(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 128 391 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
02.12.2009 Bulletin 2009/49

(21) Application number: **08157369.3**

(22) Date of filing: **30.05.2008**

(51) Int Cl.:
F01M 5/02 *(2006.01)* ***F01M 9/10*** *(2006.01)*
F16H 57/04 *(2006.01)*

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

(71) Applicant: **Perkins Engines Company Limited**
Eastfield
Peterborough PE1 5NA (GB)

(72) Inventor: **Snell, Jon Gerald**
Petersborough, Cambridgeshire (GB)

(74) Representative: **Hatzmann, Martin**
Vereenigde
Johan de Wittlaan 7
2517 JR Den Haag (NL)

(54) Start up lubrication facilitation device

(57) A lubrication facilitation device is disclosed for mounting within a splash lubrication space of an engine. The device may have a rotatable engine part that has an axis of rotation about which it is configured to be rotationally disposed within a splash lubrication space of an engine. The rotatable engine part may be provided with a plurality of oil retention pockets. Each oil retention pocket may comprise an enclosure extending from a well portion to an aperture that is spaced radially away therefrom.

EP 2 128 391 A1

Description

Technical Field

[0001] The present disclosure is directed to a start up lubrication facilitation device, and more particularly, to a start up lubrication facilitation device for an internal combustion engine.

Background

[0002] Internal combustion engines may typically include a pressurized oil feed system to lubricate internal wear surfaces. A number of these wear surfaces, for example crank shaft bearings, are lubricated directly by oil flowing directly from the feed system. Other wear surfaces, for example timing gears, are lubricated indirectly in a splash lubrication process using oil flowing from the feed system via other surfaces. For example, the teeth of the timing gears in the timing gear case may be lubricated by oil fed by the pressurized oil feed system via a bearing onto the body of one of the timing gears, and that subsequently splashes from the body of that timing gear onto the exposed surfaces of the other gears in the timing gear case.

[0003] Advantageous of splash lubrication is that it is a reliable and cost effective way of providing lubrication. In particular, it is relatively easy to lubricate a large group of wear surfaces simultaneously.

[0004] A disadvantage of splash lubrication is that during start up there may not be sufficient oil available to satisfactorily lubricate the wear surfaces. For example, during cold start of an engine of the series mentioned above, most of the oil may have drained off the timing gears, and it may take several seconds for the oil to be fed to the timing gear case and to arrive at the teeth of the timing gears. This may cause undesired wear of these surfaces.

[0005] The lubrication facilitation device of the present disclosure aims at improving prior systems.

Summary of the Invention

[0006] One aspect of the present disclosure is directed to a lubrication facilitation device for mounting within a splash lubrication space of an engine. The device may include a rotatable engine part having an axis of rotation about which it is configured to be rotationally disposed within a splash lubrication space of an engine. The rotatable engine part may be provided with a plurality of oil retention pockets. Each oil retention pocket may comprise an enclosure extending from a well portion, the well portion and the aperture being radially interspaced.

[0007] Another aspect of the present disclosure is directed to a method of facilitating start up lubrication of an engine. The method may include collecting oil in oil retention pockets of a rotatable engine part upon stop of rotation of the engine part at an engine shut down. The method may further include splashing oil from the oil retention pockets upon start of rotation of the rotatable engine part at engine start up.

Brief Description of the Drawings

[0008] Fig. 1 is a schematic perspective view of an exemplary disclosed combustion engine presenting a cover closing a timing gear casing;

[0009] Fig. 2 is a schematic perspective view of a timing gear well of the engine of Fig. 1;

[0010] Fig. 3 is a schematic cut away perspective view of a detail of a timing gear well having a timing gear with oil retention pockets; and

[0011] Fig. 4 is a schematic perspective view of a timing gear shown in Fig. 3.

Detailed Description

[0012] Fig. 1 shows an engine 1. The engine 1 may be any type of engine using a lubrication system. The engine 1 may for example be an internal combustion engine 1, such as a gasoline or diesel fuel powered engine 1. In the exemplary disclosed embodiment, the engine may be a diesel engine.

