



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
02.01.2003 Bulletin 2003/01

(51) Int Cl.7: **F02M 59/00**

(21) Application number: **02022063.8**

(22) Date of filing: **22.02.1997**

(84) Designated Contracting States:
DE FR GB IT

(62) Document number(s) of the earlier application(s) in
accordance with Art. 76 EPC:
97102947.5 / 0 860 605

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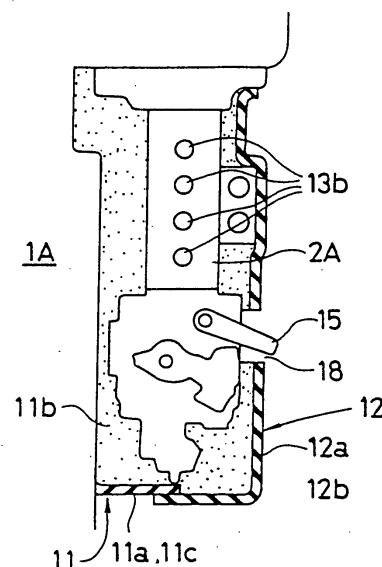
Remarks:

This application was filed on 02 - 10 - 2002 as a
divisional application to the application mentioned
under INID code 62.

(54) **Low-noise engine**

(57) In order to obtain an engine (10) having sound
absorbing members capable of reducing the noise of the
engine effectively, there is provided a shielding structure
for a fuel injection pump (2a) comprising: shielding
members substantially covering the surface of the fuel
injection pump (2a) which is fixed with a clearance to
the side of the cylinder block (1a) of an engine (10), said
shielding members including cover members covering
the noise generating face of said fuel injection pump
(2a), and sound absorbing members (11) filled between
said fuel injection pump (2a) and said cover members,
wherein the cover members of said shielding members
are made of heat resisting rubber whereas the sound
absorbing members of the same are made of a foaming
material of a synthetic resin.

Fig. 1



Description

BACKGROUND OF THE INVENTION:

[0001] The present invention relates to a structure for preventing the noise of an engine by reducing the noise produced by a fuel injection pump itself of the engine and accounting for a large ratio of the engine noise, the noise due to the standing wave between the fuel injection pump and the cylinder block of the engine, and a method of assembling the engine.

[0002] In the prior art, the engine noise is a serious problem in the manufacture of a comfortable automobile. There are the noise produced from the engine, the noise due to a standing wave in which the sounds between the cylinder block of the engine and the fuel injection pump are amplified by each other, and the sound produced by the fuel injection pump itself. These noises are generally called engine noise.

[0003] In order to keep the car compartment quiet and calm, there has been investigated in recent years a method of reducing the engine noise. Specifically, a noise preventing device has been proposed, as shown in Fig. 10, in Japanese utility model application Kokai publication No. 4-95631. According to this proposal, the gap G between a cylinder block 1 and a fuel injection pump 2 is sealed at its upper and lower portions by metal covers 4a and 4b which are attached to the side of the cylinder block 1 and the side of the fuel injection pump 2 through seal members 3. This gap G is sealed with a sound absorbing material 5 such as glass wool or a foaming resin such as foaming urethane. However, this device can prevent the aforementioned standing wave but not the noise which is produced from the fuel injection pump 2 itself. There is another problem that the noise is secondarily generated by the vibrations of the metal covers 4a and 4b.

[0004] Another noise preventing device, as shown in Fig. 11, is proposed in Japanese utility model application Kokai publication No. 3-95072. This device is equipped with a casing of a damping steel sheet which has the sound absorbing member 5 such as glass wool bonded to the inner side of the front face of the fuel injection pump 2. In this device, however, not only a gap g is left between the cylinder block 1 and the fuel injection pump 2, but also a spatial portion 7 is left between the sound absorbing member 5 bonded to the casing 6 of the front portion and the fuel injection pump 2, thus making it impossible to sufficiently prevent not only the noise due to the standing wave but also the noises produced from the cylinder block 1 and the fuel injection pump 2 itself. On the other hand, the casing 6 is made of a metal to raise a problem that secondary noise is generated by the vibration of the casing 6.

[0005] When a foaming resin is used as the sound absorbing member, moreover, there are two methods. One method is forming a fitting type sound absorbing member by producing a mold from both the fuel injection

pump and the metallic cover or casing and heating the foaming polyurethane to 40 to 50 DEG C in the mold to foam and shape it; the other is forming a filling type sound absorbing member by injecting and foaming a liquid foaming material after assembling the fuel injection pump and the metallic cover or casing.

[0006] In the method of forming the fitting type sound absorbing member, due to the deformation of the sound absorbing member or due to the variation of the shape of the mounting portion on the engine component side, the sound absorbing member and the mounting portion may fail to conform completely in their shapes, thus causing a problem that the sound absorbing member cannot be assembled in the mounting portion and a gap is established after the assembly to lower the sound absorbing effect.

[0007] When the sound absorbing member has a complicated shape, on the other hand, its mold has to be divided and resultantly the number of molds increase. In addition, a new mold is required for molding the new sound absorbing member in accordance with the change in the shape of the mounting portion, thus raising a problem that the production cost is raised.

[0008] The method of forming the filling type sound absorbing member is proposed to solve the aforementioned problem of the fitting type sound absorbing member. According to the proposal of Japanese utility model application Kokai publication No. 5-64443, for example, the foamed silicone sheet to be mounted on the side surface of the cylinder block of the engine is formed by injecting a liquid foaming silicone resin into the gap between the side portion of the cylinder block and a reinforcing plate and by foaming and setting the resin at a predetermined temperature to form the side cover.

