view showing a primary part of the vicinity of a shielding member of an EGR controlling valve device in accordance with Embodiment 2 of this invention;

Fig. 3 is a cross-sectional view showing a primary

part of a shielding member applied to an EGR controlling valve device in accordance with Embodiment 3 of this invention;

Fig. 4 is a cross-sectional view showing a primary part of the vicinity of the shielding member of the EGR controlling valve device in accordance with Embodiment 3 of this invention;

Fig. 5 is a cross-sectional view showing a primary part of the vicinity of a shielding member of an EGR controlling valve device in accordance with Embodiment 4 of this invention;

Fig. 6 is a cross-sectional view showing a primary part of the vicinity of a shielding member of an EGR controlling valve device in accordance with Embodiment 5 of this invention;

Fig. 7 is a schematic structural view showing a conventional EGR controlling device;

Fig. 8 is a cross-sectional view showing one example of an EGR controlling valve device applied to a conventional EGR controlling device;

Fig. 9 is a cross-sectional view showing another example of an EGR controlling valve device applied to the conventional EGR controlling device; and

Fig. 10 is a cross-sectional view showing still another example of an EGR controlling valve device applied to the conventional EGR controlling device.

BEST MODE FOR CARRYING OUT THE INVENTION

[0034] A preferred embodiment of this invention will be described below with reference to the drawings.

Embodiment 1

[0035] Fig. 1 is a cross-sectional view showing an EGR controlling valve device in accordance with embodiment 1.

[0036] In Fig. 1, a housing 41 is formed by aluminum die-cast molding so that an exhaust gas passage 33 is formed for communication between a passage inlet 34 and a passage outlet 35 with each other. Then, a cylindrical shielding member 42 having a valve seat 42a at its tip end is press-fitted and fixed to the passage inlet 34 from the outside so that an adjusting valve 7 comes into contact with the valve seat 42a of the shielding member 42. This shielding member 42 is formed by making a thin stainless steel plate into a cylinder and drawing its end portion to form the valve seat 42a. Then, this shielding member 42 is fitted and fixed to the housing 41 by a spring action possessed by the thin plate shape. The adjusting valve 7 is fixed to the lower end

portion of a stem portion 23 arranged so as to move up and down through an interior of a sliding member 21 mounted on the housing 41. A holder 22 having a U-shaped cross-section is provided on a lower portion of the sliding member 21, i.e., on the side facing the exhaust gas passage 33, thereby preventing carbon or the like contained in the exhaust gas from entering into the sliding portion between the stem portion 23 and the sliding member 21.

[0037] A diaphragm 8 is clamped between first and second disc-like retainer plates 18 and 19 mounted on an upper end portion 36 of the stem portion 23 and is mounted on an upper end portion 36 of the stem portion 23.

[0038] A lower vacuum pressure case 14 has retainer holes formed in the bottom portion and is fitted and fixed to an upper portion of the housing 12 by screws 13, thereby retaining a convex portion of the sliding member 21 by the retainer holes. An upper vacuum pressure case 15 is mounted on the upper portion of the lower vacuum pressure case 14 for clamping a circumferential edge portion of the diaphragm 8 in cooperation with the lower vacuum pressure case 14. Then, the vacuum pressure chamber 9 is defined by the upper vacuum pressure case 15 and the diaphragm 8. A compression spring 16 is compressed between the upper vacuum pressure case 15 and the first retainer plate 18 to thereby depress the first retainer plate 18 downwardly. A vacuum pressure introduction pipe 17 for introducing the vacuum pressure pressure from the intake pipe 3a is mounted on the upper vacuum pressure case 15. Furthermore, a packing 20 made of non-metal material is interposed between the lower vacuum pressure case 14 and the housing 12 for interrupting heat that is to be introduced into the lower vacuum pressure case 14 from the housing 12.

[0039] Thus constructed EGR valve device 40 is assembled into the EGR controlling device in such a manner that an EGR pipe 4 branched from an exhaust pipe 3b is fitted and fixed to the housing 41 through a packing 6 by bolts 25 so as to be coupled with the passage inlet 34, an exhaust gas return pipe 11 is fitted and fixed to the housing 12 through a packing 10 by bolts 26 so as to be coupled with the passage outlet 35, and the vacuum pressure introduction pipe 17 is coupled with the intake pipe 3a.

[0040] The operation of this EGR controlling device will now be described.

[0041] The gas that has been burnt within a combustion chamber 2 is discharged through the exhaust pipe 3b as the exhaust gas. Then, a part of the exhaust gas that passes through the exhaust pipe 3b is introduced into the exhaust gas passage 33 of the EGR valve device 41 through the EGR pipe 4.

