

(19)



(11)

EP 2 657 496 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:

30.10.2013 Bulletin 2013/44

(51) Int Cl.:

F02F 7/00 (2006.01)**F02F 1/24** (2006.01)(21) Application number: **12185820.3**(22) Date of filing: **25.09.2012**

(84) Designated Contracting States:

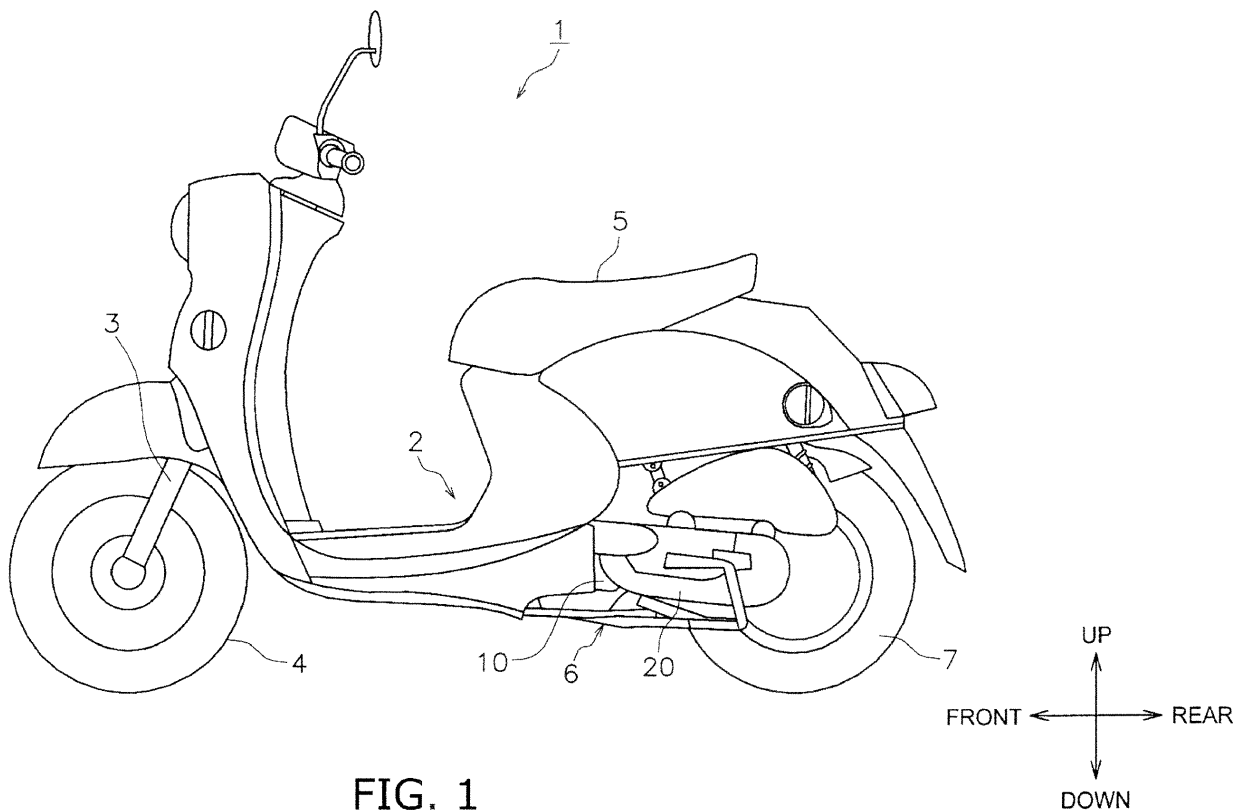
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

Designated Extension States:

BA ME(30) Priority: **27.04.2012 JP 2012103612**(71) Applicant: **Yamaha Hatsudoki Kabushiki Kaisha Iwata-shi, Shizuoka 438-8501 (JP)**(72) Inventor: **Yamamoto, Kensuke****Iwata-shi, Shizuoka 438-8501 (JP)**(74) Representative: **Grünecker, Kinkeldey,****Stockmair & Schwanhäusser****Leopoldstrasse 4****80802 München (DE)****(54) Engine and Saddle-Ride Type Vehicle**

(57) It is an object of the present invention to inhibit engine noise. A cylinder head cover (18) has a cover main body (181), a convex portion (182), a first rib (185), a second rib (186) and a third rib (187). The first rib (185)

is extended along a boundary (T) between the cover main body (181) and the convex portion (182). The second and third ribs (186, 187) are respectively coupled to the first rib (185) on the opposite side of the convex portion (182) through the first rib (185).

**FIG. 1****EP 2 657 496 A1**

Description

TECHNICAL FIELD

[0001] The present invention relates to an engine including a cylinder head cover and a saddle-ride type vehicle.

BACKGROUND ART

[0002] A method of forming a recess on a cylinder head cover side end portion of a cylinder head for accommodating a camshaft has been proposed so far in order to enhance the maintenance performance of the camshaft (see Japan Laid-open Patent Application Publication No. JP-A-2008-025451). In the publication No. JP-A-2008-025451, a seal member to be fitted into the recess of the cylinder head is attached to the cylinder head cover.

[0003] However, the method of the publication No. JP-A-2008-25451 has a drawback that noise is produced from an engine due to vibration of the seal member fitted into the recess of the cylinder head.

[0004] It is an object of the present invention to inhibit engine noise.

SUMMARY

[0005] An engine according to a first aspect of the present invention includes a crankcase, a cylinder body, a cylinder head, a cylinder head cover and a camshaft. The crankcase accommodates a crankshaft. The cylinder body is coupled to the crankcase. The cylinder head is coupled to the cylinder body. The cylinder head cover is coupled to the cylinder head. The camshaft is disposed in a space between the cylinder head and the cylinder head cover. The cylinder head includes a recessed portion formed on a cylinder head cover side end of the cylinder head. The recessed portion makes the camshaft at least partially viewable therethrough. The cylinder head cover includes a cover main body, a convex portion and first to third ribs. The cover main body covers the cylinder head. The convex portion is fitted into the recessed portion while being protruded from the cover main body towards the cylinder head. The convex portion is integrally formed with the cover main body. The first rib is extended in a first direction while being formed on a lateral surface of the cover main body along a boundary between the cover main body and the convex portion. The second and third ribs are connected on the lateral surface to the first rib on an opposite side of the convex portion through the first rib.

[0006] According to the engine of the first aspect of the present invention, it is possible to reduce vibration to be caused by minute undulation and/or torsion of the convex portion. Therefore, noise can be inhibited from being produced from the engine. Further, the convex portion is integrally formed with the cover main body. The cylinder

head cover can be thereby manufactured using, for instance, a casting mold. Therefore, it is possible to reduce the number of manufacturing steps and manufacturing cost, compared to the case that the cover member and the convex portion are separately fabricated.

[0007] In the engine according to a second aspect of the present invention, at least either of the second and third ribs is extended on the lateral surface from the first rib to the opposite side of the convex portion.

[0008] According to the engine of the second aspect of the present invention, the first rib can be rigidly supported by the second and third ribs. Therefore, vibration of the convex portion can be further reduced.

[0009] In the engine according to a third aspect of the present invention, the convex portion includes first and second end portions in the first direction. The second rib is disposed on an opposite side of the first end portion through the first rib. The third rib is disposed on an opposite side of the second end portion through the first rib.