[0009] However, the engine components such as the fuel injection pump often have complicated shapes so that the spatial portion to be formed between the component and a cover member such as the metal cover or the casing is complicated to have narrow and wide portions, making it difficult to form a guide passage leading to the back of the fuel injection pump for guiding the foaming liquid.

[0010] In the method of forming the filling type sound absorbing member, therefore, it is difficult to charge the entire region of the spatial portion with the foaming liquid, and it is impossible to distribute the foaming liquid by adjusting the amount in accordance with the local width and volume of the spatial portion. As a result, cavities and density irregularity are liable to occur in the foamed sound absorbing member, thus causing a problem that the sound absorbing effect of the foaming material cannot be exhibited to the maximum.

[0011] In order to inject the liquid foaming material after the assembly, moreover, an injection port has to be formed in a position to inject the foaming liquid into the spatial portion for forming the sound absorbing member, and an opening unnecessary to prevent the noise, has to be formed, raising a problem that the noise preventing

effect is insufficient. In addition, openings such as for the control lever other than the injection port existing in the cover member have to be closed to prevent the foaming liquid from leaking out, raising a problem that the jig and works for clogging those openings are additionally required.

SUMMARY OF THE INVENTION:

[0012] An object of the present invention is to provide an engine which can prevent the noise, produced by a fuel injection pump itself, and the noise, due to the standing wave between engine components such as the fuel injection pump and the cylinder block of the engine, and which can partially reduce the noise produced by the cylinder block.

[0013] Another object of the present invention is to provide a method of assembling an engine equipped with a sound absorbing member for preventing the noise of the engine, in which by a simple work the sound absorbing member can be formed substantially evenly without any cavity between the cover member and the engine component and in the entire region of the spatial portion between the noise generating portion of the engine and the engine component, thereby reducing the engine noise effectively.

[0014] In order to achieve the above-specified objects, there is provided a low-noise engine comprising shielding members substantially covering the surface of the fuel injection pump which is fixed with a clearance on the side of the cylinder block of an engine, the shielding members including surface cover members covering the noise generating face of the fuel injection pump, and sound absorbing members filled between the fuel injection pump and the cover members.

[0015] Those shielding members may preferably cover the entire surface and the fuel injection pump substantially except for such small openings or gaps, e.g., a control portion, a piping lead-out portion or a heat radiation window which can be neglected with respect to prevention of the noise.

[0016] In this shielding structure, the cover members constituting the shielding members are made of such a material, as heat resisting rubber not making any noise nor transmit the sound therethrough, and the sound absorbing members are made of such a material as a foaming material of a synthetic resin attenuating the noise coming from the sound source.

[0017] In the shielding structure, moreover, there is provided a low-noise engine having a structure for shielding a fuel injection pump comprising the shielding members which includes: a first shielding member arranged between the cylinder block and the fuel injection pump; and a second shielding member covering the surface of the fuel injection pump left uncovered with the first shielding member, the first and second shielding members being separable on the surface of the fuel injection pump.

[0018] The first and second shielding members are made so easily dividable at the central portion of the surface of the fuel injection pump as to cover the back portion and the front portion of the fuel injection pump individually. In this case, the forming, inspecting and adjusting works can be improved if the shielding members can be divided to facilitate the exposure of the whole faces necessary for the adjustment, inspection and repair.

[0019] Moreover, if the cover members are so positioned near the dividable portion as to contact directly with the engine component such as the fuel injection pump, no cut is required in the sound absorbing members and it is possible to eliminate the member for and the step of closing the cut portion required for filling the foaming material.

BRIEF DESCRIPTION OF THE DRAWINGS:

[0020]

Fig. 1 is a sectional top plan view showing a structure of an embodiment of the invention;

Fig. 2 is a sectional side elevation showing the structure of the embodiment of the invention;

Fig. 3 is a sectional top plan view showing a structure of another embodiment of the invention;

Fig. 4 is a sectional side elevation showing the structure of another embodiment of the invention;

Fig. 5 is a graph illustrating a noise reducing effect of the invention;

Figs. 6(a) and 6(b) are schematic views, showing the structure of an engine according to a second embodiment of the invention, in which Fig. 6(a) shows a state before foaming and Fig. 6(b) shows a state after foaming;

Figs. 7(a) and 7(b) are schematic views, showing the structure of an engine according to a third embodiment of the invention, in which Fig. 7(a) shows a state before the foaming and Fig. 7(b) shows a state after the foaming;

Fig. 8 is a perspective view showing an injection pump mounting position;

Fig. 9 is a perspective view showing a shielded portion of the injection pump;

Fig. 10 is a sectional side elevation showing the soundproof structure of the prior art; and

Fig. 11 is a sectional side elevation showing the soundproof structure of the prior art.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS:

[Embodiment 1]

[0021] A first embodiment of the present invention will be described with reference to the accompanying drawings.

[0022] As shown in Fig. 8, a fuel injection pump 2A is

so fixed on the cylinder block 1A side of an engine 10 that the fuel is sucked from a lower piping 13a and is pressurized until it is injected into the cylinder through an upper piping 13b and a fuel injection nozzle.

[0023] As hatched in Fig. 9, shielding members 11 and 12 of the present invention covers the fuel injection pump 2A substantially except for the portion in which a control lever 15 and the pipings 13a and 13b are arranged.

[0024] With reference to Figs. 1 and 2, here will be described a method of forming the shielding members 11 and 12 of the present invention comprising cover members 11a, 11c and 12a and sound absorbing members 11b and 12b.

[0025] At a first step, the fuel injection pump 2A is mounted on the cylinder block 1A. After this, the back cover member 11a made of heat resisting rubber at the lower side of the back of the fuel injection pump 2A is fixed to the block 1A with bolts 16 to substantially cover the lower side of the gap between the cylinder block 1A and the fuel injection pump 2A. Next, the portion substantially surrounded by the back cover member 11a, the cylinder block 1A and the fuel injection pump 2A is charged with a foaming material of a synthetic resin to form the back sound absorbing member 11b. This back sound absorbing member 11b is applied without any clearance.

