

(19)



Europäisches Patentamt

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Office européen des brevets



(11)

EP 0 764 781 A2

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
26.03.1997 Bulletin 1997/13

(51) Int. Cl.⁶: **F02M 35/10**

(21) Application number: **96114588.5**

(22) Date of filing: **12.09.1996**

(84) Designated Contracting States:
DE FR GB IT

(30) Priority: **21.09.1995 JP 243415/95**

(71) Applicant: **ISUZU MOTORS LIMITED**
Shinagawa-ku, Tokyo (JP)

(72) Inventors:
• **Nakagome, Akira**
Fujisawa-shi, Kanagawa-ken (JP)

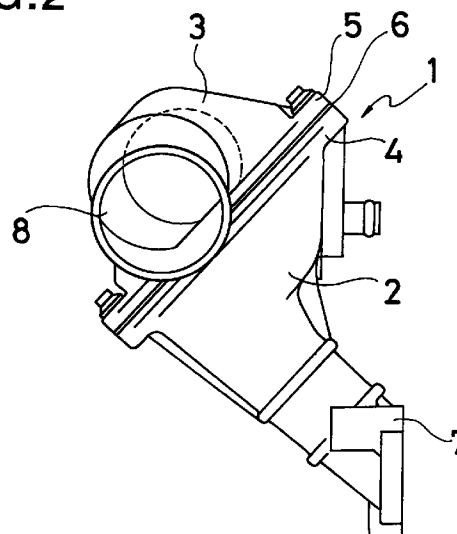
• **Watanabe, Kenji**
Fujisawa-shi, Kanagawa-ken (JP)
• **Nagaoka, Daiji**
Fujisawa-shi, Kanagawa-ken (JP)

(74) Representative: **Weber, Dieter, Dr. et al**
Weber, Dieter, Dr.,
Seiffert, Klaus, Dipl.-Phys.,
Lieke, Winfried, Dr.,
Gustav-Freytag-Strasse 25
65189 Wiesbaden (DE)

(54) Intake chamber

(57) This invention provides an intake chamber (1) interposed between an intake port connected to each cylinder of a multiple-cylinder engine and an intake pipe. The intake chamber (1) comprises a first chamber (2) integrally formed with a manifold (7) and a second chamber (3) for connecting the intake pipe. Flanges (4 and 5) are disposed at openings of the first and second chambers (2 and 3), respectively, so that they can be joined to each other, and clamp a reinforcing plate (6) between them. This reinforcing plate (6) has a communication hole (6d) which allows communication between the first and second chamber rooms (2a and 3a).

FIG.2



EP 0 764 781 A2

Description

This invention relates to an intake chamber interposed between an intake port connected to each cylinder of a multiple-cylinder engine and an intake pipe.

In order to conduct a uniform intake operation for each cylinder of a multiple-cylinder engine, an intake chamber is interposed between an intake port formed in a cylinder head and an intake pipe. Air which is purified by an air cleaner is supplied to this intake chamber through an intake pipe, and is then supplied into each cylinder through the intake manifold and the intake port.

The intake chamber is interposed between one intake pipe and an intake port formed in a cylinder head, and has a complicated structure so as to supply intake air by dividing it into as many portions as the number of the cylinders or the intake ports. Therefore, this intake chamber is generally produced by casting an aluminum alloy. However, because casting of one intake chamber, that is, a hollow body, into one unit needs a complicated casting process and invites a high cost of production, precision casting by die casting by splitting the intake chamber into two segments has been employed in many cases.

From the aspect of layout involving various devices fitted to the engine, an EGR gas introduction hole, a blow-by gas introduction hole (PCV valve), etc, are disposed in many cases in this intake manifold and for this reason, the intake chamber, too, has a complicated structure.

As described above, the intake chamber is often split into two segments and is later assembled so as to facilitate the casting process. The two-segment intake chamber produced by die casting can be formed into a small thickness and moreover, has a large opening. Therefore, this intake chamber involves the problem that its rigidity is relatively low. Though it is of course possible to shape the intake manifold into a large thickness to secure a sufficient strength, the weight undesirably increases in such a case.

