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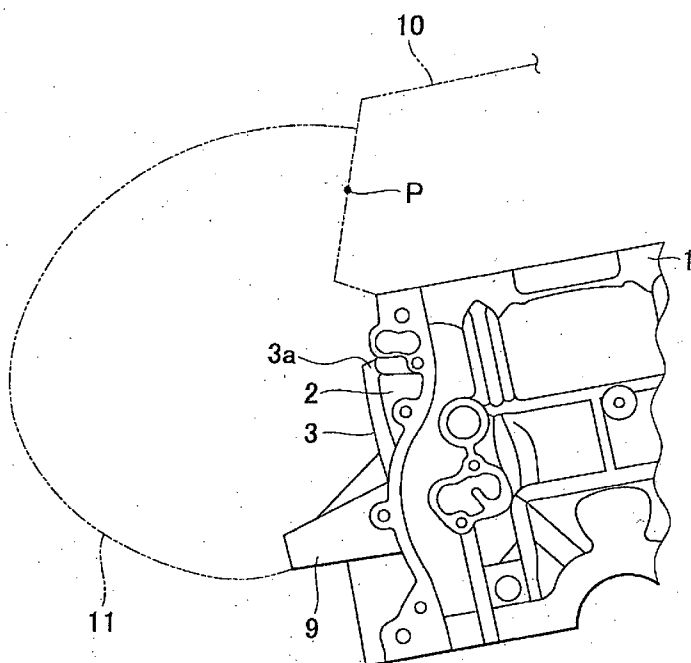
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(54) Title: OIL SEPARATION DEVICE

FIG. 5



(57) Abstract: The invention provides an oil separation device that includes: a cover (3a) that is attached to a side wall of a cylinder block (1) of the internal combustion engine and defines, between the cover (3a) and the side wall, an introduction space (4) into which blow-by gas is introduced; a separator (5), provided on the cover, that takes in the blow-by gas introduced into the introduction space and causes the flow of the blow-by gas to hit a separation wall to cause the oil in the blow-by gas to adhere to the separation wall, so that the oil is separated from the blow-by gas; and a support portion (9), formed on the cover, that supports an accessory component of the internal combustion engine. Thus, vibration of the accessory component is transmitted, through the support portion, to the separation wall of the separator, so that the oil that adheres to the separation wall smoothly drops.

OIL SEPARATION DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

5 [0001] The invention relates to an oil separation device.

2. Description of the Related Art

[0002] In an internal combustion engine mounted on a vehicle, such as a car, gas (blow-by gas) that contains fuel leaks from a combustion chamber into a crankcase through a gap between an inner wall surface of a cylinder and piston rings while the engine is operating. For this reason, a blow-by gas process is performed, in which the gas that contains fuel is returned to an intake passage and disposed of.

[0003] When such a blow-by gas process is performed, an oil separation device shown in Japanese Patent Application Publication No. 2006-336595 (JP-A-2006-336595), for example, is used to separate oil from the blow-by gas that is caused to flow from the crankcase to an intake passage. The oil separation device is provided with a cover that is attached to a side wall of a cylinder block of the internal combustion engine and defines, between the cover and the side wall, an introduction space into which the blow-by gas is introduced. In addition, the oil separation device is provided with a separator, provided on the cover, that takes in the blow-by gas introduced into the introduction space and causes the flow of the gas to hit a separation wall to cause the oil in the gas to adhere to the separation wall, so that the oil is separated from the gas. (See, for example, paragraphs [0015][0016][0018] and [0024] of JP-A-2006-336595.)

[0004] When the blow-by gas is passed through the separator of the oil separation device in the course of returning the gas to the intake passage, oil is separated from the blow-by gas by the separation wall of the separator, and the gas from which the oil has been separated is returned to the intake passage. On the other hand, the oil that is separated from the blow-by gas and adheres to the separation wall drops from the

separation wall by gravitation and is returned to the crankcase through the returning passage that is open to the introduction space.

[0005] When oil adheres to the separation wall of the separator in the oil separation device, if the oil does not smoothly drop and remains on the separation wall, the remaining oil deteriorates, which can cause the formation of sludge.

SUMMARY OF THE INVENTION

[0006] The invention provides an oil separation device that reduces the possibility that the oil that adheres to the separation wall remains on the separation wall and sludge is formed.

