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(71) Applicants: **TOYOTA JIDOSHA KABUSHIKI KAISHA** [JP/JP]; 1, Toyota-cho, Toyota-shi, Aichi-ken, 471-8571 (JP). **DENSO CORPORATION** [JP/JP]; 1-1, Showa-cho, Kariya-city, Aichi-pref, 448-8661 (JP).

(72) Inventors: **NAGATOSHI Takaharu**; c/o Toyota Jidosha Kabushiki Kaisha, of 1, Toyota-cho, Toyota-shi, Aichi-ken, 471-8571 (JP). **HAYAKAWA Tomoya**; c/o Toyota Jidosha Kabushiki Kaisha, of 1, Toyota-cho, Toyota-shi, Aichi-ken, 471-8571 (JP). **HAMADA Masaru**; c/o Toyota Jidosha Kabushiki Kaisha, of 1, Toyota-cho, Toyota-shi, Aichi-ken, 471-8571 (JP). **MINAMIGAWA Masataka**; c/o Denso Corporation, 1-1, Showa-cho, Kariya-city, Aichi-pref, 448-8661 (JP). **SUEMATSU Junichi**; c/o Denso Corporation, 1-1, Showa-cho, Kariya-city, Aichi-pref, 448-8661 (JP). **SHIBATA Masashi**; c/o Denso Corporation, 1-1, Showa-cho, Kariya-city, Aichi-pref, 448-8661 (JP).

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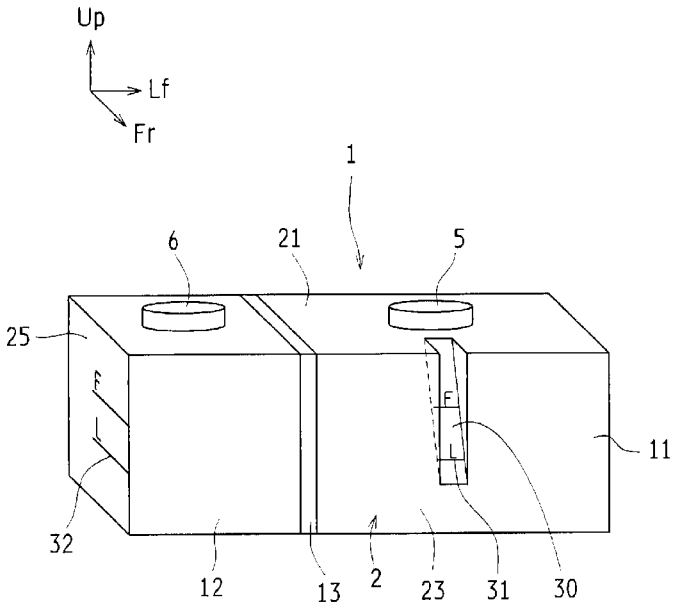
(54) Title: RESERVE TANK

FIG. 8



(57) Abstract: A reserve tank where coolant is stored includes a tank body portion having an upper surface a plurality of side surfaces. The tank body portion has a retracted surface provided in a part of one of the side surfaces, the retracted surface being positioned inward of the one of the side surfaces in the tank body portion. The retracted surface is provided so as to be continuous with the upper surface. A scale for checking a liquid quantity is provided on the retracted surface.

[Continued on next page]

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RESERVE TANK

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The invention relates to a reserve tank mounted on a vehicle.

2. Description of Related Art

[0002] It is known that a reserve tank is provided in a cooling system (circuit) in a vehicle on which a water cooled engine or the like is mounted. The reserve tank is provided in order to maintain a constant amount of coolant that circulates in the cooling system by absorbing a volume expansion of the coolant due to a temperature increase, and also to remove residual air unavoidably contained in the coolant (gas-liquid separation).

[0003] Also, the reserve tank has a function of facilitating inspection and management of the amount of the coolant circulating in the cooling system, in addition to the above-mentioned functions of maintaining the amount of the coolant constant and gas-liquid separation. More specifically, on a side surface of the reserve tank, a scale for checking a liquid quantity (hereinafter, also referred to as an F - L line) is provided together with letters "Full" and "Low" that represent the upper limit and the lower limit of the amount of the coolant, respectively (see FIG. 1 of Japanese Unexamined Patent Application Publication No. 2014-40802 (JP 2014-40802 A)). By comparing a liquid level of the coolant that can be seen through the semitransparent reserve tank to the F - L line, the amount of the coolant is inspected and managed easily.

SUMMARY OF THE INVENTION

[0004] Normally, the reserve tank is disposed inside an engine compartment. However, depending on a disposed position of the reserve tank inside the engine compartment and a positional relationship between the reserve tank and other onboard equipment, an obstacle (a vehicle body member, other onboard equipment, and so on) is

located adjacent to the side surface of the reserve tank where the F - L line is provided. Therefore, it can be hard to visually recognize the F – L line.

[0005] In addition to this, recently, due to an increase in downsized and turbocharged engine, a vehicle in which an air-to-water intercooler is mounted is on the rise. When two reserve tanks respectively for cooling an engine and for cooling an intercooler are disposed in an engine compartment, problems like inhibition of effective utilization of space and cost increase happen.

[0006] Thus, a reserve tank in which a tank portion for cooling an engine and a tank portion for cooling an intercooler are integrated may be employed. Also, an F - L line for engine cooling water may be provided on a side surface of the reserve tank corresponding to the tank portion for cooling an engine, and an F - L line for intercooler cooling water may be provided on a side surface of the reserve tank corresponding to the tank portion for cooling an intercooler. However, within the limited space inside the engine compartment, it is difficult to dispose the reserve tank so that both of the two side surfaces with the F - L lines are well visible.

[0007] The invention provides a reserve tank mounted on a vehicle, the reserve tank enabling to improve visibility of a scale for checking a liquid quantity provided on the reserve tank regardless of a disposed position of the reserve tank and a positional relationship with other onboard equipment.

[0008] In the reserve tank according to the invention, the scale for checking a liquid quantity is provided in a form that makes the scale visually recognized from above where visibility is good, regardless of a disposed position of the reserve tank and a positional relationship between the reserve tank and other onboard equipment.

[0009] The reserve tank according to the aspect of the invention stores coolant and includes a tank body portion having an upper surface and a plurality of side surfaces.

[0010] The tank body portion has a retracted surface provided in a part of one of the side surfaces, the retracted surface being positioned inward of the one of the side surfaces in the tank body portion. The retracted surface is provided so as to be continuous with the upper surface. The scale for checking a liquid quantity is provided

on the retracted surface.

[0011] With the configuration, the retracted surface is formed in the one of the side surfaces so as to be continuous with the upper surface by retracing a part of the one of the side surfaces to an inner side of the tank body portion, in other words, so that the part of the one of the side surfaces is separate from an obstacle. Therefore, even if the obstacle is adjacent to the one of the side surfaces of the reserve tank, the retracted surface is visually recognized easily from above or diagonally above the reserve tank where visibility is good. Because the scale for checking a liquid quantity is provided on the retracted surface, inspection and management of an amount of the coolant are done easily regardless of a disposed position of the reserve tank and a positional relationship between the reserve tank and other onboard equipment.

[0012] In the invention, "the retracted surface provided in a part of one of the side surfaces, the retracted surface and positioned inward of the one of the side surfaces in the tank body portion" may be, for example, a back surface of a recessed portion that is formed in the one of the side surfaces and is recessed to the inner side of the tank body portion. Alternatively, the retracted surface may be made by retracting an entire upper portion of the one of the side surfaces (may be provided in the upper portion of the one of the side surfaces throughout the entire width) to the inner side of the tank body portion. Also, the retracted surface may be made by retracing an upper corner portion of the one of the side surfaces to the inner side of the tank body portion.

[0013] When the retracted surface is formed perpendicularly (as a vertical surface), it is difficult to visually recognize the scale for checking a liquid quantity from directly above the reserve tank. Therefore, in order to address this, the retracted surface can be retracted more greatly. However, when the retracted surface is retracted more greatly, there is a problem that a volume of the reserve tank is reduced.

[0014] Thus, in the above aspect, the retracted surface may be inclined to the inner side of the tank body portion towards an upward direction. Further, the retracted surface may be provided so as to be continuous with the upper surface and the one of the side surfaces.

[0015] With the configuration, the scale for checking a liquid quantity is provided on the inclined surface continuous with the upper surface and the one of the side surfaces. In other words, the scale for checking a liquid quantity is provided in the retracted surface that is formed to be visible from both a front side and above. Therefore, the scale for checking a liquid quantity is visually recognized easily from directly above the reserve tank without retracting the retracted surface greatly.

[0016] Also in this case, the recessed portion recessed to the inner side of the tank body portion may be formed in the one of the side surfaces, and the inclined surface may be the back surface of the recessed portion. Alternatively, the inclined surface may be made by retracting the upper corner portion of the one of the side surfaces so that the upper corner portion is inclined to the inner side of the tank body portion towards the upward direction.

[0017] When the reserve tank is disposed inside an engine compartment, it is common to employ a layout in which no obstacle is adjacent to the side surface where an F - L line (the scale for checking a liquid quantity) is formed. However, when the reserve tank includes tank portions for two cooling systems that are located adjacent to and integrated with each other, it is difficult to dispose the reserve tank without any obstacle being adjacent to two side surfaces where the F - L lines are formed, respectably, in a limited space inside the engine compartment.

[0018] Therefore, in the foregoing aspect, the tank body portion may include a first tank portion that stores coolant for a first cooling system, and a second tank portion that is adjacent to and integrated with the first tank portion and stores coolant for a second cooling system. The retracted surface may be provided in a portion of a first side surface among the side surfaces. The portion corresponds to the first tank portion, and the first side surface surrounds the first tank portion and the second tank portion. The scale for checking a liquid quantity may be provided in a second side surface that surrounds only the second tank portion.

