

(19)



(11)

EP 2 253 811 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
24.11.2010 Bulletin 2010/47

(51) Int Cl.:
F01M 5/00 (2006.01) F28D 9/00 (2006.01)
F01P 11/08 (2006.01)

(21) Application number: **10163053.1**

(22) Date of filing: **18.05.2010**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR
Designated Extension States:
BA ME RS

(72) Inventors:
• **Sasaki, Kenji**
Saitama 351-0193 (JP)
• **Sato, Atsushi**
Saitama 351-0193 (JP)
• **Mori, Seiji**
Saitama 351-0193 (JP)

(30) Priority: **18.05.2009 JP 2009119849**

(74) Representative: **Herzog, Markus et al**
Weickmann & Weickmann
Patentanwälte
Postfach 86 08 20
81635 München (DE)

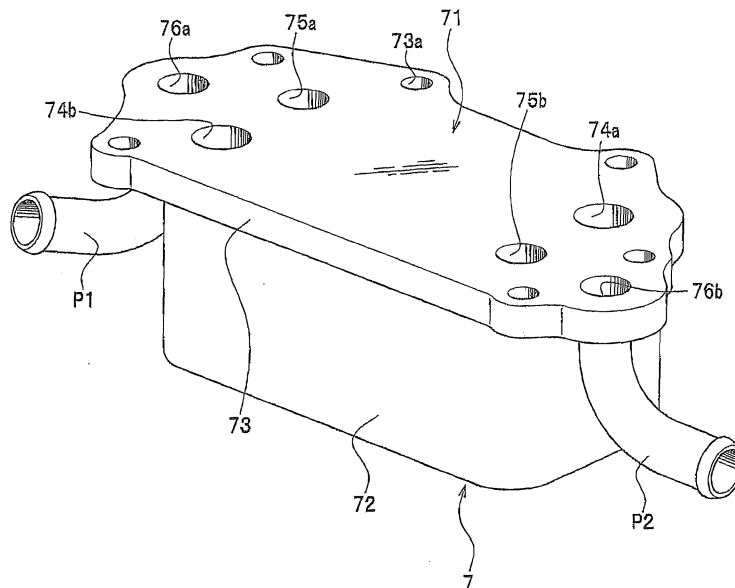
(71) Applicant: **Honda Motor Co., Ltd.**
Tokyo 107-8556 (JP)

(54) **A fluidic channel structure of internal combustion engine**

(57) This invention provides a fluidic channel structure of internal combustion engine enabling an oil cooler to be smaller in size without a complicated fluidic channel structure placed inside the internal combustion engine body. This is a fluidic channel structure including an oil cooler (7), a lubricating oil passage, and a cooling water passage. The oil cooler (7) has a core section (72) exchanging heat and a flange section (73) extending in the surrounding of the core section (72). The core section

(72) is provided with a pair of communication port for lubricating oil (74a), (74b), the flange section (73) is provided with a pair of through holes (76a), (76b), the pipes (P1), (P2) are laid out in a pair of through holes (76a), (76b), and the first concave groove (75a) and the second concave groove (75b) connecting respectively to a pair of communication port for cooling water and a pair of through holes (76a), (76b) are formed in a surface of the bottom (21a) of the oil pan (2) attaching the oil cooler (7).

FIG.2



EP 2 253 811 A1

Description

Technical Field

[0001] The present invention relates to a fluidic channel structure of internal combustion engine, in particular, to the fluidic channel structure of internal combustion engine for flowing fluid through an oil cooler.

Background

[0002] Patent Literature 1 (Patent Laid-open Unexamined Publication No. 144, 977 of 2008) discloses a brazing oil cooler of two cooling water pipe sections in an opposite side of attachment surface of an internal combustion engine of a core section. This oil cooler is provided with a core section for exchanging heat between oil and cooling water, and an end plate for forming a flange section extending in an attachment side of the internal combustion engine of the core section.

[0003] Patent Literature 2 (Patent Laid-open unexamined publication No. 077,925 of 2007) discloses an engine for automatic two-wheeled vehicle to attach a separate oil pan, different from a crankcase under a lower surface of the crankcase, to supply each oiling place inside an engine through an oil supply channel from the oil pump with oil, and to return oil after oiling to the oil pan. Specifically, Patent Literature 2 discloses a structure to attach an oil cooler arranged by way of the oil supply channel in a front surface, a side surface, or a rear surface of the oil pan.

[0004] In the oil cooler described in Patent Literature 1, the cooling water pipe is, however, brazed in a surface attaching the internal combustion engine of the core section and its opposite surface. Then, a height of the oil cooler is large in size. Accordingly, it may be possible that pipes, accessories, frames, or the like surrounding the internal combustion engine has been easily interfered one another and there has few degrees of freedom in layout in view of attachment place. When a degree of freedom in layout is sought for, the internal combustion engine is easily made larger and it is difficult to be in a compact design.

[0005] In case where the both an oil passage and a cooling water passage are formed inside the internal combustion engine body without brazing the cooling water pipe between the internal combustion engine of the core section and a surface of the opposite side, the oil cooler is required for an inlet passage and an outlet passage in each of lubricating oil and cooling water. Accordingly, a constitution of the cooling water passage and the lubricating oil passage inside the internal combustion engine comes to be complicated. Then, it may be incurred to make large the internal combustion engine body and to increase the manufacturing cost.

[0006] Various pipes, accessories and frames are arranged in a front surface, a side surface, and a rear surface of the internal combustion engine mounted in a ve-

hicle body. Then, it is difficult to make a maintenance of the oil cooler in a state mounting the internal combustion engine on a vehicle body.

[0007] In consideration of the above, a first object (task) of the present invention is to provide a fluidic channel structure of internal combustion engine possible for making smaller the oil cooler without making complicated fluidic passage structure inside the internal combustion engine.

A second object (task) is to provide a fluidic passage structure of internal combustion engine, which is easy for maintenance of the oil cooler.

[0008] The present invention is provided in the lower portion of the internal combustion engine body. It is provided with an oil pan reserving a lubricating oil, an oil pump supplying the lubricating oil and sucking from the oil pan to each lubricating section of the internal combustion engine body, an oil cooler mounting on the internal combustion engine body and cooling down the lubricating oil, a lubricating oil passage flowing the lubricating oil by connections of the oil pan, the oil pump, the oil cooler, and each lubricating section, and a refrigerant passage supplying the oil cooler with the refrigerant. The oil cooler includes a core section for exchanging heat between the lubricating oil circulating section of the lubricating oil and the refrigerant circulating section of the refrigerant, and a flange section extending from an end of the attachment side of the internal combustion engine body of the core section. The communication port for lubricating oil between the lubricating oil circulating section and the lubricating oil passage, and the refrigerant communication port between the refrigerant circulating section and the refrigerant passage are formed in the attachment side of the internal combustion engine body. The flange section is provided with a through hole penetrating from an attachment surface of the internal combustion engine body to a surface placed in the side of the core section. The through hole is arranged to communicate either of the refrigerant passage and the lubricating oil passage from a surface placed in a side of the core section. The surface of the internal combustion engine body attaching the oil cooler is provided with a concave groove connecting each of the refrigerant communication port and the lubricating oil communication port to the through hole.

