



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
19.09.2018 Bulletin 2018/38

(51) Int Cl.:
F01M 11/00 (2006.01)

(21) Application number: **16864363.3**

(86) International application number:
PCT/JP2016/083560

(22) Date of filing: **11.11.2016**

(87) International publication number:
WO 2017/082402 (18.05.2017 Gazette 2017/20)

(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 RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

(30) Priority: **12.11.2015 JP 2015222131**

(71) Applicant: **Isuzu Motors Limited**
Shinagawa-ku
Tokyo 140-8722 (JP)

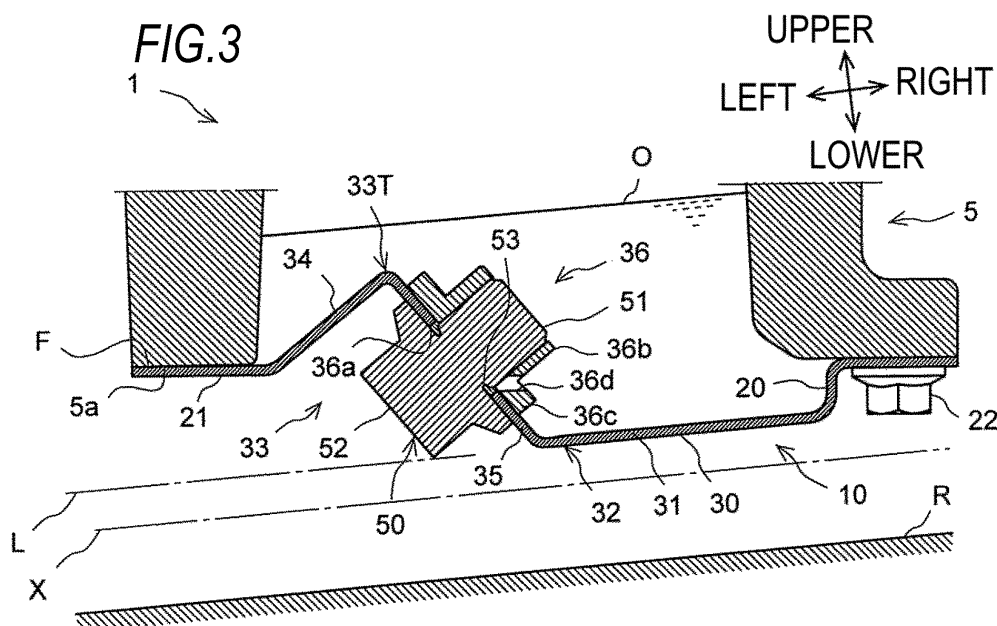
(72) Inventors:
• **MAEDA, Takaya**
Fujisawa-shi, Kanagawa 252-0881 (JP)
• **MIZUKAMI, Naoki**
Fujisawa-shi, Kanagawa 252-0881 (JP)
• **MATSUNAGA, Tsutomu**
Fujisawa-shi, Kanagawa 252-0881 (JP)
• **KITSUKAWA, Isao**
Fujisawa-shi, Kanagawa 252-0881 (JP)

(74) Representative: **Miller Sturt Kenyon**
9 John Street
London WC1N 2ES (GB)

(54) **OIL PAN DEVICE**

(57) An oil pan device (1) is provided with an oil pan (10) that is attached to a lower end (5a) of a crankcase (5) of an engine, and a drain bolt (50). The oil pan (10) includes a recessed portion (33) formed by recessing a bottom surface portion (32) upward, an inclined portion

(35) that sections the recessed portion (33), and a bolt hole (36) that is provided in the inclined portion (35), and when the drain bolt (50) is attached to the bolt hole (36), a head portion (52) of the drain bolt (50) is accommodated in the recessed portion (33).



Description

TECHNICAL FIELD

[0001] This disclosure relates to an oil pan device and particularly relates to oil pan device used in an engine of a vehicle.

BACKGROUND ART

[0002] In an engine of a vehicle, an oil pan for storing engine oil is attached to a lower end of a crankcase. Generally, a bolt hole for discharging engine oil is provided in the bottom portion of the oil pan, and a drain bolt for closing the bolt hole is detachably attached to this bolt hole.