[0026] Moreover, the back cover member 11c made of heat resisting rubber at the upper side of the back of the fuel injection pump 2A is fixed to the cylinder block 1A with the bolts 16 to substantially cover the upper side of the gap between the cylinder block 1A and the fuel injection pump 2A. At this first step, it is possible to form the first shielding member 11, comprising the back cover members 11a and 11c and the back sound absorbing member 11b.

[0027] This charge of the foaming material can be simplified by eliminating the member for and the step of closing the gap if the cover members 11a and 11c are partially constructed in contact directly with the surface of the fuel injection pump 2A.

[0028] At a second step, after the first shielding member has been formed, the front cover member 12a is so fixed by a method using clips 17 or a hook-and-loop fastener as to substantially cover the surface of the fuel injection pump 2A left uncovered with the first shielding member 11. Next, the space portion substantially surrounded by the first shielding member 11, the front cover member 12a and the fuel injection pump 2A is charged with a foaming material of a synthetic resin to form the front sound absorbing member 12b. At this step, it is possible to form the second shielding member 12 comprising the front sound absorbing member 12b and the front cover member 12a.

[0029] This second shielding member 12 is constructed to cover the surface of the fuel injection pump 2A substantially except for the control portion such as the lever 15 of the fuel injection pump 1A, the portions of

the pipings 13a and 13b, and an excepted portion 18 which is opened, as necessary, for the heat dissipation or for injecting the foaming material. This excepted portion 18 can be formed, as necessary, on the shielding member 11 side.

[0030] By these steps, it is possible to form the shielding structure in which the surface of the fuel injection pump 2A is substantially covered with the shielding members 11 and 12 comprising of the sound absorbing members 11b and 12b and the cover members 11a, 11c and 12a.

[0031] Incidentally, this charging step of those sound absorbing members 11b and 12b need not always be conducted only at the working time of mounting the fuel injection pump 2A on the cylinder block of the engine. With a mold of the same shape, the sound absorbing members can be molded beforehand for convenience of the working step by using the mold and the cover members 11a, 11c and 12a.

[0032] These first and second shielding members 11 and 12 can be mounted on and demounted from the surface of the fuel injection pump 2A by the clips 17 and the not-shown hook-and-loop fastener.

[0033] If this demountable portion is constructed such that the cover member 12a is partially in contact directly with the surface of the fuel injection pump 2A, the member for and the step of closing the gap between the fuel injection pump 2A and the cover members 11a and 11c required at the time of filling the foaming material, can be eliminated, unlike the construction having the sound absorbing members arranged in the gap, to simplify the work of filling the foaming material.

[0034] In regard to this demountable construction, for example, the shielding members 11 and 12 are divided into the back portion and the front portion of the fuel injection pump 2A so that they can be separated at the surface portion near the longitudinal center portion of the fuel injection pump 2A to facilitate the formation, disassembly and assembly.

[0035] As to this division, the adjustment, inspection and repair can be simplified if the shielding member 12 is formed such that the surface of the fuel injection pump 2A at the portions necessary for the adjustment, inspection and repair is easily exposed as a whole.

[0036] These first and second shielding members 11 and 12 need not always be made unitary but can be separated, as necessary, to facilitate the formation, disassembly and assembly.

[Embodiment 2]

[0037] Figs. 3 and 4 show another embodiment of the invention, the first shielding member 11 between the cylinder block 1A and the fuel injection pump 2A is constructed into a sandwich structure of the sound absorbing member 11b, the cover member 11a and the sound absorbing member 11b. Thanks to this sandwich structure, the effect of retaining the sound absorbing member

11 b is enhanced by the highly rigid cover member 11 a, and this cover member 11 a can be arranged at the back of the fuel injection pump 2 to enhance the noise preventing effect. This sandwich structure can also be applied to the second shielding member 12.

[0038] Fig. 5 is a graph illustrating this noise preventing effect, and the abscissa shows the number of revolutions of the engine whereas the ordinate shows the noise level measured near the engine, in a relative difference of one graduation of 2 dB.

[0039] Curve A shows the noise level of a place near by the engine but without the shielding structure, and curve B shows the noise level with the shielding structure of the present invention. Moreover, a hatched region C between the curves A and B is the difference between the aforementioned two noise levels and indicates the noise preventing effect according to the present invention. As seen from the region C of this graph, according to the present invention, a high noise preventing effect can be achieved although the reduction in the noise level is different for the engine number of revolutions.

[0040] Thus, according to the above-specified embodiments of the present invention, a high effect of preventing the engine noise is exhibited, and the sound absorbing member can be easily formed by the charging. In addition, the shielding member can be separated into a plurality of front and back parts so that it can be easily disassembled. As a result, it is possible to provide a shielding structure of a fuel injection pump for preventing the engine noise, which facilitates the adjustment, inspection and repair of the fuel injection pump.

[Embodiment 3]

[0041] The fuel injection pump 2A according to another embodiment of the invention, covered with the cover member (or pump cover) 11a, 11c and 12a, will be described with reference to Figs. 1 and 2.

[0042] As shown in Figs. 1 and 2, the fuel injection pump 2A is mounted on the side of the cylinder block 1A constituting the engine body and is constructed to suck the fuel from the fuel suction piping (13a in Fig. 8) at its lower portion and to pressurize and inject it into the cylinder through the fuel discharge piping (13b in Fig. 8) at its upper portion and the fuel injection nozzle.