[0042] The diaphragm 8 operates in response to the differential pressure between the pressure within the vacuum pressure chamber 9 and the exhaust gas that has been introduced through the EGR pipe 4, thereby

moving the stem portion 23 up and down while being guided by the sliding member 21. As a result, the opening degree of the adjusting valve 7 is adjusted by the up-and-down movement of the stem portion 23.

[0043] Therefore, the exhaust gas that has been introduced through the EGR pipe 4 is returned back to the intake pipe 3a through the passage outlet 35 and the exhaust gas return pipe 11 in response to a magnitude of the vacuum pressure that has been introduced into the vacuum pressure chamber 9 through the vacuum pressure introduction pipe 17. Then, the exhaust gas is mixed with mixture of the fuel and air passing through the intake pipe 3a and introduced into the combustion chamber 2 to be burnt. As a result, an amount of nitrogen oxides which are harmful substances contained in the exhaust gas may be reduced.

[0044] According to Embodiment 1, the exhaust gas is introduced into the shielding member 42 through the EGR pipe 4, and there is no fear that the exhaust gas comes into contact with the inlet passage 34. Also, since the shielding member 42 is made of stainless steel which is excellent in corrosion resistance against the exhaust gas in comparison with the aluminum die-cast, the inner wall surface of the shielding member 42 is not corroded by the exhaust gas. Thus, the adhesion of the fine particles such as carbon or the like at the passage inlet 34 which adversely affects the flow rate controlling mechanism of the valve device may be considerably suppressed. Therefore, it is possible to remarkably reduce the frequency of the removable work of the fine particles and to obtain the EGR valve device that is excellent in maintenance property.

[0045] Also, since the shielding member 42 is press-fitted from the outside to the passage inlet 34 of the exhaust gas passage 33 and mounted on the housing 41, the assembling workability may be enhanced.

[0046] Also, the shielding member 42 is made by drawing, it is possible to manufacture the device at low cost.

Embodiment 2

[0047] Fig. 2 is a cross-sectional view showing a primary part of the vicinity of a shielding member of an EGR controlling valve device in accordance with Embodiment 2 of the present invention.

[0048] According to this embodiment 2, a shielding member 43 is formed by making a thin plate of stainless steel into a cylinder, drawing the front end thereof to form a valve seat 43a, and then bending the rear end thereof radially outwardly to form an annular flange portion 43b. Also, a housing 44 is formed by aluminum die-cast molding so that an exhaust gas passage 33 is formed for communication between a passage inlet 34 and a passage outlet 35. Furthermore, an annular groove 44a is formed over an entire circumference at an edge portion of the passage inlet 34 of the housing 44. A depth of this groove 44a is formed to be smaller than

a thickness of the flange portion 43b. Then, the shielding member 43 is press-fitted into the passage inlet 34 from the outside until the flange portion 43b comes into contact with the bottom surface of the groove 44a. An EGR pipe 4 is fitted and fixed to the housing 44 through a packing 6 by bolts 25. Incidentally, the other structure is the same as that of the above-described embodiment 1.

[0049] According to this embodiment 2, the shielding member 43 is firmly fixed to the housing 44 by the press fitting force to the passage inlet 34 and the fastening force of the bolts 25.

[0050] Also, since the flange portion 43b projects from an end face of the housing 44, the packing 6 is depressed concentratedly between the flange portion 43b and the EGR pipe 4 to thereby enhance the sealability to prevent the leakage of the exhaust gas without fail.

Embodiment 3

[0051] Fig. 3 is a cross-sectional view showing a primary part of a shielding member applied to an EGR controlling valve device in accordance with Embodiment 3 of this invention. Fig. 4 is a cross-sectional view showing a primary part of the vicinity of the shielding member of the EGR controlling valve device in accordance with Embodiment 3 of this invention.

[0052] In this Embodiment 3, a shielding member 45 is formed by making a thin plate of stainless steel into a cylinder, drawing the front end thereof to form a valve seat (not shown), bending the rear end thereof radially outwardly to form an annular flange portion 45b, and then forming a plurality of grooves 45c in the circumferential direction on the outer circumferential surface of the flange portion 45b. Also, a liquefied seal member 46 having elasticity and made of silicone rubber or the like is applied to the outer circumferential surface of the flange portion 45b. Then, the shielding member 45 is press-fitted to the passage inlet 34 from the outside until the flange portion 45b comes into contact with the bottom surface of a groove 44a. An EGR pipe 4 is fastened and fixed to the housing 44 by bolts (not shown). Incidentally, the other structure is the same as that shown in the above-described embodiment 2.