[0007] A first aspect of the invention includes: a cover that is attached to a side wall of a cylinder block of an internal combustion engine and defines, between the cover and the side wall, an introduction space into which blow-by gas is introduced; a separator, provided on the cover, that takes in the blow-by gas introduced into the introduction space and causes flow of the blow-by gas to hit a separation wall to cause the oil in the blow-by gas to adhere to the separation wall, so that the oil is separated from the blow-by gas; and a support portion, formed on the cover, that supports an accessory component of the internal combustion engine.

[0008] As the internal combustion engine in operation vibrates, the accessory component of the engine vibrates with large amplitudes in a swinging manner about the center at the connection point at which the accessory component is connected to the internal combustion engine. According to the first aspect of the invention, such vibration of the accessory component is transmitted, through the support portion on the cover of the oil separation device, to the separation wall of the separator provided on the cover, so that the separation wall vibrates and the oil that adheres to the separation wall therefore smoothly drops. Thus, the possibility that oil remains on the separation wall is reduced, and the formation of sludge due to deterioration of the remaining oil on the separation wall is therefore suppressed.

[0009] The support portion may support an intake manifold connected to a cylinder

head of the internal combustion engine.

[0010] It is easy to locate the intake manifold that is connected to the cylinder head, near the side wall of the cylinder block. Thus, it is facilitated to bring about a state in which the intake manifold is supported by the support portion on the cover of the oil separation device that is attached to the side wall of the cylinder block.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The foregoing and further objects, features and advantages of the invention will become apparent from the following description of example embodiments with reference to the accompanying drawings, wherein like numerals are used to represent like elements and wherein:

FIG. 1 is a perspective view showing a cylinder block of an internal combustion engine provided with an oil separation device of an embodiment and a standing wall portion of the oil separation device;

FIG. 2 is a perspective view of a cylinder block, showing a state in which an attached member of the oil separation device is attached to the standing wall portion;

FIG. 3 is a perspective view showing the attached member of the oil separation device;

FIG. 4 is a schematic diagram showing an internal structure of a separator formed on the attached member; and

FIG. 5 is a schematic diagram showing a state in which an intake manifold of the internal combustion engine is attached to a cover of the attached member.

DETAILED DESCRIPTION OF EMBODIMENTS

[0012] An embodiment of the invention, which is an oil separation device that separates oil from blow-by gas in a blow-by gas process in an internal combustion engine will be described below with reference to FIGS. 1 to 5.

[0013] The oil separation device includes: a frame-like standing wall portion 2 that is formed on a side wall of a cylinder block 1 of the internal combustion engine shown in FIG. 1 and protrudes substantially perpendicularly to the side wall; and an attached

member 3 that is attached to the standing wall portion 2 with bolts or the like as shown in FIG. 2. The inside of the frame-like standing wall portion 2 is an introduction space 4 shown in FIG. 1, and blow-by gas present in a crankcase of the internal combustion engine is introduced into the introduction space 4 through passages 12 formed in the cylinder block 1.

[0014] FIG. 3 is a perspective view of the attached member 3 when viewed from the introduction space 4 side (FIG. 1). Formed on the attached member 3 is a separator 5 that takes in the blow-by gas introduced into the introduction space 4 and separates the oil in the blow-by gas from the gas. An inertial impaction-type separator, for example, is used as such a separator 5 in this embodiment. The blow-by gas from which oil is separated by the separator 5 is discharged from the introduction space 4 and returned to the intake passage of the internal combustion engine.

[0015] A cover 3a that is attached, with bolts or the like, to the standing wall portion 2 formed on the side wall of the cylinder block 1 (FIG. 1) is also formed in the attached member 3. The cover 3a defines the introduction space 4 between the side wall of the cylinder block 1 and the cover 3a in the inside of the standing wall portion 2, and closes the introduction space 4. In the attached member 3, the separator 5 is provided on the cover 3a.

[0016] The cover 3a of the attached member 3 is provided with a PCV valve 6 of which the degree of opening is adjusted to vary the flow rate at which blow-by gas is discharged when the blow-by gas is discharged from the introduction space 4 and returned to the intake passage after oil is separated from the blow-by gas by the separator 5. The PCV valve 6 provided on the attached member 3 is connected to the separator 5 via a passage formed in the attached member 3, and is also connected to the intake passage of the internal combustion engine via a hose or the like.