[0013] The engine 1 may enclose a space 2. This space 2 may be defined by various parts of the engine 1, for example internal or external walls, partitions or covers. As may be seen in Fig. 1, Fig. 2 and Fig. 3, in the exemplary enclosed embodiment, the space 2 may be defined between the timing gear well 3 and timing gear cover 4. The timing gear well 3 and the timing gear cover 4 may co-operate to form a timing gear case 5. In the exemplary disclosed embodiment, the mating surfaces of the timing gear cover 4 and the timing gear well 3 may interface via a gasket (not shown), and may be clamped onto each other using bolts 6. Fig. 2 shows the timing gear case 5 of the exemplary disclosed embodiment with the timing gear cover 4 being removed, such that the gears contained therein are visible. In particular, two timing gears 13 are shown, of which amongst others, the meshing gear teeth 30 are to be lubricated.

[0014] The space 2 may be arranged for splash lubrication. The space 2 may therewith be conditioned for an environment in which lubrication oil may be splashed around in a gaseous environment at substantially atmospheric pressure to lubricate exposed surfaces within the space 2 without significant amounts of oil leaking away from the engine 1.

[0015] The space 2 may include a lubrication oil inlet through which lubrication oil may enter the space 2. As shown in Fig. 3, in the exemplary disclosed embodiment, the lubrication oil inlet may be embodied as a pressurized oil feed line 7. Such a pressurized oil feed line 7 may for example extend through internal walls of the block of the engine 1, and may be provided with oil that is pumped up from a sump 9 using an oil pump (not shown). As an alternative or in addition, lubrication oil may enter the

space 2 from an adjacent space, e.g. an oil reservoir, or from another device.

[0016] The space 2 may include a lubrication oil outlet, for example an oil suction line or drain aperture. In the exemplary disclosed embodiment, a lubrication oil outlet may be formed by an outlet opening 8 that connects the space 2 to the sump 9 of the engine 1. In an alternative embodiment, the space 2 may be constructed without lubrication oil inlet and outlet. In such an embodiment, the space 2 may for example include an oil reservoir and may include internal oil recirculation. The lubrication oil may be of any type suitable for lubricating an engine, for example mineral oil, synthetic oil or mixtures thereof of a grade suitable for engine splash lubrication, for example 10W50.

[0017] Referring to Fig. 3 and Fig. 4, the engine 1 may include a start-up lubrication facilitation device 10. The start-up lubrication facilitation device 10 may comprise a rotatable engine part 11. The rotatable engine part 11 may have an axis of rotation 12 about which it may be rotationally disposed relative to engine 1 within the space 2. The rotatable engine part 11 may be driven to rotate by other components of the engine 1, for example by the crankhaft of the engine 1. The rotatable engine part 1 may be arranged to be driven to rotate upon starting of the engine 1. It may be further configured to also rotate during normal operation of the engine 1. The rotatable engine part 11 may be of any shape, and may for example be rotationally symmetrical about the central axis of rotation 12. The rotatable engine part 11 may be for example be disc- or wheel shaped. In one embodiment, the rotatable engine part 11 may be a gear wheel. In another embodiment, the rotatable engine part 11 may for example be a sprocket. In the exemplary disclosed embodiment, the rotatable engine 11 part may be a timing gear 13 that is indirectly driven by the crankshaft of the engine 1. The timing gear 13 may be bearing mounted on a horizontal stub axle 14 extending from the timing gear well 3 using a bearing 17. The timing gear 13 may be axially secured onto the stub axle 14 using a mounting plate 15. The mounting plate 15 may be connected to the stub axle 14 via bolts 16. In the exemplary disclosed embodiment, lubrication distribution channels may extend from the pressurized oil feed line 7 via the stub axle 14 to the bearing 17 (not shown).

[0018] The rotatable engine part 11 may be provided with a plurality of oil retention pockets 18, the functioning of which shall be discussed more in detail in the next section. The oil retention pockets 18 may comprise of an enclosure 19 extending from a well portion 20 to an aperture 21 that is radially spaced away from the aperture 21. In one embodiment, the aperture 21 may be radially more outwardly disposed than the well portion 20 relative to the central axis of rotation 12. In another embodiment, the well portion 20 may be disposed radially more outwardly than the aperture 21 relative to the axis of rotation 12. The aperture 21 may in one embodiment be partially oriented radially outwardly relative to the central axis of rotation 12. In yet another embodiment, the aperture 21 may be oriented substantially radially outwardly. The oil retention pockets 18 may be angularly spaced apart along the circumference of the rotatable engine part 11. As shown in the exemplary disclosed embodiment, the oil retention pockets 18 may also be adjoining each other. The plurality of oil retention pockets 18 may include more than two oil retention pockets. In particular, the plurality of oil retention pockets 18 may for example include at least five oil retention pockets 18. As shown in the exemplary disclosed embodiment, the oil retention pockets 18 may extend in a generally upright plane.

