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

(11) EP 2 674 583 A1

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
18.12.2013 Bulletin 2013/51

(21) Application number: **12172117.9**

(22) Date of filing: **15.06.2012**

(51) Int Cl.:
F01M 1/16 *(2006.01)* ***F04B 49/08*** *(2006.01)*
F16N 13/00 *(2006.01)* ***F04C 14/26*** *(2006.01)*

(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

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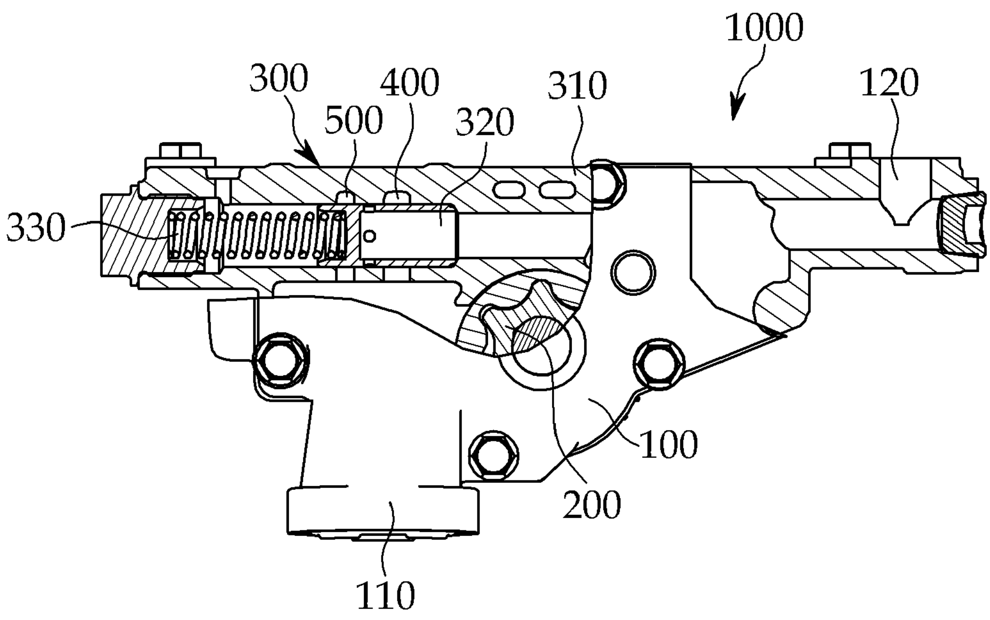
(54) **Oil supply apparatus for engine provided with two-stage relief valve**

(57) Provided is an oil supply apparatus for an engine provided with a two-stage relief valve, in which a sufficient amount of working fluid is supplied in proportion to an engine speed in a low speed range where sufficient lubrication is not performed and a flow rate of the working fluid is reduced in a medium and high speed range where smooth lubrication is performed to reduce a rotational load applied to a crankshaft, capable of reducing an engine load to decrease fuel consumption to improve fuel efficiency as well as improving a lubrication operation through supply of an appropriate flow rate.

FIG. 1



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Description

Background

1. Field of the Invention

[0001] The present invention relates to an oil supply apparatus for an engine provided with a two-stage relief valve, and more particularly, to an oil supply apparatus for an engine provided with a two-stage relief valve capable of reducing a rotational load of an engine and improving fuel efficiency by relieving a supply oil pressure at two stages of a medium speed range and a high speed range of the engine using the oil supply apparatus to prevent excessive supply of an oil pressure to the engine requiring lubrication.

2. Discussion of Related Art

[0002] In general, an engine requires a lubrication apparatus that can lubricate operating components such as a piston and a crankshaft. In particular, the lubrication apparatus requires an oil supply apparatus such as an oil pump that can supply a working fluid such as oil to places where a lubrication operation is needed.

[0003] In particular, a rotor-type oil supply apparatus is connected to a crankshaft to be used to adjust an ejected amount of a working fluid in proportion to an engine speed. Accordingly, a flow rate of an ejected working fluid of a conventional oil supply apparatus is increased in proportion to the engine speed.