[0010] According to the engine of the third aspect of the present invention, both of the end portions of the convex portion can be rigidly fixed. Therefore, vibration of the convex portion can be further reduced.

[0011] An engine according to a fourth aspect of the present invention relates to the engine according to one of the first to third aspects of the present invention. In the engine, the convex portion has a semi-circular shape in a plan view of the lateral surface.

[0012] An engine according to a fifth aspect of the present invention relates to the engine according to one of the first to fourth aspects of the present invention. In the engine, the first, second and third ribs are respectively integrally formed with the cover main body.

[0013] According to the engine of the fifth aspect of the present invention, the first to third ribs can be fabricated together with the cover main body using, for instance, a casting mold. Therefore, it is possible to reduce the number of manufacturing steps and manufacturing cost, compared to the case that the cover main body and the first to third ribs are separately fabricated.

[0014] A saddle-ride type vehicle according to a sixth aspect of the present invention includes the engine according to one of the first to fifth aspects of the present invention and a vehicle body frame supporting the engine.

[0015] Overall, according to the present invention, it is possible to provide an engine and a saddle-ride type vehicle whereby noise production can be inhibited.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] Referring now to the attached drawings which form a part of this original disclosure:

[0017] FIG 1 is a side view of a saddle-ride type vehicle 1;

[0018] FIG 2 is a cross-sectional view of an engine unit sectioned along a horizontal plane;

[0019] FIG 3 is a cross-sectional view of the engine

unit sectioned along a vertical plane;

[0020] FIG 4 is a side view of a structure of a cylinder head;

[0021] FIG 5 is a side view of a structure of a cylinder head cover;

[0022] FIG. 6 is a perspective view of the structure of the cylinder head cover;

[0023] FIG 7 is a side view of another structure of the cylinder head cover; and

[0024] FIG 8 is a side view of yet another structure of the cylinder head cover

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0025] Next, an exemplary embodiment of the present invention will be explained using figures. In the following description of the figures, the same or similar reference numeral is given to the same or similar elements. It should be noted that the figures are schematic only and respective dimensional ratios and etc. of the figures may be different from actual ones. Therefore, specific dimensions and etc. should be judged in view of the following explanation. Further, it is apparent that dimensional relations and ratios of corresponding parts/portions/sections are different among the figures.

(Schematic Structure of Saddle-Ride Type Vehicle 1)

[0026] A schematic structure of a saddle-ride type vehicle 1 according to an exemplary embodiment of the present invention will be hereinafter explained with reference to the figures. It should be noted in the present exemplary embodiment that "a back-and-forth direction" refers to a vehicle longitudinal direction seen from a rider seated on a seat 5 to be described unless particularly explained. "A right-and-left direction" refers to a vehicle transverse direction seen from a rider seated on the seat 5. "An up-and-down direction" refers to a vertical direction.

[0027] FIG. 1 is a side view of the saddle-ride type vehicle 1 according to the present exemplary embodiment. The saddle-ride type vehicle 1 is a scooter-type motorcycle. The saddle-ride type vehicle 1 includes a vehicle body 2, a front fork 3, a front wheel 4, the seat 5, an engine unit 6 and a rear wheel 7.

[0028] The vehicle body 2 includes a vehicle body frame and a vehicle body cover. The vehicle body frame supports the engine unit 6, whereas the vehicle body cover covers the vehicle body frame. The front fork 3 supports the front wheel 4 in a rotatable state. The seat 5 is disposed on the vehicle body 2 while being disposed behind the front fork 3.

[0029] The engine unit 6 is disposed under the seat 5. The engine unit 6 is pivotably supported by the vehicle body frame through a bracket (not illustrated in the figures). The engine unit 6 includes an engine 10 and a transmission case 20. In the present exemplary embod-

iment, a water-cooled 4-cycle single-cylinder SOHC (Single OverHead Camshaft) engine is exemplified as the engine 10. However, any type of SOHC engine may be employed as the engine 10. The transmission case 20 supports the rear wheel 7 in a rotatable state.

(Structure of Engine Unit 6)

[0030] Next, a structure of the engine unit 6 will be explained with reference to the figures. FIG. 2 is a cross-sectional view of the engine 10 sectioned along a horizontal plane. FIG 3 is a cross-sectional view of the engine unit 6 where the engine 10 is sectioned along a vertical plane.

[0031] The engine 10 includes a crankcase 11, a power generator 12, a crankshaft 13, a cylinder body 14, a piston 15, a connecting rod 16, a cylinder head 17, a cylinder head cover 18 and a valve train mechanism 19. Further, the transmission case 20 accommodates a V-belt automatic transmission 21, a centrifugal clutch 22 and a gear reducer 23.

[0032] The crankcase 11 is disposed in front of the rear wheel 7 while being coupled to the right side of the front end portion of the transmission case 20. The crankcase 11 accommodates the crankshaft 13.

[0033] The power generator 12 is disposed on the right side of the crankcase 11. The power generator 12 is configured to generate power by means of rotational force of the crankshaft 13.

[0034] The crankshaft 13 is disposed within the crankcase 11 along the right-and-left direction. The right end portion of the crankshaft 13 is coupled to the power generator 12, while the left end portion of the crankshaft 13 is coupled to the V-belt automatic transmission 21. Further, a driving sprocket 13a is attached to the crankshaft 13. A cam chain 14a to be described is wound about the driving sprocket 13a. The rotational force of the crankshaft 13 is transmitted to the rear wheel 7 through the V-belt automatic transmission 21, the centrifugal clutch 22 and the gear reducer 23 while being transmitted to the cam chain 14a through the driving sprocket 13a.

[0035] The cylinder body 14 is coupled to the front side of the crankcase 11. The cylinder body 14 accommodates the piston 15 and the connecting rod 16. The piston 15 is supported within the cylinder body 14 while being movable in a reciprocatory manner. The connecting rod 16 is coupled to the piston 15 and the crankshaft 13. The reciprocatory action of the piston 15 is transmitted to the crankshaft 13 through the connecting rod 16. Further, a cam chain compartment 14S is formed within the cylinder body 14 for accommodating the cam chain 14a. The rear end portion of the cam chain 14a is wound about the driving sprocket 13a, while the front end portion of the cam chain 14a is wound about a driven sprocket 19b to be described.

[0036] The cylinder head 17 is coupled to the front side of the cylinder body 14. The cylinder head cover 18 is coupled to the front side of the cylinder head 17. A cam

compartment 19S is formed within the cylinder head 17 and the cylinder head cover 18 for accommodating the valve train mechanism 19. The cam compartment 19S is an exemplary "space formed between a cylinder head and a cylinder cover". A structure of the cylinder head 17 and that of the cylinder head cover 18 will be described below.

[0037] The valve train mechanism 19 includes a camshaft 19a and the driven sprocket 19b. The camshaft 19a is disposed along the right-and-left direction. The driven sprocket 19b is attached to the left end portion of the camshaft 19a. The cam chain 14a is wound about the driven sprocket 19b.

(Structure of Cylinder Head 17)

[0038] Next, a structure of the cylinder head 17 will be explained with reference to the figures. FIG 4 is a side view of the structure of the cylinder head 17.

[0039] The cylinder head 17 has a cylinder body lateral end portion 171, a cover lateral end portion 172, a recessed portion 173, a lateral surface 174 and a flanged portion 175.