Citation List

Patent Literature

[0003] [Patent Literature 1]: Japanese Unexamined Patent Application Publication No. H5-306653

SUMMARY

Technical Problem

[0004] In a vehicle, from the viewpoint of improving steering stability and the like, there is a demand for lowering the mounting position of an engine. On the other hand, in a case where the height position of a bottom portion of an oil pan is lowered, for example, the height position may be lower than a predetermined lower limit height such as minimum ground clearance of a vehicle, and thus it has been considered to employ a thin (shallow plate) oil pan.

[0005] In a case where a thin oil pan is used, the head portion of a drain bolt protrudes downwardly from the lowermost end position of the oil pan bottom portion, which is disadvantageous in securing a predetermined lower limit height. Thus, a method of recessing the bottom portion of the oil pan upward to form a recessed portion and uprightly attaching the drain bolt in the recessed portion is considered.

[0006] However, in the method, when engine oil is discharged, a relatively large amount of engine oil remains in the oil pan around the bolt hole.

[0007] This disclosure is made in consideration of the above circumstances and provides an oil pan device capable of reducing the amount of oil remaining in an oil pan when engine oil is discharged.

Solution to Problem

[0008] An oil pan device according to this disclosure includes an oil pan that is attached to a lower end of a crankcase of an engine, and a drain bolt, wherein the oil

pan includes a recessed portion formed by recessing a bottom surface portion upward, an inclined portion that sections the recessed portion, and a bolt hole that is provided in the inclined portion, and when the drain bolt is attached to the bolt hole, a head portion of the drain bolt is accommodated in the recessed portion.

[0009] In the oil pan device, a top portion of the recessed portion may be arranged at a position higher than an attachment surface of the oil pan with the crankcase.

[0010] In the oil pan device, the recessed portion may be formed in a reversed V shape in a cross-sectional view.

Advantageous Effects

[0011] According to the oil pan device of this disclosure, it is possible to reduce the amount of oil remaining in the oil pan when engine oil is discharged.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

FIG. 1 is a schematic view illustrating a bottom surface side of an oil pan device according to an embodiment of this disclosure.

FIG. 2 is a cross-sectional view taken along line II-II of FIG. 1.

FIG. 3 is a cross-sectional view taken along line III-III of FIG. 1.

FIG. 4A is a view illustrating a level of oil remaining in the embodiment of this disclosure.

FIG. 4B is a view illustrating a level of oil remaining in a case where a drain bolt is uprightly attached in a recessed portion without an inclined portion.

DESCRIPTION OF EMBODIMENTS

[0013] Hereinafter, an oil pan device according to an embodiment of this disclosure will be described based on the accompanying drawings. In the embodiment described below, the oil pan device is in a state in which the oil pan device is mounted on an engine of a vehicle (not illustrated), and the up-and-down direction is determined based on the up-and-down direction of the vehicle.

[0014] FIG. 1 is a schematic view illustrating a bottom surface side of an oil pan device 1 according to an embodiment of this disclosure. FIG. 2 is a cross-sectional view taken along line II-II of FIG. 1.

[0015] In FIG. 2, a reference numeral R indicates a road surface. In FIG. 3, a dashed line L indicates the lowermost end position of a head portion 52 of a drain bolt 50, and a two-dot chain line X indicates the minimum ground clearance of a vehicle. In the embodiment, the engine is arranged inclined to a cylinder axis so as to be slightly inclined in the vertical direction. Therefore, in FIGS. 2 and 3, in appearance, the oil surface of engine oil O seems to be inclined to a road surface R in the left-

and-right direction.

[0016] In these drawings, the front-and-rear and left-and-right directions of the oil pan device 1 are not related with the front-and-rear and left-and-right directions of a vehicle and are merely determined for convenience of explanation. In the embodiment, the front direction of an oil pan 10 coincides with the front direction of a vehicle.

[0017] As illustrated in FIGS. 1 to 3, the oil pan device 1 includes the oil pan 10 that is attached to a lower end 5a of a crankcase 5 and a drain bolt 50.