[0019] The oil retention pockets 18 may be at least partially formed by one or more components that co-operate with the rotatable engine part 11. For example, the oil retention pockets 18 may all be formed by a single part that co-operates with the rotatable engine part 11. As shown in the exemplary disclosed embodiment, the body 22 of the timing gear 13 may be provided with radially extending ribs 23. The oil collection pockets 18 may be defined between portions of the ribs 23 that are interposed between the surface 28 of the body 22 of the timing gear 13 and a surface 24 of a washer 25. The washer 25 may for example be made from steel and the surface 24 of the washer 25 may be suitably coated to seal against the ribs 23.

[0020] In an alternative embodiment, the rotatable engine part 11 with the oil retention pockets 18 may be formed as a separate structure. Such a structure may then form the lubrication facilitation device 10 on its own. Such a separate structure may for example be disposed on a shaft that is bearing mounted to the engine 1 (not shown). Such a separate structure may for example be configured as a wheel with radially outwardly oriented oil retention pockets 18 that is mounted on the shaft of a turbo fan near its bearings.

[0021] The apertures 21 of the oil retention pockets 18 may connect to an oil collecting surface 24. In the exemplary disclosed embodiment, the oil collecting surface 29 may be formed by a portion of the surface 28 of the body 22 of the timing gear 13 adjacent the aperture 21 of the oil retention pocket 18. As an alternative or in addition, the wall surfaces enclosing the space 2 may be provided with oil guiding structures, such as ridges, ribs, ledges and niches to guide oil splashed on the wall surface towards the oil retention pockets 18. In the exemplary disclosed embodiment, the wall surface 26 may for example be provided with an oil guiding structure 27.

[0022] The lubrication facilitation device 10 may be made of any suitable material, for example steel, plastic, nylon or combinations of those materials. For example the lubrication facilitation device 10 may be built up from a metal sprocket wheel of which the body cooperates with a rubber fan shaped molding to form a plurality of oil retention pockets 18. In the exemplary disclosed embodiment, the timing gear casing 5 may comprise only one lubrication facilitation device 10. In other embodiments, however, a plurality of lubrication facilitation de-

vices may be used within the space 2 arranged for splash lubrication 2.

Industrial Applicability

[0023] The disclosed lubrication facilitation device 10 may be used in conjunction with any engine 1 having a space 2 arranged for splash lubrication to facilitate lubrication during start-up of the engine 1. During normal operation of the engine 1, wear surfaces of the engine 1 may be lubricated by lubrication oil that is splashed around in the space 2 such that a film of oil is deposited on all exposed surfaces within in the space 2. The splashing of oil may be induced by one or more rotatable engine parts 10 of which the surfaces cause oil to be splashed around. The lubrication oil may be present in a reservoir within the space 2 and/or may be fed to the space 2, for example via a pressurized oil feed system.

[0024] In the exemplary disclosed embodiment, lubrication oil may be fed via the pressurized oil feed line 7 into the space 2 enclosed by the timing gear casing 5. The oil may pass via distribution channels (not shown) to the bearing 17 to lubricate the cooperating wear surfaces of the bearing 17 between the stub axle 14 and the timing gear 13, and may continue by flowing onto the body 22 of the timing gear 13. The lubrication oil may subsequently be flowing from the body 22 of the timing gear 13 so that it is splashed around in the space 2 so that all internal surfaces that are exposed in the space 2, in particular the wear surfaces such as the meshing gear teeth 30 of the timing gears 13, may be covered by a film of oil.

[0025] In accordance with the disclosure, upon stop of rotation of the rotatable engine part 11 at engine shutdown, oil draining from the surface of the engine part is collected in oil retention pockets 18. In the exemplary disclosed embodiment, the oil film may drip downwardly from the internal exposed surfaces surrounding the space 2 via outlet opening 8 into the sump 9 of the engine 1. Some of this oil may be collected in oil retention pockets 18 of the rotatable engine part 11 that forms a lubrication facilitation device 10. In particular, oil may be collected in those retention pockets 18 that have a substantially upright orientation. The oil flowing downward under the influence of gravity may enter apertures 21 of substantially upward facing oil retention pockets 18 and may flow downward into the enclosure 19, such that it is collected at the well portion 20. The aperture 21 may be oriented radially outward to facilitate collection of oil. By providing a plurality of oil retention pockets 18, for example at least 5 pockets, it may be achieved that the number of pockets having a substantially upright orientation may be relatively large at any angular orientation of the lubrication facilitation device.