An engine main body vibrates during the engine operation and this vibration is transmitted to the intake chamber fitted to the engine main body. When a natural frequency of the intake chamber coincides with the engine vibration at this time, resonance develops and the intake chamber undergoes large deformation as has been confirmed already, and this tendency is remarkable particularly in intake chambers having low rigidity. Deformation of the intake chamber due to resonance generates large emission noise and this noise promotes the engine noise.

When the EGR and blow-by gas introduction holes are disposed in the intake chamber, a greater quantity of gas is likely to be sucked by ports closer to these introduction holes, and the problem that gas distribution is uneven is likely to develop.

As means for preventing or limiting the emission noise of the intake chamber, a method which increases rigidity by increasing the thickness or a method which

changes the natural frequency can be employed. However, the former results in the increase of the engine weight and is not advantageous for resonance because the natural frequency drops. The latter requires the reduction of the weight and yet the increase of rigidity, and cannot be therefore accomplished easily.

Various proposals have so far been made for the intake chamber. Japanese Utility Model Application Kokai Publication No. 55-142630, for example, proposes an intake inertia pipe. However, this apparatus includes an intake pipe and an extension pipe connected to the intake pipe that are disposed in one chamber, but does not deal with deformation and vibration of the intake chamber.

Japanese Utility Model Application Kokai Publication No. 63-35181 proposes an exhaust gas recirculation apparatus of an engine. This apparatus comprises a throttle body, a surge tank, a connection pipe and an intake pipe but does not provide means for reducing the noise emitted in conjunction with the vibration noise of the engine, either.

Japanese Utility Model Application Kokai Publication No. 61-9525 proposes an apparatus wherein an intake throttle valve is disposed in an inlet pipe disposed in a surge tank, but this apparatus does not provide means for reducing the noise emitted due to vibration.

Further, Japanese Utility Model Application Kokai Publication No. 2-18648 proposes an EGR passage structure of an engine. However, this reference does not propose the technical concept of dividing the surge tank into two segments and sandwiching a reinforcing plate between flange surfaces formed on their openings for reinforcement.

In any case, the references described above do not teach to facilitate casting by splitting the intake chamber into two segments, to make it possible to cast even an intake chamber having a complicated shape, to reinforce the intake chamber by clamping a reinforcing plate between the flange surfaces of the divided intake chambers, and to allow intake air to play the functions of dispersing and mixing an EGR gas and a blow-by gas by utilizing a communication hole formed in this reinforcing plate.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an intake chamber which can be easily reinforced, has less deformation due to vibration caused by the engine operation and does not generate large emission noise.

It is another object of the present invention to provide an intake chamber which can improve engine efficiency by uniformly supplying a mixed gas to each cylinder by promoting the mixture of intake air with an EGR gas and a blow-by gas, and can reduce NOx.

An intake chamber according to the present invention for accomplishing the objects described above is an intake chamber interposed between an intake port connected to each cylinder of a multiple-cylinder engine

and an intake pipe, wherein the intake chamber comprises a first chamber having a manifold formed integrally therewith and a second chamber for connecting the intake pipe, flange faces are formed at openings of the first and second chambers, respectively, so that they can be joined to each other, and a reinforcing plate is clamped between both flange faces and has a communication hole for allowing communication between the inside space of the first chamber and that of the second chamber.

The reinforcing plate includes a frame portion which comes into contact with the flange faces, and longitudinal ribs and transverse ribs disposed in a grid form in such a manner as to connect the inside of the frame, and the space defined by the frame, the longitudinal ribs and the transverse ribs is shaped into a communication hole allowing communication between the first and second chambers.

Further, the reinforcing plate is constituted in such a manner as to reinforce the first and second chambers, and to have the function of dispersing the gas passing from the second chamber to the first chamber and agitating the gas.