[0018] The oil pan 10 is formed of a metal material or a heat resistant resin material and includes a side wall 20 forming a side surface and a bottom plate 30 forming a bottom surface. Inside the oil pan 10, engine oil O for lubricating a lubrication target member such as a crank shaft (not illustrated) is stored. In the embodiment, the oil pan 10 is formed of a thin (shallow plate) oil pan in which the length of the side wall 20 in the up-and-down direction is short.

[0019] In the upper end portion of the side wall 20, a flange portion 21 which is attached to the lower end 5a of the crankcase 5 via a gasket (not illustrated) is provided. The flange portion 21 is detachably attached to the lower end 5a of the crankcase 5 by a bolt 22 or the like.

[0020] The bottom plate 30 includes a flat plate portion 31 formed in a flat plate shape, and the recessed portion 33 by recessing the bottom surface portion 32 (lower surface) upward. This recessed portion 33 is formed at a portion ahead of the left half of the bottom plate 30.

[0021] In the embodiment, particularly, the recessed portion 33 has a top portion 33T at a position higher than a position of an attachment surface F (the upper surface of the flange portion 21) of the oil pan 10 with the crankcase 5 (lower end 5a). As illustrated in FIG. 3, the recessed portion 33 is formed in a reversed V shape in a cross-sectional view.

[0022] More specifically, the recessed portion 33 is formed by partially recessing the bottom surface portion 32 in a cylindrical shape. The portion 33 having a recessed partially cylindrical shape has a first inclined portion 34 formed in a cylindrical circumferential surface shape and a second inclined portion 35 formed in a cylindrical end surface shape. In the embodiment, a bolt hole 36 is vertically provided in the second inclined portion 35.

[0023] The bolt hole 36 has a through-hole 36a passing through the second inclined portion 35, and a nut portion 36b arranged in the oil pan 10 and coaxially provided with the through-hole 36a. A flange 36c is formed at the end portion of the nut portion 36b on the second inclined portion 35 side and is fixed to the second inclined portion 35 by welding or the like.

[0024] In the bolt hole 36, a lateral hole 36d is formed at the interfacial position between the nut portion 36b and the flange 36c. The lateral hole 36d is inclined to the axis of the bolt hole 36 and passes through the interface substantially horizontally from the lowermost end position of the through-hole 36a to the interfacial position.

[0025] The drain bolt 50 is detachably attached to the bolt hole 36 from the outside of the oil pan 10. Specifically, the drain bolt 50 has a screw portion 51 and a head portion 52, and the screw portion 51 is engaged with the bolt hole 36 by screwing. An O ring 53 for sealing a gap between the screw portion and the inner circumferential surface of the through-hole 36a is attached to the root portion of the screw portion 51.

[0026] The oil pan device 1 of the embodiment is configured such that when the drain bolt 50 is attached to the bolt hole 36, the head portion 52 is accommodated in the recessed portion 33. A height position L of the lowermost end of the oil pan device 1 (here, the head portion 52 of the drain bolt 50) is positioned above a predetermined lower limit height of a vehicle and in the embodiment, a minimum ground clearance X.

[0027] Next, the action effect of the oil pan device 1 of the embodiment will be described base on FIGS. 3, 4A and 4B. FIG. 4A illustrates a level of oil remaining when the engine oil O is discharged by detaching the drain bolt 50 from the bolt hole 36 in the oil pan device 1 of the embodiment illustrated in FIG. 3. FIG. 4B illustrates a level of oil remaining in a configuration in which a drain bolt is uprightly attached in a recessed portion in an oil pan device 1' of Comparative Example without an inclined portion.

[0028] In the embodiment, as illustrated in FIG. 4A, when the drain bolt 50 is detached from the bolt hole 36, the engine oil O is discharged to the outside from the horizontal hole 36d. Thus, the lower end position (the height position indicated by the dashed line Z1) of the horizontal hole 36d of the bolt hole 36 is a level of oil remaining.

[0029] On the other hand, as illustrated in FIG. 4B, in the oil pan device 1' of Comparative Example, the lower end portion (the height position indicated by the dashed line Z2) of an opening of a horizontal hole 36d' of a bolt hole 36' in the oil pan 10' is a level of oil remaining. In Comparative Example, the level of oil remaining (Z2) is positioned higher than the level of oil remaining (Z1) of the embodiment.