[0026] The capacity to collect oil of the oil retention pockets 18 may be enhanced by providing an oil collecting surface 29 that connects to the aperture 21. In the exemplary disclosed embodiment, the oil collecting surface 29 may be a part of the surface 28 of the body 22 of the timing gear 13. The capacity to collect oil may be further enhanced by oil guide structures 27 that guide oil that travels downward under the influence of gravity along the surfaces 2 of the space towards the oil retention pockets 18. In the exemplary disclosed embodiment shown in Fig. 3, it has been illustrated with arrows how a film of oil travelling downward along the well surface 26 of the timing gear well 3 may be guided by guide structure 27 to drip onto the oil collecting surface of the body 22 of the timing gear 13. The oil may subsequently flow from the body 22 of the timing gear 13 to the upwardly facing apertures 21 of the oil retention pockets 18. This way, a volume of oil may be retained within the enclosure 19 of the at least partially upwardly orientated oil retention pockets 18.

[0027] Upon start of rotation of the rotatable engine part 11 at engine start-up, oil may be splashed from the oil retention pockets 18. In particular, the oil may be flung radially outwards of the enclosure 19 via aperture 21 in an embodiment in which the well portion 20 is located radially inward relative to the aperture 21. In an embodiment in which the well portion is located radially outward relative to the aperture, the oil retained in the oil retention pockets may flow radially inwards when the oil retention pocket 18 rotates from an upright orientation towards an inverted orientation. The oil flowing from the oil retention pockets 18 may allow for an initial lubrication of the internal exposed surfaces in the space 2. In the exemplary disclosed embodiment, when the engine 1 is cranked at start-up, even before firing of the engine 1, the oil retained in the oil retention pockets 18 may be released due to the rotation of the timing gears 13, and may be distributed within the timing gear casing 5.

[0028] The provision of the lubrication facilitation device 10 may facilitate lubrication 2 of internal surfaces arranged within the space 2 arranged for splash lubrication at engine start-up. In particular when the engine is cold started, the oil has been drained off the internal surfaces within the space 2, and may now be readily replaced with oil from the retention pockets. In the exemplary disclosed embodiment, at engine start up it may otherwise have taken several seconds for the oil to have arrived via the pressurized feed line 7, and the wear surfaces therefore may have otherwise have had an unsatisfactory amount of lubrication until oil has arrived from the pressure feed line 7. This earlier availability of even small quantities of oil may thus significantly reduce wear of for example gear teeth and bearings at start-up.

[0029] It will be apparent to those skilled in the art that various modifications and variations can be made to the lubrication facilitation device of the present disclosure without departing from the scope of the disclosure. Other embodiments will be apparent to those skilled in the art from consideration of the specification and practice of the lubrication facilitation device disclosed herein. It is intended that the specification and examples be considered as exemplary only, with a true scope of the invention

being indicated by the following claims and their equivalents.

Claims

1. A lubrication facilitation device for mounting within a splash lubrication space of an engine, the device comprising a rotatable engine part having an axis of rotation about which it is configured to be rotationally disposed within a splash lubrication space of an engine, the rotatable engine part being provided with a plurality of oil retention pockets, each oil retention pocket comprising an enclosure extending from a well portion to an aperture that is radially spaced away therefrom.

2. The device according to claim 1, in which the oil retention pockets are angularly spaced apart along the circumference of the rotatable engine part.

3. The device according to claim 1 or 2, in which the aperture connects to an oil collecting surface of the rotatable engine part.

4. The device according to any of the preceding claims, in which the rotatable engine part is a gear wheel.

5. The device according to claim 4, in which the gear wheel is a timing gear wheel.

6. The device according to any of claims 1-3, in which the rotatable engine part is a sprocket wheel.

7. An engine having a space arranged for splash lubrication, which space encloses a lubrication device according to any of the preceding claims that is rotatably disposed about its central axis relative to the engine.

8. The engine according to claim 7, in which the central axis of rotation is horizontally disposed.

9. The engine according to claims 7 or 8, in which the lubrication pockets extend in a generally upright plane.

10. The engine according to any of claims 7-9, in which the space that is arranged for splash lubrication is a timing gear case.

11. The engine according to claim 10, in which the rotationally disposed engine part includes a timing gear.

12. The engine according to any of claims 7-11, in which the rotatable engine part is bearing mounted on a stub axle of the engine.

13. The engine according to any of claims 7-11, in which the rotatable engine part is disposed on a shaft that is bearing mounted to the engine.

