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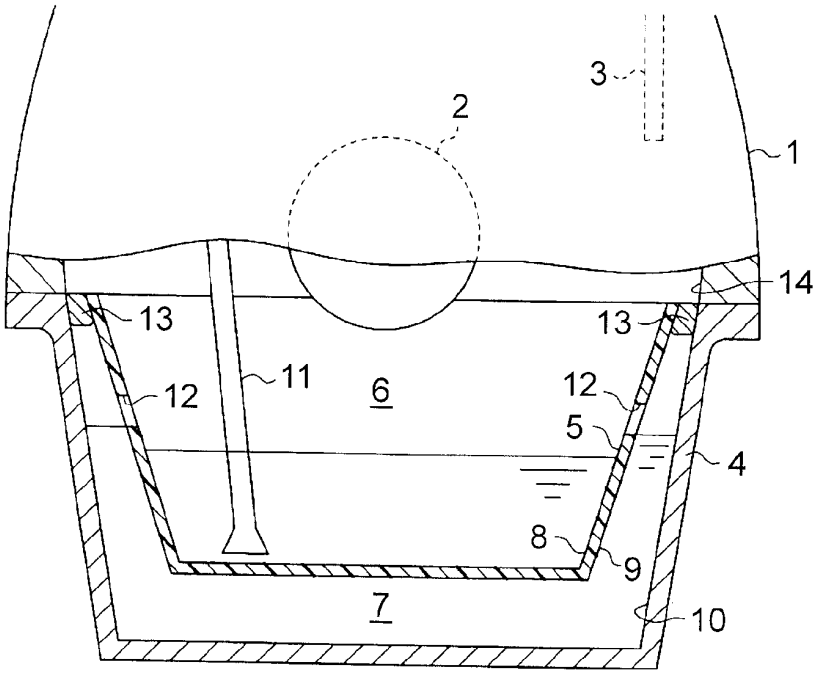
(54) **Oil pan**

(57) An oil pan (4) is a two-tank oil pan the inside of which is partitioned by a separator (5) into an inner tank (6) and an outer tank (7). The separator (5) has a communication hole (12) for communication between the inner tank (6) and the outer tank (7). A seal member (13), which seals the outer tank (7), is provided at a position above the communication hole (12) in the outer tank (7).

FIG. 1



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a two-tank oil pan having an inner tank and an outer tank.

2. Description of Related Art

[0002] A two-tank oil pan is known which has two tanks, an inner tank and an outer tank, separated by a separator installed therein (Japanese Patent Application Publication No. 2011-226394 (JP 2011-226394 A)). In such an oil pan, only the oil stored in the inner tank is circulated after the engine is started to increase the temperature of oil for quickly warming up the internal combustion engine.

SUMMARY OF THE INVENTION

[0003] The oil used for lubricating the internal combustion engine is returned to the oil pan through the oil dropping passage provided in the cylinder block or from the crank shaft. The oil, returned from the crankshaft to the oil pan, spatters as the crankshaft rotates and flows down on the inside wall of the cylinder block. A part of oil, returned through the oil dropping passage, also flows down on the inside wall of the cylinder block. The oil, which flows down on the inside wall of the cylinder block in this manner, flows into the outer tank. When the amount of oil exceeds the maximum storage capacity of the outer tank, the oil flows into the inner tank. In such a case, the temperature of the oil stored in the inner tank decreases, the internal combustion engine may be prevented from being warmed up quickly.

[0004] The present invention provides an oil pan capable of quickly warming up the internal combustion engine.

[0005] An oil pan in an aspect of the present invention includes a separator that partitions the inside of the oil pan into an inner tank and an outer tank and has a communication hole for communication between the inner tank and outer tank; and a seal member that seals the outer tank at a position above the communication hole in the outer tank.

[0006] According to the above aspect, the part above the communication hole in the outer tank is sealed by the seal member to cause the most of the oil, which flows down on the inside wall of the cylinder block, to flow into the inner tank. This configuration therefore reduces a drop in the oil temperature in the inner tank, thus allowing the internal combustion engine to be warmed up quickly.

