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(54) A SUMP AND AN ENGINE

(57) An engine, for example for use in a marine vessel, comprises an engine superstructure; and an oil sump for collecting oil from the engine superstructure. At a least a first baffle (8) extending generally horizontally and a second baffle (7) extending generally vertically are provided in the oil sump to reduce displacement of oil contained in the sump as the orientation of the engine varies.

Providing a horizontal baffle in the sump means that oil is retained within the sump even if the engine nearly or completely turns over, and providing the vertical baffle in the sump means that oil is contained within the sump even if the engine, for example, rolls from side to side or pitches from end to end.

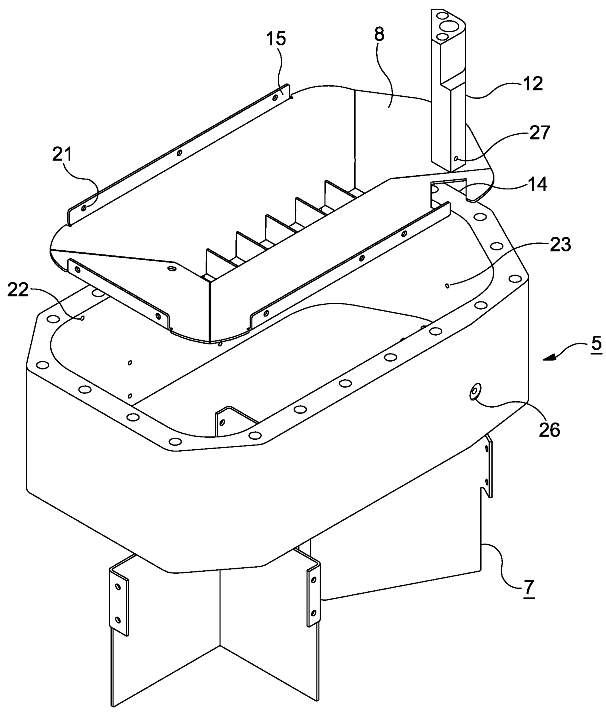

Fig. 4

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Description

[0001] The invention relates to a wet oil sump for an engine, in particular for an engine for marine application (or "marine engine"). It also relates to an engine, for example a marine engine, incorporating a sump of the invention.

[0002] Oil is used to lubricate the moving parts of an internal combustion engine, and this oil drains towards the bottom of the engine and collects in a reservoir, known as a "sump" (or as an "oil pan" in some countries such as the USA) which is provided at the bottom of the engine. In a "wet" sump an oil feed pipe is provided in the sump having an inlet disposed a short distance above the base of the sump, and oil is then pumped back up to the moving parts of the engine via the oil feed pipe by means of an oil pump provided on the engine. (In an alternative arrangement known as a "dry" sump oil is scavenged from the sump and is held in a separate reservoir, and is pumped to the moving parts of the engine from the reservoir.)

[0003] There is increasing interest in the use of unmanned vessels for monitoring a particular location, such as an oil well, a geological fault, exploratory work, surveying or military applications. These vessels may stay on station, follow a predetermined survey area or pattern, or be remotely operated for as long as possible with minimal servicing. However, there are various technical problems associated with such unmanned vessels, particular in the case of unmanned marine vessels.

[0004] Unmanned marine vessels may be surface vessels or sub-surface vessels, and so they are subject to wave action while they are in operation at their desired location or surveying an area, and can be subject to extreme pitch and/or roll, or even capsizing, in very bad seas. (As used herein, "pitch" is when a vessel rocks or oscillates about a lateral axis so that the bow of the vessel rises or falls with respect to the stern of the vessel, whereas "roll" is when a vessel rocks or oscillates about its longitudinal axis so that one side of the vessel rises or falls with respect to the other side of the vessel.) It is known to arrange for an engine of a marine vessel to cut out if the pitch or roll of the vessel exceeds a certain angle, in order to reduce the risk of water entering the engine if the vessel pitches or rolls heavily or capsizes. However, if a vessel having an engine with a wet sump pitches or rolls heavily or capsizes, oil can drain from the sump thereby substantially or completely emptying the sump of oil. This means that, when the vessel rights itself, there can be a delay in re-starting the engine if the rolling of the boat has caused the sump to empty of oil since it is necessary to wait for oil to drain back into the sump so that the level of oil in the sump reaches the inlet of the oil feed pipe. Alternatively there is the risk of damage to the engine if the engine is restarted before the level of oil in the sump reaches the inlet of the oil feed pipe, since the engine would not be correctly lubricated.

[0005] A first aspect of the invention provides an engine, comprising: an engine superstructure; and an oil sump for collecting oil from the engine superstructure; wherein at a least a first baffle extending generally horizontally and a second baffle extending generally vertically are provided in the oil sump to reduce displacement of oil contained in the sump as the orientation of the engine varies.

[0006] The terms "horizontally" and "vertically" as used herein relate to the engine in its intended orientation, in which the oil sump is located generally vertically below the engine block.

[0007] Providing a horizontal baffle in the sump means that oil is retained within the sump even if the engine nearly or completely turns over, and providing the vertical baffle in the sump means that oil is contained within the sump even if the engine, for example, rolls from side to side or pitches from end to end. When the invention is applied to an engine which is arranged to cut out if the pitch or roll exceeds a certain angle, it is possible to reduce the time taken to restart the engine after the engine returns to its normal orientation - oil is retained in the sump by the baffles, and it is not necessary to wait for oil that was lost from the sump when the engine rolled to return to the sump.

[0008] A third baffle extending generally vertically may be provided in the oil sump, the third baffle being generally crossed with the second baffle. Providing two vertical baffles, crossed with one another, in the sump means that oil is contained within the sump if the engine rolls from side to side and if the engine pitches from end to end.

[0009] An external perimeter of the first baffle may substantially correspond to the internal cross-section of the oil sump, at least one aperture being provided in the first baffle. This prevents, or minimises, leakage of oil between the first baffle and the interior wall of the oil sump, while oil draining from the engine superstructure can pass through the aperture(s) in the baffle into the sump.

[0010] At least a portion of the upper surface of the first baffle may inclined downwardly towards the at least one aperture.