[0019] With the configuration, as long as a layout is employed where no obstacle is adjacent to the second side surface that surrounds only the second tank portion, the scale

for checking a liquid quantity provided on the second side surface is visually recognized easily. Thus, an amount of coolant for the second cooling system is inspected and managed easily.

[0020] Meanwhile, even when a layout is employed where an obstacle is adjacent to the first side surface surrounding the first tank portion and the second tank portion that is adjacent to and integrated with the first tank portion, the retracted surface is formed in the portion of the first side surface, the portion corresponding to the first tank portion. Therefore, the retracted surface is visually recognized easily from above and so on of the reserve tank, and an amount of coolant for the first cooling system is inspected and managed easily.

[0021] In addition, when the tank portions for the two cooling systems are adjacent to and integrated with each other, it is normal that the side surface (the first side surface) that surrounds the two tank portions (extends over the two tank portions) has a larger area than that of the side surface (the second side surface) that surrounds each of the tank portions. However, with the configuration, an obstacle may be adjacent to the first side surface having a relatively large area. Therefore, flexibility of the layout inside the engine compartment is improved.

[0022] In the foregoing aspect, the retracted surface may be provided in one of the side surfaces, the surface facing an outer side of the engine compartment when the tank body portion is disposed inside the engine compartment.

[0023] With the configuration, the retracted surface is formed in the side surface facing the outer side of the engine compartment when the tank body portion is disposed inside the engine compartment. Thus, an operator who injects coolant from the outer side of the engine compartment is easily able to visually recognize the scale for checking a liquid quantity provided on the retracted surface.

[0024] As described so far, with the reserve tank according to the invention, visibility of the scale for checking a liquid quantity provided on the reserve tank is improved regardless of a disposed position of the reserve tank and a positional relationship between the reserve tank and other onboard equipment.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] 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 perspective view of a reserve tank according to an embodiment of the invention;

FIG. 2 is a schematic perspective view of the reserve tank mounted on an engine radiator;

FIG. 3 is a schematic view of a layout of the reserve tank inside an engine compartment;

FIG. 4 is a schematic front view of the reserve tank;

FIG. 5 is a schematic plan view of the reserve tank;

FIG. 6 is a sectional view taken along the arrows VI – VI in FIG. 5;

FIG. 7 is a schematic front view of the engine radiator;

FIG. 8 is a simplified perspective view of the reserve tank;

FIG. 9 is a schematic plan view of the reserve tank mounted on the engine radiator;

FIG. 10 is a schematic side view of the reserve tank mounted on the engine radiator;

FIG. 11 is a schematic view of a layout of a reserve tank inside an engine compartment according to another embodiment;

FIG. 12 is a schematic view of a layout of a reserve tank inside an engine compartment according to yet another embodiment;

FIG. 13 is a simplified perspective view of a reserve tank according to yet another embodiment;

FIG. 14 is a simplified perspective view of a reserve tank according to yet another embodiment; and

FIG. 15 is a simplified perspective view of a reserve tank according to yet another embodiment.

DETAILED DESCRIPTION OF EMBODIMENTS

[0026] Hereinafter, modes for carrying out the invention are described based on the drawings. In the drawings, an arrow Up represents an upward direction, an arrow Fr represents a front side (a front side in a vehicle front-rear direction), an arrow Rh represents a right side (a right side in a vehicle width direction), and an arrow Lf represents a left side (a left side in the vehicle width direction).

Reserve Tank

[0027] FIG. 1 is a schematic perspective view of a reserve tank 1 according to an embodiment. FIG. 2 is a schematic perspective view of the reserve tank 1 mounted on an engine radiator 41. FIG. 3 is a schematic view of a layout of the reserve tank 1 inside an engine compartment 50. In FIG. 3, for better visibility, equipment provided in front of the engine radiator 41 inside the engine compartment 50 (for example, a capacitor, intercooler radiator, and so on) is not shown.

[0028] The reserve tank 1 is mounted on a vehicle that includes an engine 40 downsized and turbocharged by using a supercharger (not shown). The reserve tank 1 is mounted on the engine radiator 41 as shown in FIG. 2, and is disposed at the front side in the engine compartment 50 as shown in FIG. 3. In the following description, front-rear, upper-lower, and right-left directions are defined based on a position of the reserve tank 1 mounted on a vehicle, unless otherwise specified. For example, an upper surface 21 is a surface facing upward in a state where the reserve tank 1 is mounted on a vehicle. Also, a front side surface 23 is a surface facing frontward in the state where the reserve tank 1 is mounted on a vehicle.

[0029] The reserve tank 1 is made of transparent or semitransparent resin such as acrylic resin or polycarbonate resin. As shown in FIG. 1, the reserve tank 1 includes a tank body portion 2 that stores engine cooling water (coolant), first and second tank caps 5, 6, and first to third mounting portions 7, 8, 9. The first and second tank caps 5, 6 are detachably mounted on first and second cooling water injection portions 14, 15, respectively, that are formed in the tank body portion 2 so that the tank caps 5, 6 pressurize and seal the first and second cooling water injection portions 14, 15. The first to third

mounting portions 7, 8, 9 are provided in order to mount the tank body portion 2 on the engine radiator 41.

[0030] FIG. 4 is a schematic front view of the reserve tank 1, FIG. 5 is a schematic plan view of the reserve tank 1, and FIG. 6 is a sectional view taken along the arrows VI - VI in FIG. 5. The tank body portion 2 has a two-piece structure, and is formed into a three-dimensional shape with space inside by connecting a front member 3 and a rear member 4 in the front-rear direction.

[0031] As shown in FIG. 1, FIG. 4, and FIG. 5, the tank body portion 2 is formed into a polyhedral shape that includes the upper surface 21, a lower surface 22, the front side surface 23 extending downwardly from a front end portion of the upper surface 21, a rear side surface 24 extending downwardly from a rear end portion of the upper surface 21, a first right side surface 25 extending downwardly from a right end portion of the upper surface 21, a second right side surface 26 retracting to the left side from a lower end portion of the first right side surface 25 and extending downwardly, a first left side surface 27 extending downwardly from a left end portion of the upper surface 21, and a second left side surface 28 that is curved downwardly to the right side from a lower end portion of the first left side surface 27.

[0032] In a vehicle according to the embodiment where the downsized and turbocharged engine 40 is provided, an air-to-water intercooler (not shown) is mounted. The air-to-water intercooler is used to reduce temperature of supercharged high-temperature suction air so that charging efficiency of air to be introduced into a cylinder is improved during a high-load operation. Since temperature of the engine cooling water and temperature of intercooler cooling water are different, reserve tanks for the two cooling systems for cooling the engine and the intercooler, respectively, are required. However, the reserve tank 1 employed in the embodiment has tank portions 11, 12 for the two cooling systems for cooling the engine and the intercooler, respectively, and the tank portions 11, 12 are placed adjacent to and integrated with each other in order to achieve effective utilization of space inside the engine compartment 50 and cost reduction.

[0033] Specifically, as shown in FIG. 6, the tank body portion 2 includes the first

tank portion 11 on the left side, the second tank portion 12 on the right side, and an inner wall portion 13. The first tank portion 11 stores the engine cooling water (coolant for a first cooling system). The second tank portion 12 stores the intercooler cooling water (coolant for a second cooling system) and is adjacent to the first tank portion 11 in the vehicle width direction and integrated with the first tank portion 11. The inner wall portion 13 divides the first tank portion 11 and the second tank portion 12 from each other. As shown in FIG. 6, a number of ribs 16, 17 are provided inside the first tank portion 11 and the second tank portion 12, and thus pluralities of internal spaces 11a, 12a are formed inside the first tank portion 11 and the second tank portion 12, respectively. At the same time, the reserve tank 1 is given rigidity. The internal spaces 11a formed inside the first tank portion 11 communicate with each other through communication holes (not shown), and the engine cooling water passes through the internal spaces 11a sequentially. Similarly, the internal spaces 12a formed inside the second tank portion 12 communicate with each other through communication holes (not shown), and the intercooler cooling water passes through the internal spaces 12a sequentially.

[0034] The first tank portion 11 is surrounded by a left portion of the upper surface 21 (a portion located on the left side with respect to the inner wall portion 13 in the vehicle width direction), a left portion of the lower surface 22, a left portion of the front side surface 23, a left portion of the rear side surface 24, the first left side surface 27, and the second left side surface 28 (to be more precise, by wall portions that configure the above-mentioned surfaces, respectively). The engine cooling water is first supplied to the engine 40, and then divided into flows to the engine radiator 41 and the reserve tank 1. The engine cooling water that is divided and flows into the reserve tank 1 enters the first tank portion 11 from a first inflow portion (not shown) formed in the left portion of the rear side surface 24, passes through internal spaces 11a divided by the ribs 16, and flows out from an first outflow portion 11b formed in the left portion of the lower surface 22. Then, after the engine cooling water joins the engine cooling water that flows out from the engine radiator 41, the engine cooling water is supplied to the engine 40 again. Thus, volume expansion of the engine cooling water caused by a temperature rise is absorbed,

and an amount of cooling water circulating in an engine cooling system (circuit) is maintained constant. At the same time, because flow speed of the engine cooling water is reduced as the engine cooling water passes through the internal spaces 11a, it is possible to remove residual air that is unavoidably contained in the engine cooling water (gas-liquid separation).