14. The engine according to any of claims 7-13, further including a pressurized oil feed system.

15. A method of facilitating start up lubrication of an engine, comprising:

    - collecting oil in oil retention pockets of a rotatable engine part upon stop of rotation of the engine part at engine shut down;
    - splashing oil from said oil retention pockets upon start of rotation of the rotatable engine part at engine start up.

16. The method according to claim 15, further comprising subsequently enhancing lubrication by pressure feeding oil.

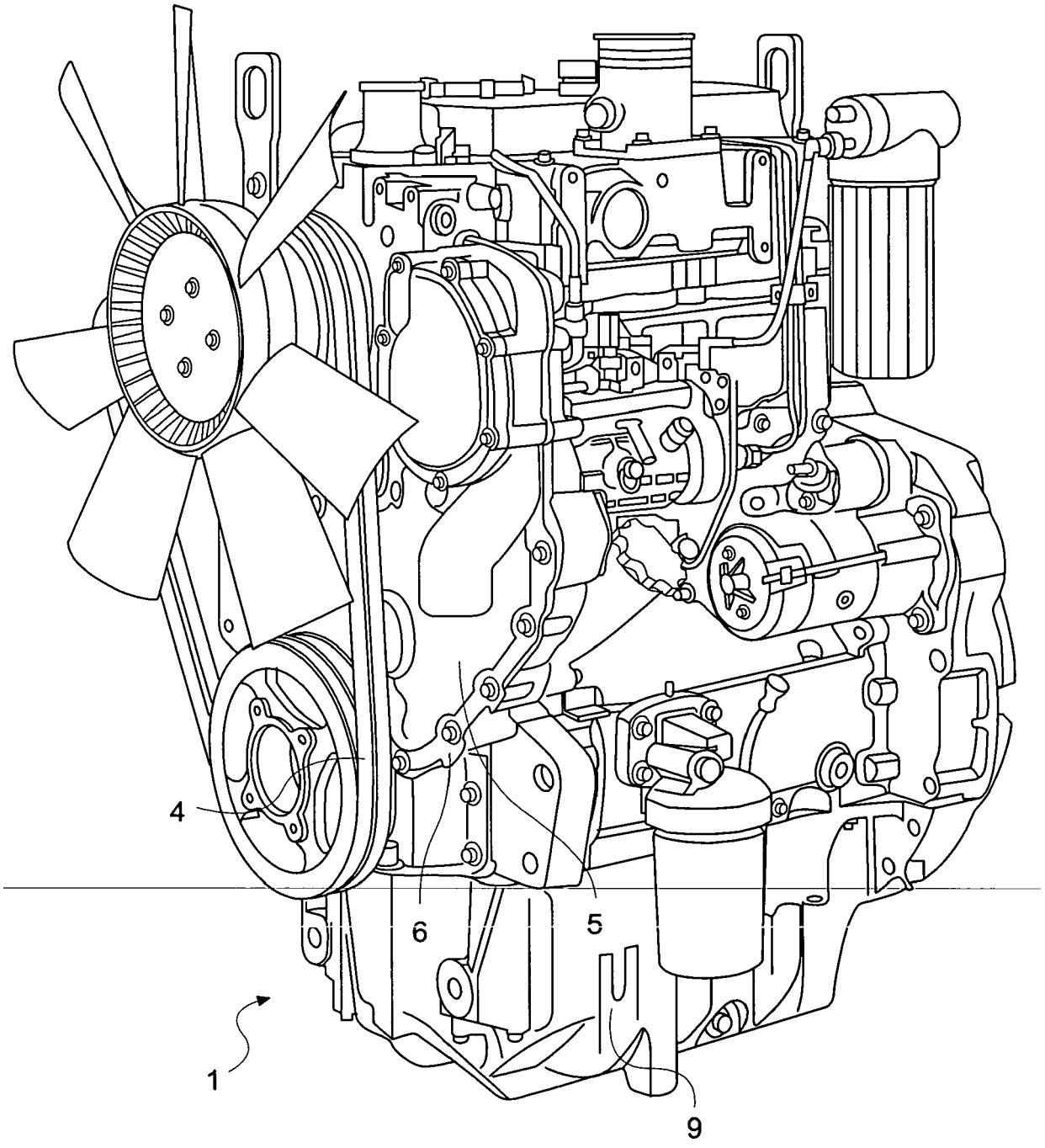

FIG. 1

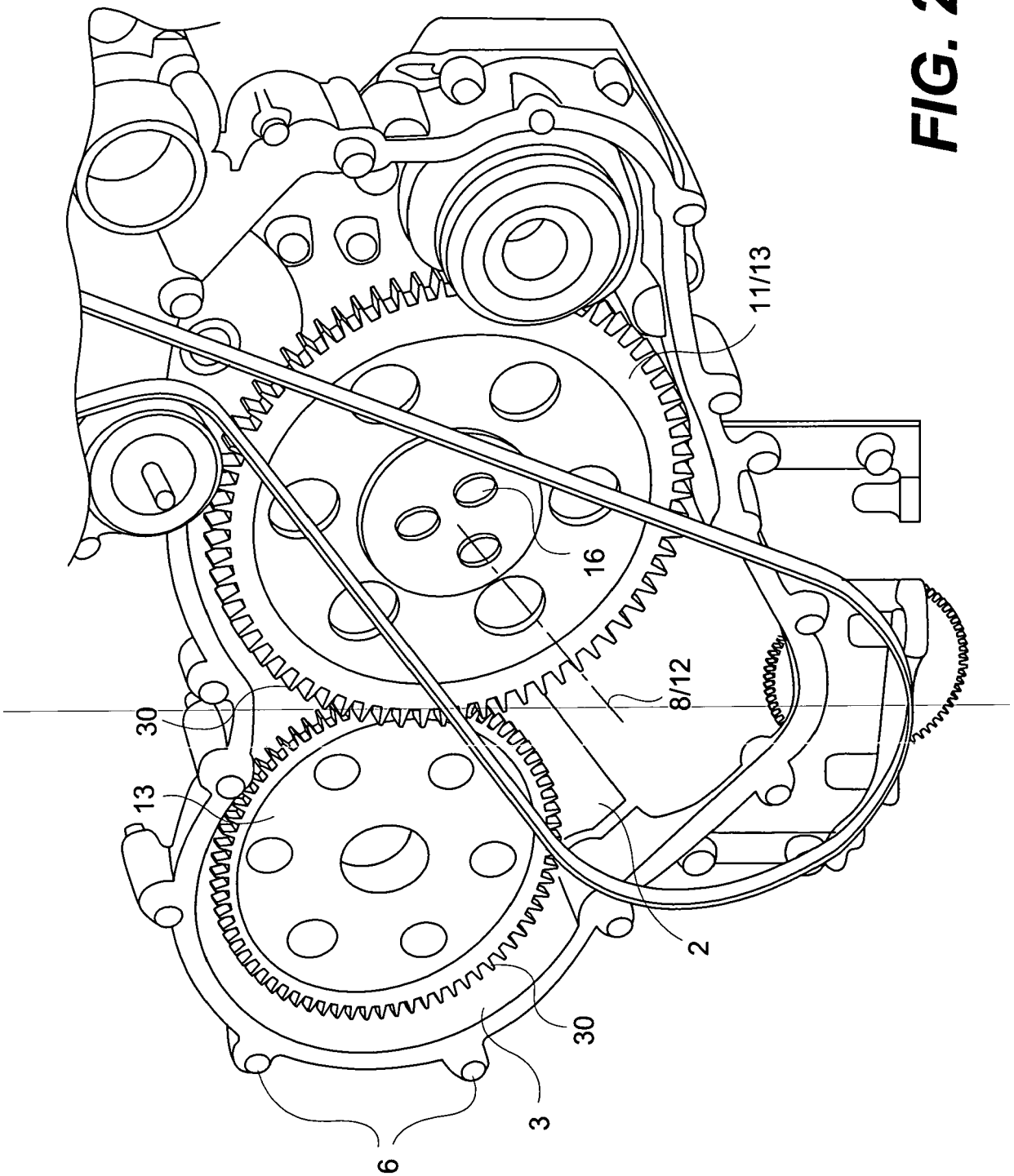

FIG. 2

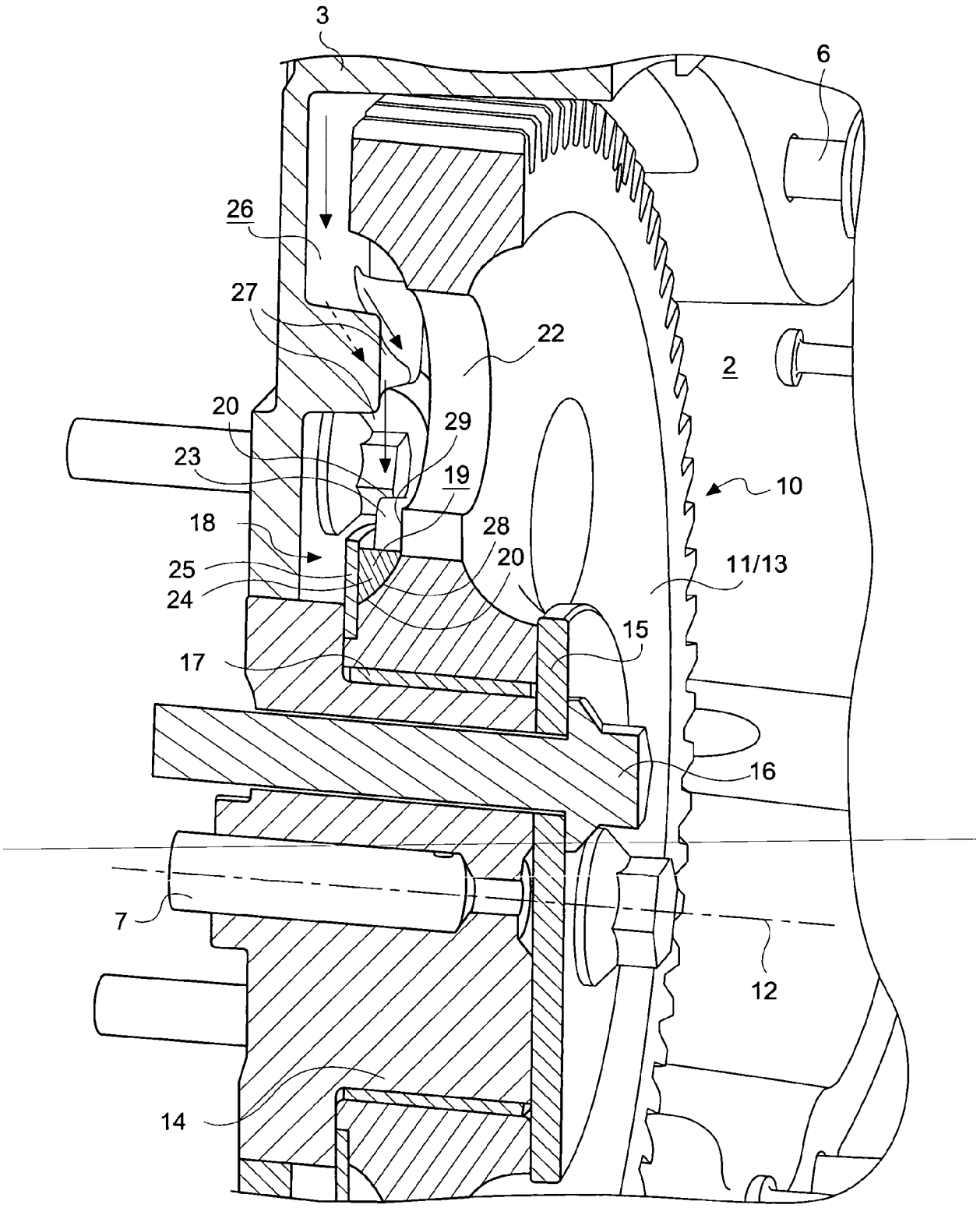

FIG. 3

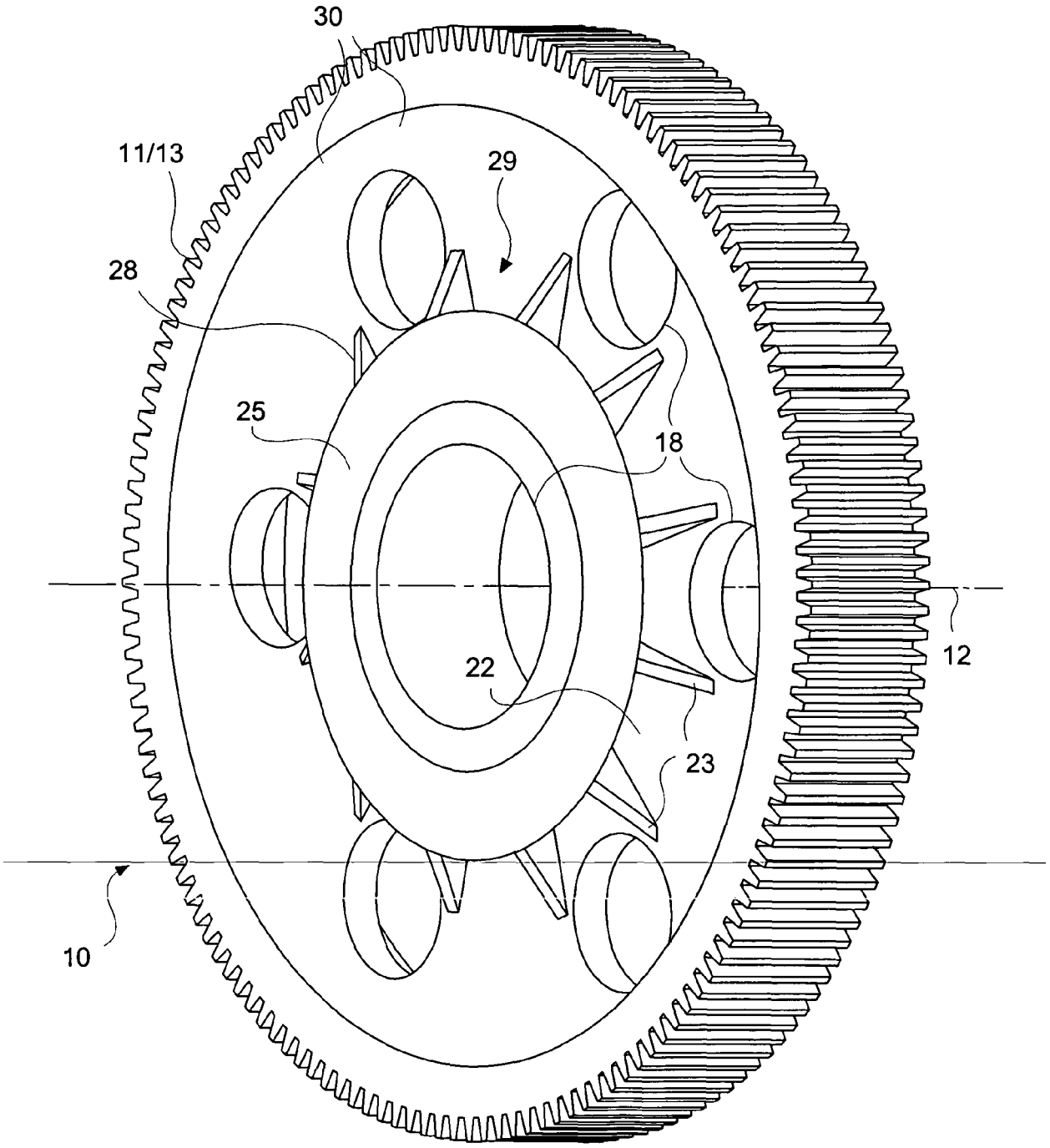

FIG. 4

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 08 15 7369

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	US 7 299 792 B1 (JONES DANIEL W [US] ET AL) 27 November 2007 (2007-11-27) * column 1, lines 23-31; figures 4,9,10,13 * -----	1,2,4, 6-9, 14-16	INV. F01M5/02 F01M9/10 F16H57/04