[0004] However, since such an oil supply apparatus ejects the working fluid in proportion to the engine speed regardless of a lubrication state of a portion at which lubrication is needed, fuel efficiency of the engine may be decreased. That is, since a sufficient amount of working fluid is not supplied when the engine is started, it is necessary to supply the sufficient amount of working fluid in proportion to the engine speed. However, since the sufficient amount of working fluid can be supplied when the engine speed is at a medium speed and a high speed, if the working fluid is supplied in proportion to the engine speed, the working fluid may be excessively supplied. In addition, since unnecessary power consumption occurs in the oil supply apparatus due to supply of the excessive amount of working fluid at the medium speed and the high speed, the fuel efficiency of the engine may be decreased.

Summary of the invention

[0005] In order to solve these problems, the present invention provides an oil supply apparatus for an engine provided with a two-stage relief valve, in which a sufficient amount of working fluid is supplied in proportion to an engine speed in a low speed range where sufficient lubrication is not performed and a flow rate of the working fluid is reduced in a medium and high speed range where smooth lubrication is performed to reduce a rotational load applied to a crankshaft, capable of reducing an engine load to decrease fuel consumption to improve fuel efficiency as well as improving a lubrication operation through supply of an appropriate flow rate.

[0006] In order to accomplish the object, the present invention is directed to an oil supply apparatus for an engine provided with a two-stage relief valve including: an oil pump housing having an inlet side and an outlet side configured to enable entry and exit of a working fluid; a rotor mounted in the oil pump housing and driven in proportion to an engine speed; a relief valve operated by a pressure of the working fluid between the inlet side and the outlet side; and first and second flow paths formed between the inlet side and the relief valve, wherein the relief valve is elastically supported and opened in a sequence from a low speed, a medium speed, a medium/high speed, and a high speed in proportion to the engine speed, and a working fluid amount of the outlet side is returned to the inlet side through the first or second flow path in proportion to the engine speed at the medium speed and the high speed.

[0007] In particular, the relief valve may block the first and second flow paths regardless of the working fluid pressure of the outlet side when the rotor is rotated at the low speed, may be opened by a hydraulic pressure of the outlet side to return a portion of the working fluid of the outlet side to the inlet side through the second flow path when the rotor is rotated at the medium speed, may be further opened by the hydraulic pressure of the outlet side to block the first and second flow paths when the rotor is rotated at the medium/high speed, and may be opened by the hydraulic pressure of the outlet side to return a portion of the working fluid of the outlet side to the inlet side through the first flow path when the rotor is rotated at the high speed.

[0008] In addition, the relief valve may include: a valve housing having both ends connected to branch pipes branched from the inlet side and the outlet side, respectively; a valve body having a fluid path hole to communicate the outlet side with the second flow path at the medium speed, and installed in the valve housing to communicate the outlet side with the first flow path at the high speed; and an elastic spring mounted in the valve housing to provide a recovering force to the valve body operated by the working fluid pressure introduced from the outlet side.

Brief Description of the Drawings

[0009] The above and other objects, features and advantages of the present invention will become more apparent to those of ordinary skill in the art by describing in detail example embodiments thereof with reference to the attached drawings, in which:

FIG. 1 is a partial cross-sectional view showing a configuration of an oil supply apparatus in accordance with an exemplary embodiment of the present invention;

FIGS. 2A to 2D are schematic views for explaining operation states of the oil supply apparatus in accordance with an exemplary embodiment of the present invention; and

FIG. 3 is a graph showing a relation between a pressure of a working fluid of the oil supply apparatus in accordance with an exemplary embodiment of the present invention and an engine speed.

Detailed Description of Example Embodiments

[0010] Hereinafter, example embodiments of the present invention will be described in detail with reference to the accompanying drawings. Terms used herein and the following claims should not be construed as limited to conventional or dictionary definition but as meanings and concepts meeting with the technical spirit of the present invention based on the principle that the inventor could appropriately define concepts of the terms to described the best mode of the invention.

[0011] Accordingly, it will be appreciated by those skilled in the art that the detailed description given herein with respect to these figures is for explanatory purposes as the invention extends beyond these limited embodiments, and various equivalents, modifications and variations may be made in these embodiments without departing from the principles and spirit of the general inventive concept.

[Embodiment]

[0012] FIG. 1 is a partial cross-sectional view showing a configuration of an oil supply apparatus in accordance with an exemplary embodiment of the present invention, and FIG. 2A is a schematic view for explaining operation states of the oil supply apparatus in accordance with an exemplary embodiment of the present invention. In FIG. 2A, arrows shown in dotted lines represent conveyance directions of the working fluid.