[0017] The blow-by gas from which oil has been separated by the separator 5 is discharged from the introduction space 4 and returned to the intake passage of the internal combustion engine through the passage formed in the attached member 3, the PCV valve 6, the hose etc. When the degree of opening of the PCV valve 6 is adjusted,

the cross section of the passage of the blow-by gas that flows from the passage formed in the attached member 3 into the hose etc. varies, and in this way, the flow rate at which the blow-by gas is discharged from the introduction space 4 is varied.

[0018] FIG. 4 is a schematic view showing an internal structure of the separator 5 of the attached member 3 (FIG. 3). Formed in the separator 5 are a speed-increasing passage 7 that communicates with the introduction space 4 and through which blow-by gas flows from the space 4 into the separator 5, and a separation wall 8 that the flow of the blow-by gas flowing through the speed-increasing passage 7 is caused to hit. The portion of the speed-increasing passage 7 on the separation wall 8 side has a diameter smaller than the portion thereof on the introduction space 4 side, and the speed-increasing passage 7 is extended substantially perpendicularly to the separation wall 8. The speed-increasing passage 7 increases the speed of flow of the blow-by gas introduced from the introduction space 4, and the direction of the flow of the gas is made substantially perpendicular to the wall surface of the separation wall 8. The flow of the blow-by gas taken into the separator 5 is increased in speed by the speed-increasing passage 7 and caused to hit the separation wall 8, so that oil in the blow-by gas adheres to the separation wall 8. Because the oil in the blow-by gas adheres to the separation wall 8 in this way, oil is separated from the gas.

[0019] The blow-by gas from which oil is separated is sent to the PCV valve 6 through the passage 13 formed in the attached member 3. On the other hand, the oil that is separated from the blow-by gas and adheres to the separation wall 8 drops from the separation wall 8 by gravitation, flows to the bottom of the introduction space 4, and is returned to the crankcase through the passages 12 that open at the bottom of the introduction space 4.

[0020] When oil adheres to the separation wall 8 of the separator 5 in the oil separation device, if the oil does not smoothly drop and remains on the separation wall 8, the remaining oil deteriorates, which may cause the formation of sludge. In the oil separation device of this embodiment, a structure for reducing the possibility that the oil that adheres to the separation wall 8 does not drop and remains on the separation wall 8 is

adopted, whereby the formation of sludge is suppressed. The structure for reducing the possibility that oil remains on the separation wall 8 will be described in detail below with reference to FIGS. 2 and 5.

[0021] As shown in FIG. 2, in the attached member 3 of the oil separation device, stays 9, protruding in the direction away from the side wall of the cylinder block 1, that support an accessory component of the internal combustion engine that is attached to the same engine are formed on the cover 3a. Such an accessory component is an intake manifold 11 that is attached to a cylinder head 10 of the internal combustion engine as shown in FIG. 5, for example. The intake manifold 11 is attached to the stays 9 formed on the cover 3a with bolts or the like, and supported by the stays 9. A hole into which the bolt is screwed is formed at the tip of each of the stays 9. In order to secure a sufficient space for installing the intake manifold, the stays 9 are provided at a lower portion of the cover. In this embodiment, the two rod-like stays 9 are provided at substantially the same level, so that the intake manifold is stably supported. In addition, the stays 9 are formed integrally with the cover 3a, which leads to a high strength and makes it easy to form the stays 9.

[0022] As the internal combustion engine in operation vibrates, the accessory component of the engine, such as the intake manifold 11, vibrates with large amplitudes in a swinging manner about the center at the connection point P at which the intake manifold 11 is connected to the internal combustion engine (more specifically, the cylinder head 10). Such vibration of the intake manifold 11 is transmitted to the separation wall 8 of the separator 5 provided on the cover 3a through the stays 9 on the cover 3a of the oil separation device, so that the separation wall 8 of the separator 5 vibrates and the oil that adheres to the separation wall 8 therefore smoothly drops. Thus, the possibility that oil remains on the separation wall 8 is reduced, and the formation of sludge due to deterioration of the remaining oil on the separation wall 8 is therefore suppressed.

[0023] With the embodiment described in detail above, the following effects can be obtained. The possibility that oil adheres to the separation wall 8 of the separator 5 and

remains on the separation wall 8 is reduced, and the formation of sludge due to deterioration of the remaining oil is therefore suppressed.

