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

Ölzuführvorrichtung für Motor mit zweistufigem Überdruckventil

Appareil d'alimentation en huile pour moteur et pourvue de soupape de surpression à deux étages

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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.

[0005] DE 199 52 287 A1 discloses a pressure relief valve characterized by two flow paths that can be unblocked in order to reduce the oil pressure and consequently to supply reduced amounts of working fluid. Said flow paths are unblocked one after the other at pre-determined oil pressure conditions in such a way that at high speed-range of engine they are both kept unblocked. This apparatus does not solve the technical problem posed by the art.

Summary of the invention

[0006] 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.

[0007] 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.

[0008] 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.

[0009] 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

[0010] 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

[0011] 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 describe the best mode of the invention.

[0012] 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]

[0013] 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.

[0014] 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.

[0015] Hereinafter, these components will be described in detail as follows.

[0016] 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.

[0017] 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.

[0018] 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 particular, 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.

[0019] 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.

[0020] 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.

[0021] 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.

[0022] 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.

[0023] 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.

[0024] 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.

[0025] 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.

[0026] 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.

[0027] 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]

[0028] 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.

[0029] 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.

[0030] 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.

[0031] 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.

[0032] 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.

[0033] 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.

[0034] 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.

[0035] 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.

[0036] 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.

[0037] 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.

[0038] 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,

SAID APPARATUS BEING CHARACTERISED IN THAT

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.

2. The oil supply apparatus according to claim 1, 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).

Patentansprüche

1. Ölzuführvorrichtung für einen Motor mit einem zwei-stufigem Überdruckventil, umfassend:

ein Ölpumpengehäuse (100) mit einer Einlassseite (110) und einer Auslassseite (120), welche dazu ausgebildet sind, einer Arbeitsflüssigkeit Eintritt und Austritt zu ermöglichen;

einen Rotor (200), welcher im Ölpumpengehäuse (100) befestigt ist und im Verhältnis zu einer Motordrehzahl angetrieben wird;

ein Überdruckventil (300), welches durch einen Druck der Arbeitsflüssigkeit zwischen der Einlassseite (110) und der Auslassseite (120) betrieben wird; und

erste und zweite Strömungswege (400, 500), welche zwischen der Einlassseite (110) und dem Überdruckventil (300) gebildet werden,

wobei das Überdruckventil (300) elastisch gelagert und gemäss einer Reihenfolge von einer tiefen Drehzahl, einer mittleren Drehzahl, einer mittleren / hohen Drehzahl geöffnet wird, und eine hohe Drehzahl im Verhältnis zu der Motordrehzahl, und eine Arbeitsflüssigkeitsmenge der Auslassseite (120) wird der Einlassseite (110) durch den ersten oder zweiten Strömungsweg (400 oder 500) im Verhältnis zu der Motordrehzahl bei der mittleren Drehzahl und der hohen Drehzahl zurückgegeben, wobei die besagte Vorrichtung **dadurch gekennzeichnet ist, dass** das Überdruckventil (300) den ersten und zweiten Strömungsweg (400, 500) unabhängig von dem Arbeitsflüssigkeitsdruck der Auslassseite (120) blockiert, wenn der Rotor (200) mit der tiefen Drehzahl rotiert, durch einen hydraulischen Druck der Auslassseite (120) geöffnet wird um einen Teil der Arbeitsflüssigkeit der Auslassseite (120) an die Einlassseite (110) durch den zweiten Strömungsweg (500) zurückzugeben wenn der Rotor (200) mit der mittleren Drehzahl rotiert, durch den hydraulischen Druck der Auslassseite (120) weiter geöffnet wird um den ersten und zweiten Strömungsweg (400, 500) zu blockieren wenn der Rotor (200) mit der mittleren / hohen Drehzahl rotiert wird, und durch den hydraulischen Druck der Auslassseite (120) geöffnet wird um einen Teil der Arbeitsflüssigkeit der Auslassseite (120) an die Einlassseite (110) durch den ersten Strömungsweg (400) zurückzugeben wenn der Rotor (200) mit der hohen Drehzahl rotiert.

2. Ölzuführvorrichtung gemäss Anspruch 1, wobei das Überdruckventil (300) umfasst:

ein Ventilgehäuse (310), wobei beide Enden mit Abzweigrohren (111, 121) verbunden sind, welche von der Einlassseite (110) beziehungsweise der Auslassseite (120) abzweigen; einen Ventilkörper (320) mit einem Flüssigkeitspfadloch (321), um die Auslassseite (120) mit dem zweiten Strömungspfad (500) bei der mittleren Drehzahl kommunizieren zu lassen, und im Ventilgehäuse (310) eingebaut, um die Auslassseite (120) mit dem ersten Strömungspfad (400) bei der hohen Drehzahl kommunizieren zu lassen; und eine Sprungfeder (330), welche im Ventilgehäuse (310) befestigt ist um eine Rückstellkraft auf den Ventilkörper (320) zur Verfügung zu stellen, welche durch den Arbeitsflüssigkeitsdruck betrieben wird, der von der Auslassseite (120) eingeführt wird.