[0035] Meanwhile, the second tank portion 12 is surrounded by a right portion of the upper surface 21 (a right portion with respect to the inner wall portion 13 in the vehicle width direction), a right portion of the lower surface 22, a right portion of the front side surface 23, a right portion of the rear side surface 24, the first right side surface 25, and the second right side surface 26 (to be more precise, by wall portions that configure the above-mentioned surfaces, respectively). The intercooler cooling water is first supplied to the intercooler, flows into the second tank portion 12 from a second inflow portion 12b formed in the right portion of the lower surface 22, and passes through the internal spaces 12a divided by the ribs 17. Then, the intercooler cooling water is supplied to an intercooler radiator (not shown) from a second outflow portion 12c formed in the right portion of the front side surface 23. Thus, volume expansion of the intercooler cooling water caused by a temperature rise is absorbed, and an amount of the cooling water circulating in the intercooler cooling system (circuit) is maintained constant. At the same time, because flow speed of the intercooler cooling water is reduced as the intercooler cooling water passes through the internal spaces 12a, it is possible to remove residual air that is unavoidably contained in the intercooler cooling water (gas-liquid separation).

[0036] In the left portion of the upper surface 21 (to be more precise, the wall portion that configures the upper surface 21), the first cooling water injection portion 14 is formed for injecting the engine cooling water into the first tank portion 11. Meanwhile, in the right portion of the upper surface 21, the second cooling water injection portion 15 is formed for injecting the intercooler cooling water into the second tank portion 12. As described earlier, the first and second cooling water injection portions 14, 15 are pressurized and sealed by the first and second tank caps 5, 6, respectively, that are mounted detachably. Thus, pressure inside the first and second tank portions 11, 12 is increased,

and the engine cooling water and so on is restrained from boiling.

[0037] In the upper surface 21, a recessed stripe 21a is formed at a position corresponding to the inner wall portion 13 and extends in the vehicle front-rear direction. Also, across the recessed stripe 21a, the right portion of the upper surface 21 corresponding to the second tank portion 12 is one step lower than the left portion of the upper surface 21 corresponding to the first tank portion 11. This reminds an operator who injects the engine cooling water and the intercooler cooling water that the reserve tank 1 is made of the integrated tank portions 11, 12 for the two cooling systems. Thus, the operator does not forget to inject cooling water into both tank portions.

[0038] As shown in FIG. 6, the inner wall portion 13 that divides the first tank portion 11 and the second tank portion 12 from each other includes a first inner wall portion 13A and a second inner wall portion 13B. The first inner wall portion 13A defines the right side of the first tank portion 11. The second inner wall portion 13B is provided at an interval from the first inner wall portion 13A in the vehicle width direction, and defines the left side of the second tank portion 12. In FIG. 6, the first inner wall portion 13A and the second inner wall portion 13B are painted in black to be emphasized. Thus, between the first tank portion 11 and the second tank portion 12, a space S is formed that is surrounded by the wall portion that configures the front side surface 23, the wall portion that configures the rear side surface 24, the wall portion that configures the upper surface 21, the wall portion that configures the lower surface 22, the first inner wall portion 13A, and the second inner wall portion 13B, in front, rear, upper, lower, right, and left directions. The space S forms an air space between the first tank portion 11 and the second tank portion 12. As described above, because the air space is interposed between the first tank portion 11 and the second tank portion 12, it is possible to restrain the intercooler cooling water with a relatively low temperature range from being influenced by the engine cooling water with a relatively high temperature range.

[0039] FIG. 7 is a schematic front view of the engine radiator 41. The reserve tank 1 configured as described above is mounted on the engine radiator 41 while being supported at three points as a first mounting portion 7, a second mounting portion 8, and a

third mounting portion 9 are fastened to a radiator shroud 41a (see FIG. 5) by bolts on the rear side of the engine radiator 41. The first mounting portion 7 is provided in an upper end portion of a left end of the front side surface 23, the second mounting portion 8 is provided in a right end portion of the front side surface 23, and the third mounting portion 9 is provided in a lower end portion of a right end of the front side surface 23. As shown in FIG. 7, the reserve tank 1 is mounted on an upper end portion of a right end of the engine radiator 41 on the rear side, and is disposed so that the curved second left side surface 28 goes along a fan shroud 43 that covers a fan 42 driven by the engine 40.

F - L Line

[0040] The reserve tank 1 has a function of facilitating inspection and management of an amount of coolant, in addition to the function of maintaining a constant amount of coolant and the gas-liquid separation function described earlier. More specifically, on the first right side surface (a second side surface) 25 that is a side surface surrounding the second tank portion 12 of the reserve tank 1, a scale for checking a liquid quantity (hereinafter, also referred to as an F - L line) 32 for the intercooler cooling water is formed together with letters "Full" (only "F" is shown in the embodiment) and "Low" (only "L" is shown in the embodiment) (for example, see FIG. 1). "Full" represents the upper limit of the amount of the coolant, and "Low" represents the lower limit of the amount of the coolant. As an operator compares a level of the intercooler cooling water that can be seen through the semitransparent reserve tank 1 to the F - L line 32, the operator is able to inspect and manage an amount of the intercooler cooling water easily.

[0041] The F - L line 32 is slightly tilted with respect to the upper surface 21 and so on in consideration of the fact that the reserve tank 1 is slightly tilted when the reserve tank 1 is mounted on the engine radiator 41 and disposed inside the engine compartment 50 (see FIG. 10).

[0042] In fact, for the reserve tank 1 in which the tank portions 11, 12 for the two different cooling systems are formed integrally as described in the embodiment, it is necessary to form the F - L lines on the side surfaces corresponding to the tank portions 11, 12, respectively. In other words, in order to make inspection and management of an

amount of the engine cooling water possible, it is necessary to form the F - L line for the engine cooling water in the first left side surface 27 or the second left side surface 28 that is the side surface surrounding the first tank portion 11, or in a portion of the front side surface 23 or the rear side surface 24 that is the side surface surrounding the first tank portion 11 and the second tank portion 12, the portion corresponding to the first tank portion 11.

[0043] However, as shown in FIG. 7, visibility of the second left side surface 28 is poor because the fan shroud 43 is located adjacent to it, and the front side surface 23 is hidden behind the engine radiator 41 because the front side surface 23 is mounted on the engine radiator 41. Further, the lower end of the first left side surface 27 is not within a position where the F - L line should be provided, and it is thus inappropriate to have the F - L line on the first left side surface 27 in terms of height. Also, even when the F - L line is provided in the rear side surface 24 that is the side surface facing an inner side of the engine compartment 50, there is a problem that it is hard for an operator to see the F - L line as the operator injects the engine cooling water from the outer side of the engine compartment 50 (the front side of the vehicle).

[0044] This means that, when the reserve tank 1 is disposed together with other onboard equipment such as the engine 40 and the engine radiator 41 in the limited space inside the engine compartment 50, it is easy to dispose the reserve tank 1 so as to make only one of the side surfaces having the F - L line 32 for the intercooler cooling water (the first right side surface 25) well visible. However, it is often difficult to dispose the reserve tank 1 so as to make two side surfaces of the reserve tank 1 well visible, the two side surfaces including the side surface where the F - L line 32 for the intercooler cooling water is formed, and the side surface where the F - L line for the engine cooling water is formed.

[0045] Therefore, in the embodiment, the F - L line 31 for the engine cooling water is provided in the reserve tank 1 in a form where the F - L line 31 is visible from above where visibility is good regardless of a disposed position of the reserve tank 1 and a positional relationship between the reserve tank 1 and other onboard equipment. To be

more specific, among the side surfaces 23, 24, 25, 26, 27, 28 of the reserve tank 1, the front side surface 23 that is the side surface surrounding the first tank portion 11 and the second tank portion 12 has a retracted surface 30. The retracted surface 30 is formed in a portion of the front side surface 23, the portion corresponding to the first tank portion 11. The retracted surface 30 is formed by retracting a part of the portion to an inner side of the tank body portion 2 (the rear side in the vehicle front-rear direction) so that the retracted surface 30 is continuous with the upper surface 21. Also, the F - L line 31 for the engine cooling water is provided in the retracted surface 30.

[0046] FIG. 8 is a simplified perspective view of the reserve tank 1. As shown in FIG. 8, while the first right side surface 25 where the F - L line 32 for the intercooler cooling water is provided is formed as a vertical surface, the retracted surface 30 where the F - L line 31 for the engine cooling water is provided is inclined towards the inner side of the tank body portion 2 (the rear side in the vehicle front-rear direction) towards the upward direction, and is formed as an inclined surface that is continuous with the upper surface 21 and the front side surface 23. In other words, in the reserve tank 1 according to the embodiment, a recessed portion recessed to the inner side of the tank body portion 2 is formed in the portion of the front side surface 23, the portion corresponding to the first tank portion 11. A back surface of the recessed portion is formed as an inclined surface that is inclined to the inner side of the tank body portion 2 (the rear side in the vehicle front-rear direction) towards the upward direction, and the F - L line 31 for the engine cooling water is provided on the inclined retracted surface 30.

[0047] The retracted surface 30 is formed so as to be continuous with the upper surface 21 as described above. Therefore, even if obstacles are present adjacent to all of the side surfaces of the reserve tank 1, the retracted surface 30 and the F - L line 31 provided in the retracted surface 30 can be visually recognized from above or diagonally above the reserve tank 1. Moreover, the retracted surface 30 is formed as an inclined surface, in other words, the retracted surface 30 is formed into a shape that is visible from both front and above. Therefore, the F - L line 31 is visually recognized easily even from directly above the reserve tank 1 without retracting the retracted surface 30 greatly.