[0030] Accordingly, in the embodiment, by providing the bolt hole 36 in the second inclined portion 35, the amount of oil remaining can be reduced by the amount corresponding to (Z2 - Z1).

[0031] In the embodiment, as illustrated in FIG. 3, the recessed portion 33 formed by recessing the bottom surface portion 32 upward is provided and the head portion 52 of the drain bolt 50 is accommodated in the recessed portion 33. As a result, it is possible to prevent the head portion 52 from protruding from the bottom surface portion 32 to the road surface R side, which is advantageous in lowering the engine mounting position.

[0032] The top portion 33T of the recessed portion 33 of the embodiment is arranged oil pan 10 at a position higher than the position of the attachment surface F with the crankcase 5. Therefore, even in a case of using a thin oil pan to meet the minimum ground clearance X as

a lower limit level, a space for accommodating the head portion 52 can be sufficiently secured.

[0033] In the embodiment, by providing the bolt hole 36 in the second inclined portion 35, an operation of attachment (detachment) of the drain bolt 50 can be easily performed using a longer spanner or wrench to which force is more easily applicable.

[0034] This disclosure is not intended to be limited to the embodiments described above and may be appropriately modified present disclosure within the range not departing from the scope of this disclosure.

[0035] For example, in the embodiment, the recessed portion is partially recessed in a cylindrical shape, but the shape of the recessed portion may have other shapes. For example, the recessed portion may be formed in a substantially hemispherical shape.

[0036] The present application is based on the Japanese patent application (JP2015-222131) filed on November 12, 2015, the contents of which are incorporated herein by reference.

Industrial Applicability

[0037] According to the oil pan device of this disclosure, it is possible to reduce the amount of oil remaining in an oil pan when engine oil is discharged.

Reference Signs List

[0038]	30
1: oil pan device	
5: crankcase of engine	
10: oil pan	
32: bottom surface portion	35
33: recessed portion	
35: (second) inclined portion	
36: bolt hole	
50: drain bolt	
52: head portion	40

Claims

1. An oil pan device comprising:
 - an oil pan that is attached to a lower end of a crankcase of an engine; and
 - a drain bolt,
 wherein the oil pan includes:
 - a recessed portion formed by recessing upwardly a bottom surface portion;
 - an inclined portion that sections the recessed portion; and
 - a bolt hole that is provided in the inclined portion, and

when the drain bolt is attached to the bolt hole, a head portion of the drain bolt is accommodated in the recessed portion.

2. The oil pan device according to claim 1, wherein a top portion of the recessed portion is arranged at a position higher than an attachment surface of the oil pan with the crankcase.
3. The oil pan device according to claim 1, wherein the recessed portion is formed in a reversed V shape in a cross-sectional view.
4. The oil pan device according to claim 2, wherein the recessed portion is formed in a reversed V shape in a cross-sectional view.