Revendications

1. Un appareil d'approvisionnement d'huile pour un moteur pourvu d'une soupape de décharge à deux étages, comprenant : un boîtier de pompe à huile (100) ayant un côté entrée (110) et un côté sortie (120) configurés pour permettre l'entrée et la sortie d'un fluide de travail ;

- un rotor (200) monté dans le boîtier de pompe à huile (100) et entraîné par rapport à une vitesse de moteur ; une soupape de décharge (300) opérée par une pression du fluide de travail entre le côté entrée (110) et le côté sortie (120); et une première et deuxième trajectoire d'écoulement (400, 500) formée entre le côté entrée (110) et la soupape de décharge (300), dans lequel la soupape de décharge (300) est supportée de manière élastique et ouverte en séquence à partir d'une vitesse faible, une vitesse moyenne, une vitesse moyenne/élevée, et une vitesse élevée par rapport à la vitesse de moteur, et une quantité de fluide de travail du côté sortie (120) est retournée vers le côté entrée (110) à travers la première ou deuxième trajectoire d'écoulement (400, 500) par rapport à la vitesse de moteur à vitesse moyenne et vitesse élevée, ledit appareil étant **caractérisé en ce que** la soupape de décharge (300) bloque la première et la deuxième trajectoire d'écoulement (400, 500) indépendamment de la pression du fluide de travail du côté sortie (120) quand le rotor (200) est tourné à vitesse faible, est ouverte par une pression hydraulique du côté sortie (120) pour retourner une partie du fluide de travail depuis le côté sortie (120) vers le côté entrée (110) à travers la deuxième trajectoire d'écoulement (500) quand le rotor (200) est tourné à vitesse moyenne, est d'avantage ouverte par la pression hydraulique du côté sortie (120) pour bloquer première et la deuxième trajectoire d'écoulement (400, 500) quand le rotor (200) est tourné à vitesse moyenne/élevée, et est ouverte par la pression hydraulique du côté sortie (120) pour retourner une partie du fluide de travail depuis le côté sortie (120) vers le côté entrée (110) à travers la première trajectoire d'écoulement (400) quand le rotor (200) est tourné à vitesse élevée.

2. L'appareil d'approvisionnement d'huile selon la revendication 1, dans lequel la soupape de décharge (300) comprend : un boîtier de soupape (310) ayant deux terminaisons connectées à des tuyaux de dérivation (111, 121) dérivés depuis le côté entrée (110) et le côté sortie (120), respectivement ; un corps de soupape (320) ayant un trou de trajectoire de fluide (321) pour communiquer le côté sortie

(120) avec la deuxième trajectoire d'écoulement (500) à vitesse moyenne ; et installé dans le boîtier de soupape (310) pour communiquer le côté sortie (120) avec la première trajectoire d'écoulement (400) à vitesse élevée ; et un ressort élastique (330) monté dans le boîtier de soupape (310) pour fournir une force de recouvrance au corps de soupape (320) opéré par la pression du fluide de travail introduit depuis le côté sortie (120).