As described above, while the reinforcing plate is clamped between the both flanges on the joint faces of the first and second chambers, these members are assembled integrally into the intake chamber. Therefore, the flange faces of the two chambers are reinforced in their transverse section by the reinforcing plate and rigidity of the individual chambers is increased. Further, the natural frequency of this intake chamber becomes high.

According to this method, rigidity can be improved extremely highly by a far smaller increase of the weight than is required to increase the thickness.

Accordingly, even when this intake chamber vibrates with the engine main body, the condition under which vibration of the engine resonates with vibration of the intake chamber can be avoided, and the noise can be reduced. Moreover, even when resonance occurs, the intake chamber itself does not undergo deformation because its rigidity is increased. Therefore, the intake chamber does not generate a large emission noise of conventional intake chambers.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a front view of an intake chamber according to an embodiment of the present invention;

Fig. 2 is a right-hand side view of Fig. 1;

Fig. 3 is a front view of a reinforcing plate for reinforcing the intake chamber;

Fig. 4 is a sectional view of the center portion of the reinforcing plate shown in Fig. 3 in a longitudinal direction;

Fig. 5 is a sectional view of the center portion of the reinforcing plate shown in Fig. 3 in a transverse direction;

Fig. 6 is an exploded perspective view of components of the intake chamber according to the present invention; and

Fig. 7 is a graph showing performance of an engine equipped with the intake chamber.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in Figs. 1 and 2, an intake chamber 1 is dividedly cast into a first chamber 2 and a second chamber 3, and flanges 4 and 5 are formed at the end openings of these chambers 2 and 3 in such a manner as to clamp a reinforcing plate 6 between them.

As many intake manifolds 7 as the number of cylinders of the engine are dispersedly formed in the first chamber 2. An intake pipe 8 is connected to one of the ends of the second chamber 3, and intake air is supplied to this intake pipe 8 through a filter and another intake pipe, and is supplied to an intake port of an engine, not shown, from the intake manifolds 7.

As shown in Fig. 6, the reinforcing plate 6 is constituted in such a manner as to partition the first chamber 2a and the second chamber 3a, to mix intake air supplied from the intake pipe 8, to disperse intake air so as to uniformly supply it to each intake manifold 7 and to reinforce the intake chamber 1 comprising the first chamber 2 and the second chamber 3 as a whole.

The reinforcing plate 6 in this embodiment has a rectangular pan shape as a whole, and one of the surfaces protrudes only slightly, as shown in Figs. 3 to 5. An ordinary rolled steel sheet or stainless steel sheet is used for this reinforcing plate 6. The reinforcing plate 6 includes a frame 6a that forms an outer shape, a seal portion and a basic portion for reinforcement, a longitudinal reinforcing rib 6c and a transverse reinforcing rib 6b. These members define windows 6d between them and form a grid shape as a whole. Further, bolt holes 6e are bored in the frame 6a.

The first chamber 2 and the second chamber 3 are assembled so that the protruding portion faces the second chamber side 2a of the first chamber 2 as shown in Fig. 6.

Though it is possible to constitute the frame 6a of the reinforcing plate 6 and the other reinforcing ribs 6b and 6c as separate members, they are preferably integrally constituted by stamping a sheet metal.

As to the shape and the size of the windows of this reinforcing plate 6, the inventors of the present invention have prepared two round windows, three elongated rectangular windows for each of the right and left sides, two rectangular windows, two elliptic windows, and so forth, and have measured vibration and noise. Further, the present inventors examined the reinforcing effect, intake performance, the mixing and distribution effect of the EGR gas and the blow-by gas, the production cost, etc., and have concluded that the structure of this embodiment provides the best result.

Fig. 7 is a graph when a four-cylinder Diesel engine having a displacement of 1,700 cc is operated at a con-

stant rotating speed in a medium speed range. The abscissa represents a load and the ordinate does an EGR variations for each cylinder at this time. A dash line represents the EGR variations in each cylinder when the intake chamber of the embodiment described above is used under the condition that the EGR variation of each cylinder of an intake chamber without the reinforcing plate according to the prior art is 100%.