[0024] It is easy to locate the intake manifold that is connected to the cylinder head 10, near the side wall of the cylinder block 1. Thus, it is facilitated to attach the intake manifold 11 to the stays 9 on the cover 3a of the oil separation device that is attached to the side wall of the cylinder block 1 and bring about a state in which the intake manifold 11 is supported by the stays 9.

[0025] The above-described embodiment can be modified as described below, for example. Although the intake manifold 11 is illustrated as the accessory component of the internal combustion engine that is supported by the stays 9 on the cover 3a, instead of the intake manifold 11, another component, such as a water pump, an alternator, an oil pump for a power steering system, or a compressor for an air conditioner, may be supported by the stays 9.

[0026] Although an inertial impaction-type separator is illustrated as the separator 5 of the attached member 3, instead of the inertial impaction-type separator, a labyrinth separator may be used. In a labyrinth separator, blow-by gas is passed through a winding passage and the flow of the blow-by gas is caused to hit the wall surface of the winding passage, so that the oil in the blow-by gas is caused to adhere to the wall surface for separation from the gas.

[0027] While some embodiments of the invention have been illustrated above, it is to be understood that the invention is not limited to details of the illustrated embodiments, but may be embodied with various changes, modifications or improvements, which may occur to those skilled in the art, without departing from the spirit and scope of the invention.

CLAIMS

1. An oil separation device comprising:

5 a cover that is attached to a side wall of a cylinder block of an internal combustion engine and defines, between the cover and the side wall, an introduction space into which blow-by gas is introduced;

a separator, provided on the cover, that takes in the blow-by gas introduced into the introduction space and causes flow of the blow-by gas to hit a separation wall to cause the oil in the blow-by gas to adhere to the separation wall, so that the oil is
10 separated from the blow-by gas; and

a support portion, formed on the cover, that supports an accessory component of the internal combustion engine.

2. The oil separation device according to claim 1, wherein the support portion
15 supports an intake manifold that is connected to a cylinder head of the internal combustion engine.

3. The oil separation device according to claim 1 or 2, wherein the support portion protrudes from the cover in a direction away from the side wall of the cylinder block.
20

4. The oil separation device according to any one of claims 1 to 3, wherein the support portion has a bolt hole for fastening the accessory component of the internal combustion engine to the support portion with a bolt.

25 5. The oil separation device according to any one of claims 1 to 4, wherein the support portion is provided at a lower portion of the cover.

6. The oil separation device according to any one of claims 1 to 5, wherein the support portion is formed integrally with the cover.