[0043] In order to prevent the noise of the fuel injection pump 2A, the shielding members 11 and 12, in which the sound absorbing members 11b and 12b are covered with the pump covers 11 a, 11 c and 12a, cover the entirety of the fuel injection pump 2A substantially except for the excepted portion, in which the control lever 15 and the fuel discharge piping 13b, the part hatched in Fig. 9.

[0044] Next, with reference to Figs. 6(a) and 6(b), a pump cover 30 (11a, 11c and 12a in Figs. 1 and 2) is made of a material having a heat resistance and a sound insulating effect and capable of keeping the cover

shape, such as a thin sheet of metallic material, e.g., a steel sheet or a damping steel sheet, or heat resisting rubber.

[0045] The sound absorbing member 31a (11b and 12b in Figs. 1 and 2) is formed, in the following manner, of a foaming material 31 of a synthetic resin, e.g., foaming urethane, which will foam at an atmosphere temperature of, say, 40 to 50 DEG C.

[0046] First of all, an appropriate amount of foaming material 31 before the foaming is applied to one or both of the inner face of the pump cover 30 and the surface of the fuel injection pump 2A, while considering its volume after the foaming. This application of appropriate amount can be optimized by partially applying the foaming material 31 in conformity with the local volume of the spatial portion or by partially applying it several times.

[0047] According to a first assembling method, moreover, the pump cover 30 coated with the foaming material 31 before the foaming is attached to the single body of the fuel injection pump 2A before assembled with the engine body 10. This pump cover 30 is heated from the outside with hot air, steam or infrared rays to raise the temperature of the pump cover 30 or its ambient temperature to the foaming level so that the foaming material 31 is foamed to expand a sound absorbing member 31a. The fuel injection pump 2A, covered with the pump cover 30, is assembled through the sound absorbing member 31a with the engine body 10.

[0048] According to a second assembling method, in another case, the fuel injection pump 2A, covered with the pump cover 30, is assembled with the engine body 1, as shown in Fig. 6(a), and after this assembly, the fuel injection pump 2A is partially heated to raise the temperature of the pump cover 30 or its ambient temperature to the foaming level so that the foaming material 31 is foamed to expand and form the sound absorbing member 31a, as shown in Fig. 7(b).

[0049] This heating may be conducted with hot air or steam from the outside of the engine but may preferably be effected by the heat of the engine itself generated when the engine is run under the bench test. If this heat of the engine itself is used, the foaming of the sound absorbing member 31a can be effected during the test run after the engine assembly without preparing any special heating source, so that the shaping work of the sound absorbing member 31a can be simplified.

[0050] The present invention has been described heretofore as related to the fuel injection pump 2A as an component of an engine but should not be limited thereto and can be applied to another engine component producing the engine noise.

[Embodiment 4]

[0051] Next, another assembling method will be described when the sound absorbing member 31a is mounted in the gap of a V-bank of a V-type engine or a noise generating portion 20 of the engine.

[0052] In this case, as shown in Fig. 7(a), an appropriate amount of the foaming material 31 before foamed is applied beforehand to one or both of the surface of a V-bank portion 20b of the cylinder block forming part of the noise generating portion of the engine and the lower face of an intake manifold 20a of the engine component. After this, the intake manifold 20a is assembled with that V-bank portion 20b to construct the engine.

[0053] The face or faces coated may be selected from those which confront the spatial portion formed in a portion of the engine or the engine component and to be charged with the foaming material and which can be easily coated without any obstruction to the assembling work.

[0054] With hot air or steam or the heat of the engine, moreover, the noise generating portion is heated to foam the foaming material 31 to expand and form the sound absorbing member 31a between the V-bank portion 20b and the engine component 20a, as shown in Fig. 7(b).

[0055] According to the engine assembling method thus far described, it is possible to dispersedly provide the foaming material 31 easily deep into the narrow portion of the spatial portion to form the sound absorbing member 31a, and to distribute an adjusted amount of foaming material 31 conforming to the local volume of the spatial portion 21 while preventing any cavity or uneven density in the foamed sound absorbing member 31a, thereby to optimize the sound absorbing effect of the foaming material.

[0056] Moreover, the cover member need not have such an opening for injecting the foaming liquid unnecessary for the sound insulation, nor need be closed the opening of the cover member for preventing the leakage of the foaming liquid other than the injection opening, so that the shaping of the sound absorbing member 31a can be simplified.

[0057] After the foaming material foamable by heating it has been applied, it is subjected to a preparatory foaming treatment in which it is heated at a foaming temperature for a short time so that it may be half foamed. As a result, the foaming material in an unfoamed gel state can be solidified and prevented from running thereby to simplify the assembling work.

[0058] In place of this method of applying the unfoamed foaming material, moreover, the unfoamed foaming material is shaped into a sheet, and this foaming sheet can be applied to the necessary portion. If this foaming sheet is used, the coating of the foaming material may be replaced by application of the foaming sheet which has been formed beforehand into a proper shape. Depending on the thickness of the sound absorbing member to be expanded, moreover, a suitable number of foaming sheets can be overlapped to distribute an appropriate amount of the foaming material easily thereby to improve the working efficiency.

[0059] In addition, if the heating is effected with the heat of the engine, generated at the test run of the en-

gine, the foaming can be performed in the test run after the engine has been assembled. As a result, the foaming step can be eliminated, and the heat source for the foaming can be eliminated, so that the shaping work can be simplified to lower the cost.

[0060] According to the invention of claim 1, the surface of the fuel injection pump is covered substantially with the shielding members comprising the sound absorbing members and the cover members so that the noise produced by the fuel injection pump itself, and the noise due to the standing wave between the cylinder block and the fuel injection pump, can be prevented. Moreover, the surface of the cylinder block can be partially covered with the shielding members to prevent a portion of the noise produced by the cylinder block.