[0009] In the above constitution, the pipe flowing the refrigerant and the lubricating oil is connected to the flange section of the oil cooler to supply and suck the refrigerant lubricating oil from the pipe through the concave groove formed on a surface of the internal combustion engine body to the oil cooler.

In other words, as the pipe for refrigerant or lubricating oil is arranged in a dead space in the surrounding of the flange section of the oil cooler, they are able to avoid interferences with the pipes, accessories, frames, or the like placed in the surrounding of the internal combustion engine, and thus an improvement of a degree of freedom in layout can be obtained, and the internal combustion engine is able to be small in size.

A simple constitution can be obtained by providing a concave groove on a surface of the internal combustion engine and providing the through hole in the flange section of the oil cooler. Then, it can be simply constituted and large-size scaling of the internal combustion engine and the manufacturing cost can be effectively restricted in its increase, compared with a case where both the refrigerant passage and the lubricating oil passage are formed inside the internal combustion engine.

As the core section is very few required for machining, a specific core section is not required for manufacturing and its material cost can be effectively restricted to increase.

[0010] The oil cooler is preferably provided in the oil pan arranged under the internal combustion engine body. More specifically, it is preferable that a recess with a part thereof depressed is provided in the bottom of the oil pan, and it is preferably constituted that the oil cooler is arranged through the flange section in the recess.

[0011] In the above constitution, as the oil cooler is arranged in the recess formed in the oil pan, it is easy to attach in or detach from the internal combustion engine body, thus to improve its maintenance, together with its operation and effect.

As the other parts are not arranged below the oil pan, the oil cooler is never interfered with the other parts, and it is also easy to make large a volume of the oil cooler.

[0012] The oil pan is constituted by an upper oil pan and a lower oil pan attached below the upper oil pan. The oil cooler is preferably constituted to be arranged in an area, in which it is placed in the bottom of the upper oil pan and the lower oil pan is not arranged.

[0013] In the above constitution, the oil cooler is mounted in an area in which the lower oil pan, i.e. an oil reservoir is not arranged among the bottoms of the upper oil pan arranged on the upper side of the oil pan to be divided into two pieces at upper and lower positions. Thus, it is able to lay out as the pipe of the oil cooler does not extrude in a lower direction relative to the bottom of the lower oil pan. As a result, the internal combustion engine body can be made to be compact.

[0014] It is preferably constituted that the refrigerant passage is laid out in the through hole from a surface placed in the side of the core section, a path between the communication hole for refrigerant and the through hole are connected by the concave groove, the communication port for lubricating oil is connected to the oil pan-integrated lubricating oil passage formed integrally inside the oil pan, and the oil pan-integrated lubricating oil passage is so preferably constituted that the oil pump provided inside the casing member arranged to one end of the oil pan and the communication port for lubricating oil are connected each other.

[0015] In the above constitution, as it is constituted to supply from the pipe for refrigerant arranged outside the internal combustion engine body to the oil cooler with refrigerant, and to supply through the oil pan-integrated lubricating oil passage as being integrally formed with

the oil pan, the complicated fluidic channel can be prevented and the internal combustion engine body can be restricted in its large-size scaling. As the oil pan-integrated lubricating oil passage is formed to cross the bottom of the oil pan being an attachment surface of the oil cooler, the bottom of the oil pan can be effectively reinforced.

[0016] According to this invention, it can provide a fluidic channel structure of internal combustion engine, which is possible to make small the oil cooler without a complicated fluidic channel inside the internal combustion engine body.

Brief description of Drawings

[0017]

Figure 1 is a side view of an automobile engine providing with a fluidic channel structure of internal combustion engine relating to this embodiment.

Figure 2 is a perspective view of the oil cooler.

Figure 3 is an exploded perspective view showing a state as the oil pan and the oil cooler looked up from oblique lower.

Figure 4 is a sectional view of the oil pan and the oil cooler taken along a line I - I shown in Figure 1.

Figure 5 is a perspective view showing a state as the bottom of the oil pan and the side wall of the cylinder block looked down from oblique upper.

Figure 6 is a sectional view taken along a line II - II shown in Figure 5.

Best Mode for Carrying out the Invention

[0018] A first embodiment of the present invention will be described in detail with reference to the attached drawings. In the description, the duplicated description will be omitted by designating the same numerical number in the same element. In the first embodiment, it will be described by giving an example applied to an automotive engine.

[0019] Figure 1 is a side view of an automotive engine providing a fluidic channel structure of internal combustion engine relating to this embodiment.

As shown in Figure 1, an automotive engine 1 constituting an internal combustion engine body is constituted by cumulating an oil pan 2, a cylinder block 3, a cylinder head 4, and a cylinder head cover 5 arranging in order from the lower. A chain casing 6 is provided in the side of the engine 1 to cover a timing chain as not shown and the like.

[0020] The oil pan 2 is a member for reserving the lubricating oil, and is provided with two members, which is disposed of an upper oil pan 21 receiving the lubricating oil as dropped from the internal combustion engine body. A part of the bottom 21a of the upper oil pan 21 is adapted to extrude an attachment opening 21b for mounting the lower oil pan 22. The lower oil pan 22 is mounted to choke the attachment opening 21b.

An area, in which the attachment opening 21b of the bot-

tom 21a of the upper oil pan 21 is not formed, is constituted to form a recess 23 as a part of the bottom of the oil pan 2 depressed. In this embodiment, an oil cooler 7 for cooling down the lubricating oil is provided in the bottom (that is, the bottom 21a of the upper oil pan 21) of the recess 23.

[0021] The cylinder block 3 is a member in which a plurality of cylinders are arranged and various kinds of moving parts are housed. A crankshaft 31 is rotatably provided inside the cylinder block 3. Although it is shown by drawings, the crankshaft 31 is connected through a connection rod to a piston to rotate the crankshaft 31 by sliding the piston in an up-and-down direction inside the cylinder.

[0022] In both ends 31a, 31b of the crankshaft 31, an oil pump 8 and the driving sprocket wheel as not shown is attached to one end 31a thereof.

[0023] A cylinder head 4 is a member as constituted mainly by an intake port for supplying this combustion chamber with air, and an outtake port for exhausting an exhaust air from a combustion chamber. The side of the cylinder head 4 is provided with an exhaust manifold 41 for exhausting an exhaust air from the outtake port to the outside. The opposite side of the cylinder head 4 is provided with the intake manifold (as not shown) for intaking air to the intake port.