FIG. 1

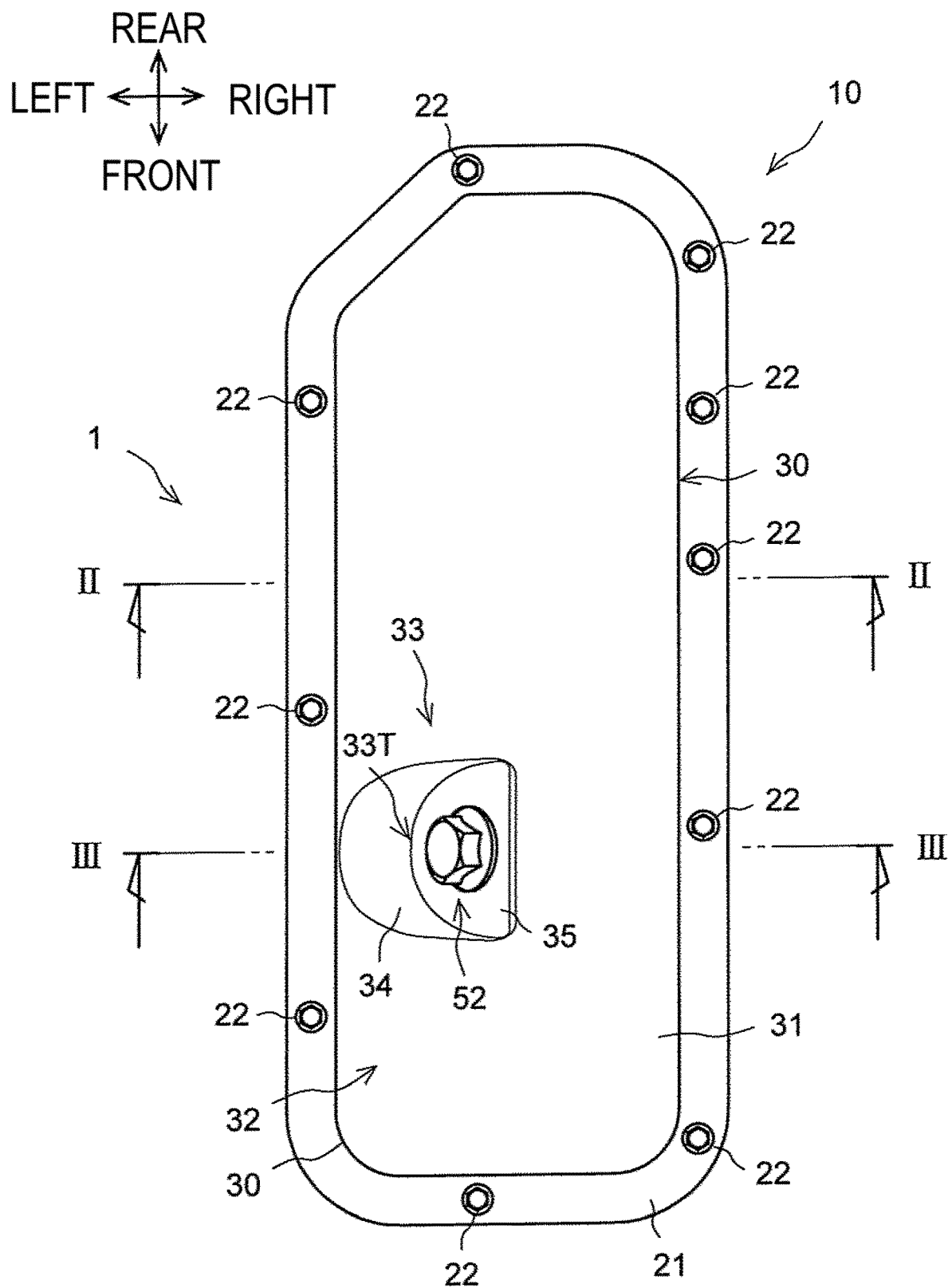


FIG.2

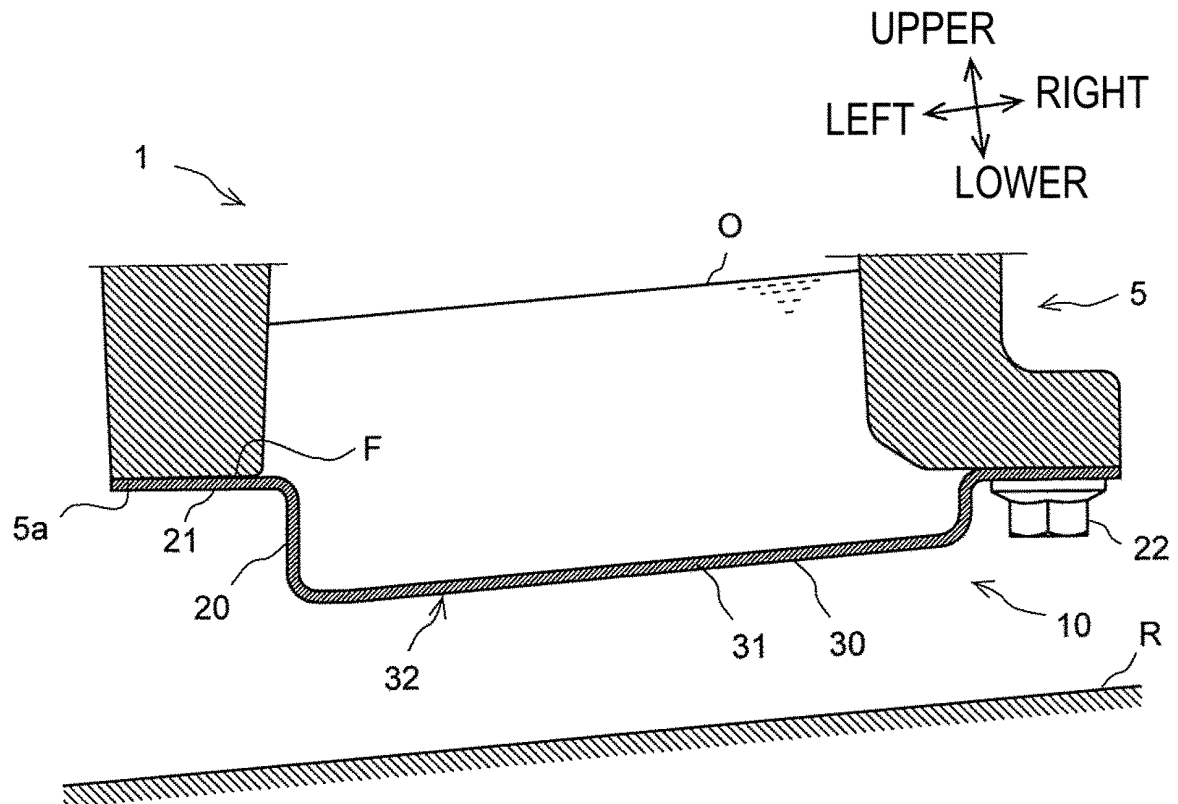