[0011] A downwardly extending wall may be provided on a lower surface of the first baffle, the wall enclosing the circumference of the at least one aperture. If the vehicle in which the engine is mounted should overturn, or nearly overturn, oil in the sump may leak out of the sump through the aperture(s) in the horizontal baffle - and providing the wall on the lower surface of the horizontal baffle can reduce this leakage.

[0012] The second baffle may extend from a first internal face of the sump to an opposite internal face of the oil sump, and the third baffle may extend from a second internal face of the oil sump to an opposite internal face of the oil sump.

[0013] The oil sump may comprise a sump base portion and a sump extension portion disposed between the sump base portion and the engine superstructure. Providing the extension portion increases the volume of the sump, and this increases the time that the engine can operate without requiring the oil in the sump to be changed or refilled.

[0014] The engine may be a marine engine.

[0015] A second aspect of the invention provides a vehicle comprising an engine of the first aspect.

[0016] The vehicle may comprise a marine vessel. It may comprise an unmanned marine vessel. It may comprise a remotely-operated marine vessel

[0017] A further aspect of the invention provides a sump for an engine of the first aspect.

Brief description of the drawings

[0018] Preferred features of the present invention will now be described by way of illustrative example with reference to the accompanying figures, in which:

figure 1 is a schematic side view of a propulsion unit according to an embodiment of the invention;
figure 2 is a partial sectional view of the propulsion unit of figure 1;
figure 3 is a perspective view of the sump extension of the propulsion unit of figure 1;
figure 4 is a perspective exploded view of the sump extension of figure 3;
figure 5 is a perspective view of a baffle of the propulsion unit of figure 1;
figure 6 is a perspective view of another baffle of the propulsion unit of figure 1;
figure 7 is a side view of the baffle of figure 6; and
figure 8 is a view of the sump extension from above, showing some hidden detail.

Detailed Description

[0019] Figure 1 is a schematic view of an internal combustion engine to which the present invention has been applied. The engine 1 comprises an engine superstructure 2 mounted on a base plate 3. The details of the engine superstructure 2 are not material to the present invention, and the engine superstructure will therefore not be described further. The engine may be a marine engine, although the invention is not in principle limited to marine engines.

[0020] The engine further comprises a sump 4 mounted on the opposite face of the base plate 3 to the engine superstructure such that, in the intended orientation of the engine, the sump 4 is below the engine superstructure 2. Oil used to lubricate moving parts of the engine superstructure 2 drains towards the bottom of the engine, and collects in the sump 4.

[0021] In principle, the present invention could be incorporated in an engine at manufacture. However, supply of engines for use in remotely operated vessels is a relatively small market, and in many cases it is therefore not worthwhile for an engine manufacturer to design and manufacture an engine that is adapted for this specific application. It is therefore likely that, in the majority of cases, the invention will be implemented by modifying an engine that has been manufactured to a conventional engine design - and the invention will therefore be described with reference to an engine that has been modified after manufacture to incorporate the principles of the invention.

[0022] Figure 2 is a sectional view through the sump 4 of the engine of Figure 1. The sump comprises an upper portion or "sump extension" 5 and a lower part 6. The lower part 6 of the sump optionally is the original sump for the engine, and the sump extension 5 is preferably provided to increase the volume of the sump and thereby increase the length of time that the engine may operate without attention. That is, the engine of Figure 1 has been obtained by modifying a conventional engine by, inter alia, providing the sump extension 5 - in the unmodified engine, the sump extension 5 would not be present, and the sump would be constituted by the lower sump 6 which would be attached direct to the engine base plate 3.

[0023] The sump is provided with an oil pick-up 9 that, as shown in Figure 2, comprises an inlet 10 connected to a conduit pipe 11, which in turn is connected to an extension conduit 12. The extension conduit 12 was again provided when the engine was modified to incorporate the teaching of the invention, so that the inlet 10 remains in substantially the same position relative to the bottom of the sump. The engine is provided with an oil pump (not shown) which, in operation, sucks oil from the sump up into the engine superstructure 2, via the inlet 10, the conduit 11 and the extension conduit 12, so that oil is available in the engine superstructure where needed for lubrication.

[0024] It will be understood that correct operation of the engine requires that the oil inlet 10 is below the level of oil in the sump 4 - if the inlet is not immersed in the oil held in the sump, oil will not be removed from the sump via the inlet 10 and conduit 11, and the engine will not be lubricated correctly. In many applications of an engine, it is straightforward to ensure that the sump contains sufficient oil for the oil level to cover the inlet 10. However, where the engine is to be used in applications where the orientation of the engine may vary significantly - such as marine applications, for example - it may not be straightforward to ensure a continuous supply of oil to the engine superstructure. Where an engine is mounted in a boat, for example, if the boat rolls or pitches in rough seas, oil held in the sump will be displaced within the sump relative to the inlet 10 and, if the vessel rolls or pitches by a sufficient amount, the oil in the sump may be displaced so much that the inlet 10 is no longer immersed in the oil held in the sump.

[0025] A further problem occurs with vessels that are designed with a "self-righting" capability, so as to automatically right themselves after a capsize, such as rescue vessels, manned or unmanned. If such a vessel should capsize the oil will drain out of the sump into the engine superstructure 2, and this will cause a delay in restarting the engine once the vessel has righted itself - after the vessel has righted itself it will be necessary to wait for oil to drain back into the sump before it is safe for the engine to be re-started. This delay in re-starting the engine is undesirable, and potentially dangerous

[0026] Accordingly, the present invention provides one or more vertical baffles 7 and one or more horizontal baffles 8 in the sump to reduce the displacement of oil in the sump that occurs if the vessel rolls or pitches, or even completely overturns and ensure, to the greatest extent possible, that the inlet 10 remains below the oil level even if the vessel in which the engine 1 is mounted should roll or pitch significantly.

[0027] Figure 4 is an exploded partial view of the sump of Figure 2, showing the sump extension 5, a horizontal baffle 8, and a vertical baffle 7. Figure 3 shows the components of Figure 4 assembled. Figure 5 is a perspective view of the vertical baffle 7.

[0028] It should be understood that the terms "horizontal" and "vertical" in "horizontal baffle" and "vertical baffle" indicate that the baffles extends generally horizontally and generally vertically, respectively, when the engine is in its normal orientation as shown in Figure 1. As will become clear from the description below, the vertical baffle(s) prevent, or reduce, displacement of oil in the sump in one or more generally horizontal directions, and the horizontal baffle(s) 8 prevents, or restricts, oil from draining from the sump if the engine is subjected to extreme angles of pitch or roll, or completely overturns.