[0024] The cylinder head cover 5 is provided on the cylinder head 4, and is a member covering a cam holder providing a dynamic valve mechanism including a cam shaft as not shown. The cam shaft is designed to rotably hold the cam holder and one end thereof is provided with a driven sprocket wheel (as not shown).

[0025] A chain casing 6 is a member covering a timing chain wound around the above driving sprocket wheel and the driven sprocket wheel. An oil pump 8 and an oil pump casing 9, which are casing members, covering the oil pump 8 and forming a lubricating oil passage are arranged inside the chain casing 6.

An oil filter 10 for filtering the lubricating oil is arranged at the side of a lower end of the chain casing 6.

[0026] Figure 2 is a perspective view of the oil cooler. Figure 3 is an exploded perspective view showing a state looking up the oil pan and the oil cooler from oblique lower. Figure 4 is a sectional view of the oil pan and the oil cooler taken along a line I - I.

The oil cooler 7 is a cooling device of the lubricating oil by the cooling water being a refrigerant. As shown in Figure 2, the refrigerating device is provided with a plate-like base plate 71, and an approximately rectangular core section 72 arranged at the lower side of the base plate 71. The base plate 71 has a function for a lid of the core section 72 as described in the following. The circumferential edge portion of the base plate 71 is constituted to extend from the side of the core section 72 to constitute a flange section 73 by the extended portion. The flange section 73 is provided with a plurality of bolt holes 73a. As shown in Figure 3, the oil cooler 7 is mounted in the recess 23 of the oil pan 2 by inserting a plurality of bolts

B into a plurality of bolt holes 73a and screwing in the bottom 21a of the upper oil pan 21.

[0027] A pair of communication ports for lubricating oil 74a, 74b are penetratingly formed to enter the lubricating oil in the core section 72 or to supply the lubricating oil from the core section 72 in an inner side of the flange section 73 of the base plate 71. A pair of communication ports for lubricating oil 74a, 74b are respectively arranged in a place corresponding to a pair of corners, which lie in either one of diagonal lines of the core section 72.

A pair of communication ports for cooling water 75a, 75b are penetratingly formed to enter the cooling water in the core section 72 or to supply the cooling water from the core section 72 in an inner side of the flange section 73 of the base plate 71. A pair of the communication ports for cooling water 75a, 75b are respectively arranged in places corresponding to a pair of corners, which lie in the other diagonal line of the core section 72.

The flange section 73 of the base plate 71 is respectively provided with a pair of through holes 76a, 76b penetrating in a surface placed in the side of the oil pan 2 to a surface placed in the side of the core section 72. The through holes 76a, 76b are respectively formed in the proximity of the communication ports for cooling water 75a, 75b.

[0028] The pipes P1, P2 having an approximately L-letter shape constituting the cooling water passage are laid out in the side of the core section 72 of the through holes 76a, 76b formed in the flange section 73. The pipes P1, P2 are, for example, brazed in the frange section 73 of the oil cooler 7. The flange section 73 of the pipes P1, P2 and the opposite end are connected, for example, through a connection hose as not shown to a cooling water passage such as water jacket formed inside the engine 1.

[0029] As shown in Figure 4, the core section 72 is provided with the lubricating oil circulating section 72a flowing the lubricating oil, and the cooling water circulating section 72b flowing the cooling water. The lubricating oil circulating section 72a and the cooling water circulating section 72b are mutually separated by a partition 79. For example, they are alternately cumulated to be a uniform layer in up-and-down direction.

The upstream side of the cooling water circulating section 72b is connected to the communication port for cooling water 75a placed in the intake side, and the downstream side of the cooling water circulating section 72b is connected to the communication port for cooling water 75b in the outtake side.

Although drawings are omitted as well as the above, the upstream side of the lubricating oil circulating section 72a is connected to the communication port for lubricating oil 74a, and the downstream side of the lubricating circulating section 72a is connected to the communication port for lubricating oil 74b in the outtake side.

In this constitution, the heat of lubricating oil circulating the lubricating oil circulating section 72a is transferred to the cooling water circulating in the cooling water circulating section 72b through the partition 79, thus to cool

down the lubricating oil. Naturally, a constitution of the core section 72 is not particularly restricted.

[0030] As shown in Figure 3 and 4, a first concave groove 25a is formed in a surface (lower surface) of the bottom 21a of the upper oil pan 21 and in a place corresponding to the communication port for cooling water 75a and a through hole 76a in the intake side of the oil cooler 7. A second concave groove 25b is formed in a surface (lower surface) of the bottom 21a of the upper oil pan 21 and in a place corresponding to the communication port for cooling water 75b and a through hole 76b in the outtake side of the oil cooler 7. As shown in Figure 4, the first concave groove 25a is connected to the communication port for cooling water 75a in the intake side and the through hole 76a in a state as the oil cooler 7 in the bottom 21a of the upper oil pan 21 attached.

[0031] As above mentioned, as shown in Figure 4, (a part of) cooling water passage is so constituted that the pipe P1, the through hole 76a, the first concave groove 25a, the communication port for cooling water 75a, the cooling water circulating section 72b in the core section 72, the communication port for cooling water 75b, the second concave groove 25b, the through hole 76a, and the pipe P2 are serially connected in order.

[0032] As shown in Figure 3, the openings 26a, 26b of the lubricating oil passages are respectively provided in places corresponding to the communication port for lubricating oil 74a, 74b (c.f. Figure 2) of the oil cooler 7 in the bottom 21a of the upper oil pan 21. In the above, the lubricating oil passage formed inside the engine 1 and the communication ports for lubricating oil 74a, 74b are mutually connected in a state as the oil cooler 7 attached in the bottom 21a of the upper oil pan 21.

[0033] An elliptical and annular sealing grooves 28a, 28b are formed in the surrounding of the first concave groove 25a and the second concave groove 25b. Annular sealing grooves 27a, 27b are formed in the surrounding of the openings 26a, 26b of the lubricating oil passage. These sealing grooves 27a, 27b, 28a, 28b are respectively provided with a sealing member S (c.f. Figure 4) for preventing the lubricating oil or cooling water from leaking.

In addition, the bottom 21a of the upper oil pan 21 is provided with a female screw hole 21c engaging with a bolt B at a place corresponding to a plurality of bolt holes 73a formed in the flange section 73 of the oil cooler 7.

[0034] Figure 5 is a perspective view showing a state looking down the bottom of the oil pan and the side wall of the chain casing from oblique upper. Figure 6 is a sectional view taken along a line II - II in Figure 6.

As shown in Figure 5 and 6, an oil pump casing 9 is arranged in a surface placed in the side of the cylinder block 3 of the side wall 63 of the chain casing 6. The oil pump casing 9 is provided with an insert hole 93a for inserting one end 31a of the crankshaft 31 as the oil pump 8 attached.