FIG.3

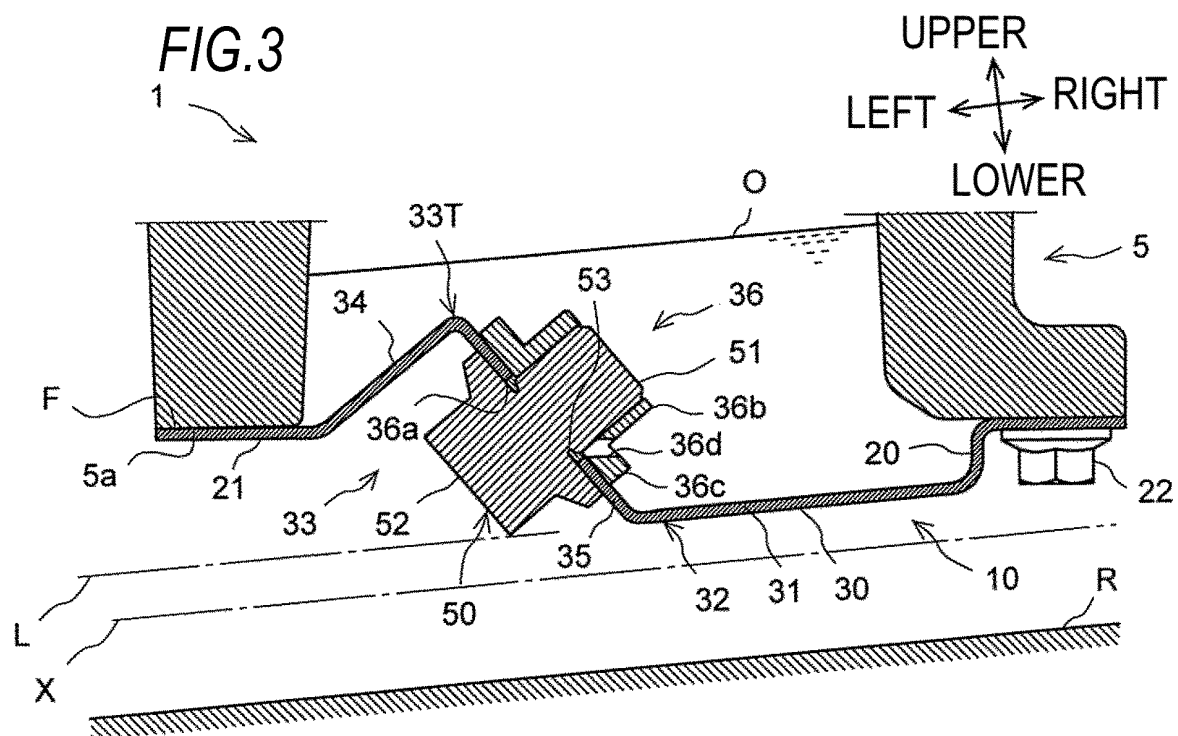


FIG.4A