[0053] According to this embodiment 3, when the EGR pipe 4 is fastened and fixed to the housing 44, the seal member 46 is depressed and filled in the grooves 45c to thereby ensure the sealability. It is therefore unnecessary to use the packing 6, which facilitates the positional alignment of the bolt holes and enhances the assembling property.

Embodiment 4

[0054] In this embodiment 4, as shown in Fig. 5, the rear end of the shielding member 42 is extended from the housing 41. Incidentally, the other structure is the

same as that of the above-described embodiment 1.

[0055] According to this embodiment 4, since the rear end of the shielding member 42 is extended into the EGR pipe 4, the packing 6 is separated away from the exhaust gas, the corrosion of the packing 6 by the exhaust gas is suppressed so that the sealability may be enhanced.

Embodiment 5

[0056] Fig. 6 is a cross-sectional view showing a primary part of the vicinity of a shielding member of an EGR controlling valve device in accordance with embodiment 5 of this invention.

[0057] In this embodiment 5, an EGR pipe 47 is formed of stainless steel. The front end thereof is machined into a valve seat 47a by drawing. Furthermore, the front end side thereof is bent to form an annular flange portion 47b projecting radially outwardly. Also, a housing 48 is formed by aluminum die-cast molding so that an exhaust gas passage 33 is arranged to communicate a passage inlet 34 and a passage outlet 35 with each other. Furthermore, an inlet side of the passage inlet 34 is formed to have a large diameter and a female screw is formed on the inner circumferential wall surface of a large diameter portion 34a. Then, since the EGR pipe 47 is inserted from the outside until its flange portion 47b comes into contact with the bottom surface of the large diameter portion 34a and a mounting nut 49 mounted on the EGR pipe 47 is fastened to the female screw of the large diameter portion 34a and fixed to the housing 48. Incidentally, the other structure is the same as that of the above-described embodiment 1.

[0058] According to this embodiment 5, the flange portion 47b is clamped between the mounting nut 49 and the bottom surface of the large diameter portion 34a by the fastening force of the mounting nut 49 to thereby ensure the sealability. Therefore, it is possible to dispense with the packing 6 or the bolts 25. And hence it is possible to dispense with the intricate positional alignment work of the bolt holes and to considerably enhance the assembling workability.

[0059] Also, since the valve seat 47a is formed integrally with the EGR pipe 47, it is possible to reduce the number of the components so that the assembling workability is enhanced.

[0060] Incidentally, although the housing is formed by aluminum die-cast molding in each of the foregoing embodiments, the housing may be formed of cast iron without any limitation to aluminum die-casting.

[0061] Also, in each of the foregoing embodiment, the shielding plate or the EGR pipe is made of stainless steel, but it is sufficient that the material having better corrosion resistance against the exhaust gas than that of the material of the housing. For example, it is possible to use a nickel base anti-corrosive alloy, niobium, titanium or the like therefor.

[0062] As described above, according to this inven-

tion, there is provided an EGR controlling valve device comprising: a housing having an exhaust gas passage therein; an adjusting valve provided in this housing for adjusting an amount of exhaust gas to be recirculated into an intake pipe of an engine from an exhaust pipe of the engine through the exhaust gas passage; a shielding member formed into a cylinder having a valve seat at its front end, and made of material that is more excellent than the housing in corrosion resistance against the exhaust gas, the shielding member being mounted on a passage inlet of the exhaust gas passage so as to bring the valve seat into contact with the adjusting valve and cover an inner wall surface of the passage inlet of the exhaust gas passage; a stem portion integrally formed with the adjusting valve and disposed to be slidable relative to a sliding member press-fitted in the housing; a diaphragm mounted at an end portion of this stem portion for opening/closing the adjusting valve in accordance with differential pressure; and a vacuum pressure case mounted on the sliding member for generating the differential pressure through the diaphragm. Therefore, since the wall surface of the passage inlet is covered by the shielding member that is superior in corrosion resistance against the exhaust gas, it is possible to suppress the adhesion of the fine particles in the passage inlet to thereby considerably reduce the frequency of the maintenance. Furthermore, the shielding member having the valve seat may be mounted onto the passage inlet from the outside, it is possible to obtain the EGR recirculation controlling valve device that may enhance the assembling property.

[0063] Also, since the shielding member is formed integrally with the front end of a pipe connected to the passage inlet and branched from the exhaust pipe, it is possible to perform the coupling of the pipes without using the conventional packings. It therefor is possible to reduce the number of the components so that the assembling property is enhanced.