[0013] An oil supply apparatus 1000 in accordance with an exemplary embodiment of the present invention includes an oil pump housing 100 and a rotor 200 configured to supply a working fluid in proportion to an engine speed, a relief valve 300 configured to return a portion of the working fluid of an output side to an input side, a first flow path 400 configured to form a flow path such that a portion of the working fluid output from the oil pump housing 100 is returned when the engine speed is at a medium speed, and a second flow path 500 configured to form a flow path such that a portion of the working fluid output from the oil pump housing 100 is returned when the engine speed is at a high speed.

[0014] Hereinafter, these components will be described in detail as follows.

[0015] The oil pump housing 100 has inner teeth 130 formed therein, and an inlet side 110 and an outlet side 120 formed at both sides thereof and configured to receive the working fluid and discharge the working fluid at a predetermined pressure.

[0016] In particular, a branch pipe 111 is provided at the inlet side 110 to receive the working fluid returned from the relief valve 300, and another branch pipe 121 is provided at the outlet side 120 to divide the working fluid to the relief valve 300. The branch pipes 111 and 121 are connected to both ends of the relief valve 300, respectively.

[0017] The rotor 200 is a rotary body, which is conventionally connected to a crankshaft of an engine and driven in proportion to a speed of the engine. In particularly, the rotor 200 has outer teeth 210 formed at an outer circumference thereof. The outer teeth 210 compress a space between the inner teeth 130 and the outer teeth 210 to pressurize the working fluid filled therein as the rotor 200 is rotated. Driving of the rotor 200 is conventionally performed by a well known configuration of a rotor-type oil pump, and thus, detailed description thereof will be omitted.

[0018] The relief valve 300 includes a valve housing 310 having both ends connected to the branch pipes 111 and 121, respectively, a valve body 320 installed in the valve housing 310 and operating in a longitudinal direction thereof, and an elastic spring 330 configured to provide a constant elastic force to the valve body 320.

[0019] The valve housing 310 has a hollow cylindrical shape, and is provided with both ends connected to the branch pipes 111 and 121 to receive a working fluid pressure from the inlet side 110 and the outlet side 120.

[0020] The valve body 320 has a compartment 321a formed at one side thereof and configured to receive the working fluid through the branch pipe 121, and a seat surface 322 formed at the other side and on which the elastic spring 330 is mounted.

[0021] In particular, the compartment 321a has a fluid path hole 321 through which the working fluid of the outlet side 120 is returned to the inlet side 110. Here, the fluid path hole 321 is formed at a position that can be in communication with the second flow path 500 (described later) when the engine speed is at a medium speed.

[0022] In addition, the compartment 321a is manufactured to have a length such that the first and second flow paths 400 and 500 are blocked when the engine speed is at a medium/high speed or less and the branch pipe 121 is in communication with the first flow path 400 when the engine speed is at a high speed.

[0023] The elastic spring 330 functions to provide an elastic force to a rear portion of the valve body 320 to allow the valve body 320 to block the outlet side 120 in the valve housing 310. The elastic spring 330 is installed to be supported in the valve housing 310 at one end and seated on the seat surface 322 at the other end.

[0024] The first flow path 400 and the second flow path 500 are flow paths formed to communicate between the inlet side 110 and the valve housing 310. Here, the first flow path 400 and the second flow path 500 are formed to sandwich the fluid path hole 321 therebetween. In addition, as shown in FIG. 2A, a position of the fluid path hole 321 is shown when the valve body 320 is closed by the elastic force of the elastic spring 330 and the working fluid pressure of the inlet side 110.

[0025] The first flow path 400 configured as described above is kept closed by the valve body 320, and is connected to be in communication with the inlet side 110 only when the valve body 320 is opened by a pressure of the outlet side 120 while the engine is rotated at a high speed.

[0026] In addition, the second flow path 500 is kept closed by the valve body 320, and is connected to be in communication with the fluid path hole 321 to communicate the outlet side 120 with the inlet side 110 as the valve body 320 is opened by the pressure of the outlet side 120 while the engine is rotated at a medium speed.