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FIG. 1

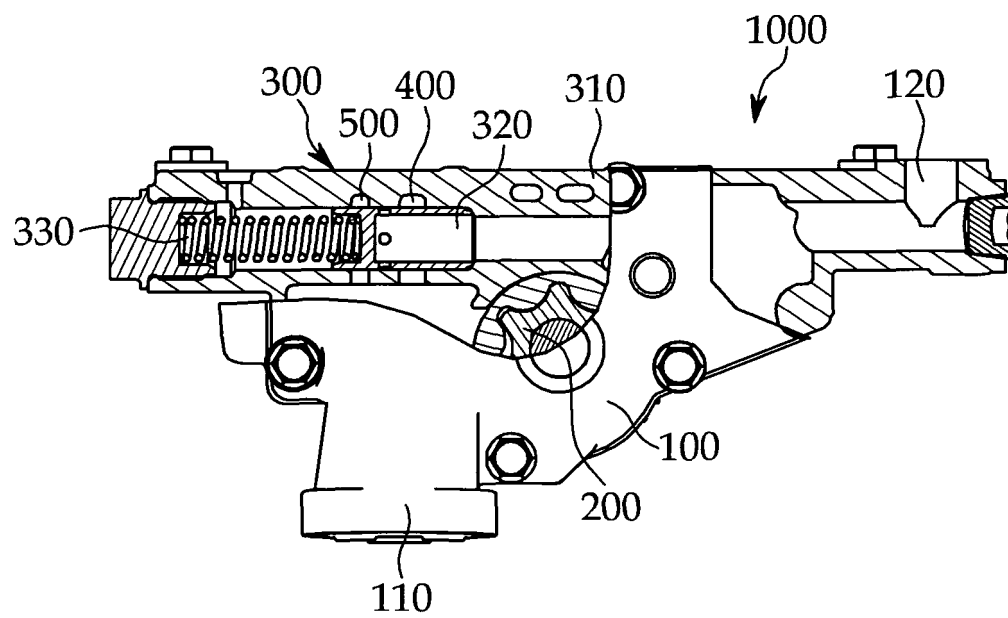


FIG. 2a

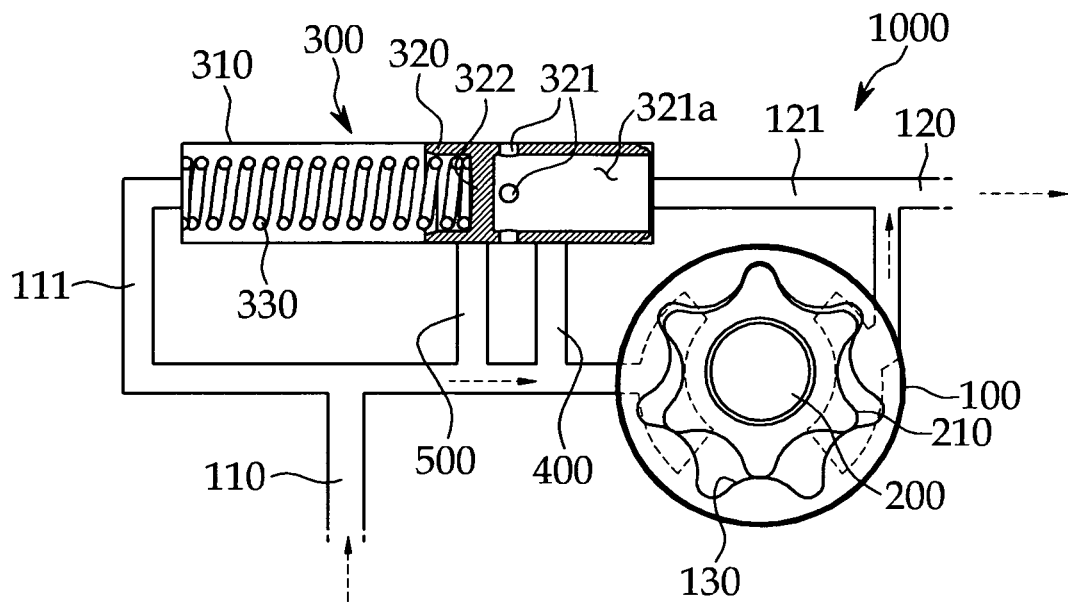