As shown in this graph, the Diesel engine equipped with the intake chamber according to the present invention mixes intake air with the EGR gas and disperses the mixed gas while preventing the vibration. Therefore, an EGR ratio having a uniform and small variations for the four cylinders can be obtained particularly in the load range in which EGR is effected. Accordingly, this embodiment can exploit more efficiently the EGR effect than in the conventional engines, and can purify the exhaust gas.

Having the construction described above, the intake chamber according to the present invention can provide the following effects.

A) The intake chamber 1 is reinforced by clamping the reinforcing plate 6 between the joint faces of the flanges of the first and second chambers 2 and 3 that are formed in the split form. Therefore, even when the intake chamber 1 vibrates during the engine operation, the intake chamber 1 does not undergo great deformation unlike the conventional chambers, and large emission noise does not occur.

B) Because the longitudinal reinforcing ribs 6c and the transverse reinforcing ribs 6b are disposed in the grid form in the reinforcing plate 6 in such a manner as to define a plurality of windows 6d, these reinforcing ribs 6b and 6c are used as the reinforcing members of the intake chamber and at the same time, serve as agitation plates for agitating, mixing and dispersing intake air when it is supplied to the cylinder. Therefore, while suitable turbulence is imparted to the intake air stream and mixing of intake air with the EGR gas and the blow-by gas is promoted, the mixed gas is uniformly supplied to each cylinder and consequently, engine efficiency can be improved.

As a result, dispersion of the gas can be improved and the NOx concentration in the exhaust gas can be reduced.

Claims

1. An intake chamber (1) interposed between an intake port connected to each cylinder of a multiple-cylinder engine and an intake pipe, characterized in that said intake chamber (1) comprises a first chamber (2) having an intake manifold (7) integrally formed therewith and a second chamber (3) for connecting said intake pipe, flange faces (4 and 5)

are formed at openings of said first and second chambers (2 and 3), respectively, so that they can be joined to each other, a reinforcing plate (6) is clamped between said flange faces (4 and 5), and a communication hole (6d) for allowing communication between the inside space of said first chamber (2) and that of said second chamber (3) is formed in said reinforcing plate (6).

2. An intake chamber according to claim 1, wherein said reinforcing plate (6) includes a frame portion (6a) contacting said flange faces (4 and 5), longitudinal ribs (6c) and transverse ribs (6b) disposed in a grid form in such a manner as to connect the inner portions of said frame (6a), and spaces (6d) defined by said frame (6a), said longitudinal ribs (6c) and said transverse ribs (6b) and used as said communication hole (6d) for allowing communication between the inside space of said first chamber (2) and that of said second chamber (3).

3. An intake chamber according to claim 1, wherein said reinforcing plate (6) reinforces said first chamber (2) and said second chamber (3), and has the function of dispersing and agitating a gas passing from the inside space of said second chamber (3) to the inside space of said first chamber (2).