[0064] Also, since the shielding member is provided with an annular flange portion extending radially outwardly and is formed integrally with the rear end of the shielding member, and the flange portion is clamped between an end face of a pipe branched from the exhaust pipe and an outer circumferential end face of the passage inlet of the housing when the pipe is fastened and fixed to the housing so that the pipe is coupled with the passage inlet, the fastening of the shielding member having the valve seat may be ensured and the stable valve operation may be obtained.

[0065] Also, since a plurality of annular grooves are formed in the outer circumferential surface of the flange portion and a seal member in the form of liquid having elasticity is coated and formed on the outer circumferential surface of the flange portion, it is possible to perform the coupling of the pipes without using the conventional packings, and it is possible to reduce the number of the components so that the assembling prop-

erty is enhanced.

Claims

1. An exhaust gas recirculation controlling valve device comprising:

a housing having an exhaust gas passage therein;

an adjusting valve provided in said housing for adjusting an amount of exhaust gas to be recirculated into an intake pipe of an engine from an exhaust pipe of the engine through said exhaust gas passage;

a shielding member formed into a cylinder having a valve seat at its front end, and made of material that is more excellent than said housing in corrosion resistance against the exhaust gas, said shielding member being mounted on a passage inlet of said exhaust gas passage so as to bring said valve seat into contact with said adjusting valve and cover an inner wall surface of the passage inlet of said exhaust gas passage;

a stem portion integrally formed with said adjusting valve and disposed to be slidable relative to a sliding member press-fitted in said housing;

a diaphragm mounted at an end portion of said stem portion for opening/closing said adjusting valve in accordance with differential pressure; and

a vacuum pressure case mounted on said sliding member for generating the differential pressure through said diaphragm.

2. The exhaust gas recirculation controlling valve device according to claim 1, characterized in that said shielding member is formed integrally with an end of a pipe connected to said passage inlet and branched from said exhaust pipe.

3. The exhaust gas recirculation controlling valve device according to claim 1, characterized in that said shielding member is provided with an annular flange portion extending radially outwardly and formed integrally with the rear end thereof, and said flange portion is clamped between an end face of a pipe branched from said exhaust pipe and an outer circumferential end face of said passage inlet of said housing when said pipe is fastened and fixed to said housing so that said pipe is coupled with said passage inlet.

4. The exhaust gas recirculation controlling valve device according to claim 3, characterized in that a plurality of annular grooves are formed in the outer circumferential surface of said flange portion and a seal member in the form of liquid having elasticity is coated and formed on the outer circumferential surface of said flange portion.