[0048] FIG. 9 is a schematic plan view of the reserve tank 1 mounted on the engine radiator 41, and FIG. 10 is a side view of the reserve tank 1 mounted on the engine radiator 41. According to the embodiment, the retracted surface 30 is formed in the front side surface 23 so as to extend to the upper surface 21 by retracing and inclining a part of the front side surface 23 so that the part of the front side surface 23 is separate from the engine radiator 41 that is an obstacle. Therefore, as shown in FIG. 9, even when the engine radiator 41 is adjacent to the front side surface 23 of the reserve tank 1, the retracted surface 30 is visually recognized easily from above or diagonally above the reserve tank 1 without greatly retracting the retracted surface 30. Because the F - L line 31 is provided on the retracted surface 30, an amount of the engine cooling water is inspected and managed easily regardless of a disposed position of the reserve tank 1 and a positional relationship between the reserve tank 1 and other onboard equipment.

[0049] Thus, according to the embodiment, as shown in FIG. 10, the F - L line 32 provided on the first right side surface 25 is visually recognized easily from the right side in the vehicle width direction, and, at the same time, as shown in FIG. 9, the F - L line 31 provided on the retracted surface 30 that is an inclined surface is visually recognized easily from above or the like of the reserve tank 1. Therefore, the amounts of the intercooler cooling water and the engine cooling water are inspected and managed easily.

[0050] Moreover, the retracted surface 30 is formed in the front side surface 23 that faces the outer side of the engine compartment 50 when the tank body portion 2 is disposed inside the engine compartment 50. Therefore, an operator is easily able to visually recognize the F - L line 31 provided on the retracted surface 30 from the outer side of the engine compartment 50 (the front side in the vehicle front-rear direction).

[0051] In addition, in the embodiment, the obstacle (the engine radiator 41) is located adjacent to the front side surface 23 having a relatively large area, and no obstacle is located adjacent to the first right side surface 25 having a relatively small area. Because of this, disposition of the other onboard equipment is less restricted, thereby increasing flexibility in the layout inside the engine compartment 50.

Other Embodiments

[0052] The invention is not limited to the embodiment, and is carried out in various other forms without departing from the spirit and main characteristics of the invention.

[0053] In the foregoing embodiment, the reserve tank 1 is mounted on the upper end portion of the right end on the rear side of the engine radiator 41. However, the invention is not limited to this. A reserve tank 1A may be formed into a shape symmetrical with the reserve tank 1 according to the embodiment, and, for example, as shown in FIG. 11, the reserve tank 1A may be mounted on the upper end portion of a left end on the rear side of the engine radiator 41. This way, the F - L line 32 for the intercooler cooling water is visually recognized easily from the left side in the vehicle width direction, and the F - L line 31 for the engine cooling water is visually recognized easily from above or the like of the reserve tank 1A.

[0054] In the foregoing embodiment, the reserve tank 1 is mounted on the rear side of the engine radiator 41. However, the invention is not limited to this. For example, as shown in FIG. 12, the reserve tank 1 may be mounted on an apron 51 or the like so that the reserve tank 1 is separated from the engine radiator 41 and the side surface where the retracted surface 30 is formed faces the outer side in the vehicle width direction (the left side). In this case, an operator is still able to visually recognize the F - L line 32 for the intercooler cooling water easily from the front side of the vehicle, and is able to visually recognize the F - L line 31 for the engine cooling water easily from the left side in the vehicle width direction. Because an obstacle (the apron 51) is located adjacent to the side surface with a relatively large area, it is possible to improve flexibility of a layout inside the engine compartment 50.

[0055] In the foregoing embodiment, the retracted surface 30 of the reserve tank 1 is formed as the inclined surface continuous with the upper surface 21 and the front side surface 23. However, the invention is not limited to this. For example, like a reserve tank 1B shown in FIG. 13, a retracted surface 30B may be formed perpendicularly (as a vertical surface, that is, as to be parallel to the front side surface 23).

[0056] In the foregoing embodiment, the retracted surface 30 is the back surface

of the recessed portion that is recessed to the inner side of the tank body portion 2. However, the invention is not limited to this. For example, like a reserve tank 1C shown in FIG. 14, a retracted surface 30C may be formed in a left end portion of the front side surface 23 as the left end portion is retracted to the inner side of the tank body portion 2.

[0057] Further, in the foregoing embodiment, the retracted surface 30 is the back surface of the recessed portion that is recessed to the inner side of the tank body portion 2. However, the invention is not limited to this. For example, like a reserve tank 1D shown in FIG. 15, a retracted surface 30D may be formed on an upper portion of the front side surface 23 throughout the entire width as the upper portion is retracted to the inner side of the tank body portion 2.

[0058] In the foregoing embodiment, the invention is applied to a vehicle in which the downsized and turbocharged engine 40 and the air-to-water intercooler are mounted. However, the invention is not limited to this as long as a vehicle is provided with water-cooling equipment. The invention is thus applicable to, for example, a hybrid vehicle in which an engine, an inverter and so on are cooled, and an electric vehicle in which two or more pieces of equipment are water-cooled.

[0059] Further, in the foregoing embodiment, the invention is applied to the reserve tank 1 in which the tank portions 11, 12 for the two cooling systems are integrated with each other. However, the invention is not limited to this, and may be applied to a reserve tank that only has a tank portion for a single cooling system. In this case, even when obstacles are adjacent to all side surfaces of the reserve tank, an F - L line is visually recognized easily.

[0060] In the foregoing embodiment, the invention is applied to the reserve tank 1 made of resin. However, a material of the reserve tank is not particularly limited. For example, a retracted surface made of transparent resin may be incorporated in a metal reserve tank.

[0061] As described above, the foregoing embodiment is just an example in every aspect, and should not be narrowly interpreted. Further, all modifications and changes pertaining to an equivalent scope to the claims fall within the scope of the invention.

[0062] According to the invention, it is possible to improve visibility of a scale for checking a liquid quantity provided on a reserve tank regardless of a disposed position of the reserve tank and a positional relationship between the reserve tank and other onboard equipment. Therefore, the invention is extremely useful when it is applied to a reserve tank mounted on a vehicle.

CLAIMS:

1. A reserve tank where coolant is stored, the reserve tank comprising a tank body portion having an upper surface and a plurality of side surfaces, wherein:

the tank body portion has a retracted surface provided in a part of one of the side surfaces, the retracted surface being positioned inward of the one of the side surfaces in the tank body portion;

the retracted surface is provided so as to be continuous with the upper surface; and

a scale for checking a liquid quantity is provided on the retracted surface.

2. The reserve tank according to claim 1, wherein the retracted surface is inclined to an inner side of the tank body portion towards an upward direction.

3. The reserve tank according to claim 1 or 2, wherein the retracted surface is provided so as to be continuous with the upper surface and the one of the side surfaces.

4. The reserve tank according to claim 1, wherein the retracted surface is provided so as to be parallel to the one of the side surfaces.

5. The reserve tank according to any one of claims 1 to 4, wherein the retracted surface is provided in an end of the one of the side surfaces.

6. The reserve tank according to any one of claims 1 to 5, wherein the retracted surface is provided in an upper portion of the one of the side surfaces throughout an entire width.

7. The reserve tank according to any one of claims 1 to 6, wherein:

the tank body portion includes a first tank portion that stores coolant for a first cooling system, and a second tank portion that is adjacent to and integrated with the first tank portion and stores coolant for a second cooling system;

the retracted surface is provided in a portion of a first side surface among the side surfaces, the portion corresponding to the first tank portion, and the first side surface surrounding the first tank portion and the second tank portion; and

the scale for checking a liquid quantity is provided in a second side surface that surrounds only the second tank portion.

8. The reserve tank according to any one of claims 1 to 7, wherein the retracted surface is provided in one of the side surfaces, the surface facing an outer side of an engine compartment when the tank body portion is disposed inside the engine compartment.

FIG. 1

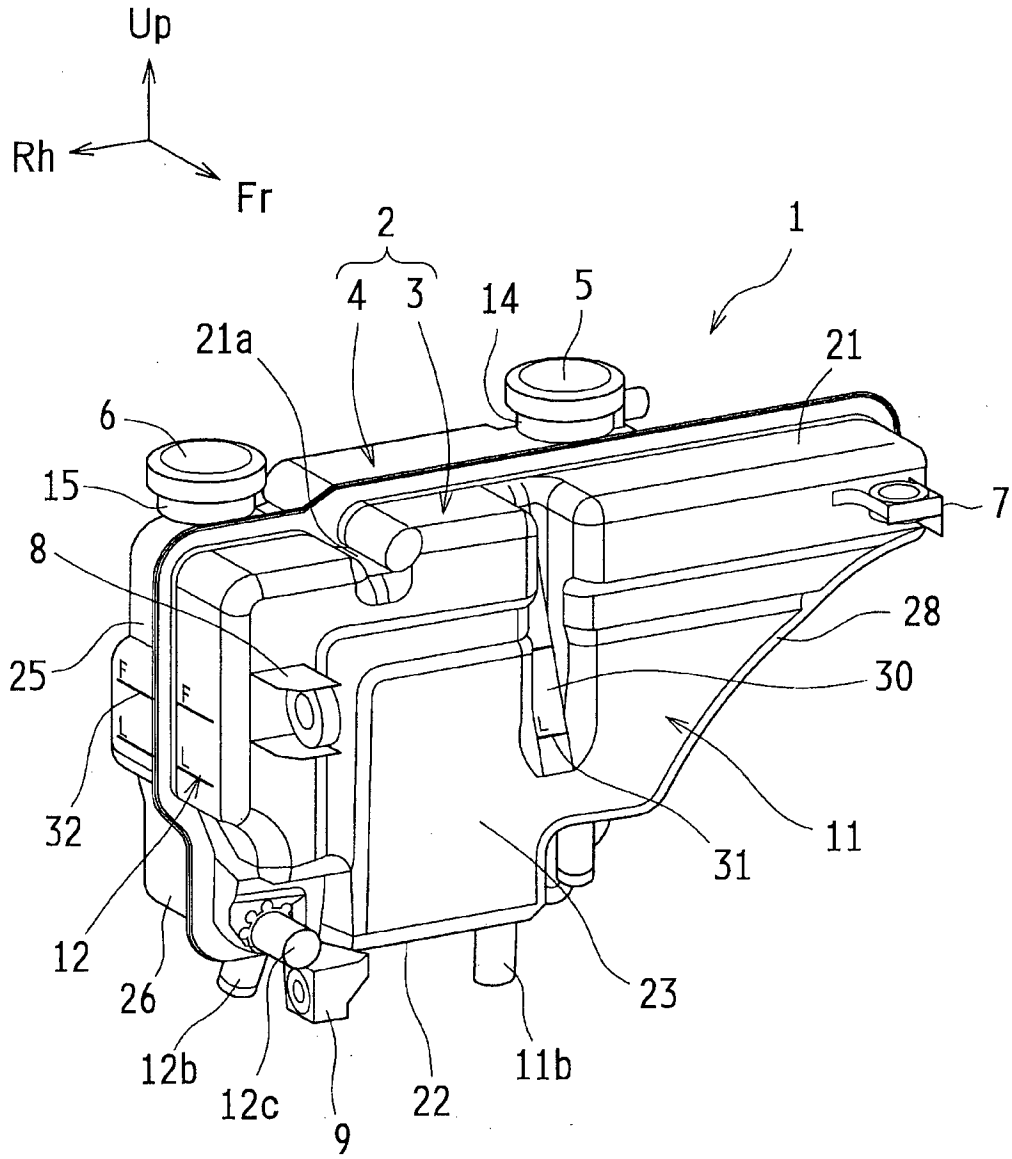
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FIG. 2