A circulating section for oil pump 94 being a lubricating oil passage used also for an installment space of the oil

pump 8 in a place between the side wall 63 and the oil pump casing 9 (c.f. Figure 1) in the surrounding of the insert hole 93a is formed. A circulating section for oil filter 95 being a lubricating oil passage communicating the inside of the oil pan 2 and an intake port of the oil filter 10 in a place between the side wall 63 and the oil pump casing 9 is formed. A circulating section for main gallery 97 being a lubricating oil passage communicating an outtake port of the oil filter 10 and the main gallery 36 in a place between the side wall 63 and the oil pump casing 9 is formed.

[0035] In this constitution, the main gallery 36 is a part of the lubricating oil passage formed inside the cylinder block 3, and connected to be able to supply each of lubricating oil sections such as the bearing cap and oil jet provided inside the cylinder block 3 with the lubricating oil. Although drawings are omitted, the main gallery 36 is designed to supply a sliding section (lubricating section) of cam shaft through the oil passage formed in the cylinder head 4 with the lubricating oil.

[0036] In addition, the oil pump casing 9 is provided with a relief valve passage 98 connecting an intake port 94a and an outtake port 94b of the circulating portion for oil pump 94 to arrange a relief valve (as not shown) inside the relief valve passage 98.

[0037] A suction pipe 22a for sucking the lubricating oil reserved in the lower oil pan 22 is provided inside the oil pan 2. One end of the suction pipe 22a is connected to an oil strainer as not shown, and the other end of the suction pipe 22a is connected to the intake port 94a of the circulating section for oil pump 94.

[0038] As shown in Figure 5 and 6, a first oil pan-integrated lubricating oil passage 211 connecting the outlet port 94b of the circulating section for oil pump 94 and the communication port for lubricating oil 74a placed in the intake side of the oil cooler 7 is integrally formed with the upper oil pan 21 on an upper surface of the bottom 21a of the upper oil pan 21 as the oil cooler 7 attached. The oil pan-integrated 211 represents an external form swelling up an upper surface of the bottom 21a of the upper oil pan 21 in a semicylindrical shape.

A second oil pan-integrated lubricating oil passage section 212 connecting the communication port for lubricating oil 74b placed in the outtake side of the oil cooler 7 and the intake port 95a of the circulating section for oil filter 95 is integrally formed with the upper oil pan 21. In addition, as the second oil pan-integrated lubricating oil passage section 212 represents approximately the same constitution as the first oil pan-integrated lubricating oil passage section 211, its drawings are omitted.

[0039] Thus, as shown in Figure 5, (a part of) the lubricating oil passage is so constituted that the suction pipe 22a, the circulating section for oil pump 94, the first oil pan-integrated lubricating oil passage section 211, the communication port for lubricating oil 74a, the lubricating oil circulating section 72a inside the core section 72, the communication port for lubricating oil 74b, the second oil pan-integrated lubricating oil passage section 212, the

circulating section for oil filter 95, the oil filter 10, and the circulating section for main gallery 97 are communicated in the above order.

[0040] The first oil pan-integrated lubricating oil passage section 211 and the second oil pan-integrated lubricating oil passage section 212 are, for example, formed to be parallel to an axial direction of the crankshaft 31.

The first oil pan-integrated lubricating oil passage section 211 and the second oil pan-integrated lubricating oil passage section 212 are integrally manufactured with the upper oil pan 21 by disposing a core in a hollow portion at the time of casting the upper oil pan 21.

As shown in Figure 6 and 4, the first oil pan-integrated lubricating oil passage section 211 is formed like straddling the second concave groove 25b.

[0041] Although the fluidic channel structure of internal combustion engine relating to this embodiment is fundamentally constituted by the above, operations as well as functions and effects of oil passage structure of internal combustion engine relating to this embodiment will be described with reference to Figure 1 to 6.

[0042] As shown in Figure 4, cooling water supplied from a radiator, as not shown, is designed to flow through the pipe P1, the through hole 76a, the first concave groove 25a, and the communication port for cooling water 75a, and enter the cooling water circulating section 72b of the core section 72. After the cooling water entering the cooling water circulating section 72b rises in temperature by absorbing heat from the lubricating oil circulating the lubricating oil circulating section 72a, it flows through the communication port for cooling water 75b, the second concave groove 25b, the through hole 76b and the pipe P2, and then returns to the radiator.

[0043] On the other hand, as shown in Figure 5, the lubricating oil reserved in the oil pan 2 is sucked through the suction pipe 22a by driving the oil pump 8. As shown in Figure 6, the lubricating oil sucked in the suction pipe 22a flows through the oil pump circulating section 94, the first oil pan-integrated lubricating oil passage section 211, and the communication port for lubricating oil 74a, and enters the lubricating oil circulating section 72a of the core section 72.

After the lubricating oil entered in the lubricating oil circulating section 72a of the core section 72 is cooled down owing to the heat absorbed by cooling water circulating through the cooling water circulating section 72b, it flows through the communication port for lubricating oil 74b, the second oil pan-integrated lubricating oil passage section 212 and the circulating section for oil filter 95, and enters the oil filter 10. The lubricating oil filtering impurities at the oil filter 10 is supplied by pressure through the circulating section for main gallery 97 to the main gallery 36.

The lubricating oil supplied by pressure to the main gallery 36 is supplied to each of lubricating portions of the engine 1 and relieves the friction at each of the lubricating portions. The lubricating oil supplied to the lubricating

portion returns through channels such as channels for drainage as not shown to the oil pan 2.

[0044] In the engine 1 having the fluidic channel structure of such internal combustion engine, the pipes P1, P2 are connected to the flange section 73 of the oil cooler 7. Then, the cooling water are intaken and outtaken from the pipes P1, P2 through the first concave groove 25a and the second concave groove 25b formed on a surface of the bottom 21a of the upper oil pan 21 to the core section 72 of the oil cooler 7.

As the pipes P1, P2 for cooling water are arranged in a dead space positioned in the surrounding of the flange section 73 of the oil cooler 7, they can avoid interfering with pipings, accessories, frames, or the like placed in the surrounding of the engine 1, and the improvement of degrees of freedom in layout and the small-size scaling of internal combustion engine can be obtained.

[0045] The cooling water passage can be realized in a simple constitution by that the first concave groove 25a and the second concave groove 25b are formed in a surface of the bottom 21a of the upper oil pan 21 and the flange section 73 of the oil cooler 7 is provided with the through holes 76a, 76b. Thus, in comparison with the case where both the cooling water passage leading to the oil cooler 7 and the lubricating oil passage are formed inside the engine 1, it is formed in a simple constitution and a large-size scaling of the engine 1 and an increase of manufacturing cost can be effectively restricted.