[0061] According to the invention of claim 2, the cover members are made of the heat resisting rubber so that the vibration transmitted from the engine block and the fuel injection pump can be attenuated by the attenuation characteristics of the rubber against the vibration thereby to prevent secondary noise generation.

[0062] The sound absorbing members are formed by filling the foaming material of a synthetic resin so that the noise can be prevented by the sound absorbing characteristics of the foaming material and so that the space where the standing wave may be generated, defined by the cylinder block, the fuel injection pump and the cover members, can be filled up with the foaming material without any cavity to prevent the noise due to the standing wave. Moreover, the shaping of the sound absorbing members is facilitated to improve the working efficiency at the time of making the shielding members.

[0063] According to the invention of claim 3, the shielding members can be separated into a plurality of parts to facilitate the shaping, and the disassembly and assembly for the adjustment, inspection and repair. Especially, if the shielding members are divided into such a shape that the portions necessary for the adjustment, inspection and repair may be easily exposed altogether, the number of shielding members necessary for the disassembly can be reduced to improve the workability of the disassembly and assembly.

[0064] According to the above mentioned engine assembling methods, therefore, it is possible to manufacture an engine which is equipped with the sound absorbing members capable of reducing the noise of the engine effectively.

[0065] Moreover, the foaming material can be foamed by making use of the heat of the engine at the running time so that it can eliminate the heat source and the heating work for foaming thereby to simplify the forming of the sound absorbing members.

Claims

1. A shielding structure for a fuel injection pump comprising: shielding members substantially covering

the surface of the fuel injection pump which is fixed with a clearance to the side of the cylinder block of an engine, said shielding members including cover members covering the noise generating face of said fuel injection pump, and sound absorbing members filled between said fuel injection pump and said cover members, wherein the cover members of said shielding members are made of heat resisting rubber whereas the sound absorbing members of the same are made of a foaming material of a synthetic resin.

2. A shielding structure according to claim 1, wherein said shielding members substantially cover the entire surface of the fuel injection pump.
3. A shielding structure according to claim 1 or 2, wherein said shielding members include: a first shielding member arranged between the cylinder block and said fuel injection pump; and a second shielding member covering the surface of said fuel injection pump left uncovered with said first shielding member, said first and second shielding members being separable on the surface of said fuel injection pump.
4. A shielding structure according to claim 3, wherein the first and second shielding members are made dividable at the central portion of the surface of the fuel injection pump as to cover the back portion and the front portion of the fuel injection pump individually.
5. A shielding structure according to claim 4, wherein the shielding member covering the back portion of the fuel injection pump is applied without any clearance.
6. A shielding structure according to claim 3, 4, or 5, wherein the first shielding member arranged between the cylinder block and the fuel injection pump is constructed as a sandwich structure consisting of a sound absorbing sheet (11b), the cover member (11a) and a further sound absorbing member (11b).
7. A shielding structure according to any of the claims 1 - 6, wherein the shielding member can be separated into a plurality of front and back parts.
8. A shielding structure according to any of the claims 1 - 7, wherein the space defined by the cylinder block, the fuel injection pump and the cover members is filled up with the foaming material without any cavity.