[0040] The cylinder body lateral end portion 171, corresponding to the rear end portion of the cylinder head 17, is coupled to the cylinder body 14. The cover lateral end portion 172, corresponding to the front end portion of the cylinder head 17, is coupled to the cylinder head cover 18.

[0041] The recessed portion 173 is formed on the cover lateral end portion 172. The recessed portion 173 is formed by partially cutting out the front end of the lateral surface 174. The recessed portion 173 is formed with an appropriate size in an appropriate position for making the camshaft 19a viewable from the outside of the cylinder head 17. In the present exemplary embodiment, the camshaft 19a is roughly entirely positioned inside the recessed portion 173 in a side view of the cylinder head 17. Therefore, the camshaft 19a can be pulled out to the outside from the recessed portion 173. It should be noted that the structure of the recessed portion 173 is not limited to the above. The recessed portion 173 is only required to be formed for making the camshaft 19a at least partially viewable in a side view of the cylinder head 17. In other words, as illustrated in FIG 4, the camshaft 19a is only required to be partially positioned within a viewable region r arranged between a front end line R1 indicating the front end of the recessed portion 173 and a rear end line R2 indicating the rear end of the recessed portion 173. Further, the recessed portion 173 is more preferably formed for making the driven sprocket 19b viewable from the outside of the cylinder head 17. With the recessed portion 173 structured as described above, easy and convenient access to the camshaft 19a, the driven sprocket 19b and the cam chain 14a can be implemented in executing a maintenance work of the valve train mechanism 19.

[0042] The lateral surface 174 is a surface arranged

roughly perpendicularly to the extended direction of the camshaft 19a (i.e., the right-and-left direction) and forms a part of the outer peripheral surface of the cylinder head 17. Therefore, an end of the camshaft 19a is disposed inside the recessed portion 173 as illustrated in FIG 4.

[0043] The flanged portion 175 is formed along the front end of the cover lateral end portion 172. The flanged portion 175 is coupled to the cylinder head cover 18 through a gasket to be described.

(Structure of Cylinder Head Cover 18)

[0044] Next, a structure of the cylinder head cover 18 will be explained with reference to the figures. FIG 5 is a side view of the structure of the cylinder head cover 18. FIG 6 is a perspective view of the structure of the cylinder head cover 18.

[0045] The cylinder head cover 18 has a cover main body 181, a convex portion 182, a first rib 185, a second rib 186 and a third rib 187.

[0046] The cover main body 181 is a lid-shaped member to be put on the cylinder head 17. The cover main body 181 has a flanged portion 181a, a lateral surface 183 and an opposed surface 184. The flanged portion 181a is fitted to the flanged portion 175. The gasket (not illustrated in the figures) is attached to the inside of the flanged portion 181a. The lateral surface 183 is a surface arranged roughly perpendicularly to the right-and-left direction and forms a part of the outer peripheral surface of the cover main body 181. Therefore, the lateral surface 183 is arranged roughly in parallel to the lateral surface 174 of the cylinder head 17. The opposed surface 184 is a surface opposed to the cylinder head 17. In a side view, the position of the opposed surface 184 is matched with that of a boundary line R5 indicating a boundary T.

[0047] The convex portion 182 has a semi-circular shape while being protruded towards the cylinder head 17 from the cover main body 181. The convex portion 182 is fitted into the recessed portion 173 of the cylinder head 17. In other words, the convex portion 182 functions as a cover for closing the recessed portion 173. In the present exemplary embodiment, the convex portion 182 is integrally formed with the cover main body 181 (specifically, the flanged portion 181a). FIG 5 depicts an upper end line R3 indicating an upper end 182a (an exemplary first end portion) of the convex portion 182, a lower end line R4 indicating a lower end portion 182b (an exemplary second end portion) of the convex portion 182, and the boundary line R5 indicating the boundary T between the cover main body 181 and the convex portion 182.

[0048] The first rib 185 is disposed on the lateral surface 183 of the cover main body 181. The first rib 185 is extended in the up-and-down direction (an exemplary first direction) along the boundary T between the cover main body 181 and the convex portion 182. In the present exemplary embodiment, the first rib 185 is entirely formed on the lateral surface 183 in the up-and-down direction. Therefore, the upper end of the first rib 185 is upwardly

extended across the second rib 186, whereas the lower end of the first rib 185 is downwardly extended across the third rib 187. It should be noted in the present exemplary embodiment that the first rib 185 is integrally formed with the cover main body 181.

[0049] The second rib 186 is disposed on the lateral surface 183 of the cover main body 181. The second rib 186 is coupled to the first rib 185 on the opposite side of the convex portion 182 through the first rib 185. The second rib 186 is extended from the first rib 185 to the opposite side of the convex portion 182 (i.e., to the forward). The second rib 186 has a rectangular outer contour in a side view. The second rib 186 is disposed perpendicularly to the first rib 185 in a side view. Further, the second rib 186 is disposed on the opposite side of the upper end portion 182a of the convex portion 182. Therefore, the second rib 186 is overlapped with the upper end line R3 indicating the upper end portion 182a of the convex portion 182 in a side view.

[0050] The third rib 187 is disposed on the lateral surface 183 of the cover main body 181. The third rib 187 is coupled to the first rib 185 on the opposite side of the convex portion 182 through the first rib 185. The third rib 187 is extended from the first rib 185 to the opposite side of the convex portion 182 (i.e., to the forward). The third rib 187 has a rectangular outer contour in a side view. The third rib 187 is disposed perpendicularly to the first rib 185 in a side view. Further, the third rib 187 is disposed on the opposite side of the lower end portion 182b of the convex portion 182. Therefore, the third rib 187 is overlapped with the lower end line R4 indicating the lower end portion 182b of the convex portion 182 in a side view.

(Actions and Effects)

[0051] (1) The cylinder head cover 18 according to the present exemplary embodiment has the cover main body 181, the convex portion 182, the first rib 185, the second rib 186 and the third rib 187. The first rib 185 is extended in the up-and-down direction (an exemplary first direction) along the boundary T between the cover main body 181 and the convex portion 182. Each of the second and third ribs 186 and 187 is coupled to the first rib 185 on the opposite side of the convex portion 182 through the first rib 185.

[0052] Therefore, it is possible to reduce vibration to be produced by minute undulation and/or torsion of the convex portion 182. As a result, noise can be inhibited from being produced from the engine 10.

[0053] Further, in the cylinder head cover 18 according to the present exemplary embodiment, the convex portion 182 is integrally formed with the cover main body 181.

[0054] Therefore, the cylinder head cover 18 can be manufactured using, for instance, a casting mold. As a result, it is possible to further reduce the number of manufacturing steps and manufacturing cost compared to the case that the cover main body 181 and the convex portion 182 are separately fabricated.

[0055] (2) The second and third ribs 186 and 187 are respectively extended from the first rib 185 to the opposite side of the convex portion 182.

[0056] Therefore, the first rib 185 can be rigidly supported by the second and third ribs 186 and 187. As a result, vibration of the convex portion 182 can be further reduced.

[0057] (3) The second rib 186 is disposed on the opposite side of the upper end portion 182a (an exemplary first end portion) of the convex portion 182, whereas the third rib 187 is disposed on the opposite side of the lower end portion 182b (an exemplary second end portion) of the convex portion 182.