FIG.1

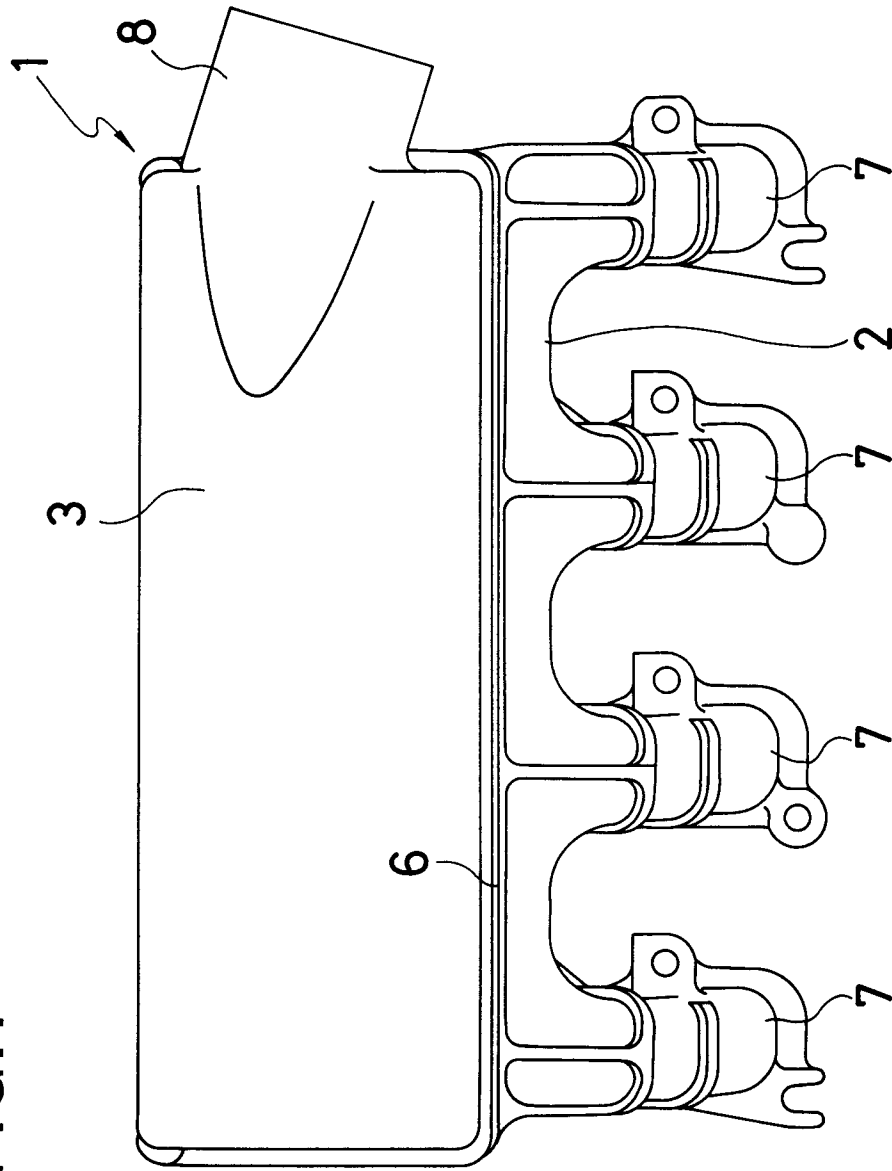


FIG.2

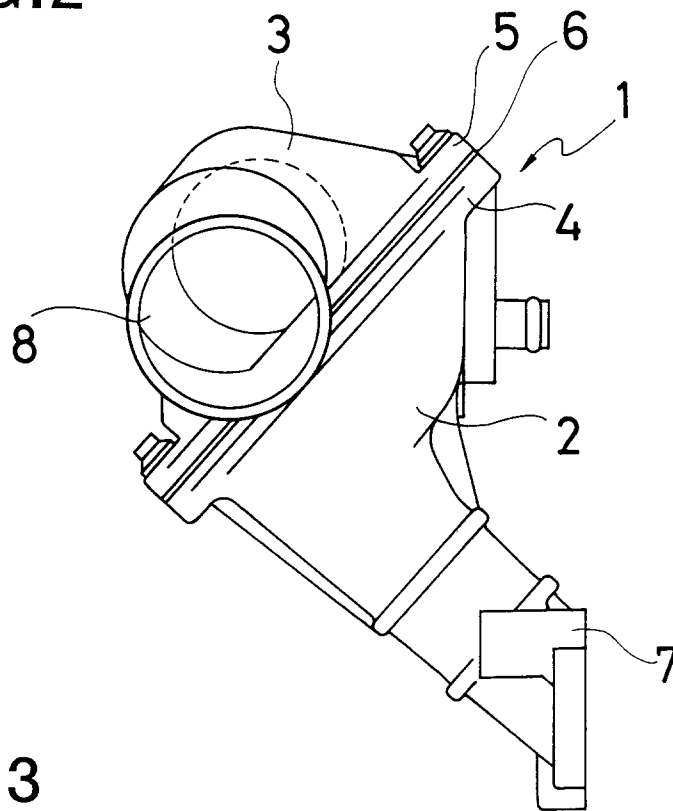