Fig. 1

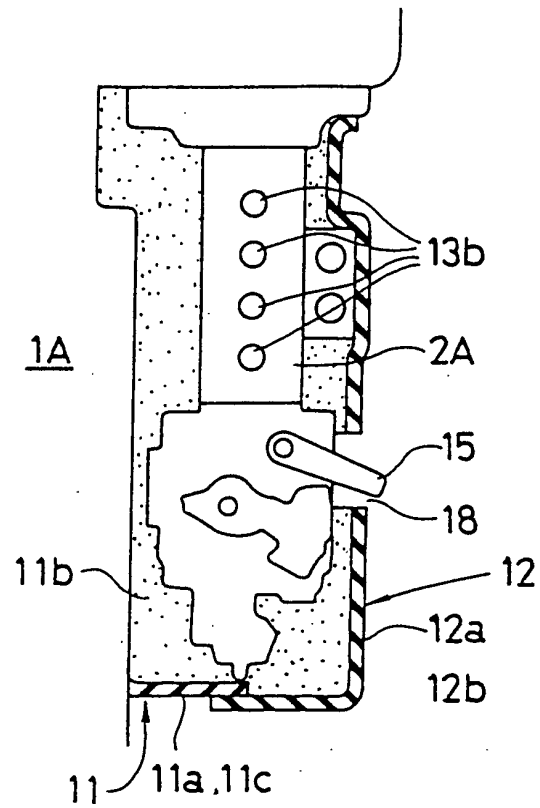


Fig. 2

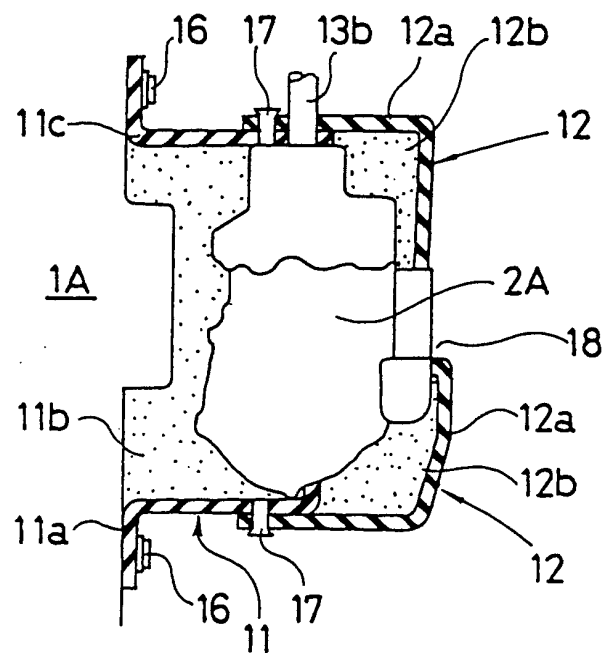


Fig.3

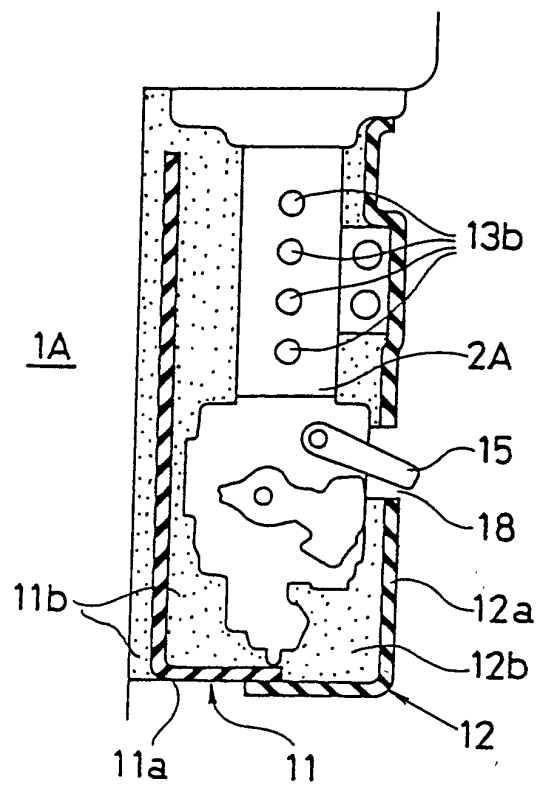


Fig.4

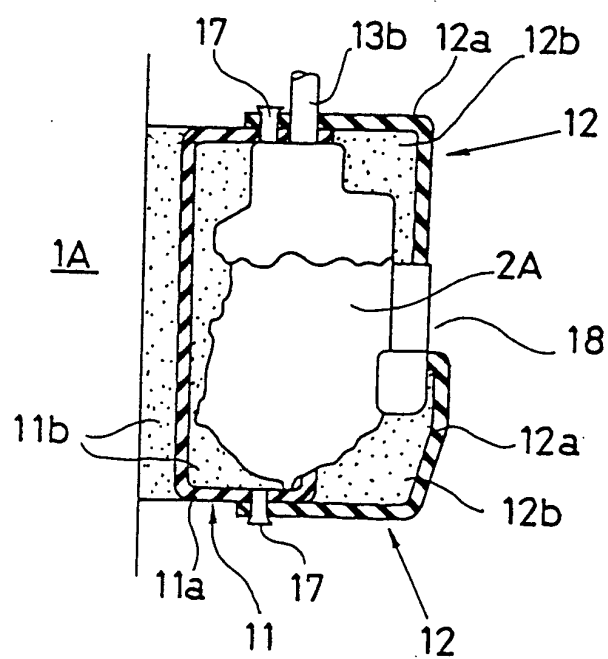


Fig. 5

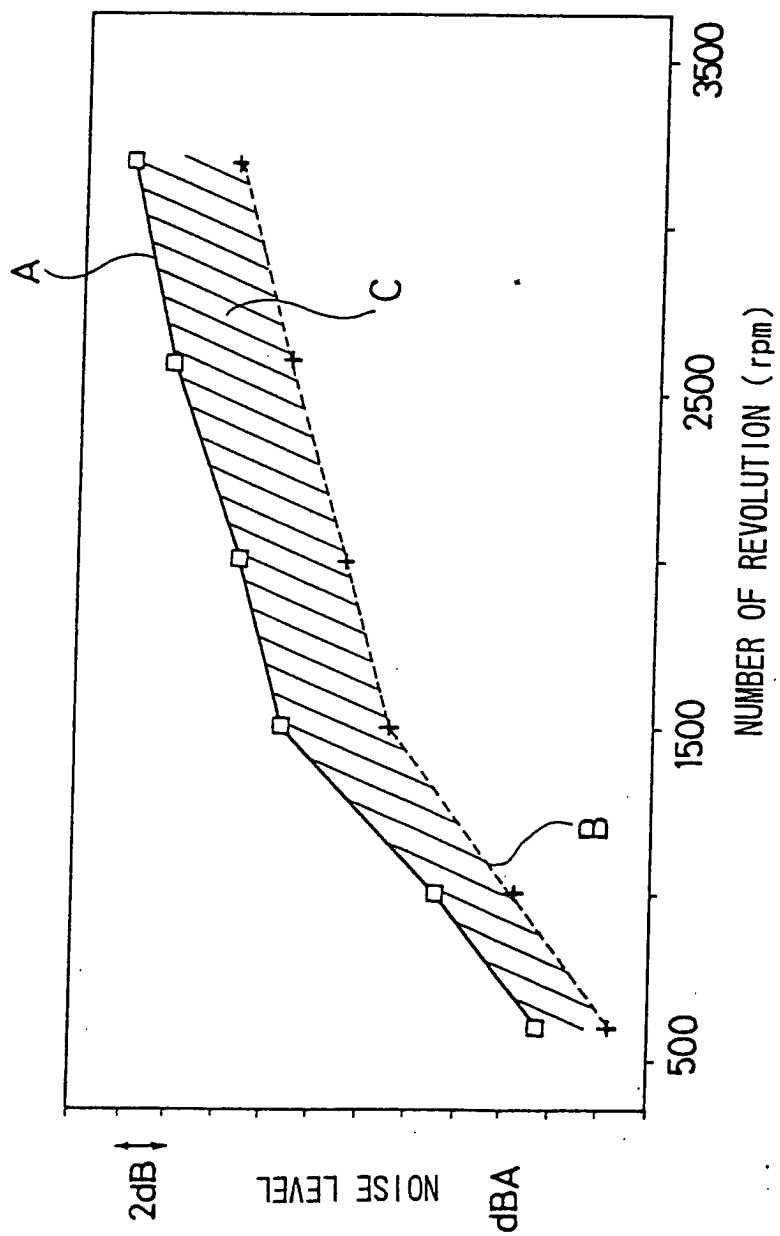


Fig.6 (a)