[0007] The seal member of the oil pan may be made of an elastic material and the separator may be assembled on the oil pan via the seal member. This configuration allows the seal member to deform elastically and thereby seals the outer tank more securely to complete the warm-up of the internal combustion engine more quickly. Even if there is a size error in the separator, this configuration allows the separator to be assembled on the oil pan while allowing the error, thus ensuring higher design flexibility. In addition, because the separator is supported by the oil pan via the elastic seal member, a vibration in the separator and the oil pan is reduced.

[0008] In the above aspect, the seal member may seal the outer tank at its upper end. This configuration reduces the amount of oil that would be left stayed above the seal member in the outer tank.

[0009] In the above aspect, the elastic material may be a liquid packing. The liquid packing, which is a liquid when applied, can adhere together, and seal between, the separator and the oil pan even when the installation surface of the separator and/or the oil pan is uneven. Therefore, the configuration described above makes it easier to assemble the oil pan and the separator together. The seal member may also be a gasket.

[0010] In the above aspect, the separator may be made of resin. In the configuration in which the separator is made of resin, the heat insulating effect is higher than when the separator is made of metal, thus reducing the transfer of heat between the inner tank and the outer tank. Therefore, the temperature of the oil in the inner tank can be increased quickly.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Features, advantages, and technical and industrial significance of exemplary embodiments of the invention will be described below with reference to the accompanying drawings, in which like numerals denote like elements, and wherein:

FIG. 1 is a schematic diagram showing the general structure of an oil pan in one exemplary embodiment;
FIG. 2 is a cross sectional diagram showing the flow of the oil in the oil pan in the exemplary embodiment; and
FIG. 3 is a cross sectional diagram showing an example of another exemplary embodiment of an oil pan.

DETAILED DESCRIPTION OF EMBODIMENTS

[0012] An oil pan in one exemplary embodiment will be described below with reference to FIG. 1 and FIG. 2. As shown in FIG. 1, a cylinder block 1 of the internal combustion engine has a crankshaft 2 and an oil dropping passage 3. The cylinder block 1 has an oil pan 4 assembled at its lower end. A separator 5, which has a box-like shape with its opening opened upward, is provided inside the oil pan 4. This separator 5 is formed by resin. The oil pan 4 has its inside partitioned into an inner tank 6 and an outer tank 7 by the separator 5. In other words, in the oil pan 4, the part surrounded by an inner circumference surface 8 of the separator 5 is the inner tank 6 and the

part surrounded between an outer circumference surface 9 of the separator 5 and an inside wall surface 10 of the oil pan 4 is the outer tank 7. In the inner tank 6, an oil strainer 11 for sucking the stored oil is provided. In addition, the inner tank 6 and outer tank 7 communicate with each other via a communication hole 12 provided on the side wall of the separator 5.

[0013] The upper end of the outer circumference surface 9 of the separator 5 is adhered, over the entire periphery, to the inside wall surface 10 of the oil pan 4 by a liquid packing. That is, the upper end of the outer tank 7 is sealed by a seal member 13 of a liquid packing over the entire periphery. The separator 5 and the oil pan 4 are adhered by the liquid packing as described below.

[0014] First, the liquid packing is applied to the upper end of the outer circumference surface 9 of the separator 5 over the entire periphery. Then, before the liquid packing is cured, the liquid packing application surface of the separator 5 and the inside wall surface 10 of the oil pan 4 are crimped to cure the liquid packing. The adhesive strength of the liquid packing assembles the separator 5 and the oil pan 4 together. Once cured, the liquid packing becomes elastic.

[0015] Next, the operation of the oil pan 4 with this configuration will be described below. After the engine is started, the oil pump is driven to suck the oil from the inner tank 6 through the oil strainer 11. The sucked oil is used to lubricate the components of the internal combustion engine and is returned from the oil dropping passage 3 or the crankshaft 2 to the oil pan 4. As described above, a part of the oil flows down on an inside wall 14 of the cylinder block 1.

[0016] Because the upper end of the outer tank 7 is sealed by the seal member 13 as shown in FIG. 2 in this exemplary embodiment, the oil flowing down on the inside wall 14 of the cylinder block 1 flows, not into the outer tank 7, but into the inner tank 6. This reduces a drop in the temperature of the oil in the inner tank 6.