FIG.3

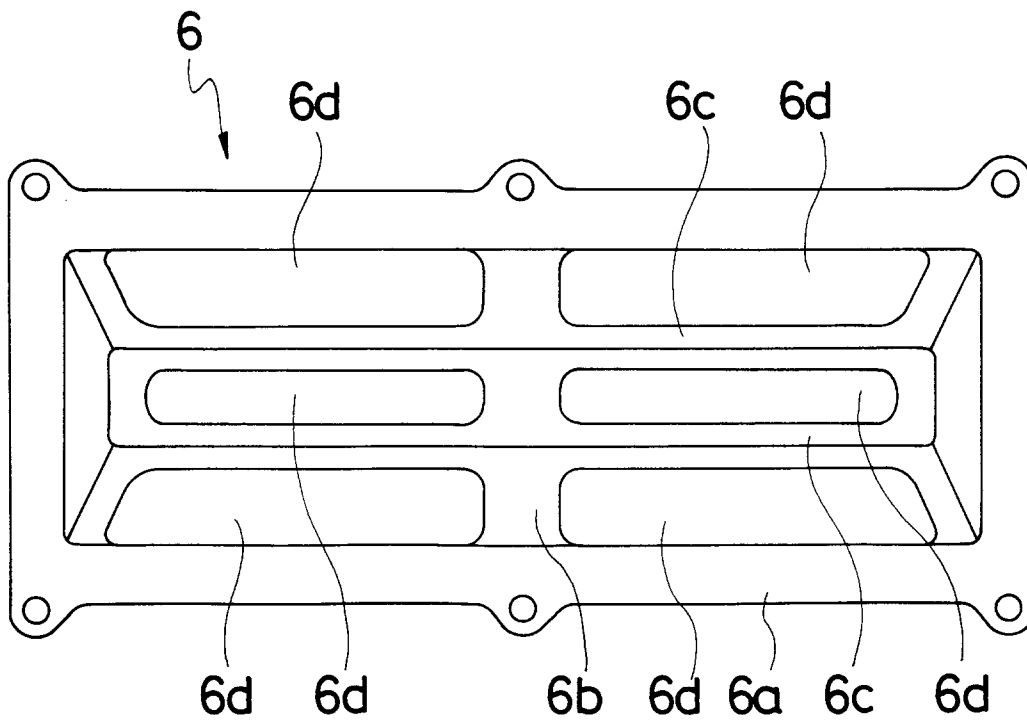


FIG.4

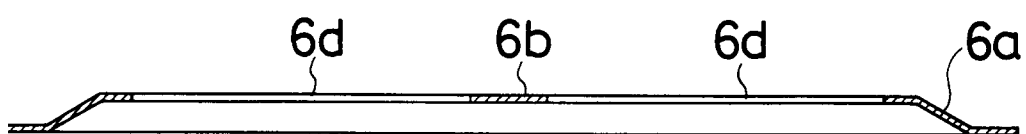


FIG.5