[0029] The horizontal baffle 8 of figure 4 is provided with a drainage aperture 13 that allows oil that has drained down through the engine structure 3 to pass into the sump 4. To assist in the flow of oil into the sump, the upper surface horizontal baffle 8 is preferably not exactly horizontal, but is arranged to slope gently downwards towards the aperture 13 to reduce the tendency for oil to accumulate on the upper surface of the horizontal baffle 8. Typically a slope of 5-10° is sufficient to ensure good drainage of oil towards the aperture 13.

[0030] The horizontal baffle 8 of figure 4 serves to restrict the flow of oil out of the sump if the engine should completely overturn, or pitch or roll very heavily. It will be appreciated that, as the engine nears the inverted position, oil will be able to drain out of the sump through the aperture 13 in the horizontal baffle. To minimise this, a surround 19 is provided on the underside of the horizontal baffle 8, extending around the perimeter of the aperture 13 and extending downwardly away from the horizontal baffle 8. Furthermore, transverse dividers 20 are preferably provided within the surround 19, to effectively divide the aperture 13 into a series of smaller apertures. The effect of providing the surround 19 and dividers 20 is that, even if the vessel in which the engine is mounted should completely overturn, some oil will be retained in the sump - thereby reducing the time delay after the vessel has been righted before it is safe to re-start the engine.

[0031] The horizontal baffle 8 has an exterior perimeter that, as closely as possible, matches the interior profile of the sump extension 5, to prevent, or at least minimise, leakage of oil between the edge of the horizontal baffle and the sump extension 5.

[0032] The horizontal baffle(s) can be secured to the sump extension by any suitable technique. As an example, the horizontal baffle may be provided with upturned edge portions 15a-15d that are provided with apertures 21 that, when the horizontal baffle is correctly positioned, align with threaded apertures 22 in the interior wall of the sump extension to allow the horizontal baffle to be secured in position by bolts 28 or other suitable fasteners.

[0033] Figure 5 is a perspective view of the vertical baffle 7. Preferably, the vertical baffle 7 comprises at least two baffle plates that extend in directions that are crossed with one another. This will ensure that the vertical baffle is effective to retain oil in the sump whether the vessel in which the engine is mounted rolls from side to side or pitches from end to end. In the example of Figure 5 the vertical baffle comprises one baffle plate 16 that, when installed, runs generally along the central longitudinal axis of the sump, and two further baffle plates 17, 18 that are crossed with this first baffle plate 16. The baffle plates 16, 17, 18 are dimensioned so as to be a close fit into the interior of the sump extension - that is, each baffle plate preferably extends from one interior face of the sump to an opposing interior face - to prevent, or at least minimise, leakage of oil between the edges of the baffle plates 16,17,18 and the interior of the sump extension 5. The vertical baffle 7 is again provided with mounting means for mounting the vertical baffle in position, and in the example of Figure 5 these comprise mounting plates 16a, 17a, 18a that are provided with apertures 22 that, when the vertical baffle 7 is in position, align with threaded apertures in the interior surface of the sump extension to allow the vertical baffle to be secured in position by bolts 28 or other suitable fasteners.

[0034] As shown in Figure 2, the vertical baffle 7 extends for substantially the entire depth of the sump extension 5 that is not occupied by the horizontal baffle 8 and the surround 19. The vertical baffle 7 further extends into the lower sump portion 6, and extends over a significant portion of the height of the lower sump portion 6. The vertical baffle terminates shortly above the oil inlet 10; the separation between the bottom edge of the vertical baffle 7 and the bottom of the sump is indicated as "d" in Figure 2, and this generally takes the value of around twice the distance between the oil pickup inlet 10 and the base of the lower sump.

[0035] In the example of figure 2 the internal cross-sectional dimensions of the lower sump portion 6 are slightly less than the internal cross-sectional dimensions of the sump extension 5]. To facilitate the provision of vertical baffles in the lower sump portion while still allowing easy assembly and disassembly, the horizontal dimensions of the lower portion of the baffle plates 16-18 are preferably made slightly smaller than the horizontal dimensions of the upper portion of the baffle plates 16-18, so as to produce a "step" 24 in the profile of the edges of the baffle plates 16-18. As shown in Figure 2, when the vertical baffle 7 is installed the step 24 in the end profile coincides with the change in internal profile of the sump 4 at the boundary between the sump extension 5 and the sump bottom 6, thereby minimising leakage of oil between the baffle plates and the interior of the sump 4 over the entire extent of the baffle plates.

[0036] The baffle plates 16-18 making up the vertical baffle may be arranged to have any desired arrangement, subject to the constraint that the baffle plates must leave a space free to accommodate the oil pick-up 9. In the embodiment of Figure 5, it is intended that, when the engine is assembled, the oil pick-up 9 will be present in region 25 denoted in Figure 5.

[0037] As noted it is expected that, in the majority of cases, the present invention will be implemented by modifying an engine that has been manufactured as a conventional engine. Where it is required to modify a conventional engine to implement the present invention, the principal steps required would be as follows:

> The original sump and oil-pick-up are removed from the engine, and the sump extension 5 is provided. This increases the oil-holding capacity of the sump, and thus extends the length of time that the engine can operate without requiring the lubricating oil to be re-filled/replaced. The sump extension 5 is preferably configured such that it may be fastened to the base plate 3 using the fastenings provided in the base plate for attachment of the original sump, and/or (where the original sump forms the lower sump portion 6 of the modified engine) so that the original sump can be fastened to the sump extension using the fastenings provided on the original sump.

[0038] The oil pick-up is assembled from the inlet 10, conduit 11 and extension conduit 12. In one example the inlet 10 and conduit 11 are components of the original engine that are re-used, and this is preferable as it reduces the number of new components needed.. It is necessary to extend the length of the oil pick-up 9 by an amount approximately equal to the length of the sump extension, to maintain the inlet 10 in substantially the same position relative to the bottom of the sump - if this were not done the benefit of increasing the volume of the sump by providing the sump extension would be lost. The extension conduit 12 is therefore provided to increase the length of the oil pick-up 9. In this example the conduit 11 terminates in a mounting block 11 a that, in the original engine, is used to secure the conduit to the engine baseplate - and in the modified engine the mounting block 11 a may be used to secure the conduit and the extension conduit 12 to the engine baseplate, as shown in Figure 2.