As it is very few required to machine the core section 72, it is not required to manufacture a specific core section 72 and the material costs can be effectively restricted to be lower.

[0046] As the oil cooler 7 is arranged in the recess 23 formed in the oil pan 2, it is easy to attach and detach the oil cooler 7 from the engine 1 and improve the maintenance in addition to the above functions and effects. As the other parts are very few arranged in the lower portion of the oil pan 2, the oil cooler 7 never interferes with the other parts, and it is easy to increase a volume of the oil cooler 7.

It is possible to lay out such that the pipes P1, P2 of the oil cooler 7 does not extrude below the bottom of the lower oil pan 22, and it is possible to provide a compact engine 1.

[0047] The first oil pan-integrated lubricating oil passage section 211 and the second oil pan-integrated lubricating oil passage section 212 are formed to cross a surface (upper surface) of the bottom 21a of the upper oil pan 21 being an attachment surface of the oil cooler 7. Thus, the bottom 21a of the upper oil pan 21 can be effectively reinforced.

[0048] As above mentioned, although an embodiment of the present invention has been described in detail with reference to the drawings, the present invention is not limited thereto and it can be appropriately modified or changed without departing from an essence or gist of the present invention.

[0049] In this embodiment, for example, although the

cooling water is adapted to flow through the through holes 76a, 76b formed in the flange section 73 and the first concave groove 25a and the second concave groove 25b formed in the bottom of the oil pan 2 to the oil cooler 7, and to flow the lubricating oil from the lubricating oil passage provided in the oil pan 2 to the oil cooler 7, the present invention is not limited thereto. It may be adapted to flow the lubricating oil to the through hole 76a formed in the flange section 73, the first concave groove 25a and the second concave groove 25b formed in the bottom of the oil pan 2. It may be also adapted to flow the cooling water from the cooling water passage provided in the oil pan 2 to the oil cooler 7.

In this constitution, as the fluid flowing from the outside of the engine 1 to the oil cooler 7 may be appropriately modified according to a constitution of the cooling water passage and the lubricating oil passage, properties and variations of the layout can be improved.

[0050] As shown in Figure 5, although the lubricating oil passage is adapted to be formed between the chain casing 6 and the oil pump casing 9 in this embodiment, the present invention is not limited thereto, and the lubricating oil passage may be provided only by the oil pump casing 9.

[0051] Although this embodiment has been described by giving an example of an automotive engine 1, the fluidic channel structure of internal combustion engine can be, of course, applied to an internal combustion engine other than an automotive vehicle.

This invention provides a fluidic channel structure of internal combustion engine enabling an oil cooler to be smaller in size without a complicated fluidic channel structure placed inside the internal combustion engine body. This is a fluidic channel structure including an oil cooler (7), a lubricating oil passage, and a cooling water passage. The oil cooler (7) has a core section (72) exchanging heat and a flange section (73) extending in the surrounding of the core section (72). The core section (72) is provided with a pair of communication port for lubricating oil (74a), (74b), the flange section (73) is provided with a pair of through holes (76a), (76b), the pipes (P1), (P2) are laid out in a pair of through holes (76a), (76b), and the first concave groove (25a) and the second concave groove (25b) connecting respectively to a pair of communication port for cooling water and a pair of through holes (76a), (76b) are formed in a surface of the bottom (21a) of the oil pan (2) attaching the oil cooler (7).

Claims

1. A fluidic Channel Structure of Internal Combustion Engine having
an oil pan provided in a lower portion of an internal combustion engine body and reserving a lubricating oil,
an oil pump supplying each lubricating portion of the internal combustion engine body with the lubricating

oil sucked from the oil pan,
an oil cooler attached to the internal combustion engine body and cooling down the lubricating oil,
a lubricating oil passage circulating the lubricating oil by connecting the oil pan, the oil pump, the oil cooler, and the each lubricating portion in series, and a refrigerating passage supplying the oil cooler with refrigerant, wherein

the oil cooler comprises a core section exchanging heat between a lubricating oil circulating section of the lubricating oil and a refrigerant circulating section of the refrigerant, and a flange section extending from an end of an attachment side of the internal combustion engine body of the core section to an ambient environment,

and wherein

the internal combustion engine body forms a communication port for lubricating oil communicating the lubricating oil circulating section and the lubricating oil passage and, a communication port for refrigerant communicating the refrigerant circulating section and the refrigerant passage in the attachment side thereof, and the flange section forms a through hole penetrating from a surface of the attachment side of the internal combustion engine body to a surface placed in the side of the core section,

and wherein

the through hole is so designed that either of the refrigerant passage and the lubricating oil passage is laid out, and

a concave groove connecting either of the communication port for refrigerant and the communication port for lubricating oil and the through hole is formed in a surface of the internal combustion engine body attaching the oil cooler.

2. The Fluidic Channel Structure of Internal Combustion Engine according to Claim 1,
wherein

a recess as a part of the bottom depressed is formed in the bottom of the oil pan, and
the recess is provided with the concave groove and the oil cooler is arranged through the flange section.

3. The Fluidic Channel Structure of Internal Combustion Engine according to Claim 1 or 2,
wherein

the oil pan is constituted by an upper oil pan and a lower oil pan arranged below the upper oil pan, and the oil cooler is a bottom of the upper oil pan to be arranged in an area as the lower oil pan not arranged.

4. The Fluidic Channel Structure of Internal Combustion Engine according to Claim 2 or 3,
wherein

the refrigerant passage is laid out from a surface placed in the side of the core section in the through hole,

the concave groove is constituted to connect the communication port for refrigerant and the through hole,

the communication port for lubricating oil is connected to an oil pan-integrated lubricating oil passage as integrally formed inside the oil pan, and

the oil pan-integrated lubricating oil passage is connected to the oil pump provided inside the casing material arranged in one end of the oil pan, and a communication port for lubricating oil.