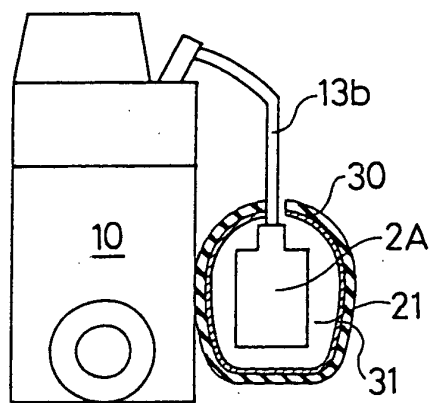


Fig.6(b)

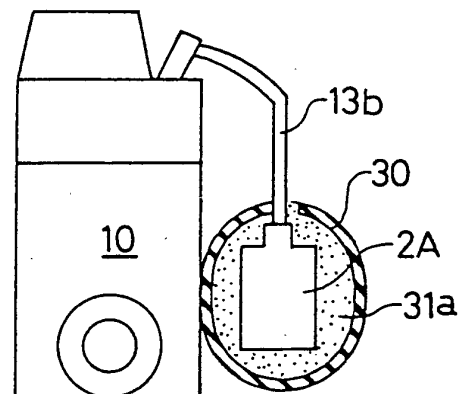


Fig.7 (a)

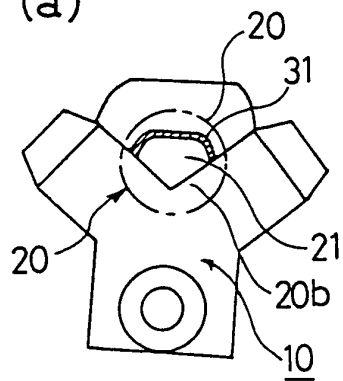


Fig.7 (b)