7. The oil separation device according to any one of claims 1 to 6, wherein the support portion is plural in number.

FIG. 1

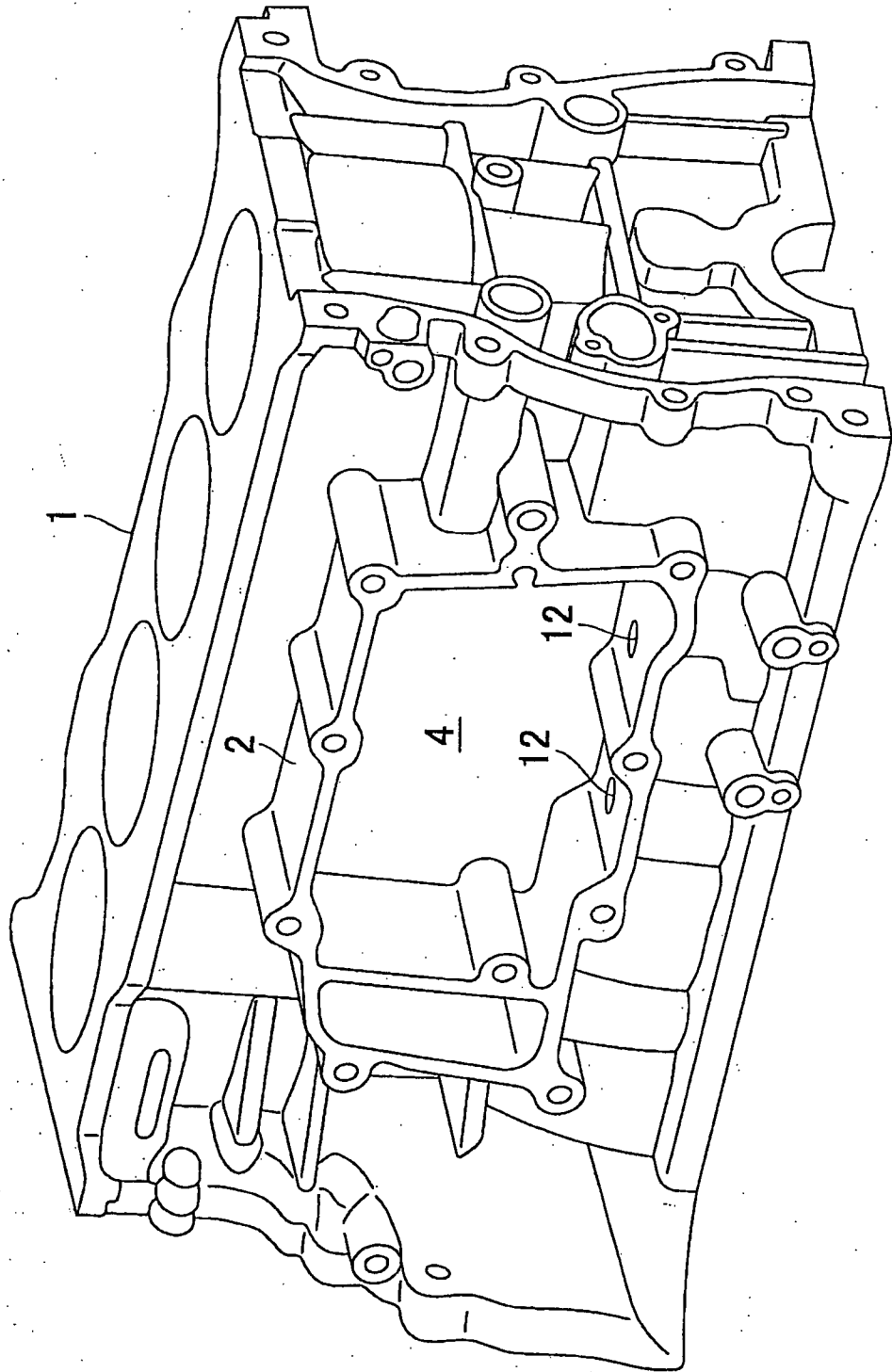


FIG. 2

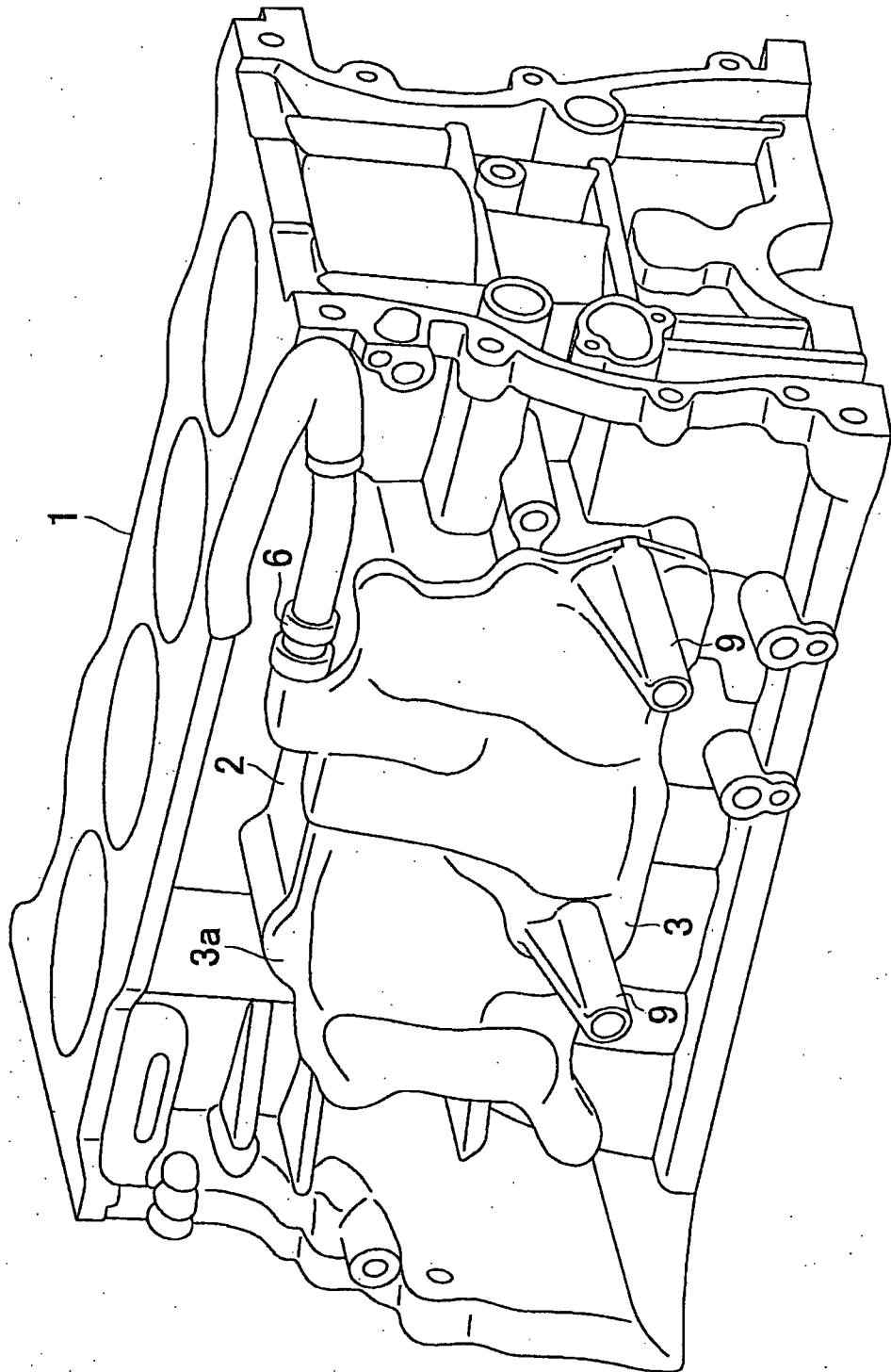


FIG. 3

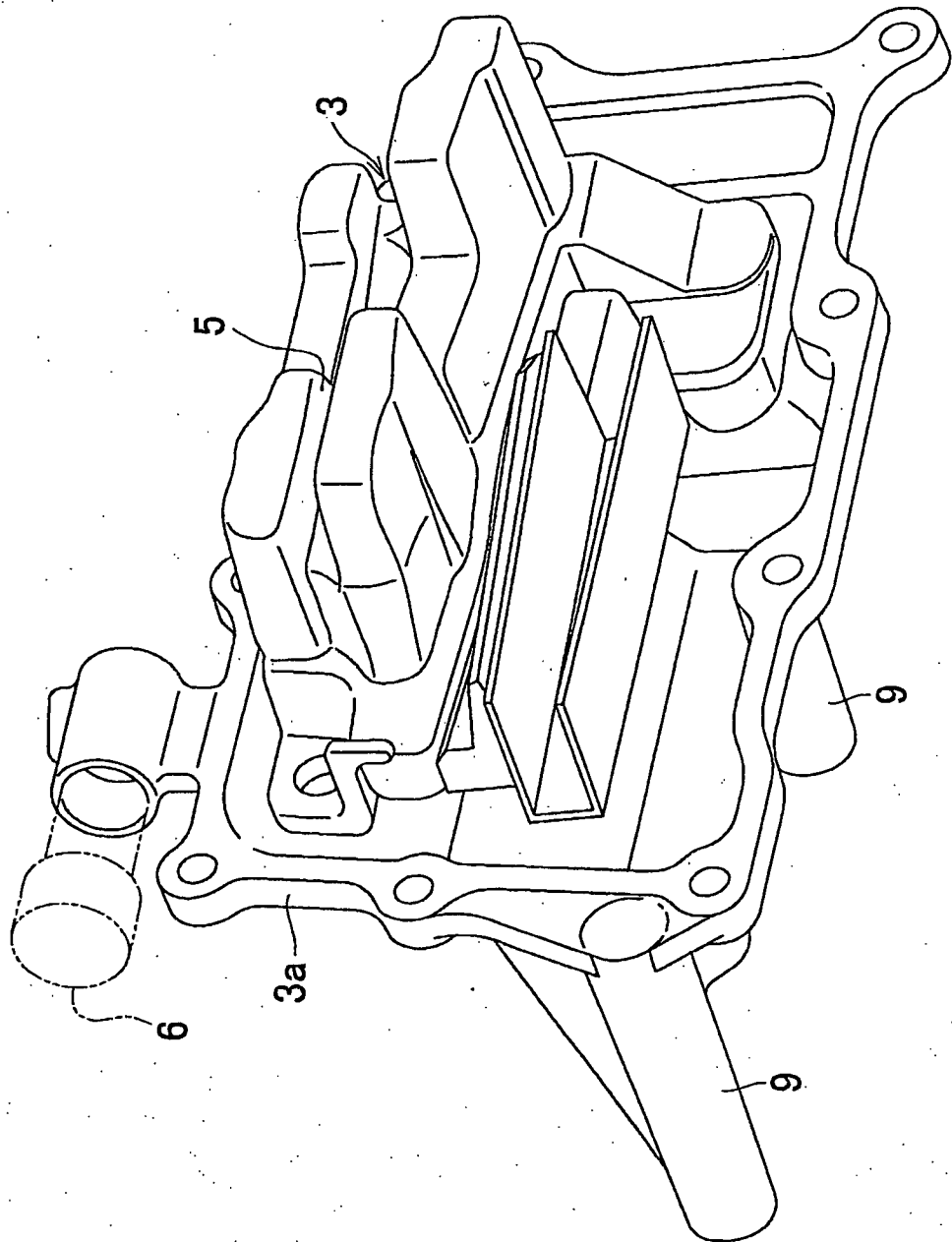


FIG. 4