[0058] Therefore, the both end portions of the convex portion 182 can be rigidly fixed. As a result, vibration of the convex portion 182 can be further reduced.

[0059] (4) The first rib 185, the second rib 186 and the third rib 187 are respectively integrally formed with the cover main body 181.

[0060] Therefore, the first to third ribs 185 to 187 can be fabricated together with the cover main body 181 using, for instance, a casting mold. As a result, it is possible to further reduce the number of manufacturing steps and manufacturing cost compared to the case that the cover main body 181 and the first to third ribs 185 to 187 are separately fabricated.

(Other Exemplary Embodiments)

[0061] The present invention has been described with the aforementioned exemplary embodiment. However, it should not be understood that the description and figures, forming a part of this disclosure, are intended to limit the present invention. A variety of alternative exemplary embodiments, practical examples and operational techniques would be apparent for those skilled in the art from this disclosure.

[0062] (A) In the aforementioned exemplary embodiment, the first rib 185 is entirely formed on the lateral surface 183 in the up-and-down direction. However, the structure of the first rib 185 is not limited to the above. For example, as illustrated in FIG 7, the first rib 185 may be disposed between the second rib 186 and the third rib 187.

[0063] (B) In the aforementioned exemplary embodiment, each of the second and third ribs 186 and 187 has a rectangular outer contour in a side view. However, the outer contours of the second and third ribs 186 and 187 are not limited to the above. For example, the outer contours of the second and third ribs 186 and 187 can be set to be in arbitrary shapes such as a circular shape (including a semi-circular shape and etc.) and a triangular shape (including an isosceles triangular shape, a right triangular shape and etc.) as illustrated in FIG 8.

[0064] Further, the second and third ribs 186 and 187 are respectively disposed perpendicularly to the first rib 185 in a side view. However, the arrangements of the second and third ribs 186 and 187 are not limited to the

above. The second and third ribs 186 and 187 may be disposed obliquely to the first rib 185 in a side view.

[0065] (C) In the aforementioned exemplary embodiment, each of the recessed portion 173 and the convex portion 182 has an outer contour of a semi-circular shape in a side view. However, the shapes of the recessed portion 173 and the convex portion 182 are not limited to the above. Each of the recessed portion 173 and the convex portion 182 can be set to have an outer contour of an arbitrary shape such as a triangular shape, a square shape or etc.

[0066] (D) In the aforementioned exemplary embodiment, the arrangements of the respective members have been explained using terms of the back-and-forth direction, the right-and-left direction and the up-and-down direction. However, the arrangements of the members are not limited to those set in the aforementioned exemplary embodiment. For example, the engine 10 may not be disposed along the back-and-forth direction. The crankshaft 13 may not be disposed along the right-and-left direction. Thus, the arrangements of the respective members can be changed depending on the entire structure of the saddle-ride type vehicle 1.

[0067] (E) In the aforementioned exemplary embodiment, the scooter-type motorcycle has been explained as an exemplary saddle-ride type vehicle. However, the saddle-ride type vehicle is not limited to the above. The saddle-ride type vehicle may include an all-terrain vehicle, a snowmobile and etc. other than the motorcycle. Further, the motorcycle may include an off-road motorcycle, an on-road motorcycle, a moped and etc. other than the scooter-type motorcycle.

[0068] It is thus apparent that the present invention encompasses a variety of embodiments and etc. not herein described. Therefore, the technical scope of the present invention should be defined only by the matters specifying the present invention related to claims that are valid from the aforementioned explanation.

Industrial Applicability

[0069] According to the present invention, engine noise can be inhibited. Therefore, the present invention is useful in the field of engines and the field of saddle-ride type vehicles. Reference Signs List

[0070]

- | | |
|----|--------------------------|
| 1 | Saddle-ride type vehicle |
| 2 | Vehicle body |
| 6 | Engine unit |
| 10 | Engine |
| 11 | Crankcase |
| 12 | Power generator |
| 13 | Crankshaft |
| 14 | Cylinder body |
| 15 | Piston |
| 16 | Connecting rod |
| 17 | Cylinder head |

- | | |
|-------|-----------------------|
| 173 | Recessed portion |
| 18 | Cylinder head cover |
| 182 | Convex portion |
| 185 | First rib |
| 5 186 | Second rib |
| 187 | Third rib |
| 19 | Valve train mechanism |
| 19a | Camshaft |
| 19b | Driven sprocket |

10

Claims

1. An engine comprising:

15

a crankcase configured to accommodate a crankshaft;
 a cylinder body coupled to the crankcase;
 a cylinder head coupled to the cylinder body;
 a cylinder head cover coupled to the cylinder head; and
 a camshaft disposed in a space between the cylinder head and the cylinder head cover, the cylinder head including a recessed portion formed on a cylinder head cover side end of the cylinder head, the recessed portion making the camshaft at least partially viewable there-through,
 the cylinder head cover including a cover main body, a convex portion, a first rib, a second rib and a third rib,
 the cover main body covering the cylinder head, the convex portion fitted into the recessed portion, the convex portion protruded from the cover main body towards the cylinder head, the convex portion integrally formed with the cover main body,
 the first rib extended in a first direction, the first rib formed on a lateral surface of the cover main body along a boundary between the cover main body and the convex portion,
 the second and third ribs connected on the lateral surface to the first rib on an opposite side of the convex portion through the first rib.

40

45

2. The engine according to claim 1, wherein

at least either of the second and third ribs is extended on the lateral surface from the first rib to the opposite side of the convex portion.

50

3. The engine according to one of the claims 1 to 2, wherein

the convex portion includes a first end portion and a second end portion in the first direction, the second rib is disposed on an opposite side of the first end portion through the first rib, and the third rib is disposed on an opposite side of the second end portion through the first rib.

55

4. The engine according to one of the claims 1 to 3,
wherein
the convex portion has a semi-circular shape in a
plan view of the lateral surface.

5

5. The engine according to one of the claims 1 to 4,
wherein
the first rib, the second rib and the third rib are re-
spectively integrally formed with the cover main
body.

10

6. A saddle-ride type vehicle comprising:

the engine according to one of the claims 1 to
5; and
a vehicle body frame configured to support the
engine.