X	EP 0 839 992 A (HONDA MOTOR CO LTD [JP]) 6 May 1998 (1998-05-06) * figures 1,2 * -----	1-5, 7-13,15	
X	US 4 693 133 A (TOMITA TAKAO [JP] ET AL) 15 September 1987 (1987-09-15) * figures 6,9,13 * -----	1,2,4,5, 7-16	
A	US 3 767 013 A (CALDWELL J) 23 October 1973 (1973-10-23) * abstract * -----	1,15	

TECHNICAL FIELDS SEARCHED (IPC)

F01M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	30 December 2008	Flamme, Emmanuel

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

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 08 15 7369

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.

30-12-2008

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 7299792 B1	27-11-2007	NONE	
EP 0839992 A	06-05-1998	DE 69712012 D1	23-05-2002
		DE 69712012 T2	19-09-2002
		JP 3172103 B2	04-06-2001
		JP 10131733 A	19-05-1998
		US 5857441 A	12-01-1999
US 4693133 A	15-09-1987	NONE	
US 3767013 A	23-10-1973	AU 462558 B2	26-06-1975
		AU 4529472 A	07-02-1974
		CA 959769 A1	24-12-1974
		FR 2150085 A5	30-03-1973
		GB 1340990 A	19-12-1973
		JP 48031550 A	25-04-1973
		JP 52029368 B	02-08-1977

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82