5

10

15

20

25

30

35

40

45

50

55

FIG.1

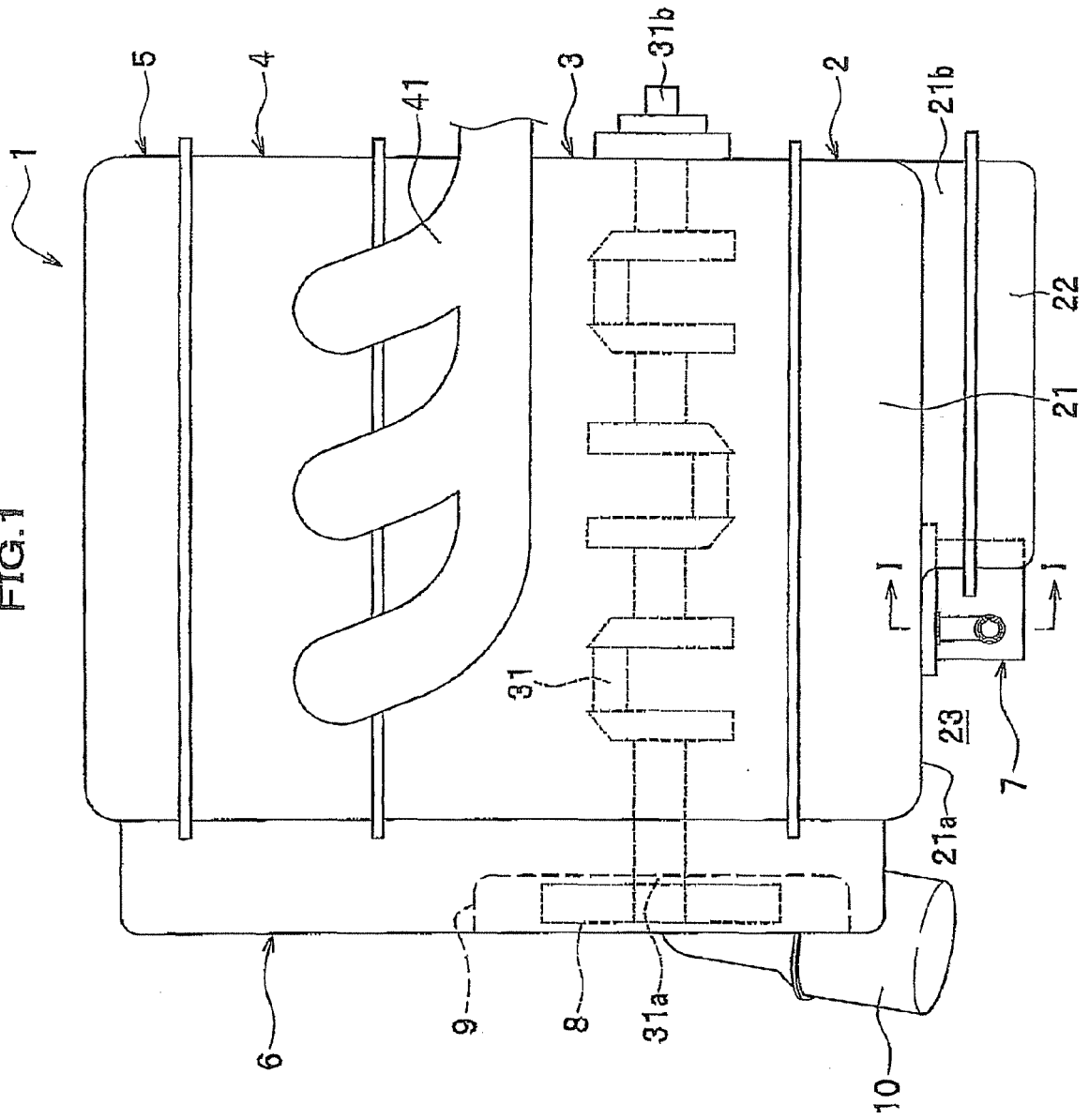


FIG.3

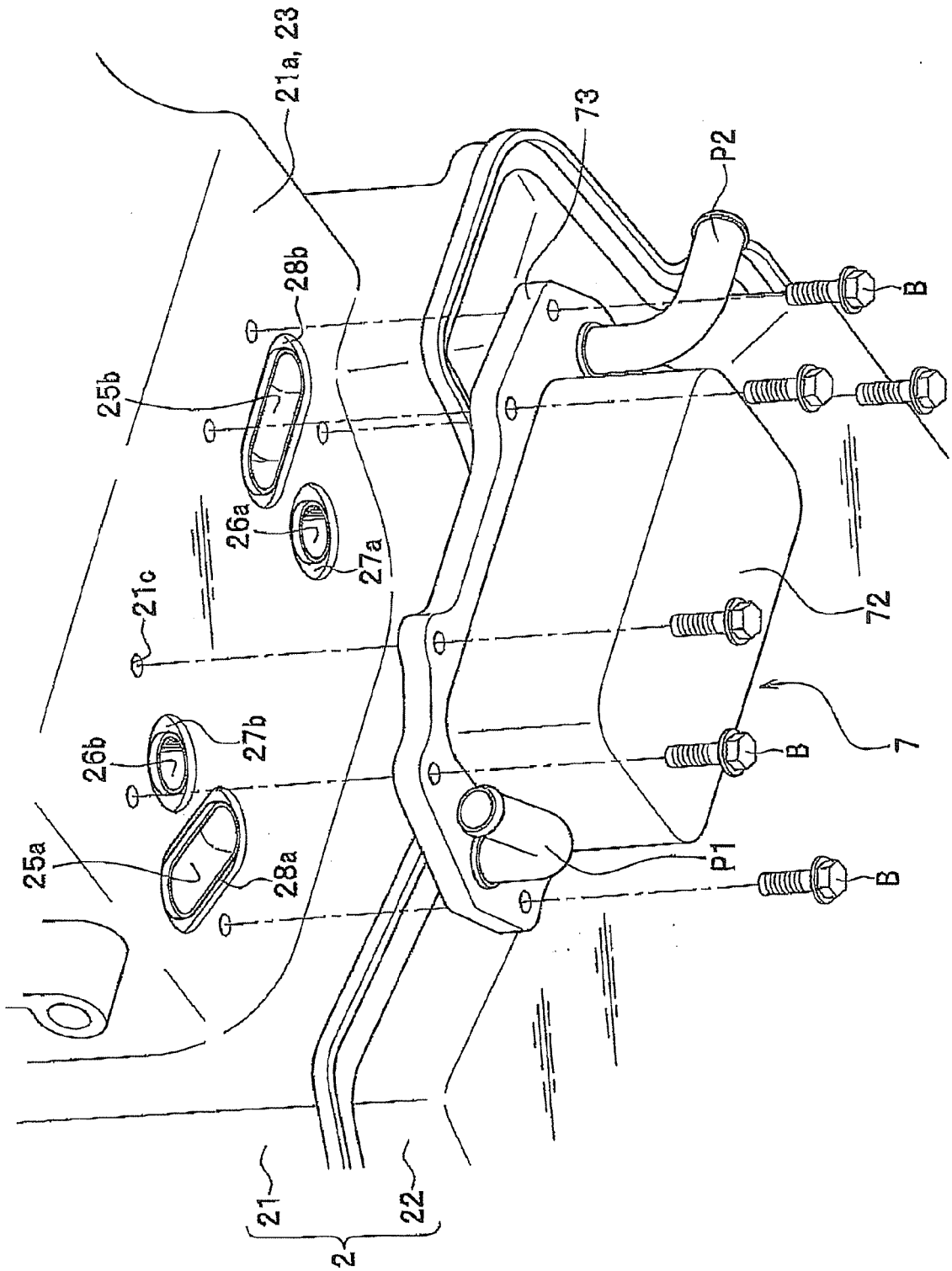


FIG.4

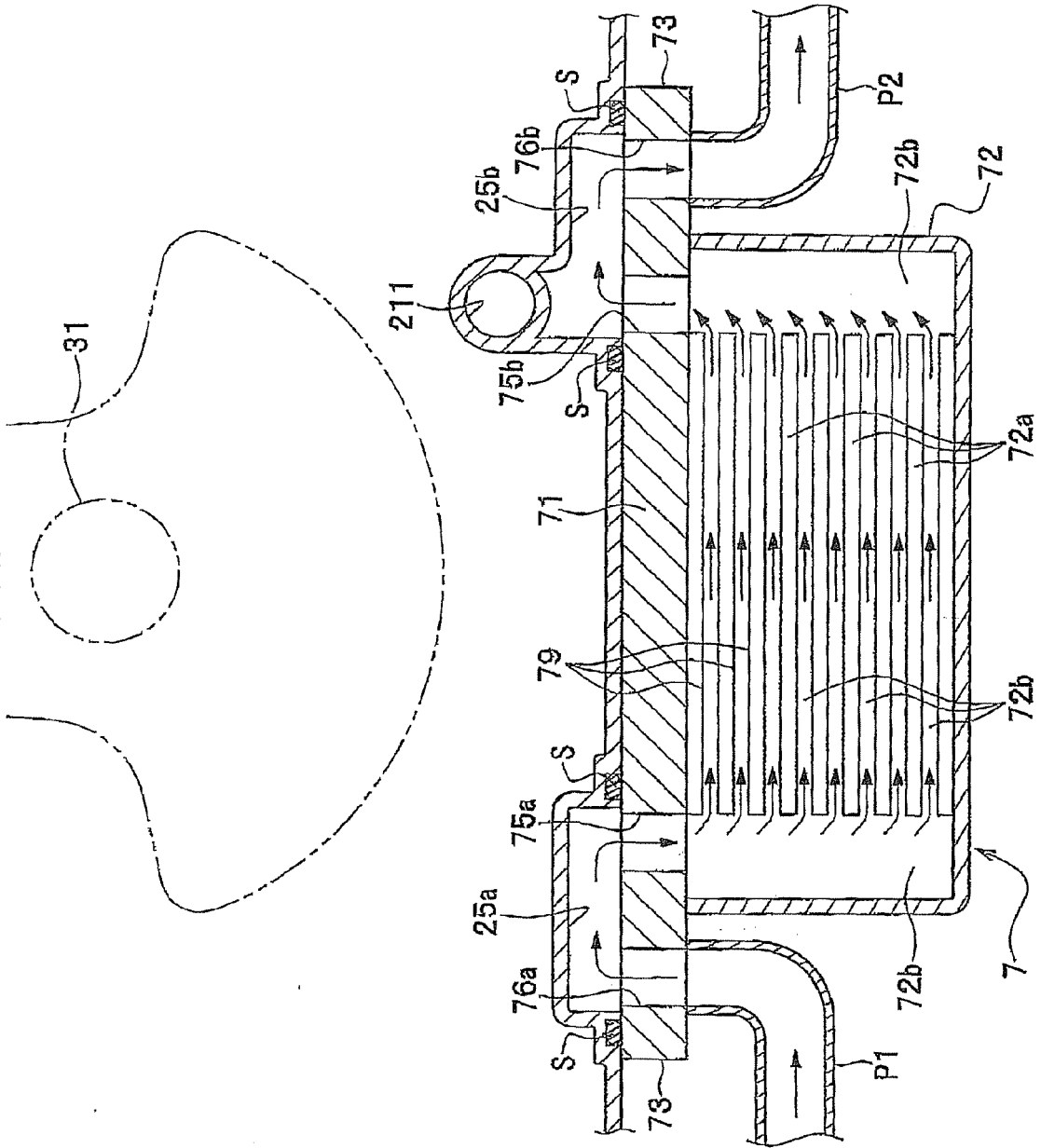


FIG.5

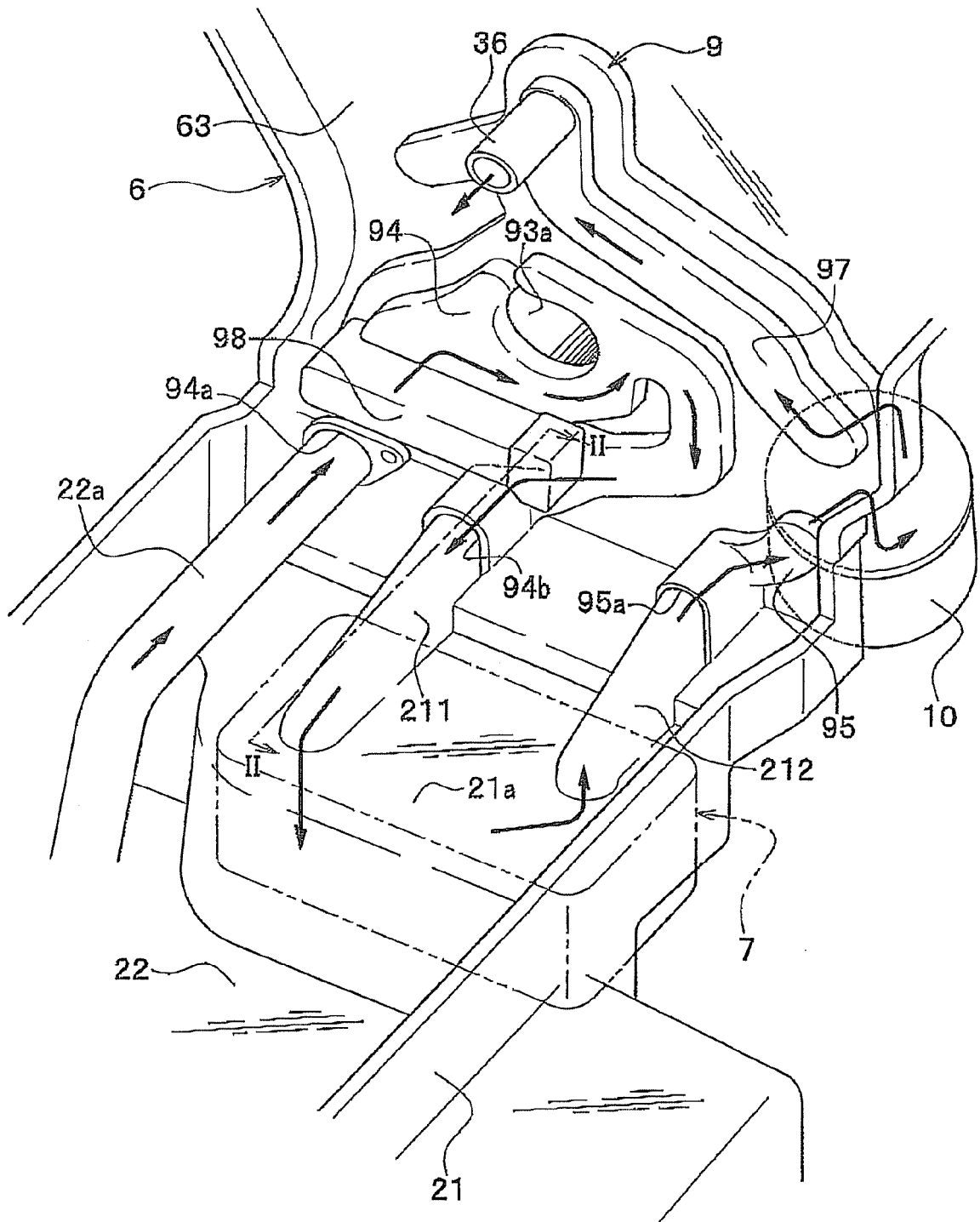
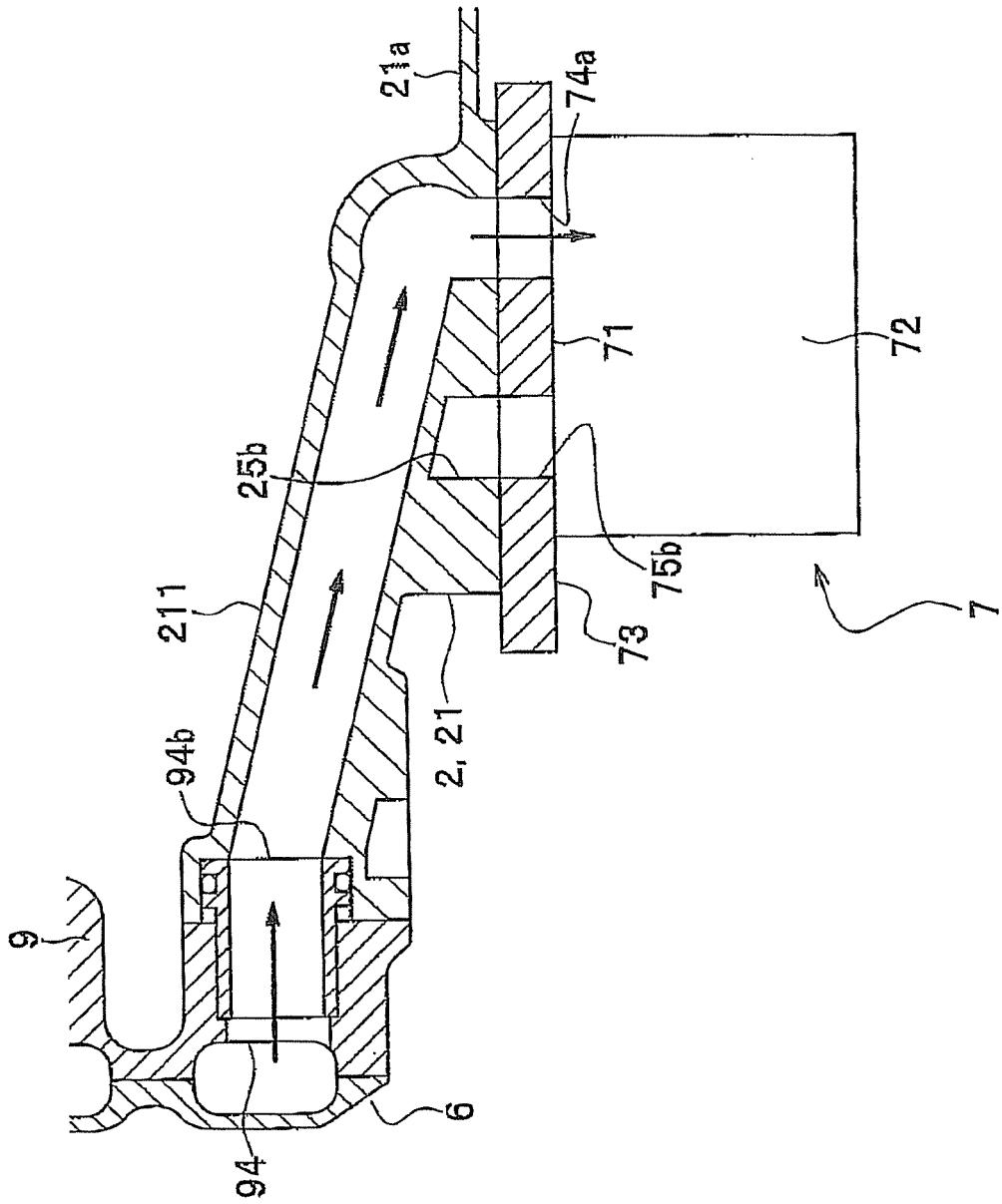


FIG. 6





EUROPEAN SEARCH REPORT

Application Number
EP 10 16 3053

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP 2 043406 U (-) 26 March 1990 (1990-03-26) * figures 2,4 *	1	INV. F01M5/00 F28D9/00 F01P11/08
X	----- JP 55 067303 U (-) 9 May 1980 (1980-05-09) * figures 1-3 *	1	