15

20

25

30

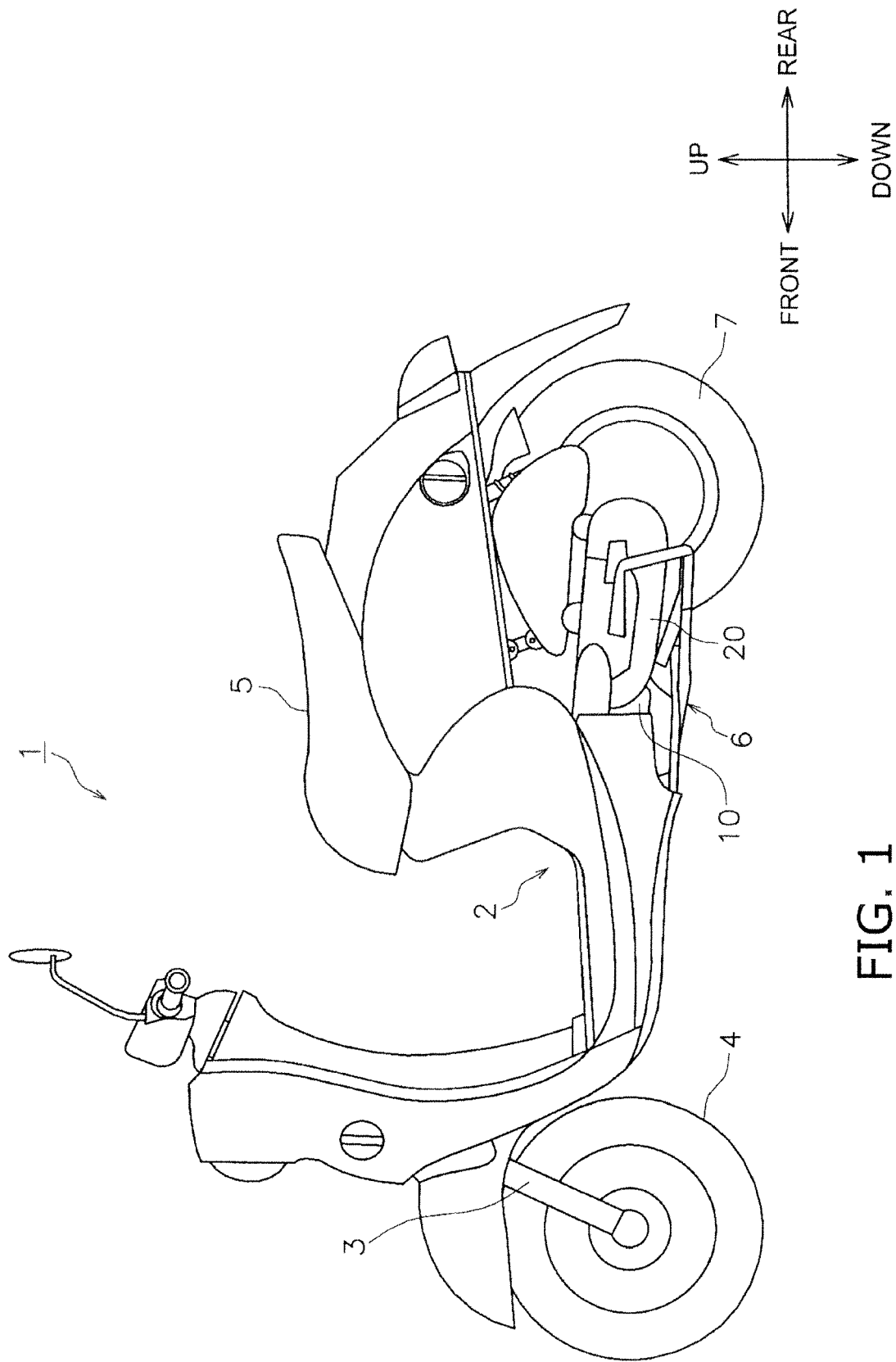
35

40

45

50

55



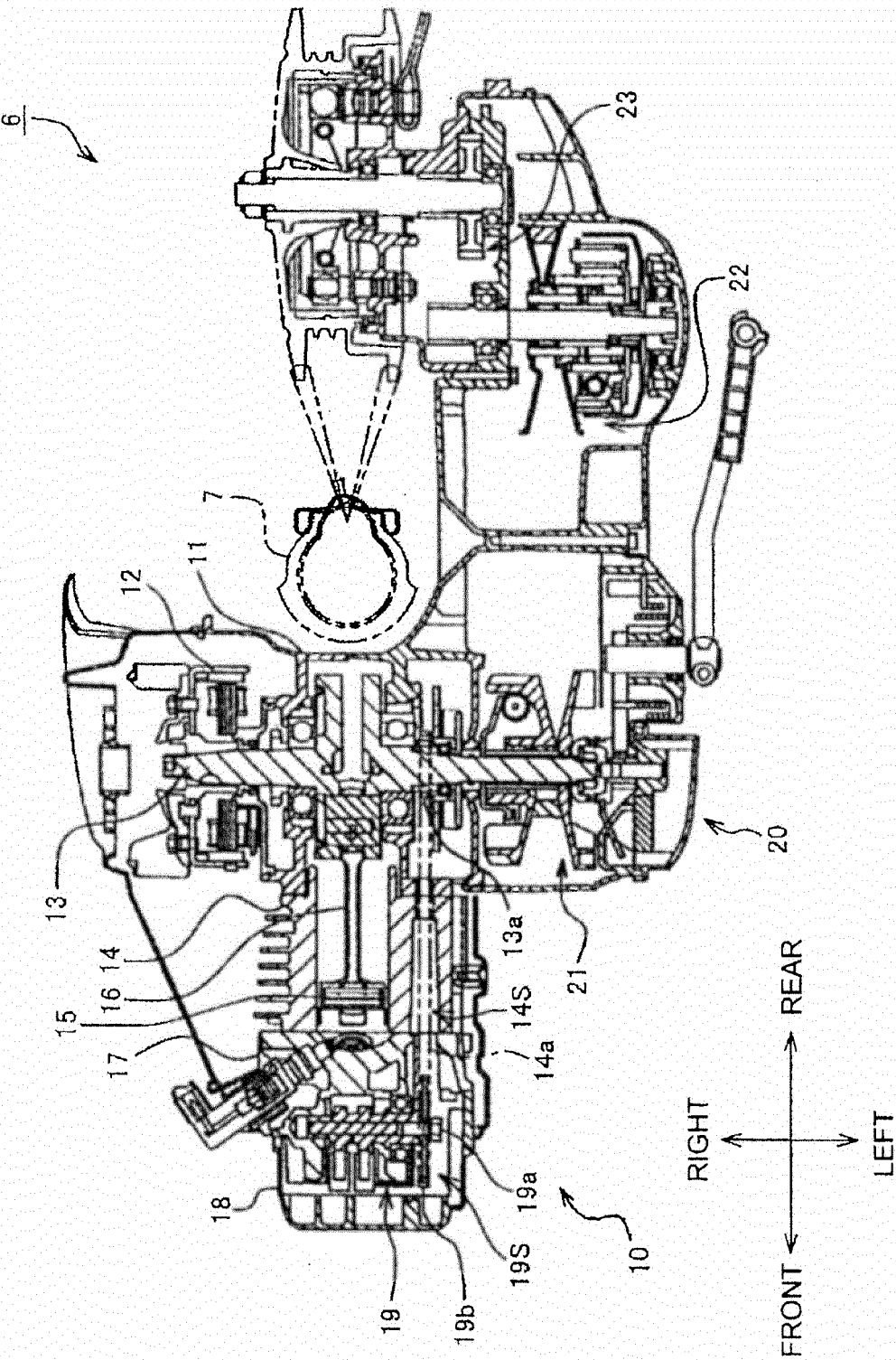


FIG. 2

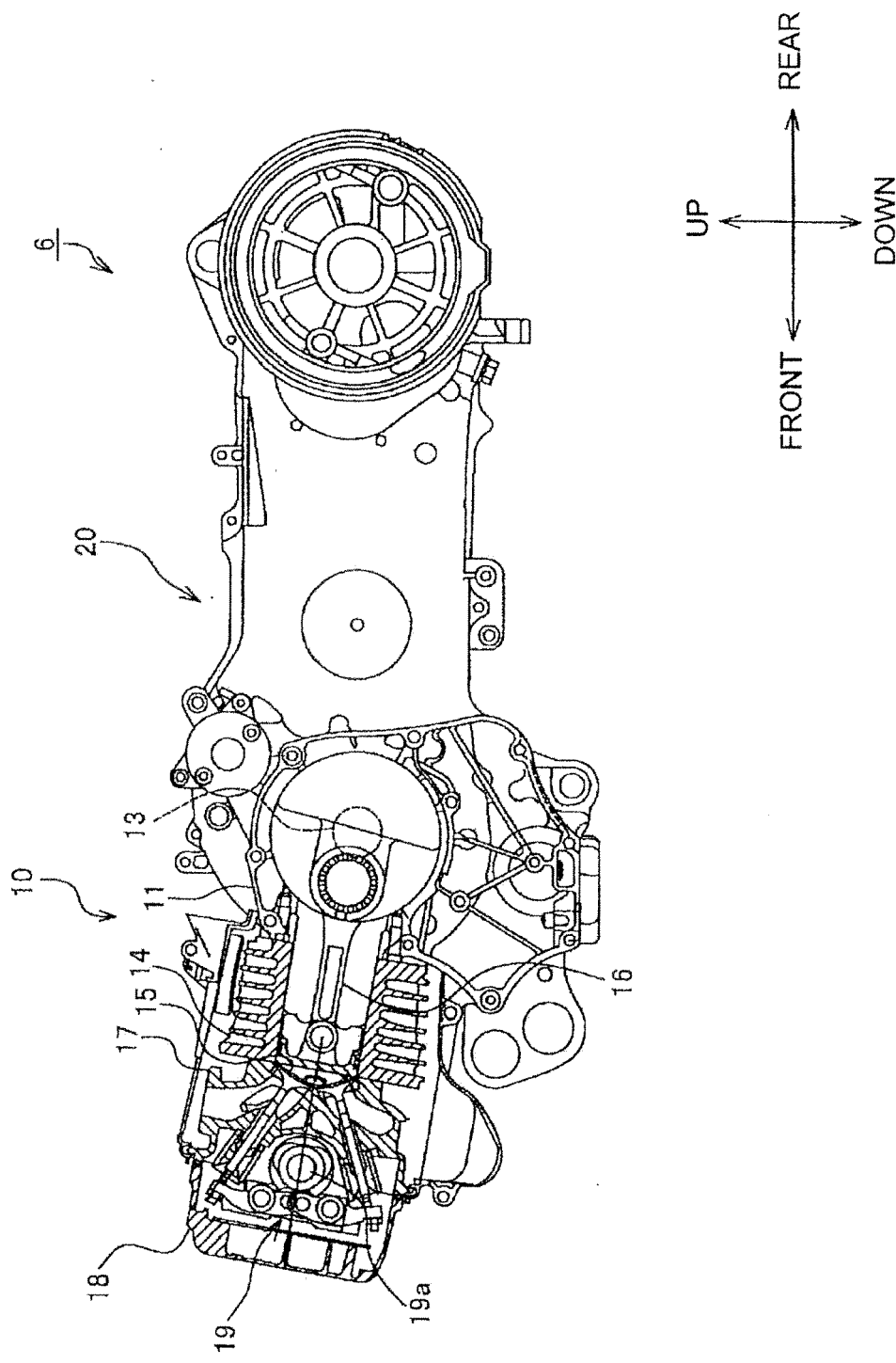


FIG. 3

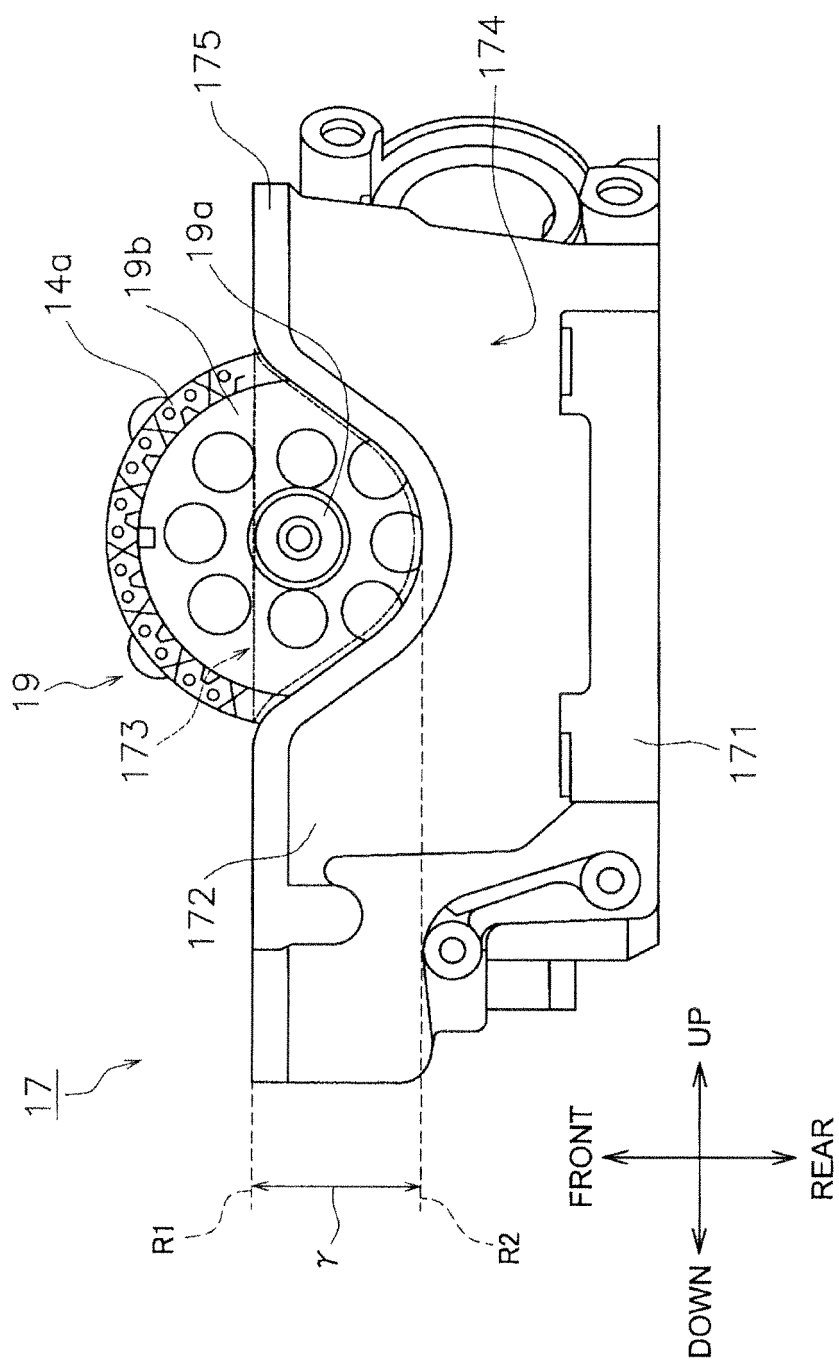


FIG. 4

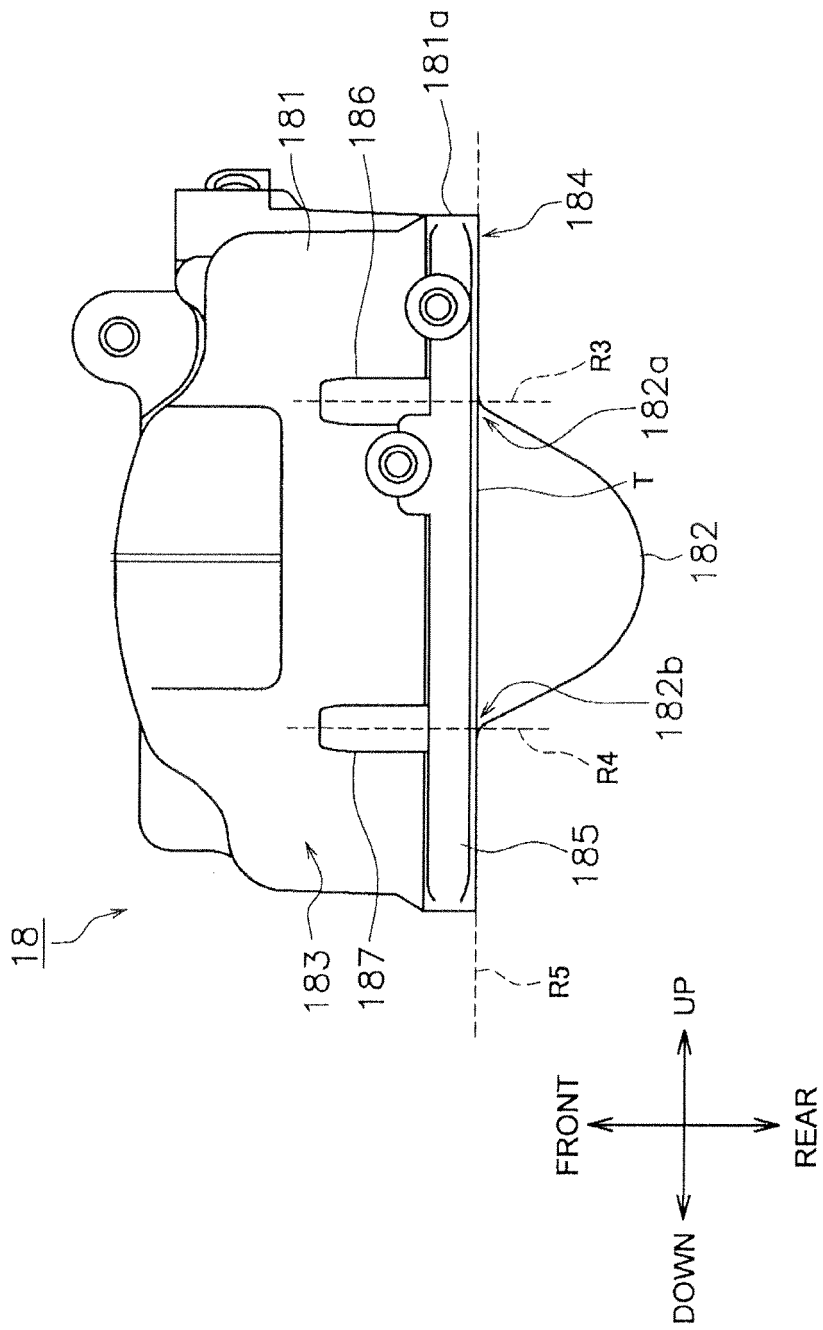


FIG. 5

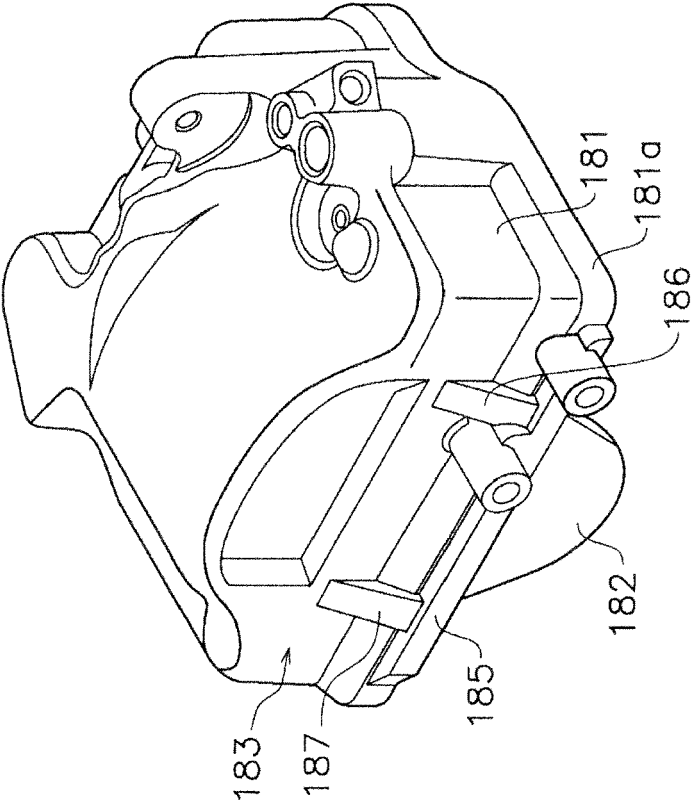


FIG. 6

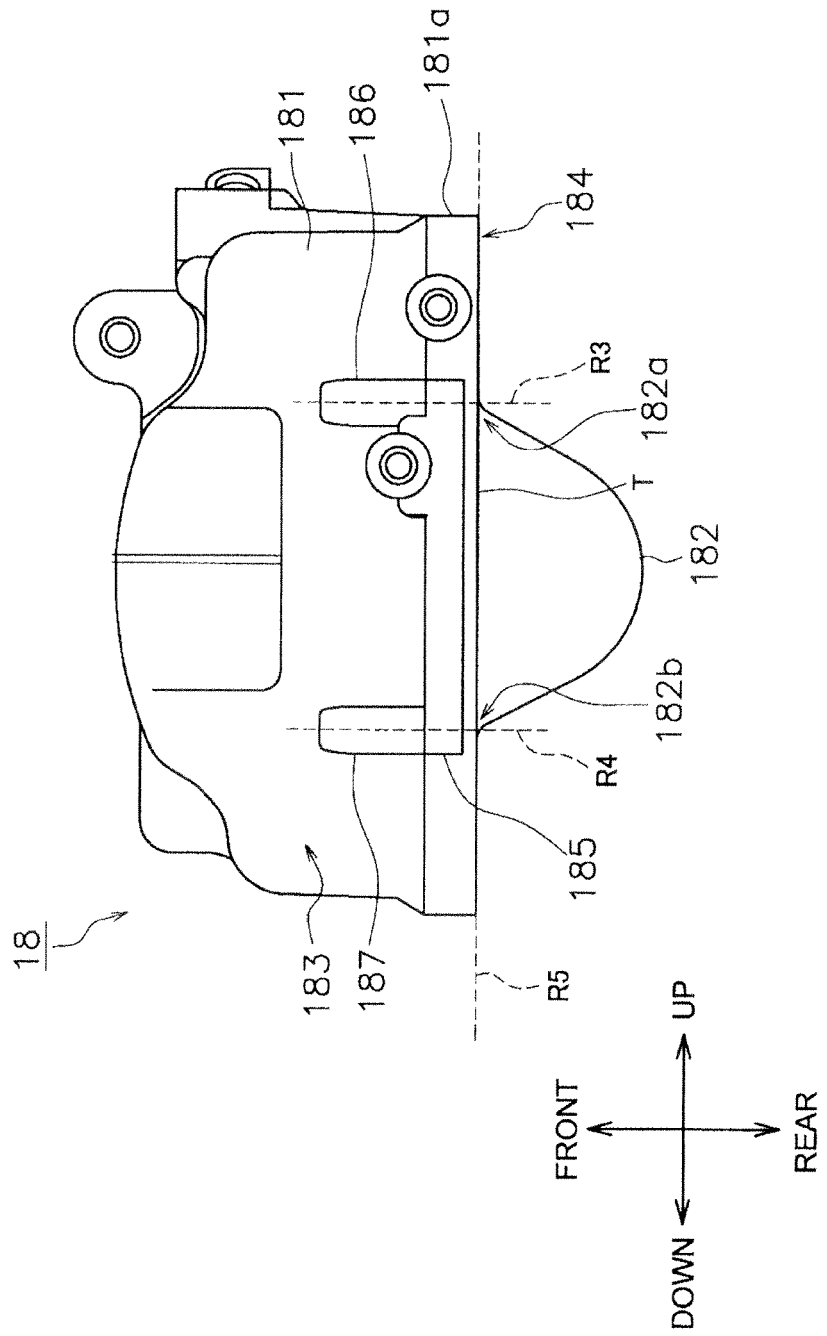


FIG. 7

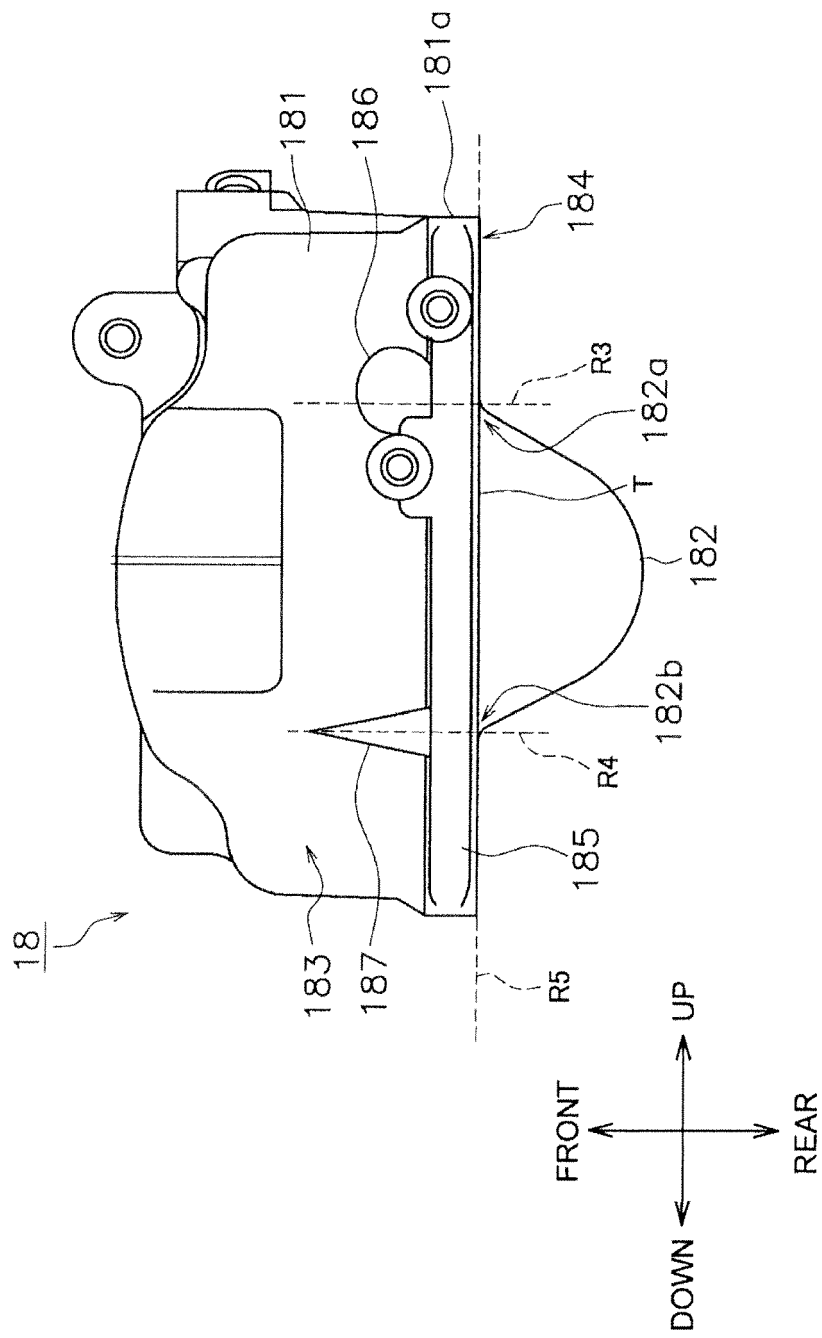


FIG. 8



EUROPEAN SEARCH REPORT

Application Number
EP 12 18 5820

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	EP 1 310 637 A2 (PORSCHE AG [DE]) 14 May 2003 (2003-05-14)	1-5	INV. F02F7/00 F02F1/24