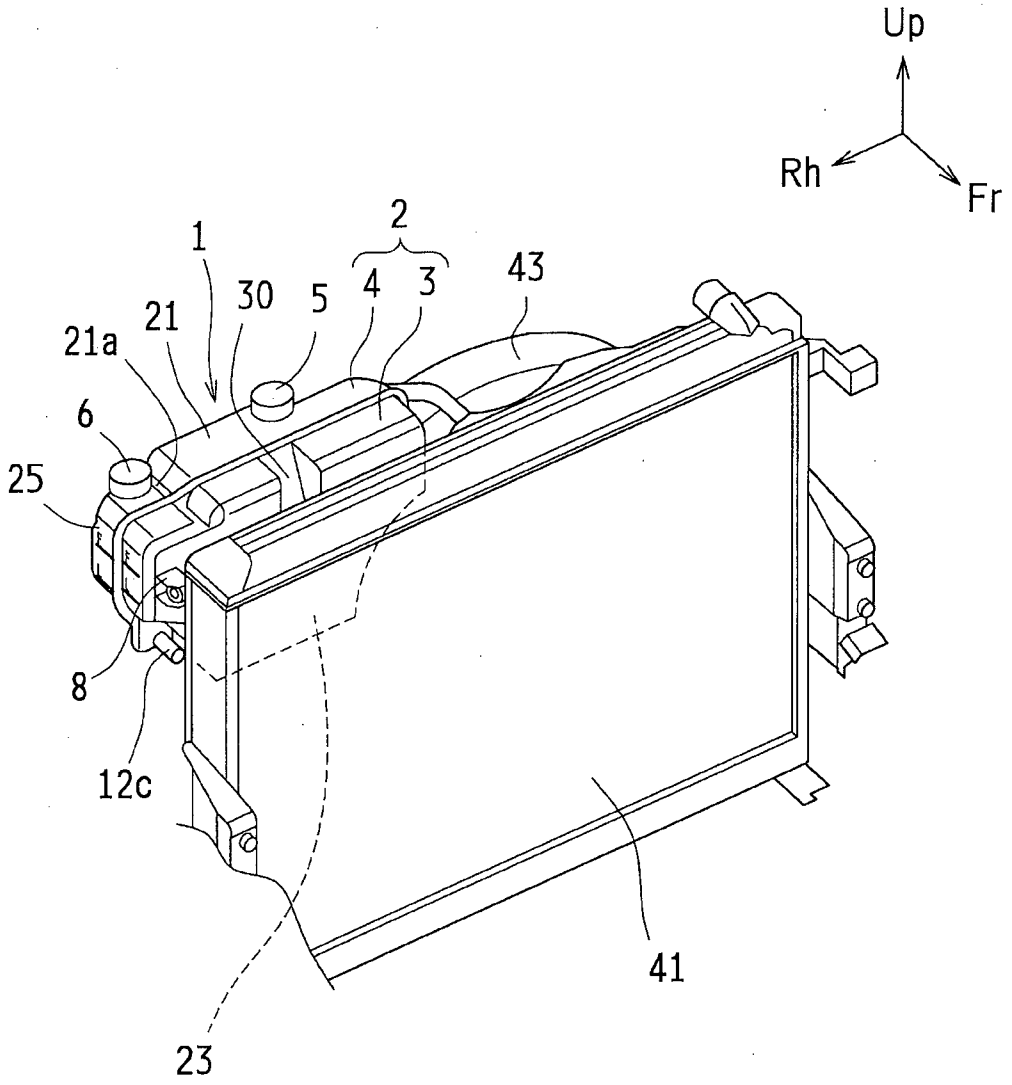

FIG. 3

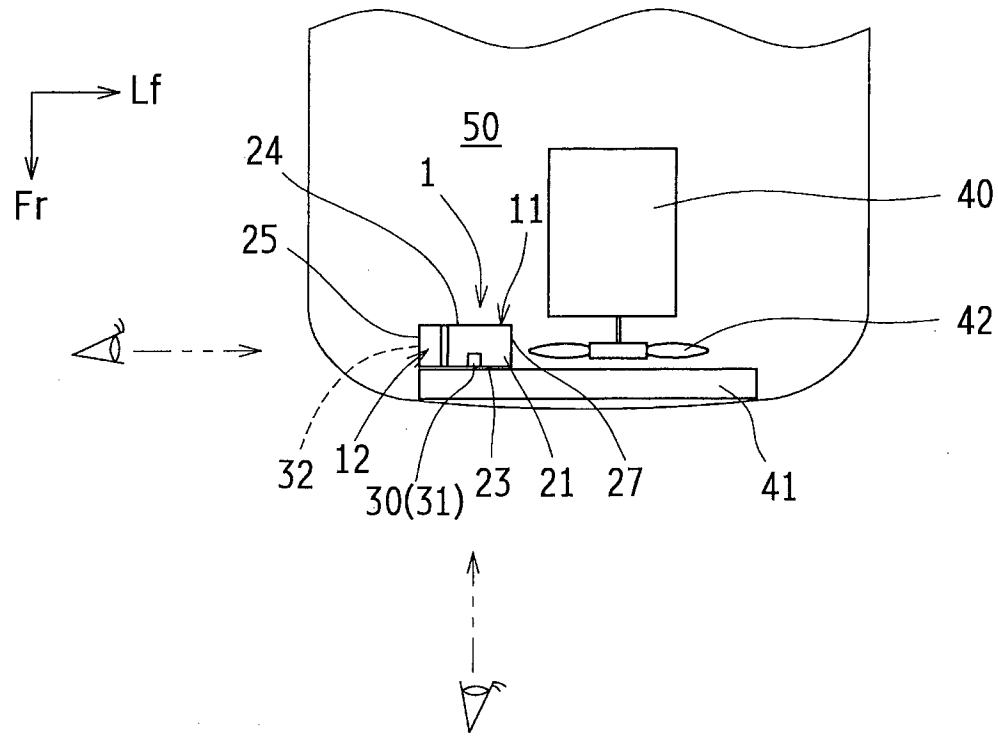

FIG. 4

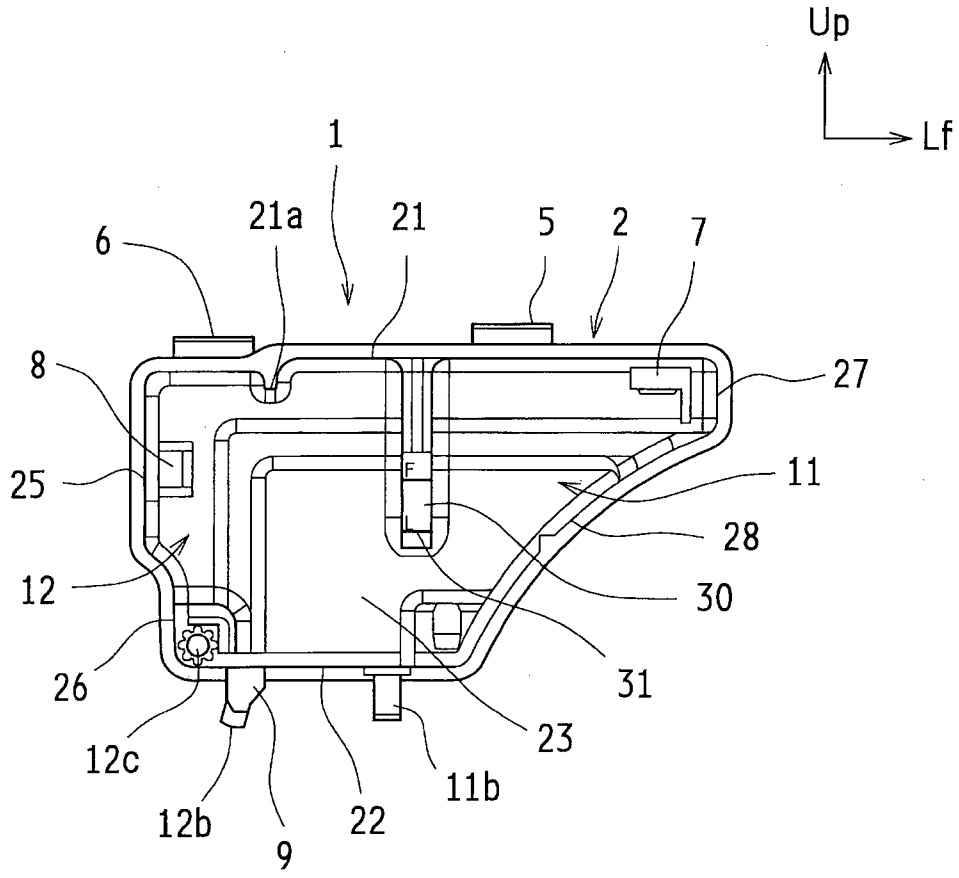

FIG. 5

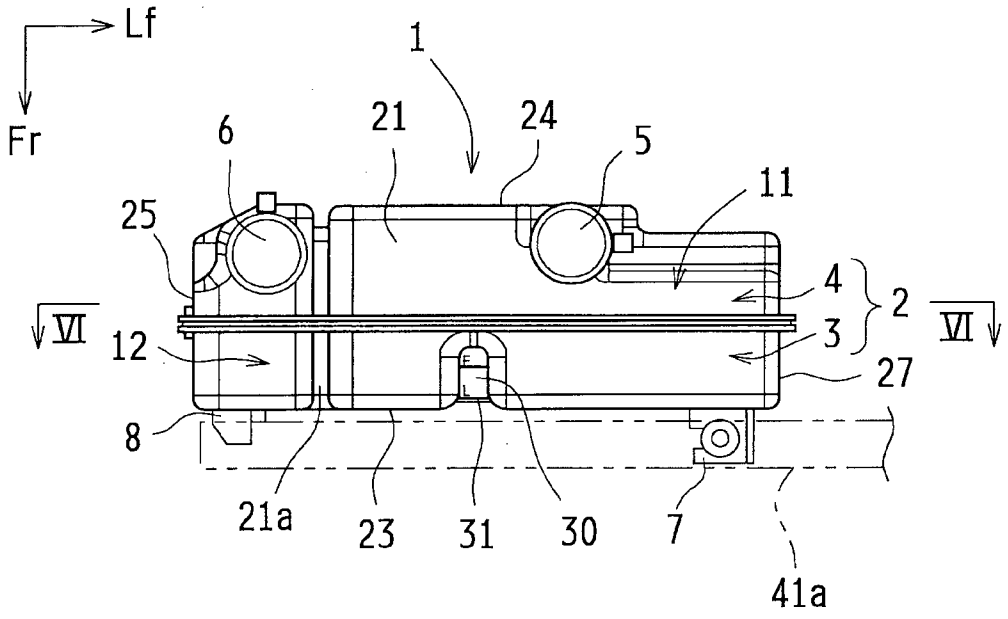

FIG. 6

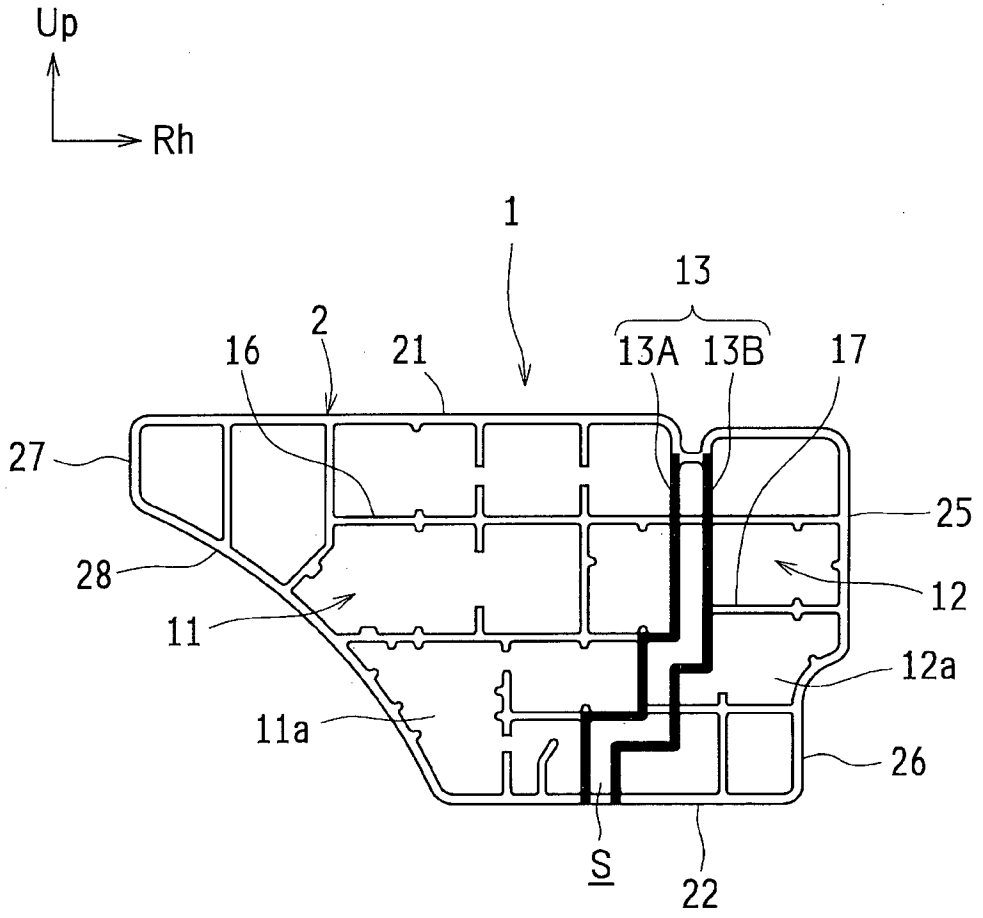

FIG. 7