[Operation of Embodiment]

[0027] FIGS. 2A to 2D are schematic views for explaining operation states of the oil supply apparatus in accordance with an exemplary embodiment of the present invention; and FIG. 3 is a graph showing a relation between a pressure of a working fluid of the oil supply apparatus in accordance with an exemplary embodiment of the present invention and an engine speed. In addition, in FIGS. 2A to 2D, arrows shown in dotted lines represent a conveyance direction of the working fluid, and arrows shown in solid lines represent a returned direction of the working fluid, and in FIG. 3, a dotted line represents a pressure variation line increased in proportion to the engine speed.

[0028] As will be described below, the oil supply apparatus 1000 in accordance with an exemplary embodiment of the present invention is divided into a low speed range A, a medium speed range B, a medium/high speed range C and a high speed range D, which have different pressures of the working fluid.

[0029] First, in the low speed range A, for example, when the engine speed is less than 1000 RPM, as shown in FIG. 2A, since the magnitude of a force obtained by summing the pressure of the inlet side 110 and the elastic force of the elastic spring 330 is larger than that by the pressure of the outlet side 120, both the first flow path 400 and the second flow path 500 are kept closed by the valve body 320. As a result, the pressure of the working fluid output from the outlet side 120 is increased in proportion to the RPM of the rotor 200, i.e., the engine speed.

[0030] In addition, in the medium speed range B, for example, when the engine speed is between 1000 and 3000 RPM, as shown in FIG. 2B, the pressure of the outlet side 120 is higher than that of the inlet side 110 due to an increase in engine speed. As a result, as the valve body 320 moves leftward in a longitudinal direction of the valve housing 310 to be opened, the fluid path hole 321 is in communication with the second flow path 500.

[0031] Accordingly, the pressure of the outlet side 120 is partially returned to the inlet side 110 through the second flow path 500 to be decreased below the dotted line, which represents a graph in proportion to the engine speed, as shown in FIG. 3.

[0032] In addition, in the medium/high speed range C, for example, when the engine speed is between 3000 and 3500 RPM, as shown in FIG. 2C, as the pressure of the outlet side 120 is higher than that of the medium speed range B, the valve body 320 is further pushed leftward. Accordingly, the fluid path hole 321 in communication with the second flow path 500 is blocked to prevent the pressure of the outlet side 120 from returning to the inlet side 110.

[0033] Therefore, the pressure of the outlet side 120 is increased, and at this time, since the pressure in the medium/high speed range C is reduced under the pressure already decreased from the medium speed range B as shown in FIG. 3, the pressure is increased from the low pressure to a pressure in proportion to the engine speed.

[0034] Finally, in the high speed range D, for example, when the engine speed is 3500 RPM or more, as shown in FIG. 2D, as the pressure of the outlet side 120 is higher than that of the medium/high speed range C, the valve body 320 is further pushed leftward. Accordingly, the first flow path 400 blocked by the valve body 320 is opened, a hydraulic pressure of the outlet side 120 is partially returned to the inlet side 110 to decrease an output hydraulic pressure as shown in FIG. 3.

[0035] As described above, as the present invention relieves the supply oil pressure at two stages of the medium speed range and the high speed range of the vehicle, the flow rate of the working fluid can be supplied according to an amount required by the lubrication operation, and thus, the load applied to the engine can be reduced to decrease the fuel consumption and improve the engine output.

[0036] As can be seen from the foregoing, the oil supply apparatus for an engine provided with a two-stage relief valve in accordance with the present invention has the following effects.

1) Since the large amount of working fluid is supplied when the substantial lubrication is not performed, for example, at the beginning of the engine start, and the supply amount of the working fluid is reduced to supply an appropriate amount of working fluid required for the lubrication when the excessive working fluid is supplied, for example, at the engine speed in the medium speed range and the high speed range, a lubrication effect can be increased.

2) As the working fluid amount is reduced in the medium speed range and the high speed range, the rotational load applied to the crankshaft is reduced, and thus, the fuel consumption of the engine is also

reduced, improving the fuel efficiency.

3) Since the load applied to the engine by the oil supply apparatus in the medium/high speed is reduced, the engine output in this range is improved.

4) The structure can be simplified to obtain the effect of the present invention at a minimum cost.