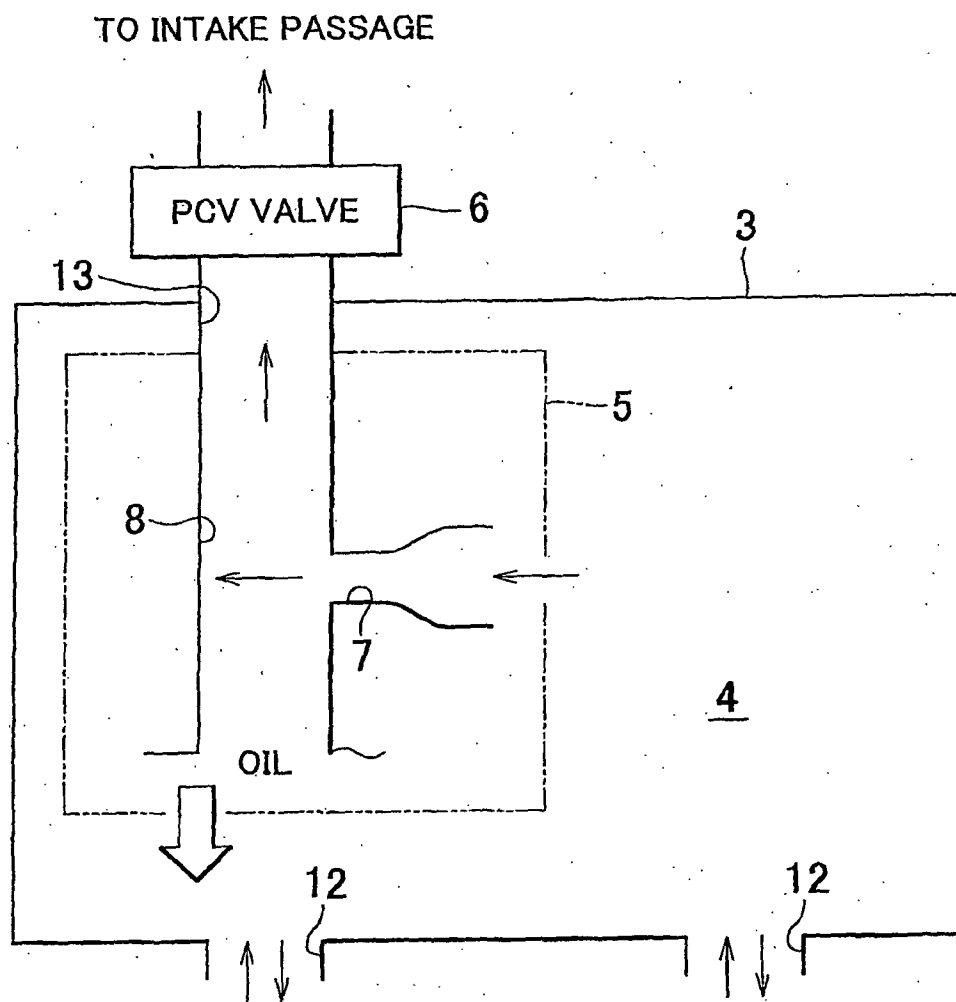
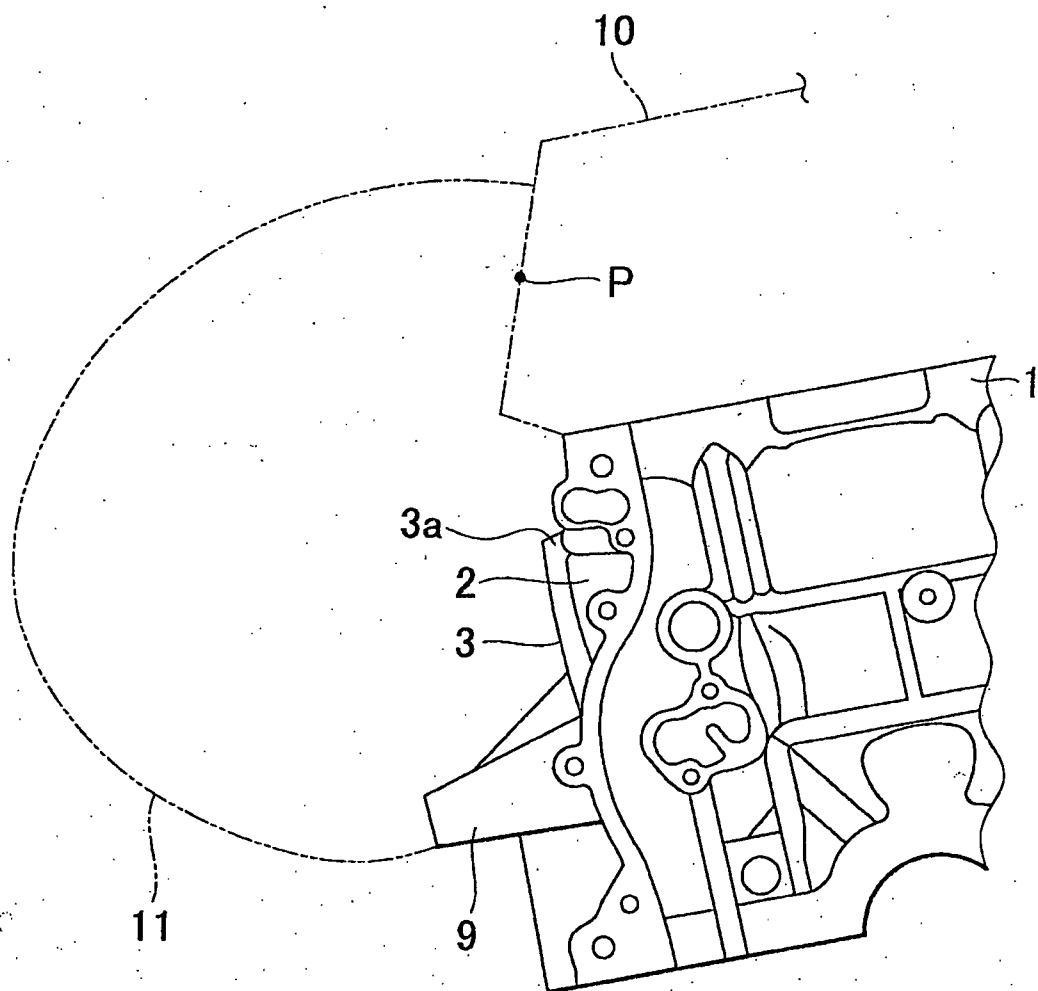


FIG. 5



INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2008/003538

A. CLASSIFICATION OF SUBJECT MATTER

INV. F01M13/04
ADD. F01M13/00

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)

F01M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	US 2 346 736 A (WILLIAM ENGSTROM ET AL) 18 April 1944 (1944-04-18) figures	1, 4, 6
X	DE 199 13 176 A1 (FEV MOTORENTECH GMBH [DE]) 28 September 2000 (2000-09-28) figures	1
X	EP 0 926 319 A (FIAT AUTO SPA [IT]) 30 June 1999 (1999-06-30) figures	1
X	EP 1 447 532 A (NIFCO INC [JP]; MAZDA MOTOR [JP]) 18 August 2004 (2004-08-18) figures	1



Further documents are listed in the continuation of Box C.



See patent family annex.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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