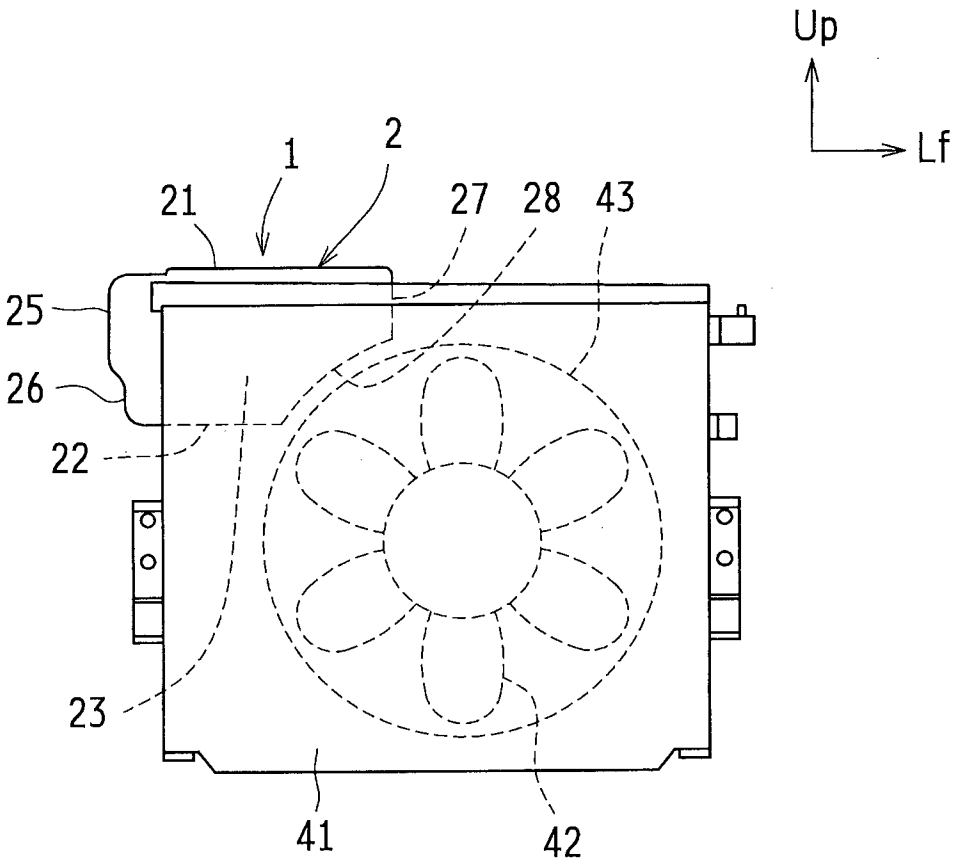

FIG. 8

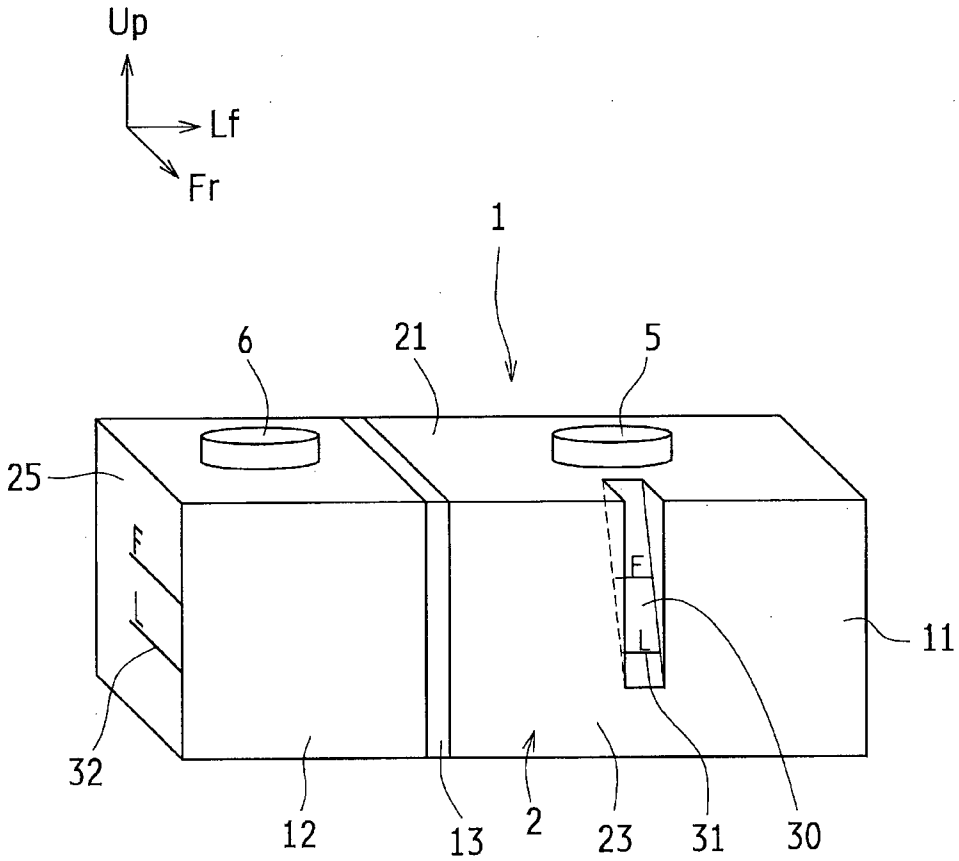
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FIG. 9

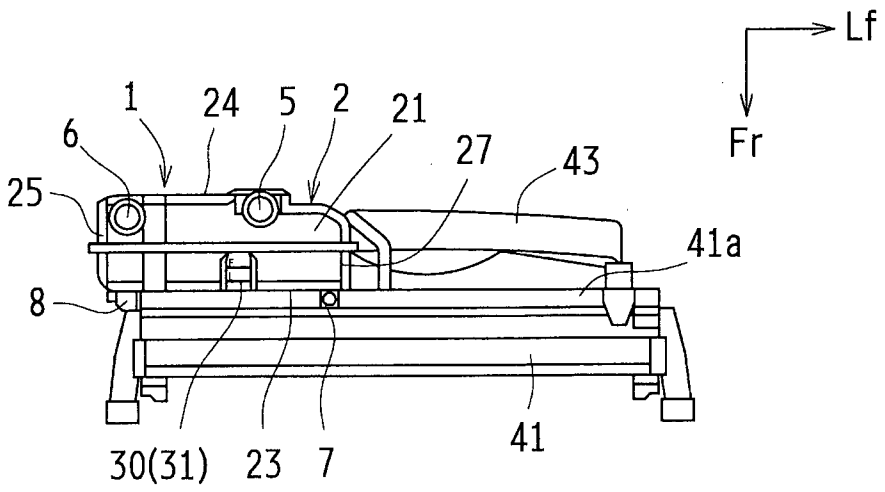
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FIG. 10