[0037] While the invention has been shown and described with reference to certain example embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

Claims

1. An oil supply apparatus for an engine provided with a two-stage relief valve, comprising:

an oil pump housing (100) having an inlet side (110) and an outlet side (120) configured to enable entry and exit of a working fluid;
a rotor (200) mounted in the oil pump housing (100) and driven in proportion to an engine speed;
a relief valve (300) operated by a pressure of the working fluid between the inlet side (110) and the outlet side (120); and
first and second flow paths (400, 500) formed between the inlet side (110) and the relief valve (300),
wherein the relief valve (300) is elastically supported and opened in a sequence from a low speed, a medium speed, a medium/high speed, and
a high speed in proportion to the engine speed, and a working fluid amount of the outlet side (120) is returned to the inlet side (110) through the first or second flow path (400 or 500) in proportion to the engine speed at the medium speed and the high speed.

2. The oil supply apparatus according to claim 1, wherein the relief valve (300) blocks the first and second flow paths (400, 500) regardless of the working fluid pressure of the outlet side (120) when the rotor (200) is rotated at the low speed,
is opened by a hydraulic pressure of the outlet side (120) to return a portion of the working fluid of the outlet side (120) to the inlet side (110) through the second flow path (500) when the rotor (200) is rotated at the medium speed,
is further opened by the hydraulic pressure of the outlet side (120) to block the first and second flow paths (400, 500) when the rotor (200) is rotated at the medium/high speed, and
is opened by the hydraulic pressure of the outlet side (120) to return a portion of the working fluid of the outlet side (120) to the inlet side (110) through the first flow path (400) when the rotor (200) is rotated at the high speed.

3. The oil supply apparatus according to claim 1 or 2, wherein the relief valve (300) comprises:

a valve housing (310) having both ends connected to branch pipes (111, 121) branched from the inlet side (110) and the outlet side (120), respectively;
a valve body (320) having a fluid path hole (321) to communicate the outlet side (120) with the second flow path (500) at the medium speed, and installed in the valve housing (310) to communicate the outlet side (120) with the first flow path (400) at the high speed; and
an elastic spring (330) mounted in the valve housing (310) to provide a recovering force to the valve body (320) operated by the working fluid pressure introduced from the outlet side (120).