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FIG. 1

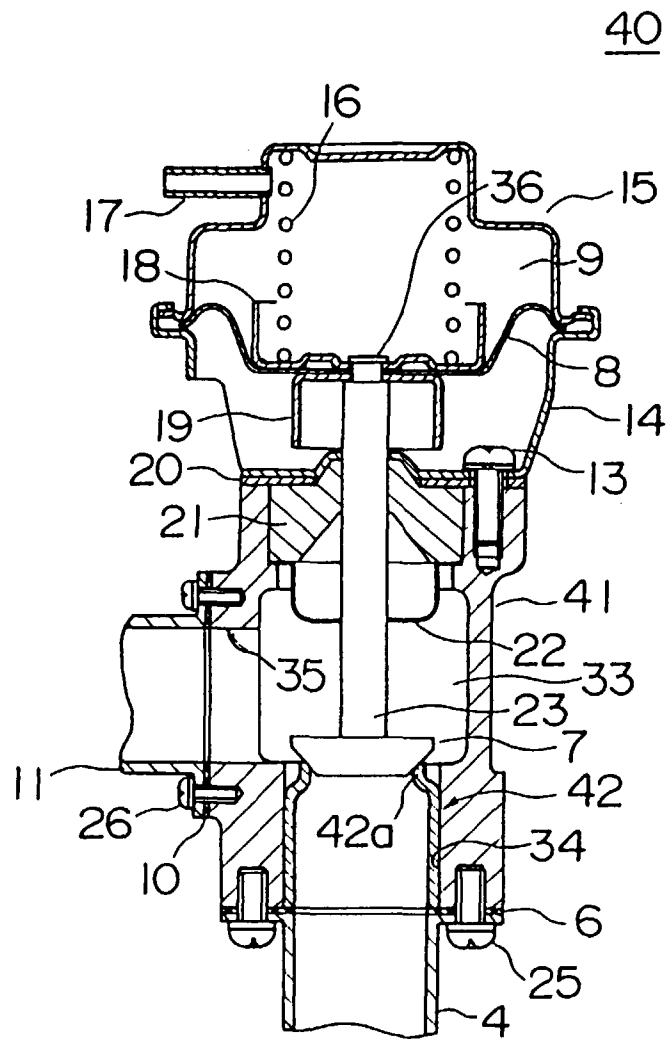


FIG. 2

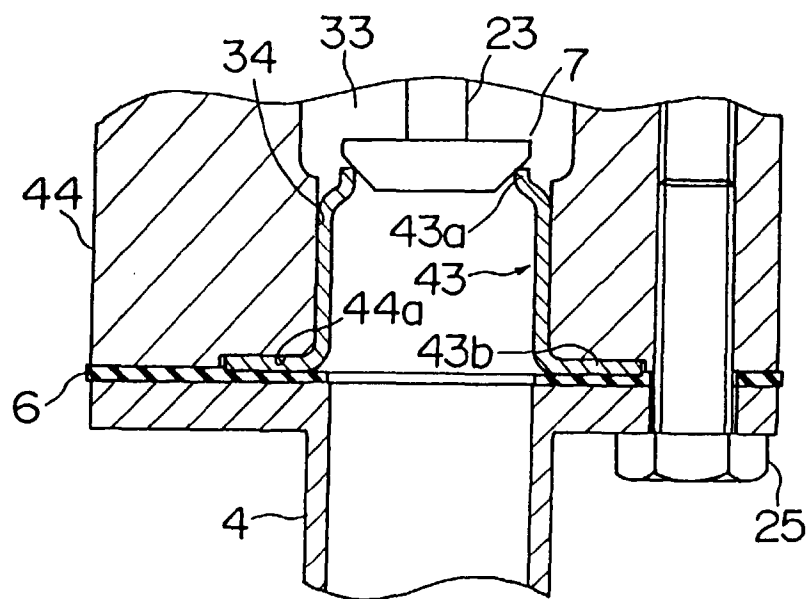


FIG. 3

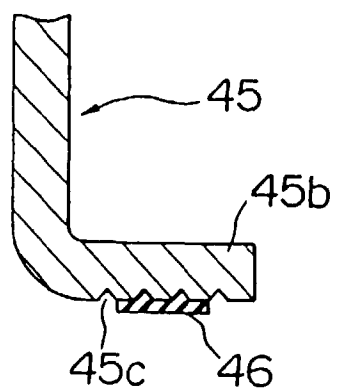


FIG. 4

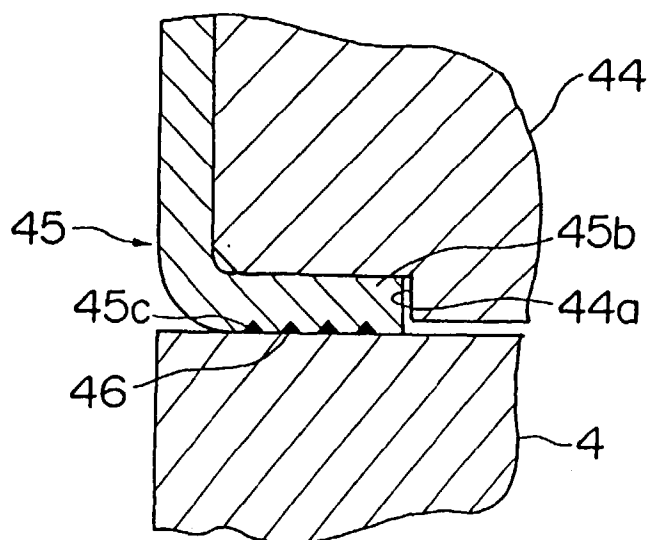


FIG. 5

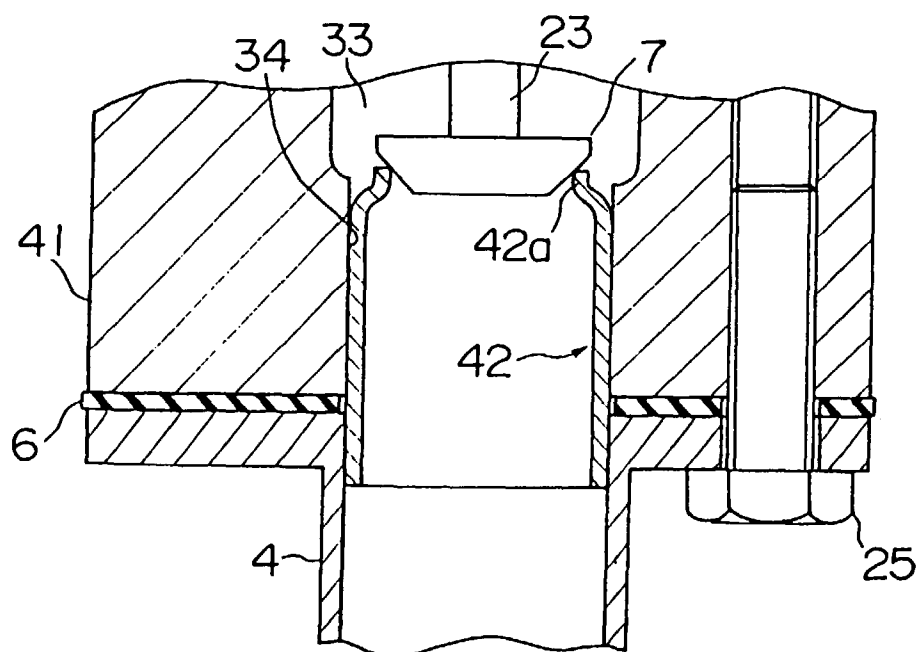


FIG. 6

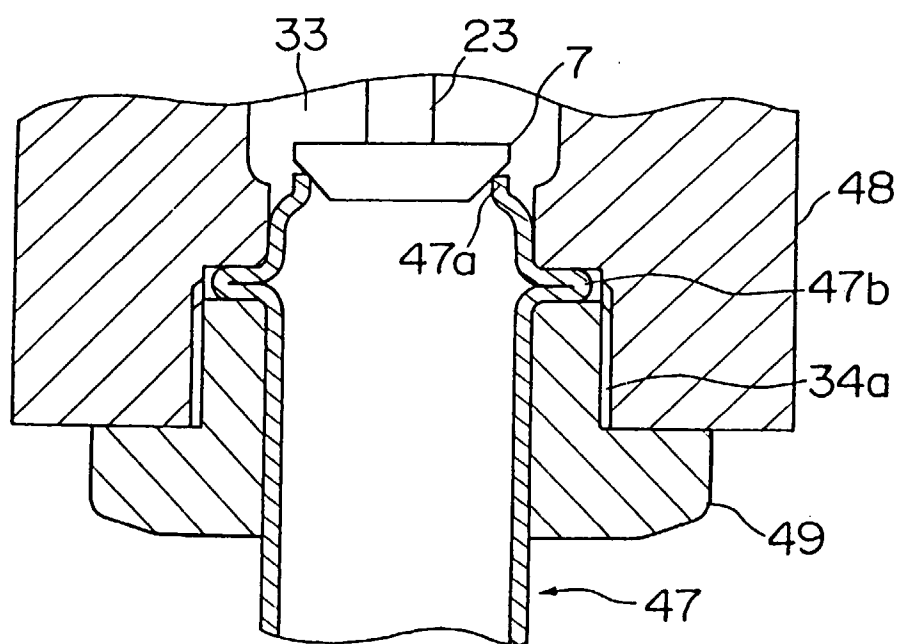


FIG. 7

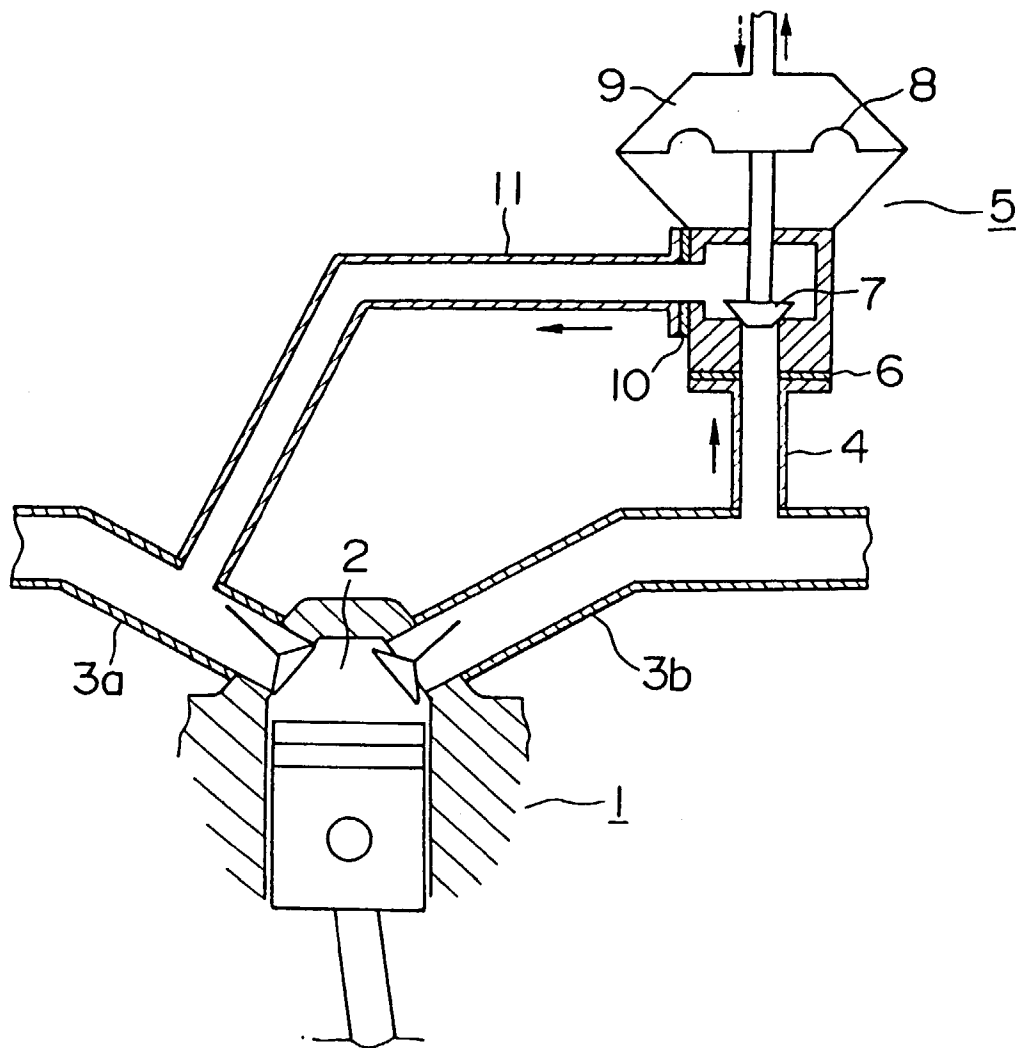