[0039] The assembled oil pick-up, formed in this example by the inlet 10, the conduit 11, the mounting block 11 a and the extension conduit 12, is then mounted in position on the sump extension. In one example the extension conduit 12 is provided with a threaded recess 27, which is used to secure the extension conduit to the sump extension 5 using a fastener 31 such as a bolt.

[0040] The vertical baffle 7 is then placed in the sump extension 5, and is secured to the sump extension.

[0041] The horizontal baffle is then placed in the sump extension, such that the extension conduit of the oil pick-up passes through the cut-out 14 in the horizontal baffle, and the horizontal baffle is secured to the sump extension. Figure 8 is a schematic view from above of the sump extension 5 after the oil pick-up and the vertical and horizontal baffles have been mounted. Portions of the vertical baffle 7 that are behind the horizontal baffle are shown as broken lines for clarity. (It should be noted that figure 8 shows some hidden details for clarity of explanation, such as apertures in the sump extension for receiving bolts to secure the conduit extension and the baffles.)

[0042] The conduit 11 is preferably secured to the vertical baffle by a clamp 30, shown in figure 2, to prevent the oil pick-up from being affected by vibrations of the engine.

[0043] The sump extension 5 may then be positioned on the engine baseplate 3, and is held temporarily in position. As shown in figure 3 the extension conduit protrudes above the horizontal baffle 8, and indeed above the upper edge of the sump extension, and the protruding portion of the extension conduit 12 is dimensioned to fit in a recess in the lower face of the baseplate.

[0044] The oil pickup assembly is preferably fastened to the engine baseplate as well as to the sump extension. In one advantageous example the extension conduit is provide with through-holes that extend along its length, and that align with the existing fastening holes for the oil conduit in the engine baseplate. The oil pick-up may then be lengthened simply by, after unfastening the mounting block 11 a from the engine baseplate, positioning the extension conduit 12 between the engine baseplate and the mounting block 11 a and fastening the mounting block 11 a to the engine baseplate using bolts that pass through the through-holes 32 in the extension conduit, thereby also securing the extension conduit 12 in place. This requires no modification to the engine baseplate or to the mounting block, and simply requires the use of new bolts that are longer than the original bolts by approximately the length of the extension conduit.

[0045] The lower sump portion 6 (which, as noted, may be the original sump of the engine) is then fastened to the engine. In one advantageous example the sump extension is provide with through-holes that extend along its length, and that align with the existing fastening holes for the sump in the engine baseplate. The lower sump portion (which as noted may be the original sump) is secured to the baseplate of the engine by fasteners (eg bolts) that pass through holes in the flange of the lower sump portion 6, pass through corresponding through-holes of the sump extension 5, and are inserted into the fastening holes for the sump provided in the engine base plate. This requires no modification to the engine baseplate or to the original sump (where this is re-used as the lower sump portion 6), and simply requires the use of new bolts that are longer than the original bolts by approximately the length of the sump extension.

[0046] It should be noted that when an engine is modified to increase the time that it can run without maintenance visits, it may be desired to make modifications to the engine superstructure 2 as well as to increase the sump capacity and install the horizontal and vertical baffles of the present invention. The modifications to the engine structure are, however, unrelated to the modifications to the sump, and will therefore not be described further.

[0047] An engine of the present invention may be used in a vehicle such as for example, a marine vessel, and may provide particular advantage when used in an unmanned marine vessel. (It should be understood that the term "marine vessel" as used herein is not limited to a sea-going vessel, but also encompasses vessels intended for operation on fresh water.)

[0048] The invention has been described above with reference to some examples for illustrative purposes, but the invention is not limited to the examples described above. For example, although the arrangement of baffles shown in the figures is just an example of one possible arrangement, and many other arrangements could be used and still reduce the tendency of oil drain from the sump if the vessel in which the engine is mounted pitches or rolls heavily.

[0049] As one example, although the figures shown just one horizontal baffle it would be possible to provide two, or even more, horizontal baffles at different levels in the sump extension or lower sump portion. Preferably each horizontal baffle would extend over generally the entire width and breadth of the sump cross-section and be similar to the present baffle - and in particular would be provided with one or more drainage apertures 13. The spacing between adjacent horizontal baffles would be determined by the number of horizontal baffles, and by the overall depth of the sump extension and lower sump. Use of two or more horizontal baffles would further reduce the flow of oil from the sump when the oil is subjected to movement due to the pitch and/or roll of the vessel in which the engine is mounted. In addition, the apertures in different horizontal baffles could be offset from one another, to further obstruct the flow of oil from the sump if the vessel in which the engine is mounted overturns, or nearly overturns.

[0050] As a further example, more vertical baffles than shown in the figures could be provided, and this also would further reduce the flow of oil from the sump if the vessel in which the engine is mounted pitches and/or rolls.

Claims

1. A marine engine, comprising:

an engine superstructure; and
an oil sump for collecting oil from the engine superstructure;

wherein at a least a first baffle extending generally horizontally and a second baffle extending generally vertically are provided in the oil sump to reduce displacement of oil contained in the sump as the orientation of the engine varies.

2. An engine as claimed in claim 1 wherein a third baffle extending generally vertically is provided in the oil sump, the third baffle being generally crossed with the second baffle.

3. An engine as claimed in claim 1 or 2, wherein an external perimeter of the first baffle substantially corresponds to the internal cross-section of the oil sump, at least one aperture being provided in the first baffle.

4. An engine as claimed in claim 3 wherein at least a portion of the upper surface of the first baffle is inclined downwardly towards the at least one aperture.

5. An engine as claimed in claim 3 or 4 when dependent from claim 3, wherein a downwardly extending wall is provided on a lower surface of the first baffle, the wall enclosing the circumference of the at least one aperture.

6. An engine as claimed in any preceding claim 1, wherein the second baffle extends from a first internal face of the sump to an opposite internal face of the oil sump.

7. An engine as claimed in claim 2, or in any one of claims 3 to 6 when dependent from claim 2, wherein the third baffle extends from a second internal face of the oil sump to an opposite internal face of the oil sump.