FIG. 1

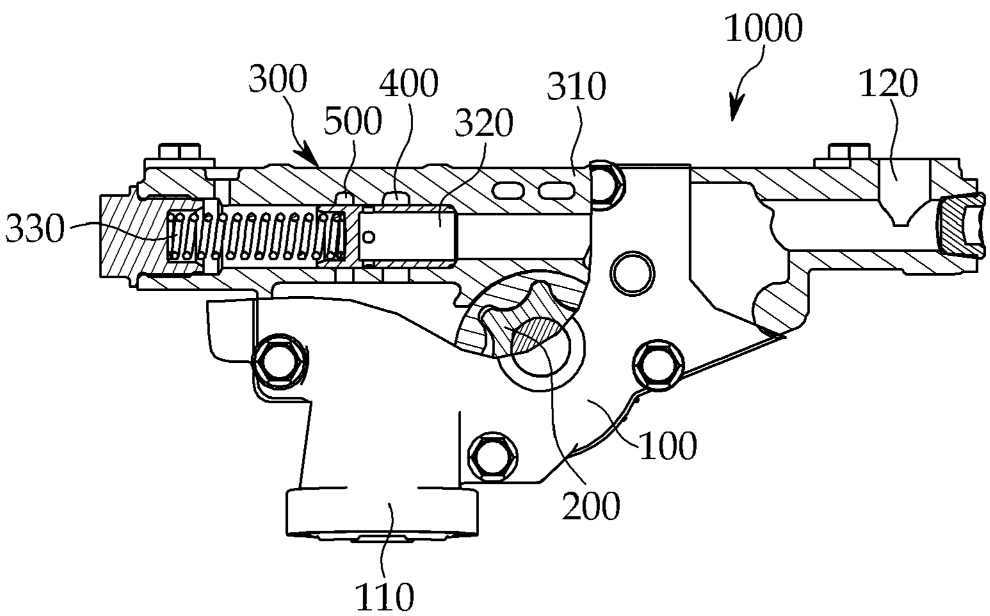


FIG. 2a

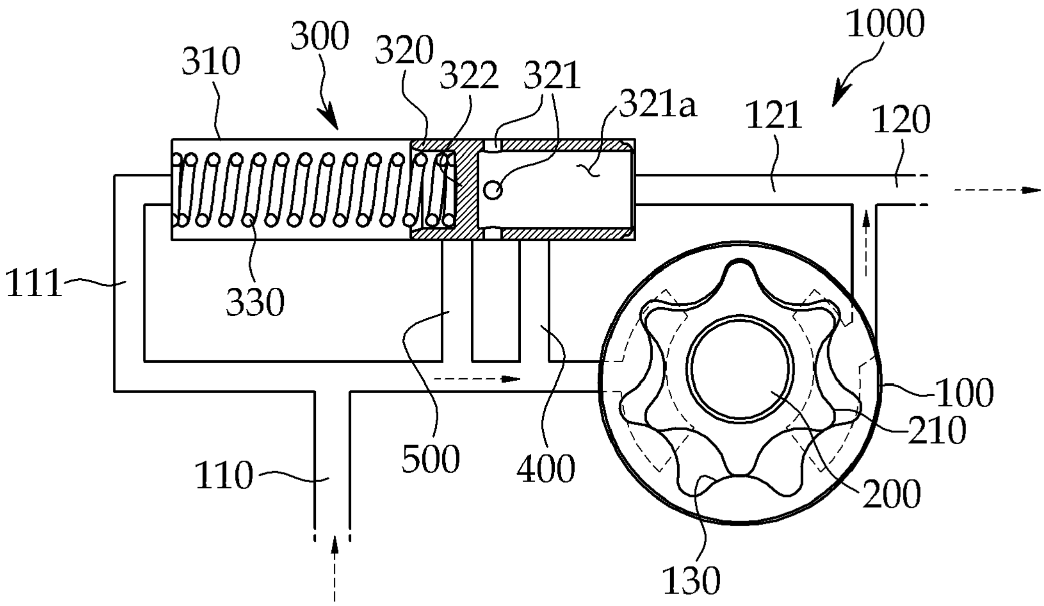
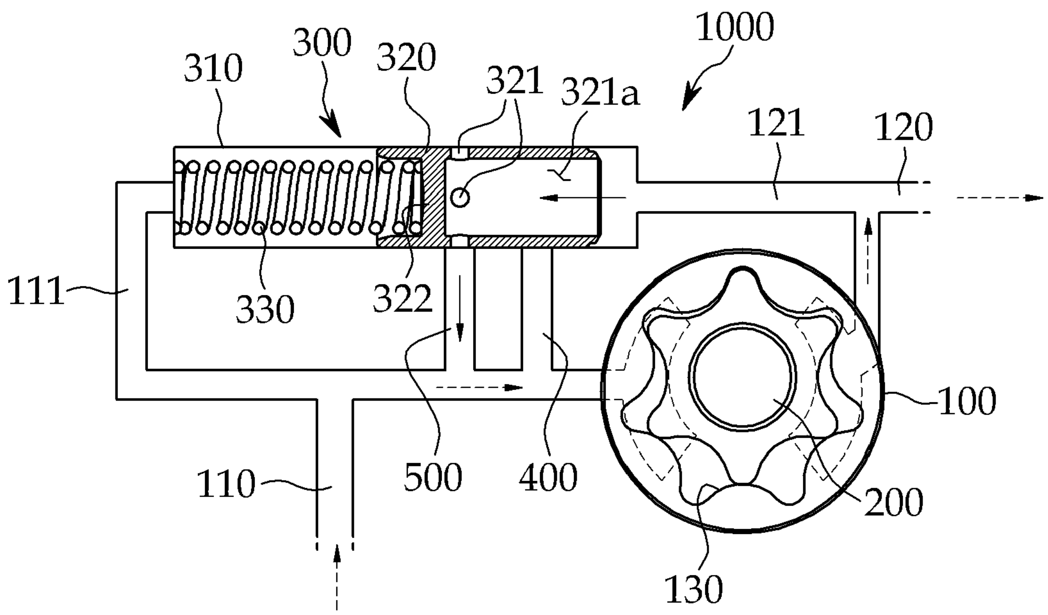

310
300
320
322
321
321a
1000
121
120
111
330
100
210
110
500
400
200
130

FIG. 2b


1000
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310
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321
321a
121
120
111
330
322
100
110
500
400
200
130