[0017] After the engine is stopped, the sucking of the oil is stopped and at the same time the oil, which have lubricated the components of the internal combustion engine, is returned to the inner tank 6, causing the level of the oil, stored in the inner tank 6, to rise. When the oil level rises above the communication hole 12, the oil flows from the inner tank 6 into the outer tank 7 through the communication hole 12. The oil, which flows and diffuses from the inner tank 6 into the outer tank 7 in this manner, reduces the deterioration of the oil in the inner tank 6.

[0018] The seal member 13 is elastic. This elasticity causes the seal member 13 to stick to both the outer circumference surface 9 of the separator 5 and the inside wall surface 10 of the oil pan 4, making it possible to seal the outer tank 7 more securely. Even if there is a size error in the separator 5, this elasticity causes the separator 5 to be assembled on the oil pan 4 while allowing the error. In addition, this seal member 13 reduces a vibration generated in the separator 5 and the oil pan 4.

[0019] Even when the installation surface of the separator 5 and/or the oil pan 4 is uneven, the liquid packing used as the seal member 13 adheres to the separator 5 and to the oil pan 4, thus sealing between the separator 5 and the oil pan 4.

[0020] In addition, because the seal member 13 seals the outer tank 7 at its upper end, the top surface of the seal member 13 and the top end surface of the separator 5 are almost at the same level. This configuration prevents the oil, which flows down on the inside wall 14, from staying above the oil stored in the outer tank 7.

[0021] The separator 5 made of resin, with a higher heat insulating effect than that of a separator made of metal, reduces the transfer of heat between the inner tank 6 and the outer tank 7. Therefore, the temperature of the oil in the inner tank 6 can be increased quickly.

[0022] The exemplary embodiment described above has the following effects. In the outer tank 7, the part above the communication hole 12 is sealed by the seal member 13. This configuration reduces a drop in the oil temperature in the inner tank 6 after the engine is started, thus allowing the internal combustion engine to be warmed up quickly.

[0023] The seal member 13, made of an elastic material, seals the outer tank 7 more securely to complete the warm-up of the internal combustion engine more quickly. The use of this elastic seal member 13 to assemble the separator 5 on the oil pan 4 also ensures higher design flexibility. In addition, this elasticity reduces a vibration in the separator 5 and the oil pan 4.

[0024] The seal member 13, formed by a liquid packing, makes it easier to assemble the oil pan 4 and the separator 5 together. Because the seal member 13 is provided at the upper end of the outer tank 7, the amount of oil that would be left stayed above the seal member 13 in the outer tank 7 can be reduced.

[0025] One exemplary embodiment described above may also be implemented by an exemplary embodiment created by modifying the above-described exemplary embodiment as follows. The separator 5, though made of resin in the exemplary embodiment described above, may also be made of other materials such as aluminum or iron. Such a configuration also achieves the same effect as the configuration of the exemplary embodiment described above.

[0026] In the exemplary embodiments described above, the separator 5 may also be assembled on the oil pan 4 not only by the adhesive strength of the seal member 13 but also by a bolt that fastens the separator 5 onto the oil pan 4 with the seal member 13 between the two.

[0027] Although the upper end of the outer tank 7 is sealed in the exemplary embodiments above, the sealing position may be changed as necessary as long as it is above the communication hole 12. Such a configuration also achieves the same effect as the configuration of the exemplary embodiments described above.

[0028] Although a liquid packing is used in the exemplary embodiment described above as the seal member

13 for sealing the upper end of the outer tank 7, the seal member 13 is not limited to the liquid packing. FIG. 3 shows one such example. In the configuration shown in FIG. 3, the configuration of the seal member of the oil pan 4 is different from that of the seal member in the exemplary embodiments described above. The same reference numeral is given to the part of the configuration similar to that of the exemplary embodiments above and the detailed description is omitted.

[0029] As shown in FIG. 3, the separator 5 is fastened on the oil pan 4 by a bolt with a rubber gasket 15, V-shaped in cross section, provided over the entire periphery of the outer circumference surface 9. This configuration seals the upper end of the outer tank 7, causing the oil, which flows down on the inside wall 14 of the cylinder block 1, to flow not into the outer tank 7 but into the inner tank 6. Therefore, this configuration reduces a drop in the temperature of the oil in the inner tank 6. In addition, the separator 5 is assembled on the oil pan 4 via the elastic rubber gasket 15. Therefore, this configuration achieves the same effect as the configuration described above.