8. An engine as claimed in any preceding claim 1 wherein the oil sump comprises a sump base portion and a sump extension portion disposed between the sump base portion and the engine superstructure.

9. A vehicle comprising an engine as defined in any one of claims 1 to 8.

10. A vehicle as claimed in claim 9 wherein the vessel is an unmanned marine vessel.

11. A vehicle as claimed in claim 9 wherein the vessel is a remotely-operated marine vessel.

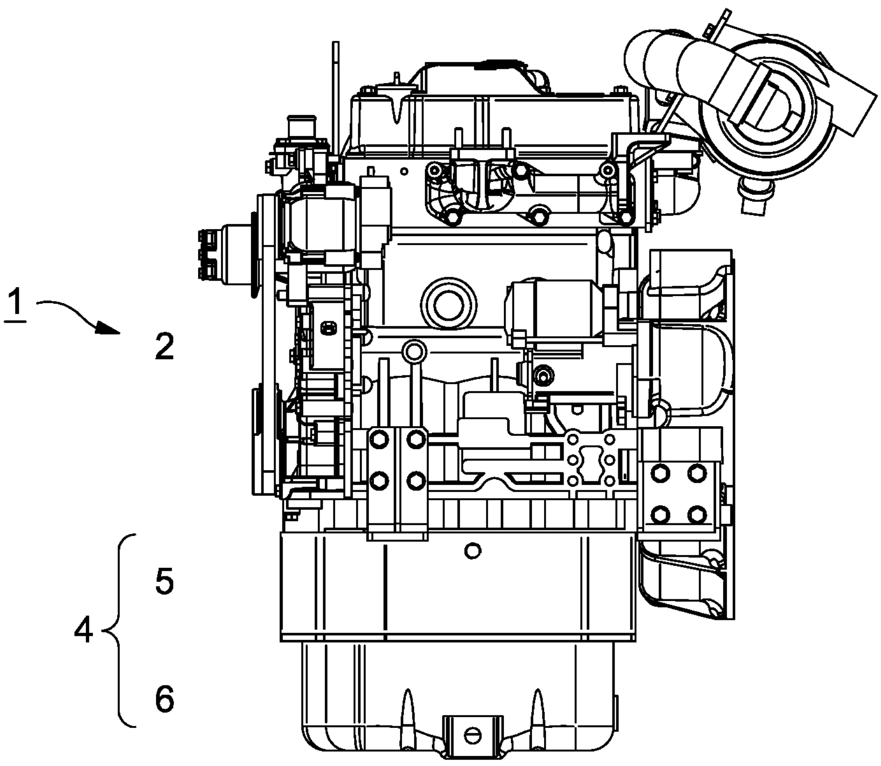

Fig. 1

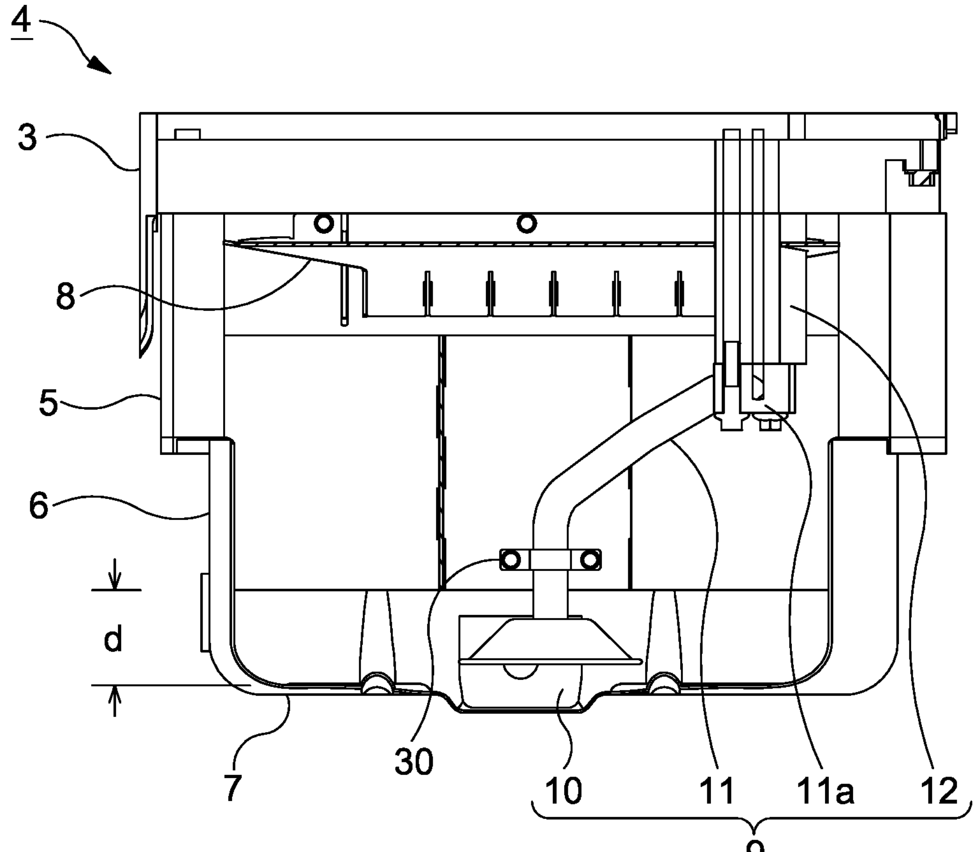

Fig. 2

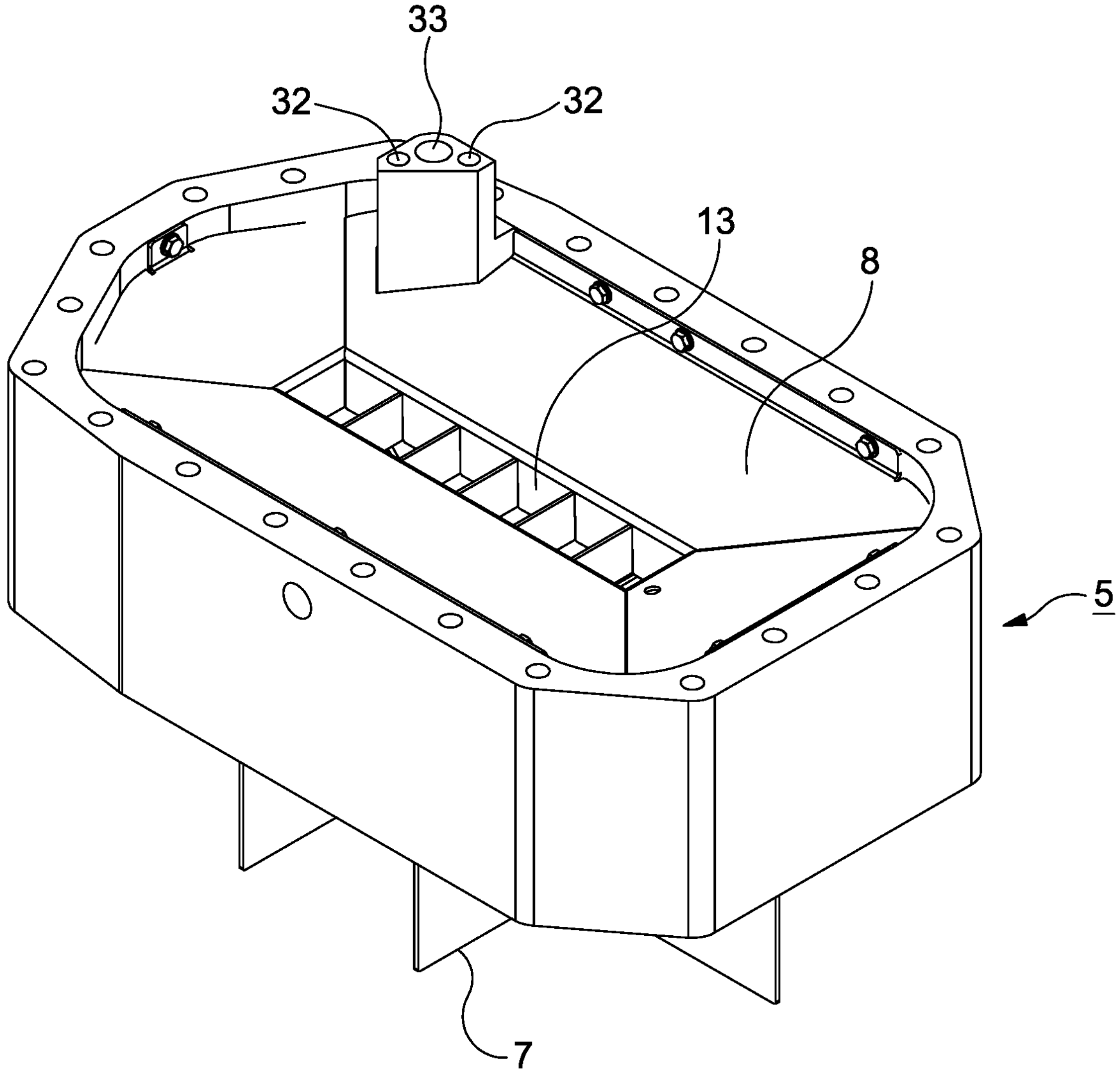

Fig. 3

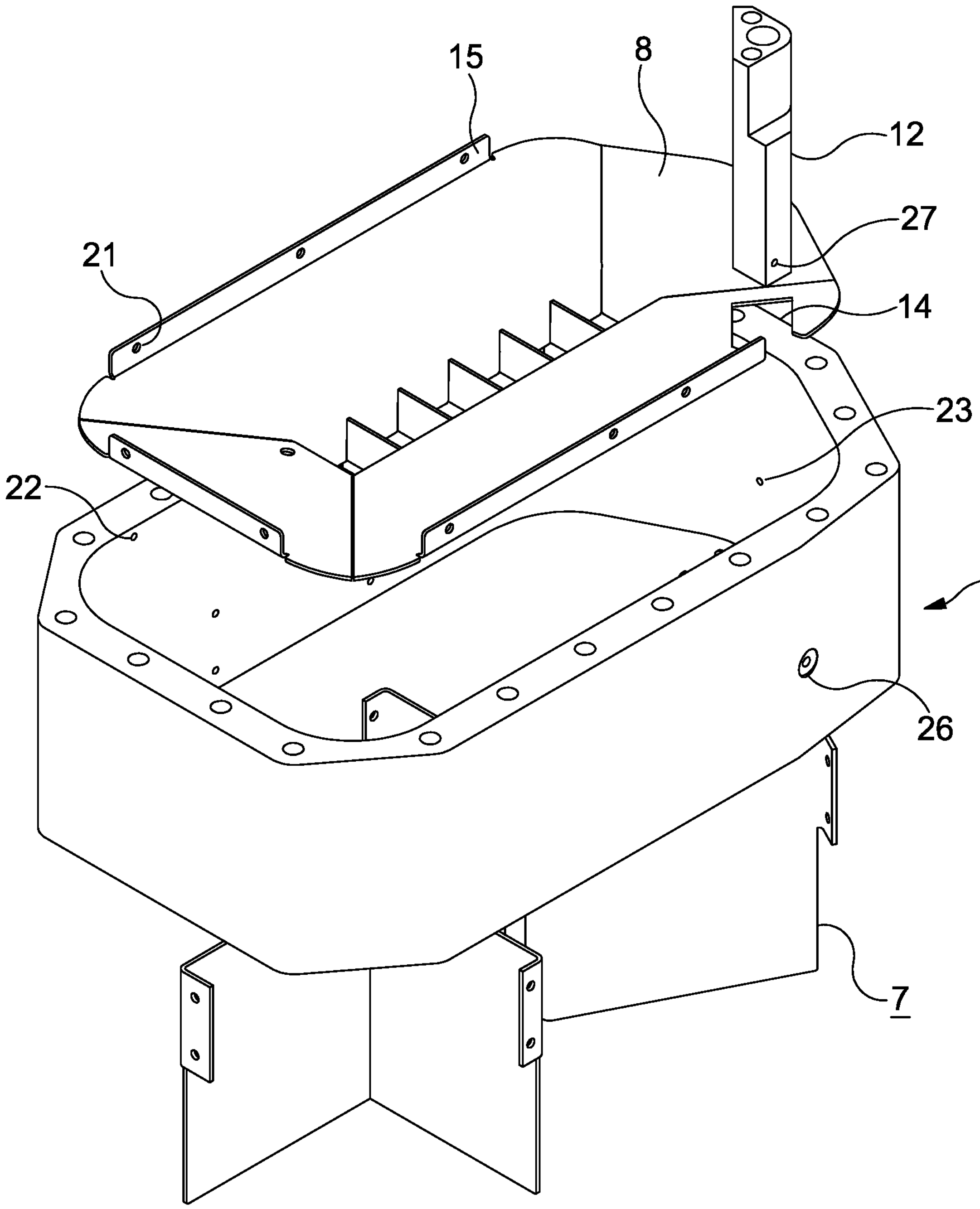

Fig. 4

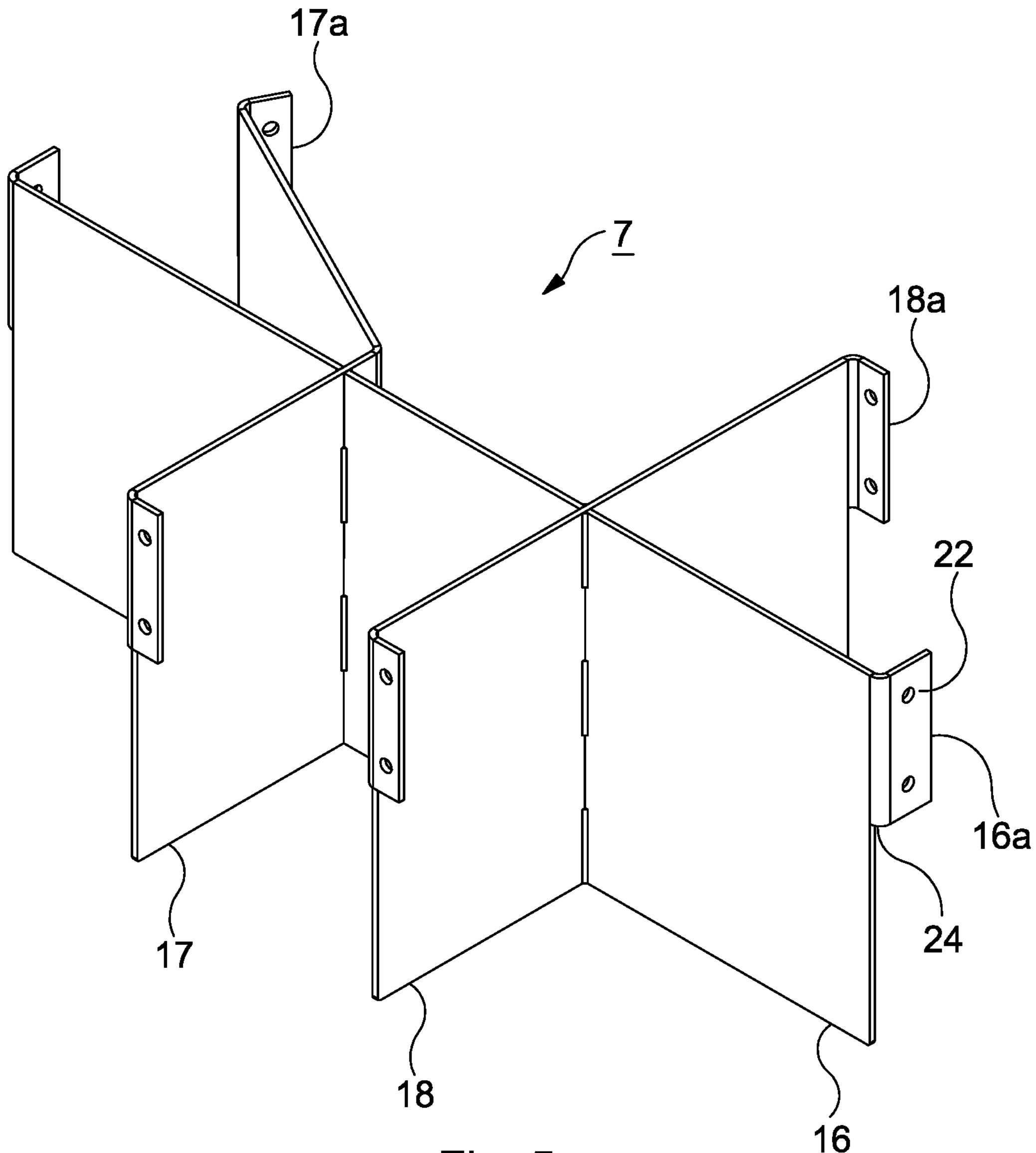