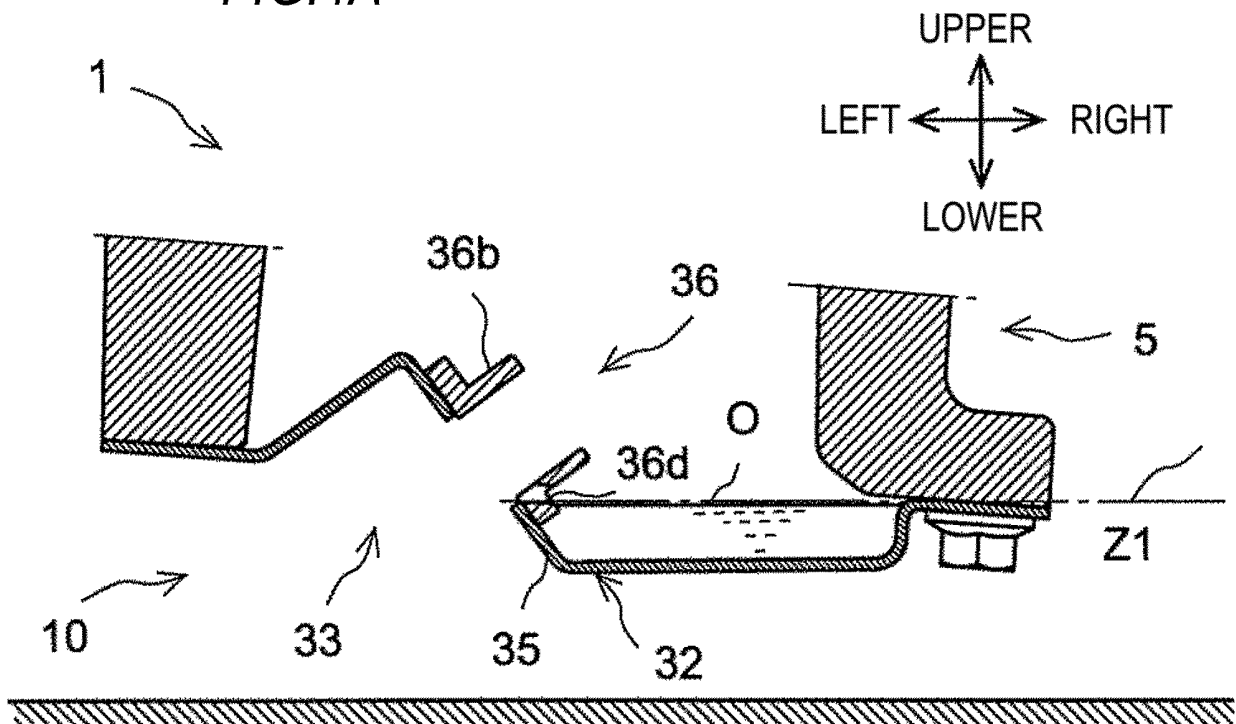
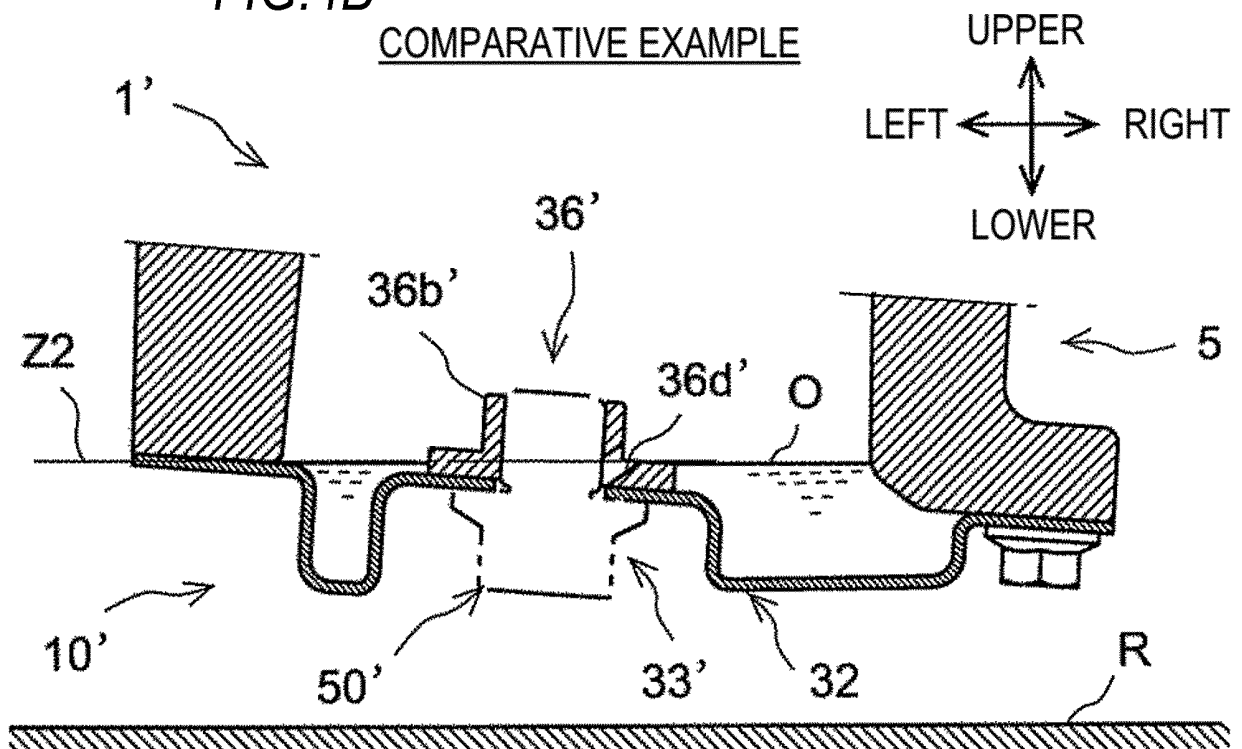