FIG. 8

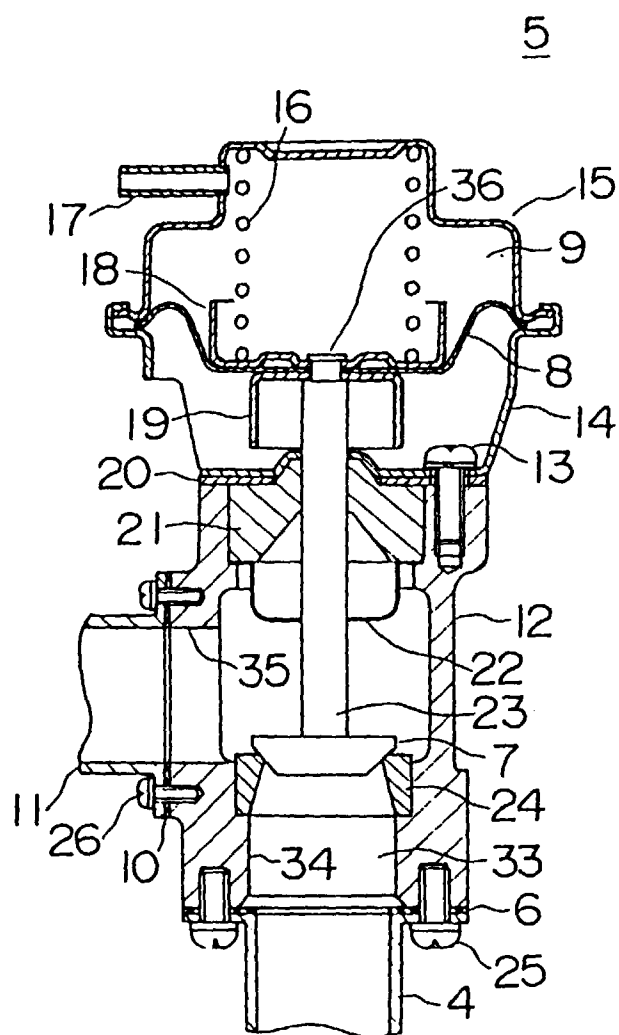


FIG. 9

5A

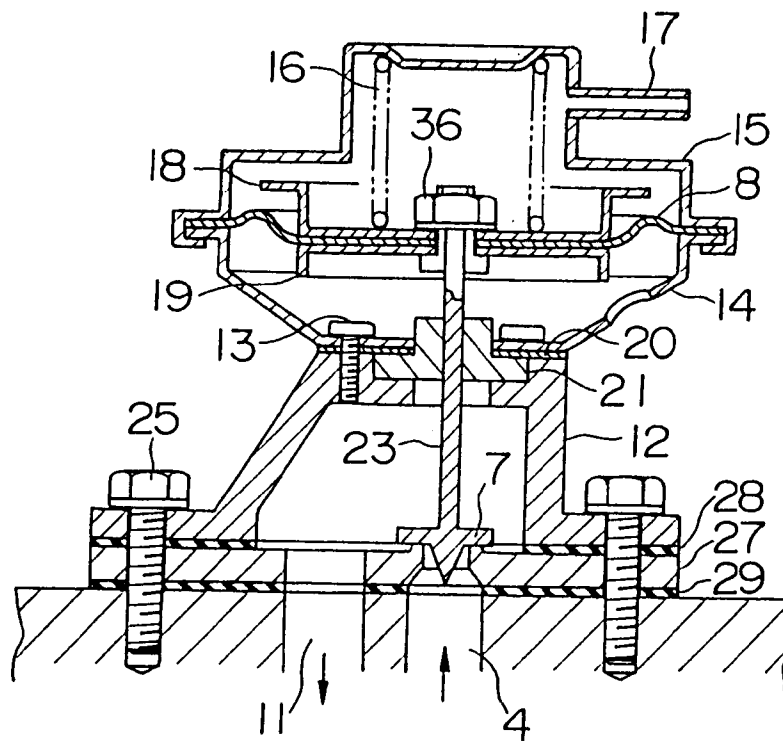
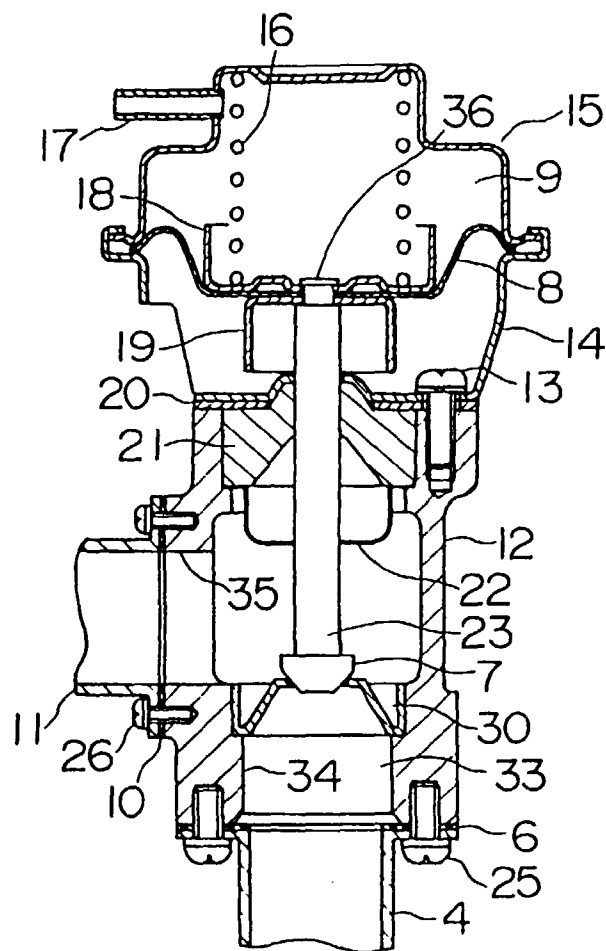


FIG. 10

5B



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP97/03822

A. CLASSIFICATION OF SUBJECT MATTER		
Int. Cl ⁶ F02M25/07		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
Int. Cl ⁶ F02M25/07		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Jitsuyo Shinan Koho 1926 - 1996 Jitsuyo Shinan Toroku Kokai Jitsuyo Shinan Koho 1971 - 1998 Koho 1996 - 1998 Toroku Jitsuyo Shinan Koho 1994 - 1998		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 16612/1979 (Laid-open No. 116865/1980) (Nissan Diesel Motor Co., Ltd.), August 18, 1980 (18. 08. 80) (Family: none)	1
Y	Page 1, line 19 to page 3, line 16; Fig. 1	3 - 4
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 170182/1978 (Laid-open No. 85554/1980) (Toyota Motor Corp.), June 12, 1980 (12. 06. 80), Page 3, line 12 to page 4, line 6; Fig. 3 (Family: none)	3 - 4
☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search		Date of mailing of the international search report
January 21, 1998 (21. 01. 98)		January 27, 1998 (27. 01. 98)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)