[0030] The seal member, though made of an elastic material in the exemplary embodiments described above, may also be made of a non-elastic material such as a metal gasket. This configuration also achieves the same effect as the configuration described above.

Claims

1. An oil pan **characterized by** comprising:

a separator (5) that partitions the inside of the oil pan (4) into an inner tank (6) and an outer tank (7) and has a communication hole (12) for communication between the inner tank (6) and outer tank (7); and
a seal member (13) that seals the outer tank (7) at a position above the communication hole (12) in the outer tank (7).

2. The oil pan according to claim 1, wherein the seal member (13) is made of an elastic material and the separator (5) is assembled on the oil pan (4) via the seal member (13).

3. The oil pan according to claim 1 or 2, wherein the seal member (13) seals the outer tank (7) at an upper end thereof.

4. The oil pan according to claim 2 or 3, wherein the elastic material is a liquid packing.

5. The oil pan according to any one of claims 1 to 3, wherein the seal member (13) is a gasket.

6. The oil pan according to any one of claims 1 to 5, wherein the separator (5) is made of resin.

FIG. 1

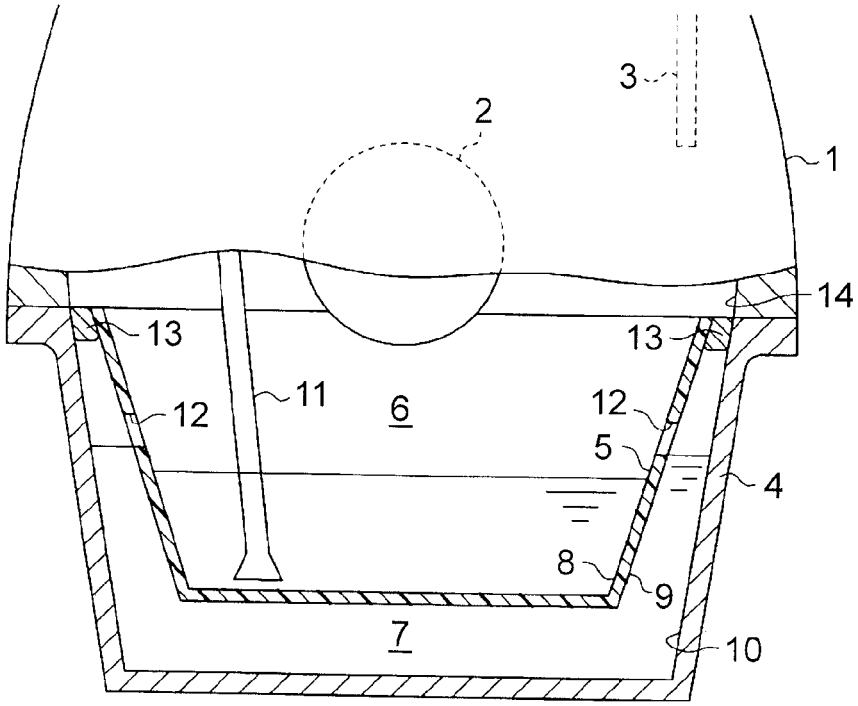


FIG. 2

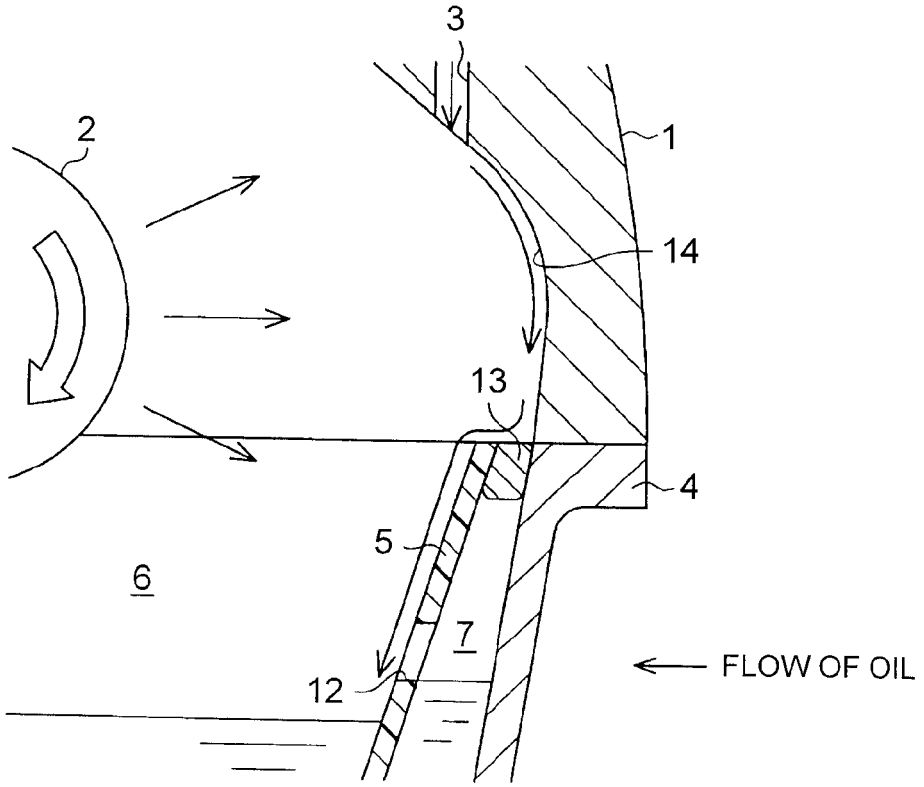
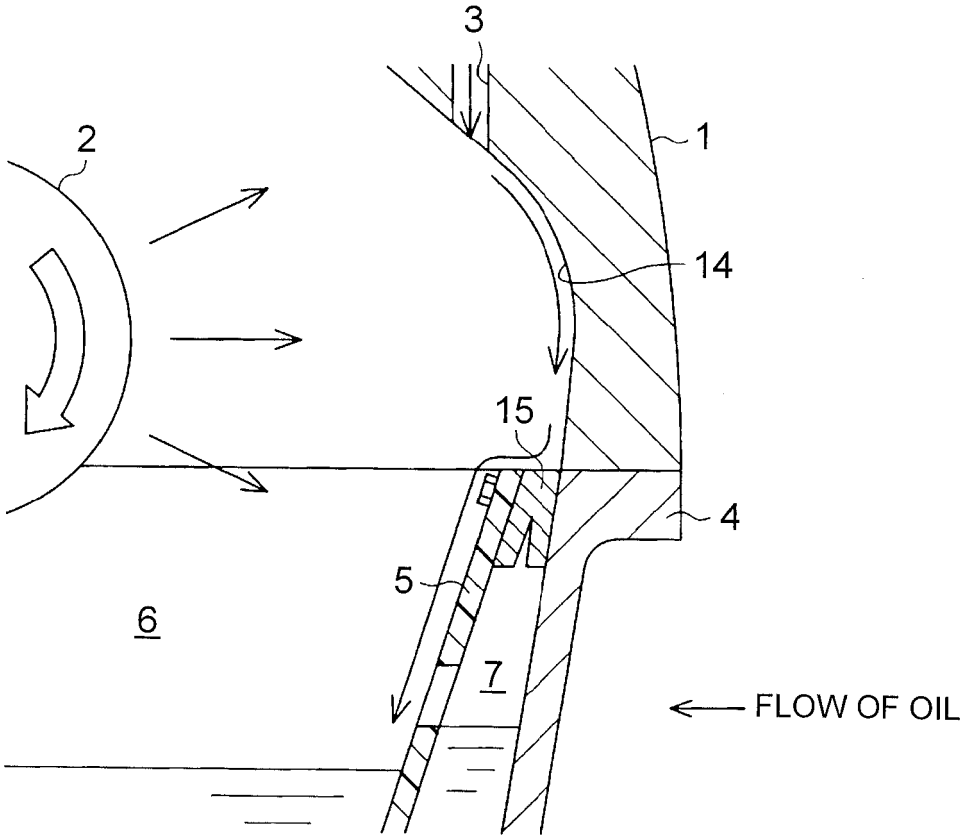


FIG. 3



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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