A	----- JP 2004 346916 A (TOYOTA IND CORP) 9 December 2004 (2004-12-09) * abstract; figure 1 *	1	
A	----- US 5 165 468 A (TAJIMA MAKOTO [JP] ET AL) 24 November 1992 (1992-11-24) * figures 1-2 *	1	
A	----- US 5 934 241 A (VON ESEBECK GOETZ FREIHERR [DE] ET AL) 10 August 1999 (1999-08-10) * figures 5,7 *	1	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			F01M F28D F01P
Place of search		Date of completion of the search	Examiner
The Hague		12 August 2010	Flamme, Emmanuel
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		& : member of the same patent family, corresponding document	

2

EPO FORM 1503 03.82 (P04C01)

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

EP 10 16 3053

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

12-08-2010

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
JP 2043406	U	26-03-1990	NONE	
JP 55067303	U	09-05-1980	JP 57035603 Y2	06-08-1982
JP 2004346916	A	09-12-2004	NONE	
US 5165468	A	24-11-1992	DE 4125079 A1	13-02-1992
			JP 2521328 Y2	25-12-1996
			JP 4041972 U	09-04-1992
US 5934241	A	10-08-1999	DE 19619977 A1	04-12-1997
			EP 0807748 A1	19-11-1997

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- WO 144977 A [0002]
- WO 077925 A [0003]