FIG.4B

COMPARATIVE EXAMPLE



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2016/083560

A. CLASSIFICATION OF SUBJECT MATTER

F01M11/00(2006.01) i

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)

F01M11/00-12

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2017
 Kokai Jitsuyo Shinan Koho 1971-2017 Toroku Jitsuyo Shinan Koho 1994-2017

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	WO 2014/079591 A1 (MANN+HUMMEL GMBH), 30 May 2014 (30.05.2014), page 8, line 29 to page 10, line 3; fig. 1 & EP 2923045 A1	1, 3 2, 4
X A	JP 2009-236091 A (Mazda Motor Corp.), 15 October 2009 (15.10.2009), paragraphs [0028] to [0029]; fig. 1, 4 (Family: none)	1, 3 2, 4
A	JP 2012-047092 A (Daihatsu Motor Co., Ltd.), 08 March 2012 (08.03.2012), paragraphs [0019] to [0025]; fig. 1 to 6 (Family: none)	1-4

☒ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"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

"Y"

document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&"

document member of the same patent family

 Date of the actual completion of the international search
 18 January 2017 (18.01.17)

 Date of mailing of the international search report
 31 January 2017 (31.01.17)

 Name and mailing address of the ISA/
 Japan Patent Office
 3-4-3, Kasumigaseki, Chiyoda-ku,
 Tokyo 100-8915, Japan

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2016/083560

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2015-194115 A (Daihatsu Motor Co., Ltd.), 05 November 2015 (05.11.2015), fig. 1 to 4 (Family: none)	1-4
A	JP 2004-211597 A (Honda Motor Co., Ltd.), 29 July 2004 (29.07.2004), fig. 1 to 4 (Family: none)	1-4
A	JP 6-147008 A (Toyoda Automatic Loom Works, Ltd.), 27 May 1994 (27.05.1994), fig. 1(a), 2 (Family: none)	1-4

Form PCT/ISA/210 (continuation of second sheet) (January 2015)

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

- JP H5306653 B [0003]
- JP 2015222131 A [0036]