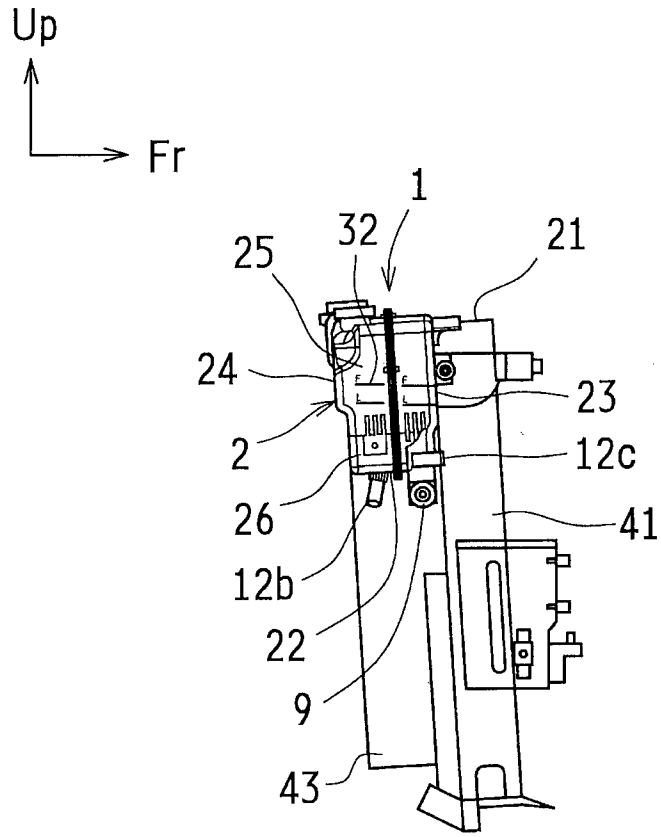

FIG. 11

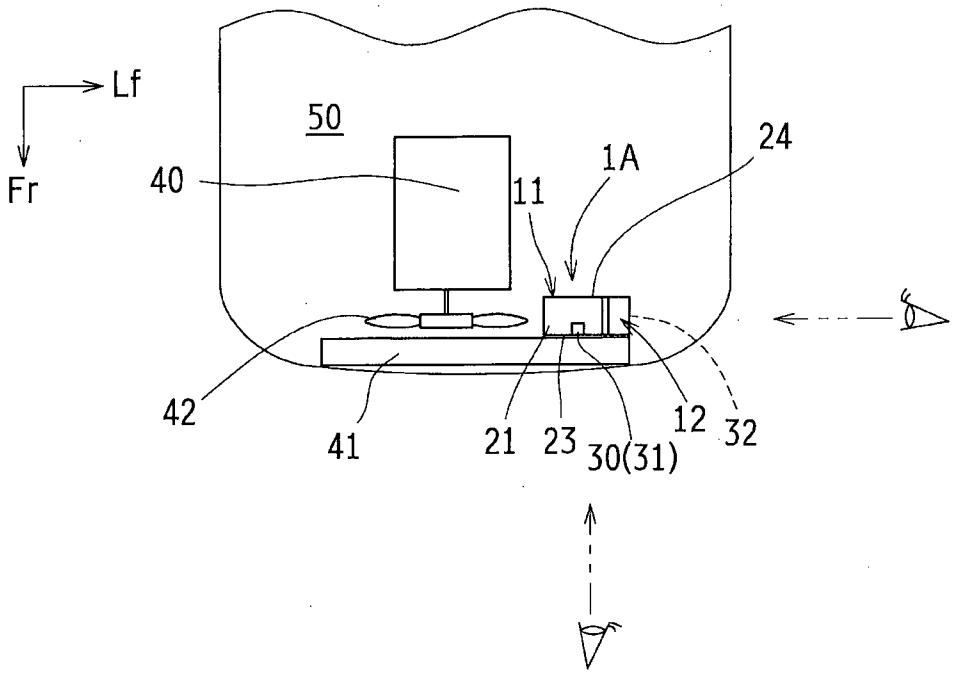
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FIG. 12

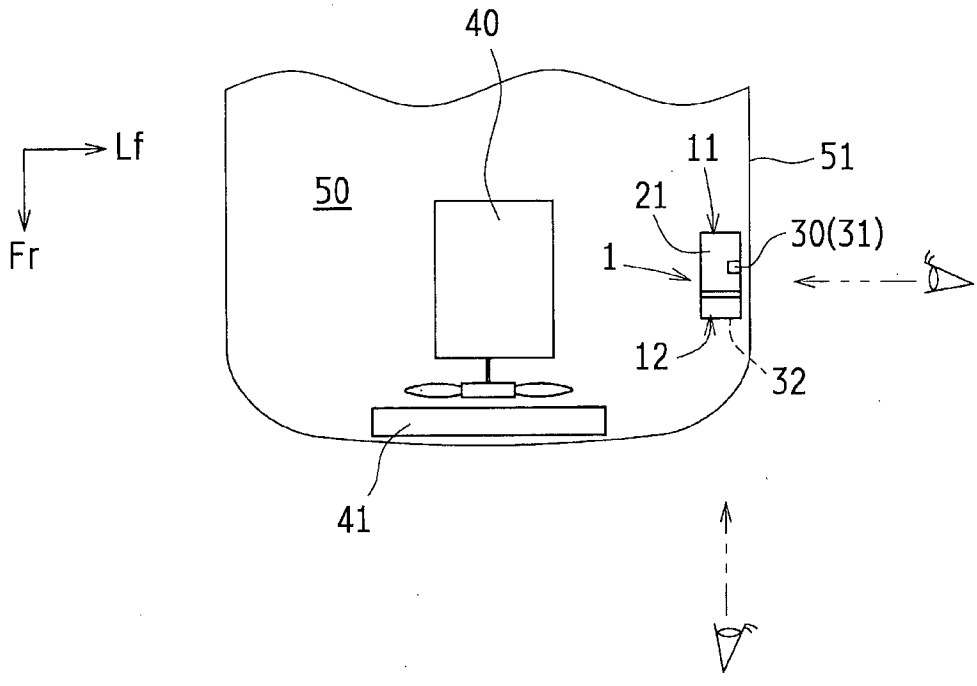
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FIG. 13