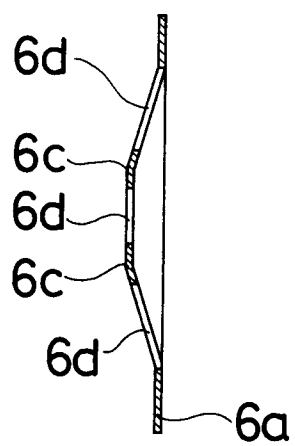


FIG.6

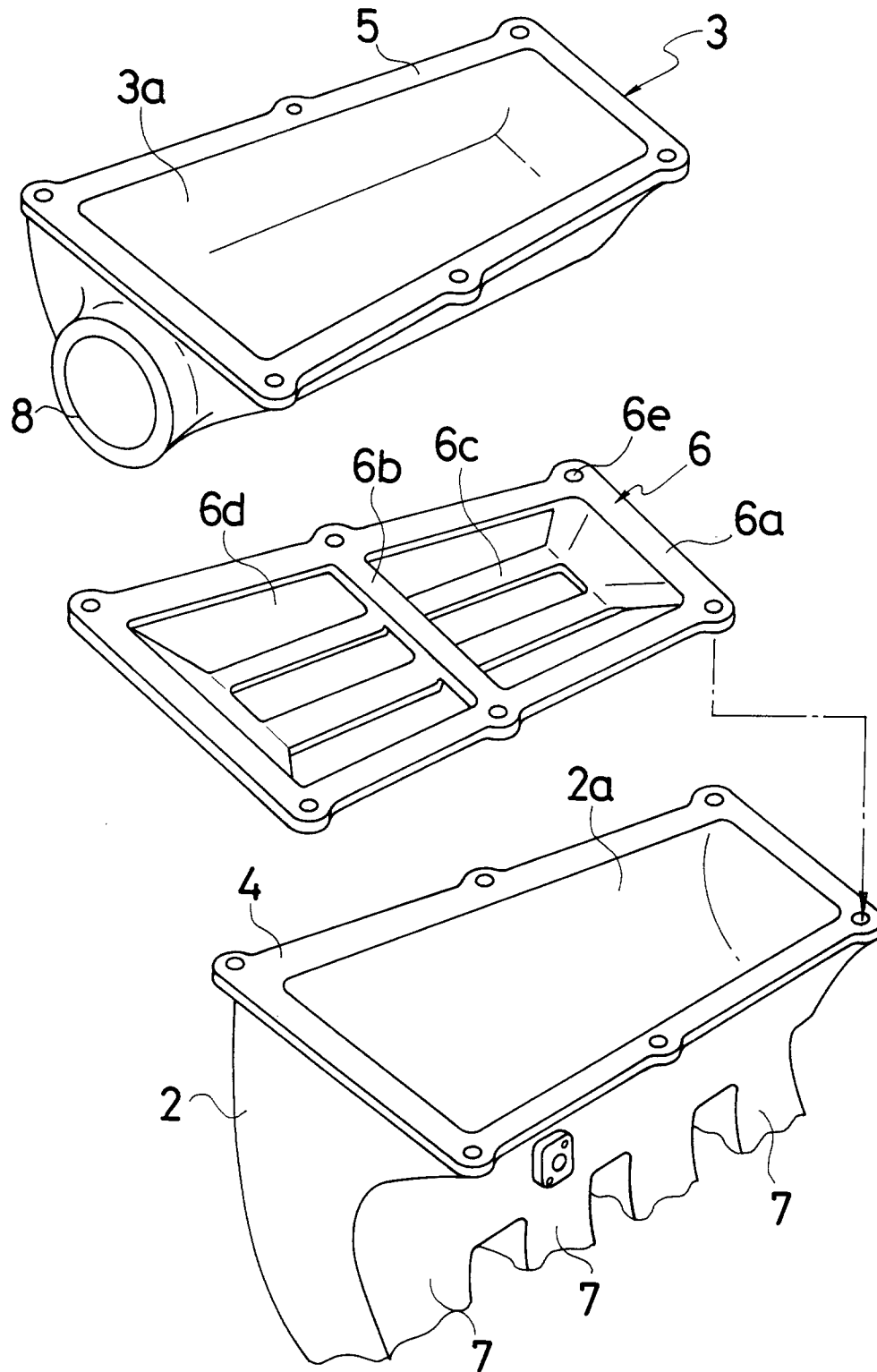


FIG.7