Fig. 5

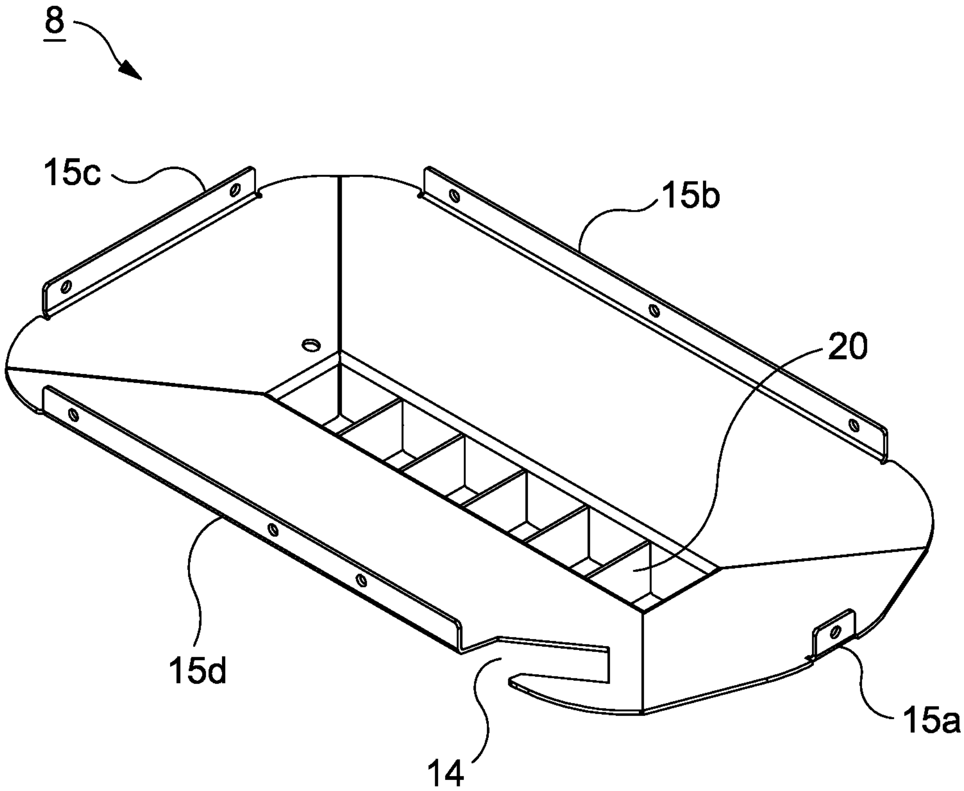

Fig. 6

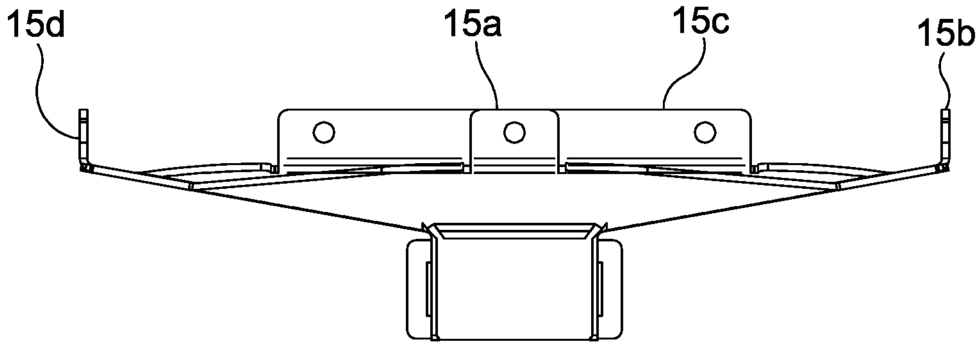

Fig. 7

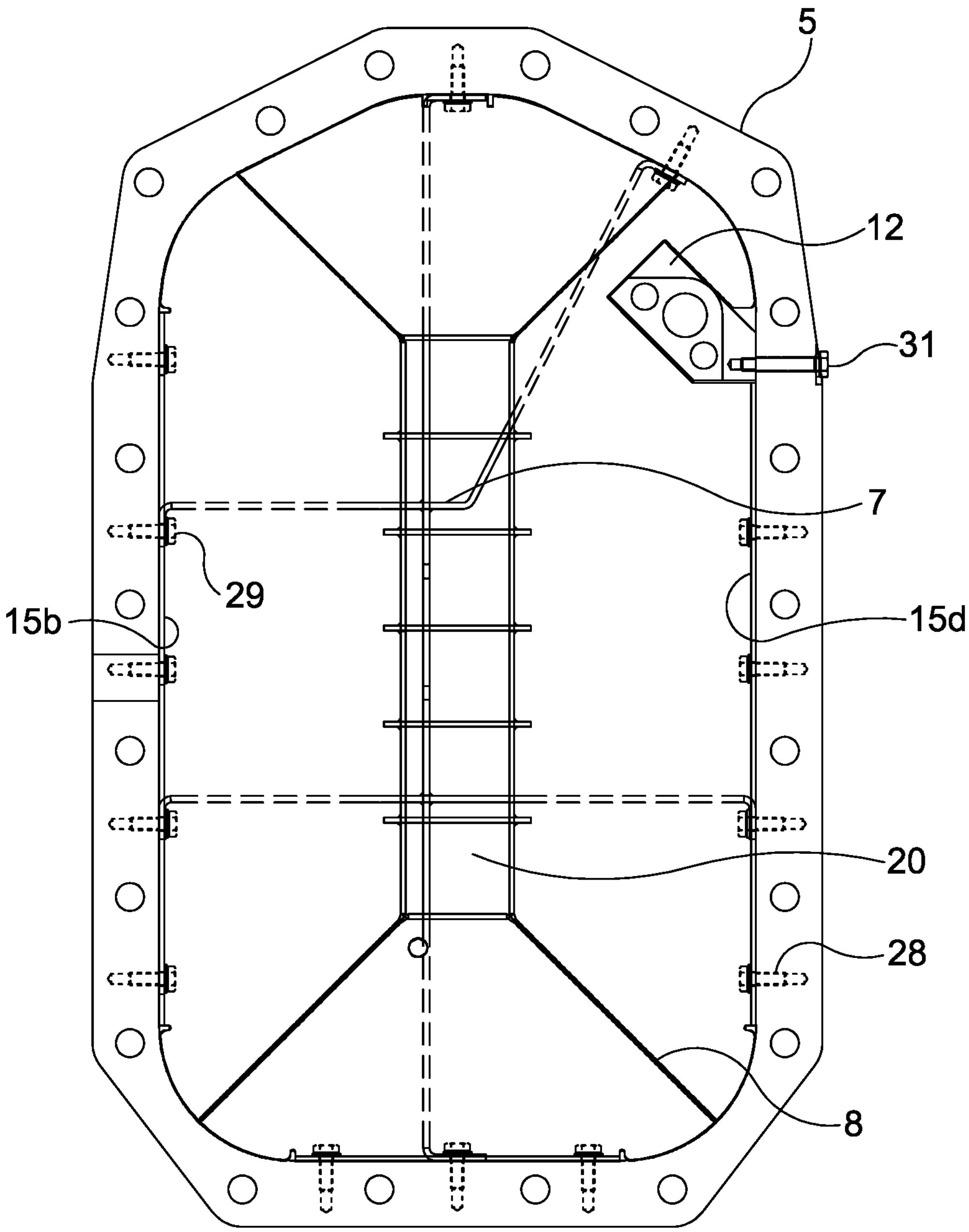

Fig. 8

Europäisches Patentamt
European Patent Office
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EUROPEAN SEARCH REPORT

Application Number
EP 16 16 9800

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 Y	DE 196 21 603 A1 (MTU FRIEDRICHSHAFEN GMBH [DE]) 4 December 1997 (1997-12-04) * the whole document * -----	1,3,6, 9-11 2,4,5,7	INV. F01M11/00 F01M11/06
Y	JP S63 26756 U (FUJITSU) 22 February 1988 (1988-02-22) * figures 1,2 * -----	4,5	
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