FIG. 2c

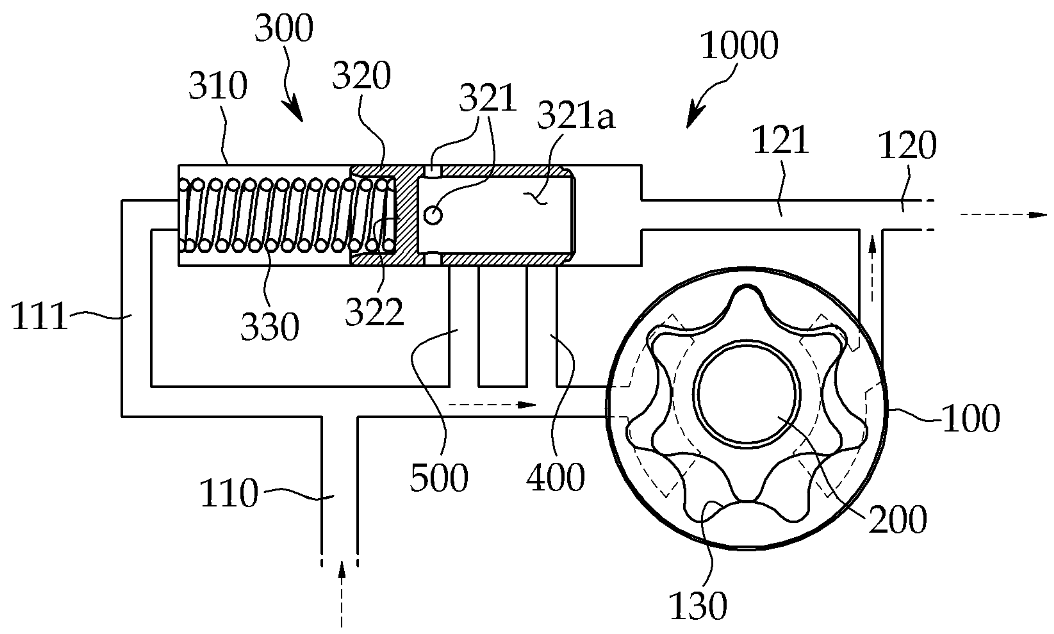

300
310
320
321
321a
1000
121
120
111
330
322
500
400
100
110
200
130

FIG. 2d

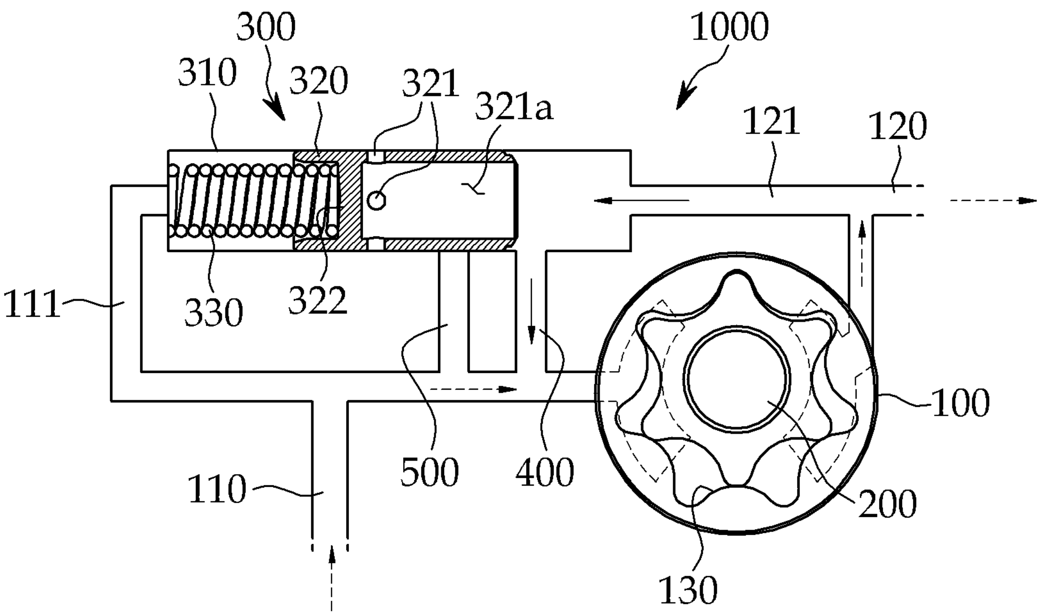
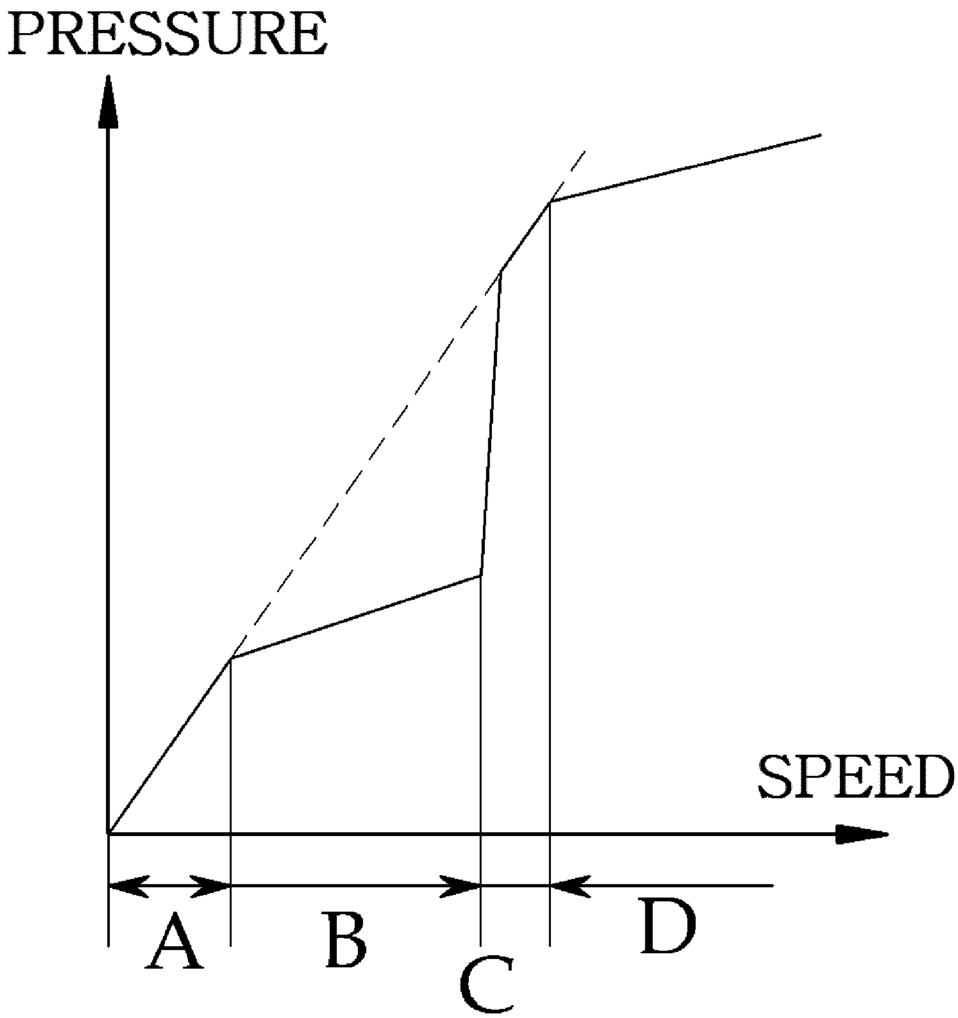

300
1000
310
320
321
321a
121
120
111
330
322
100
500
400
110
200
130

FIG. 3



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EUROPEAN SEARCH REPORT

Application Number
EP 12 17 2117

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	DE 199 52 287 A1 (UNISIA JECS CORP [JP] HITACHI LTD [JP]) 22 March 2001 (2001-03-22) * column 3, line 3 - column 6, line 55; figures * -----	1,3	INV. F01M1/16 F04B49/08 F16N13/00 F04C14/26
X	DE 196 31 296 A1 (FORD WERKE AG [DE] FORD GLOBAL TECH INC [US]) 5 February 1998 (1998-02-05) * column 3; figures 1,3 * -----	1,3	
X	DE 10 2004 004055 A1 (AISIN SEIKI [JP]) 12 August 2004 (2004-08-12) * paragraphs [0015] - [0017]; figure 1 * -----	1	

TECHNICAL FIELDS SEARCHED (IPC)

F01M
F04B
F16N
F04C

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	9 November 2012	Vedoato, Luca

CATEGORY OF CITED DOCUMENTS

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09-11-2012

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