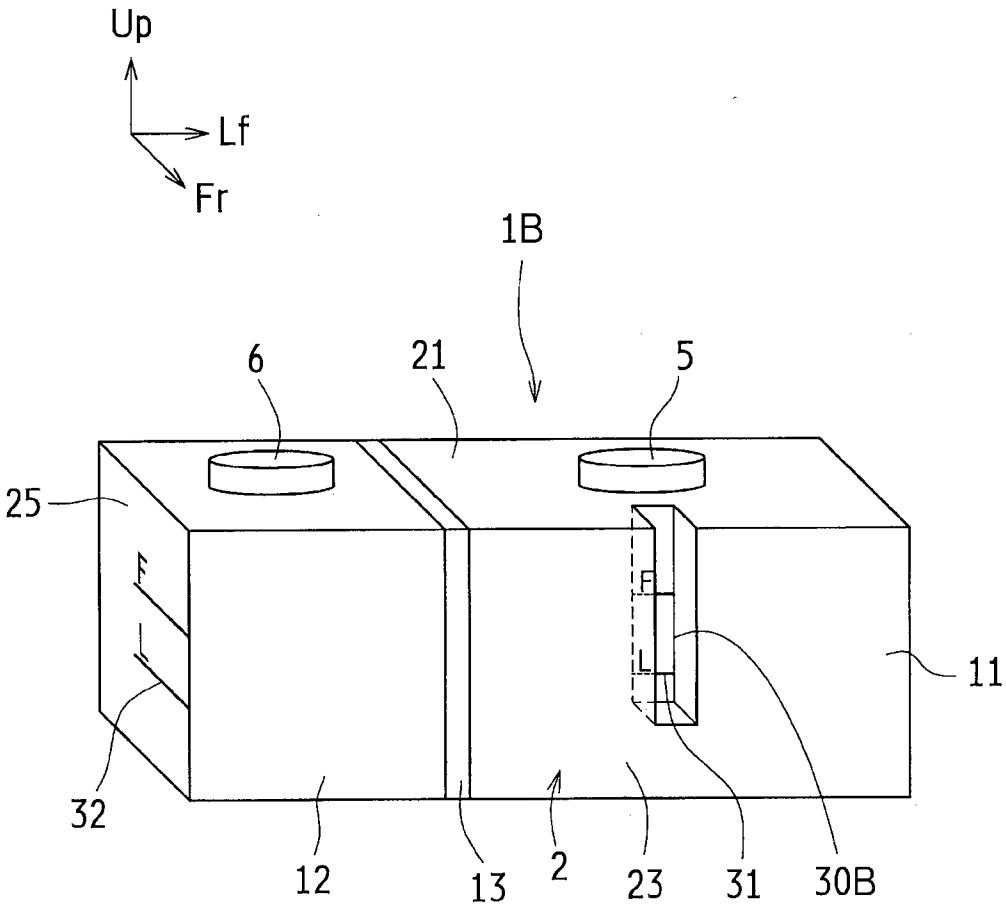


FIG. 14

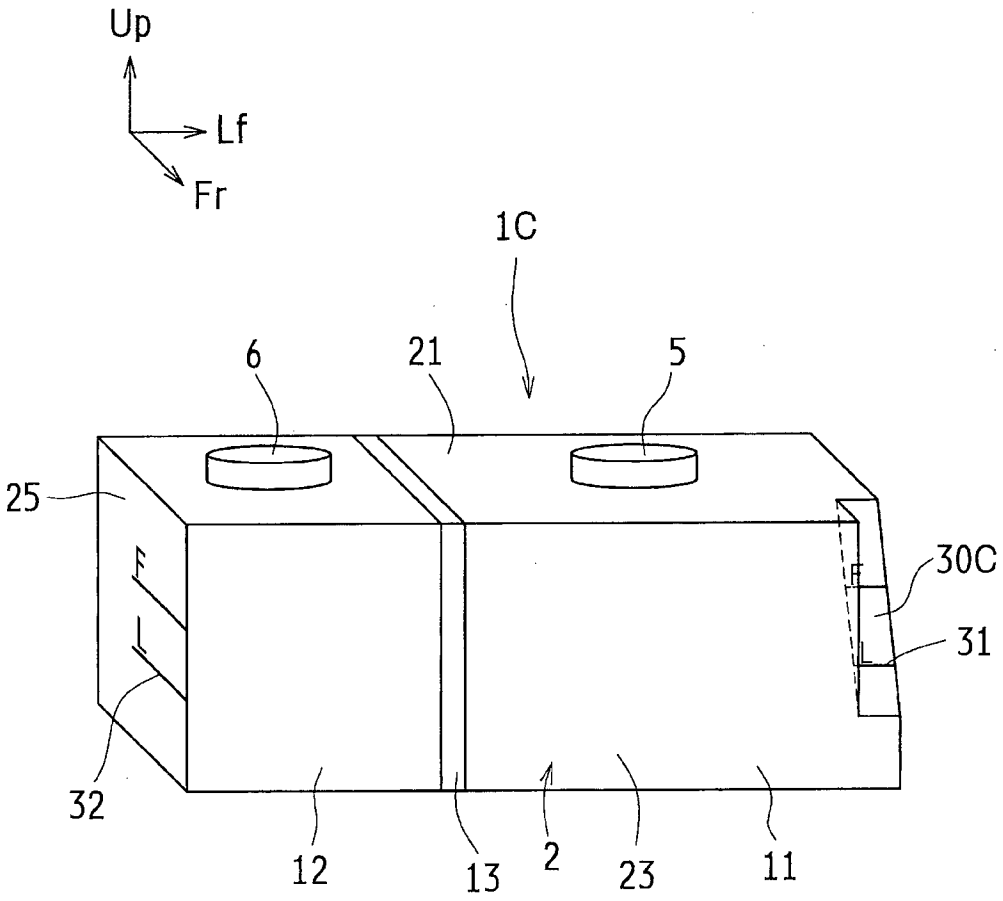
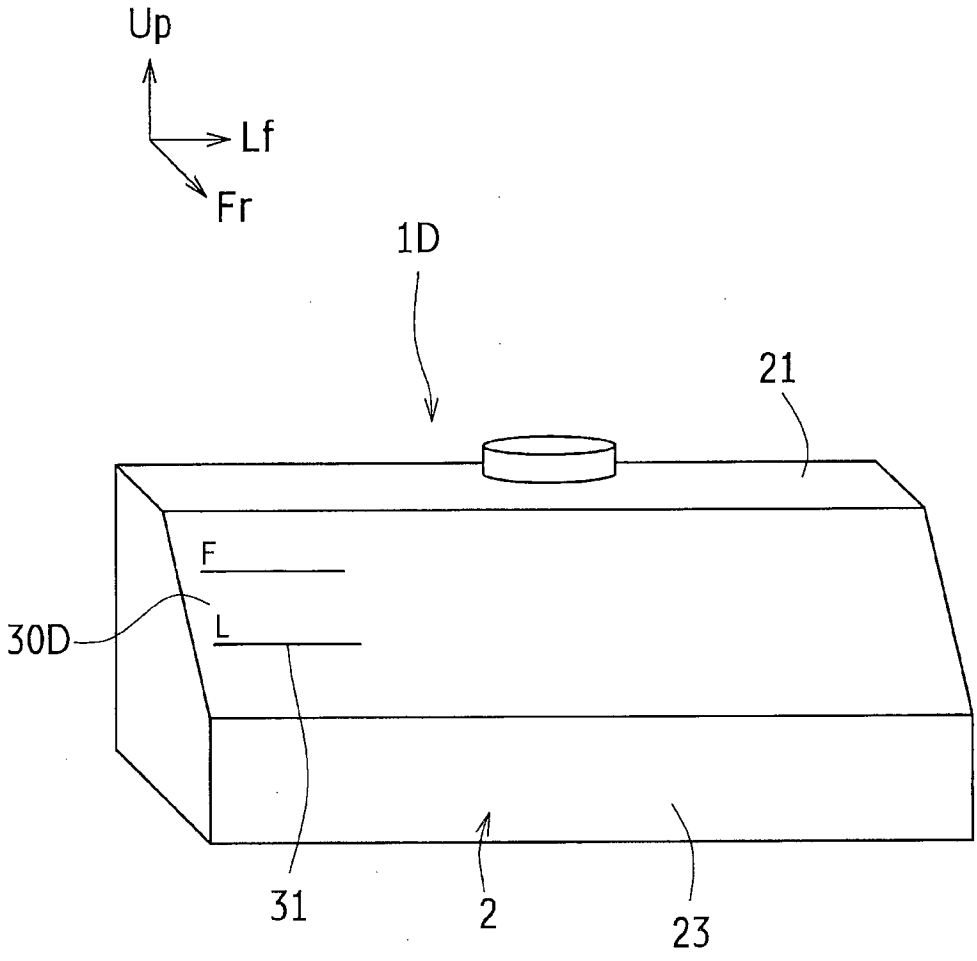


FIG. 15



INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2019/000053

A. CLASSIFICATION OF SUBJECT MATTER
INV. F01P11/02 F01P11/18
ADD.

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)
F01P

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 practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 2006/112910 A1 (OHZONO GEN [JP]) 1 June 2006 (2006-06-01) paragraphs [0012] - [0064] figures 1-6	1-6,8 7

X	US 2007/215073 A1 (LAWRENCE PATRICK N [US] ET AL) 20 September 2007 (2007-09-20) paragraphs [0006] - [0047] figures 1-3	1-6,8

Y	WO 2010/059106 A1 (SCANIA CV AB [SE]; KARDOS ZOLTAN [SE]; SOEDERBERG ERIK [SE]) 27 May 2010 (2010-05-27) pages 4-9 figures 1-3	7

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 April 2019	13/05/2019

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Schwaller, Vincent

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2019/000053

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 00/60223 A1 (CUSTOM MOLDERS INC [US]; LABELLE SUOMELIA INC [US]) 12 October 2000 (2000-10-12) figures 3-4	1-8
A	US 2006/048924 A1 (DESAI SAMEER [US]) 9 March 2006 (2006-03-09) figures 4-10	1-8

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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