Y	* figures 1-6 * * paragraphs [0012] - [0016] * -----	6	
X	Anonymous: "Porsche Originalteile Katalog - Cayenne - D_9pa_Katalog", 15 January 2010 (2010-01-15), pages 38-38, XP055075590, Retrieved from the Internet: URL: http://www.porsche.com/all/media/pdf/originalparts/de/D_9pa_KATALOG.pdf [retrieved on 2013-08-19] * the whole document *	1-5	
Y	EP 1 881 174 A1 (HONDA MOTOR CO LTD [JP]) 23 January 2008 (2008-01-23) * figures 9-15 * * paragraph [0016] * & JP 2008 025451 A (HONDA MOTOR CO LTD) 7 February 2008 (2008-02-07) * abstract *	6	
A	JP S61 167148 A (SUZUKI MOTOR CO) 28 July 1986 (1986-07-28) * the whole document *	1-6	
A	JP H07 17936 U (- ? -) 31 March 1995 (1995-03-31) * the whole document *	1-6	TECHNICAL FIELDS SEARCHED (IPC)
			F02F F02B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 19 August 2013	Examiner Schwallier, Vincent
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

 2
EPO FORM 1503 03.82 (P04C01)

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

EP 12 18 5820

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

19-08-2013

Patent document cited in search report		Publication date		Patent family member(s)		Publication date
EP 1310637	A2	14-05-2003	AT	346224	T	15-12-2006
			DE	10154669	A1	22-05-2003
			EP	1310637	A2	14-05-2003
			JP	2003184534	A	03-07-2003
			US	2003089323	A1	15-05-2003

EP 1881174	A1	23-01-2008	CN	101144423	A	19-03-2008
			EP	1881174	A1	23-01-2008
			KR	20080008967	A	24-01-2008
			TW	200823103	A	01-06-2008

JP S61167148	A	28-07-1986	NONE			

JP H0717936	U	31-03-1995	NONE			

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 2008025451 A [0002] [0003]