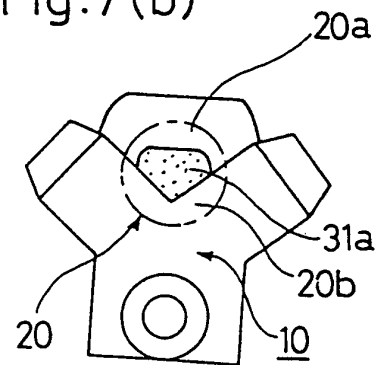


Fig. 8

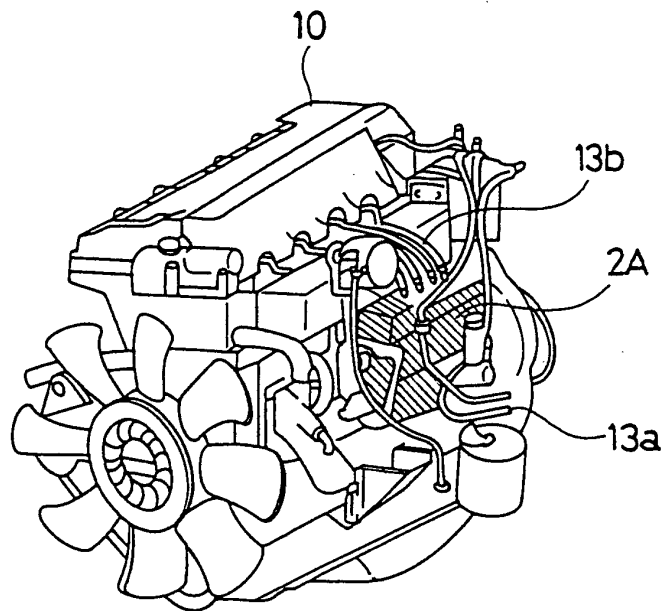


Fig. 9

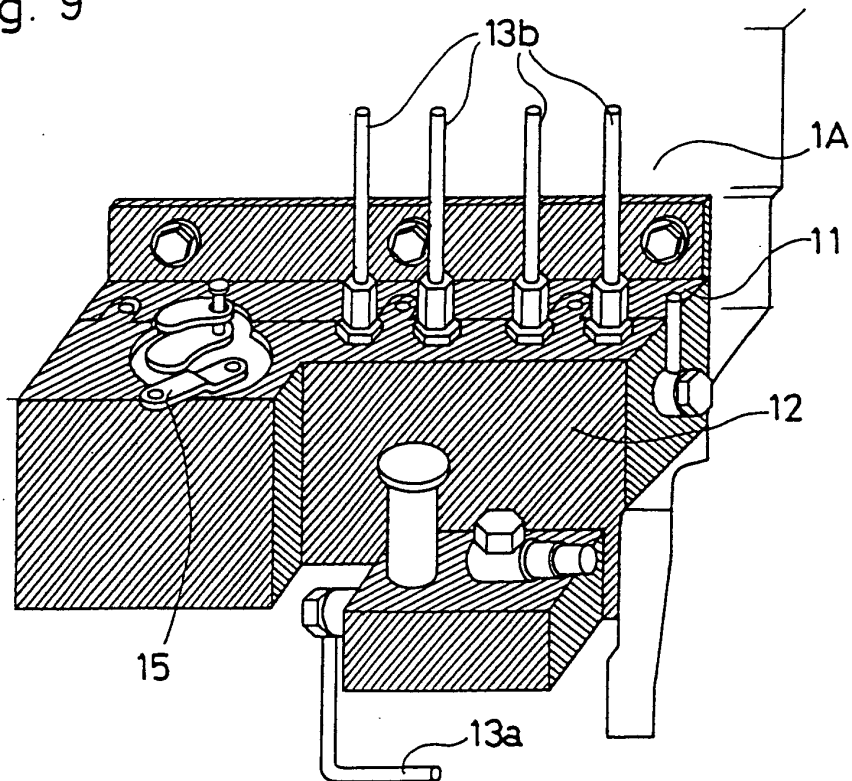


Fig. 10

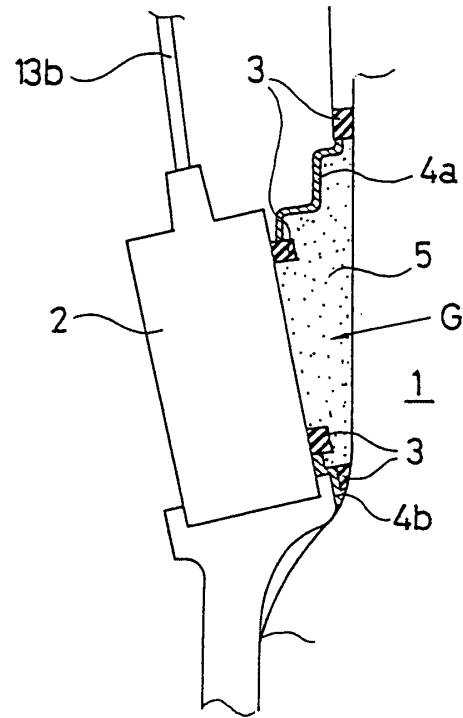
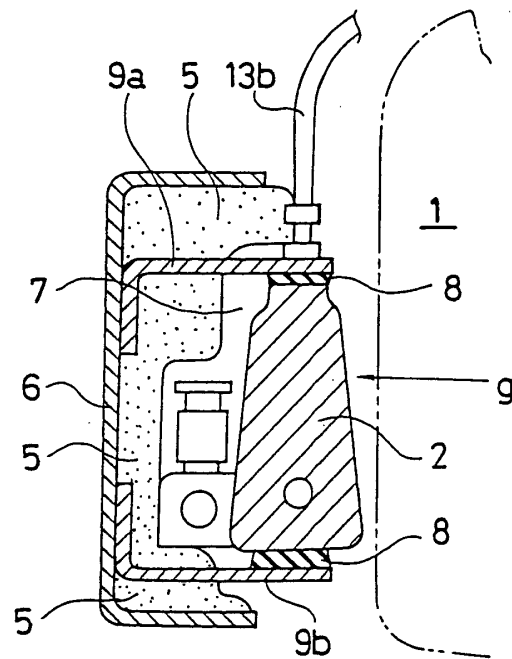


Fig. 11





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 02 02 2063

DOCUMENTS CONSIDERED TO BE RELEVANT					
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)		
A	EP 0 691 462 A (STEYR NUTZFAHRZEUGE) 10 January 1996 (1996-01-10) * figure 1 * * abstract * * column 5, line 1 - line 7 * ---	1	F02M59/00		
A	GB 2 094 948 A (MASSEY FERGUSON PERKINS LTD) 22 September 1982 (1982-09-22) * the whole document * ---	1			
A	US 3 534 828 A (HARVEY DENIS NORTON ET AL) 20 October 1970 (1970-10-20) * figure 1 * * abstract * ---	1			
A	EP 0 341 330 A (ESSEX COMPOSITE SYSTEMS) 15 November 1989 (1989-11-15) * figure 1 * * abstract * ---	1			
A	DE 34 08 750 A (MISAWA HOMES CO) 13 September 1984 (1984-09-13) * figures 1-20 * * claims 1-11 * -----	1,2	<table border="1"> <thead> <tr> <th>TECHNICAL FIELDS SEARCHED (Int.Cl.7)</th> </tr> </thead> <tbody> <tr> <td>F02B F02G</td> </tr> </tbody> </table>	TECHNICAL FIELDS SEARCHED (Int.Cl.7)	F02B F02G
TECHNICAL FIELDS SEARCHED (Int.Cl.7)					
F02B F02G					
The present search report has been drawn up for all claims					
Place of search THE HAGUE		Date of completion of the search 17 October 2002	Examiner Wassenaar, G		
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EPO FORM 1503 03.92 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 02 02 2063

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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17-10-2002

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0691462	A	10-01-1996	AT 403945 B	25-06-1998
			AT 134094 A	15-11-1997
			DE 59500838 D1	27-11-1997
			EP 0691462 A1	10-01-1996
			ES 2109033 T3	01-01-1998

GB 2094948	A	22-09-1982	NONE	

US 3534828	A	20-10-1970	GB 1228621 A	15-04-1971

EP 0341330	A	15-11-1989	EP 0341330 A1	15-11-1989
			US 4751249 A	14-06-1988

DE 3408750	A	13-09-1984	JP 1581434 C	11-10-1990
			JP 2005895 B	06-02-1990
			JP 59165826 A	19-09-1984
			JP 1581435 C	11-10-1990
			JP 2005896 B	06-02-1990
			JP 59165827 A	19-09-1984
			JP 60013960 A	24-01-1985
			JP 1516811 C	07-09-1989
			JP 60013961 A	24-01-1985
			JP 63065817 B	16-12-1988
			AU 567544 B2	26-11-1987
			AU 2522784 A	13-09-1984
			CA 1240963 A1	23-08-1988
			DE 3408750 A1	13-09-1984
			FR 2542377 A1	14-09-1984
			IT 1182255 B	05-10-1987
			KR 9206809 B1	20-08-1992
			US 4517799 A	21-05-1985

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82