FIG. 2b

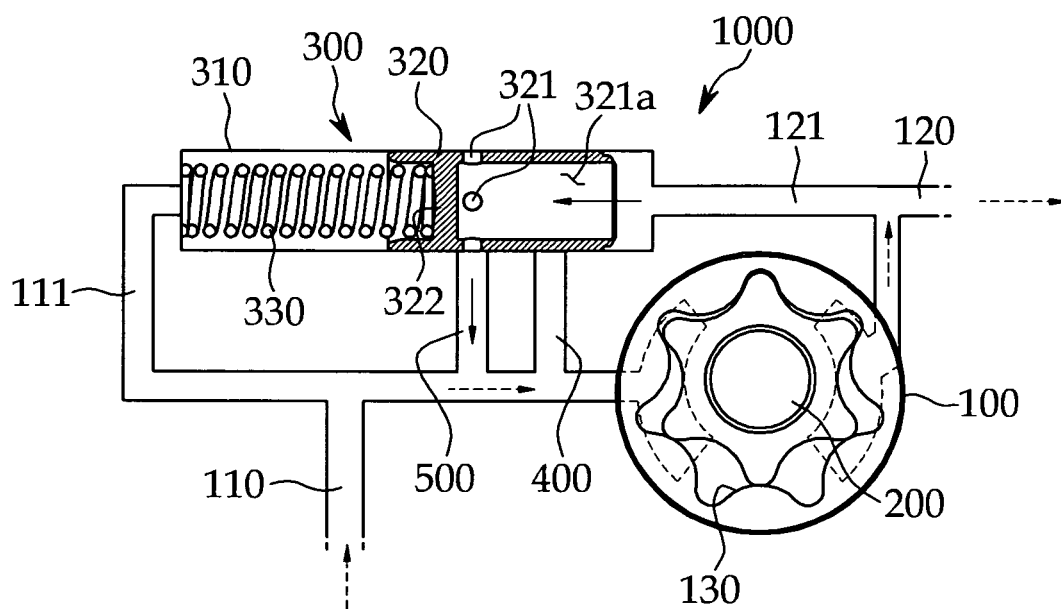


FIG. 2c

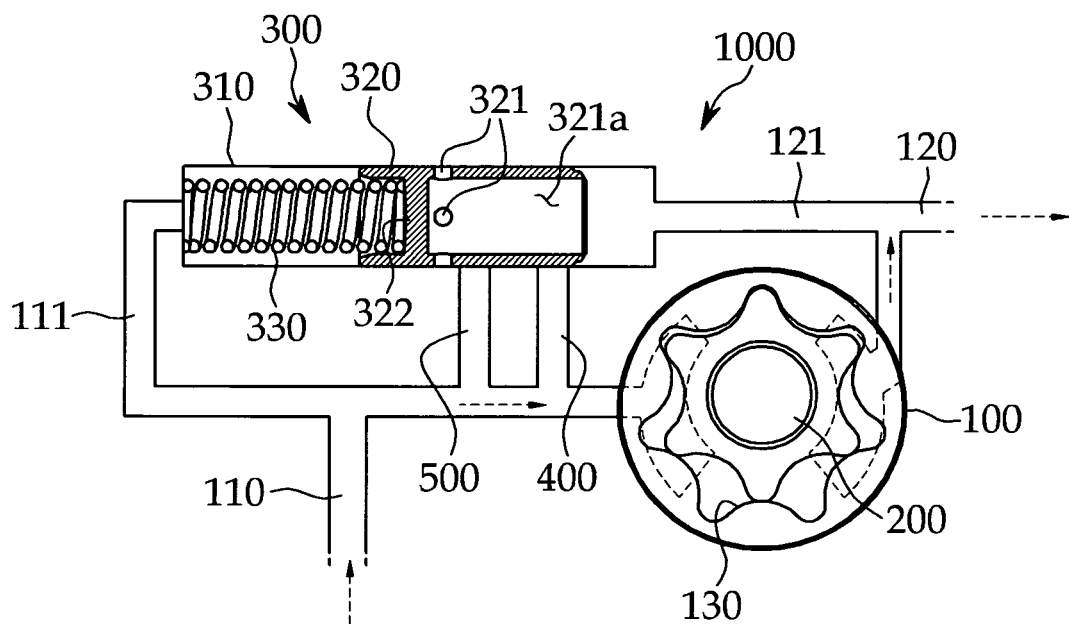


FIG. 2d

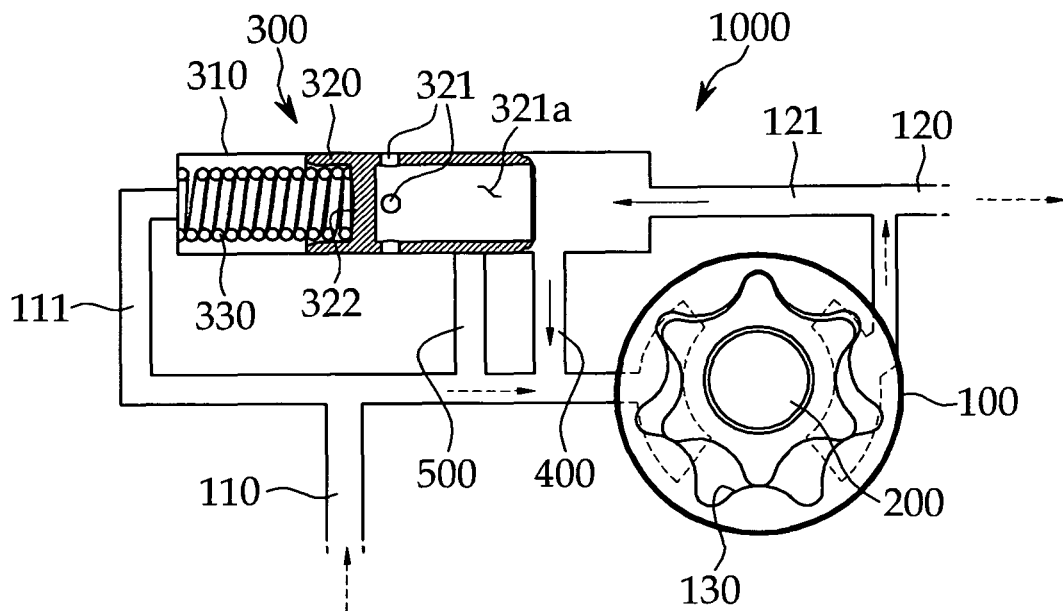
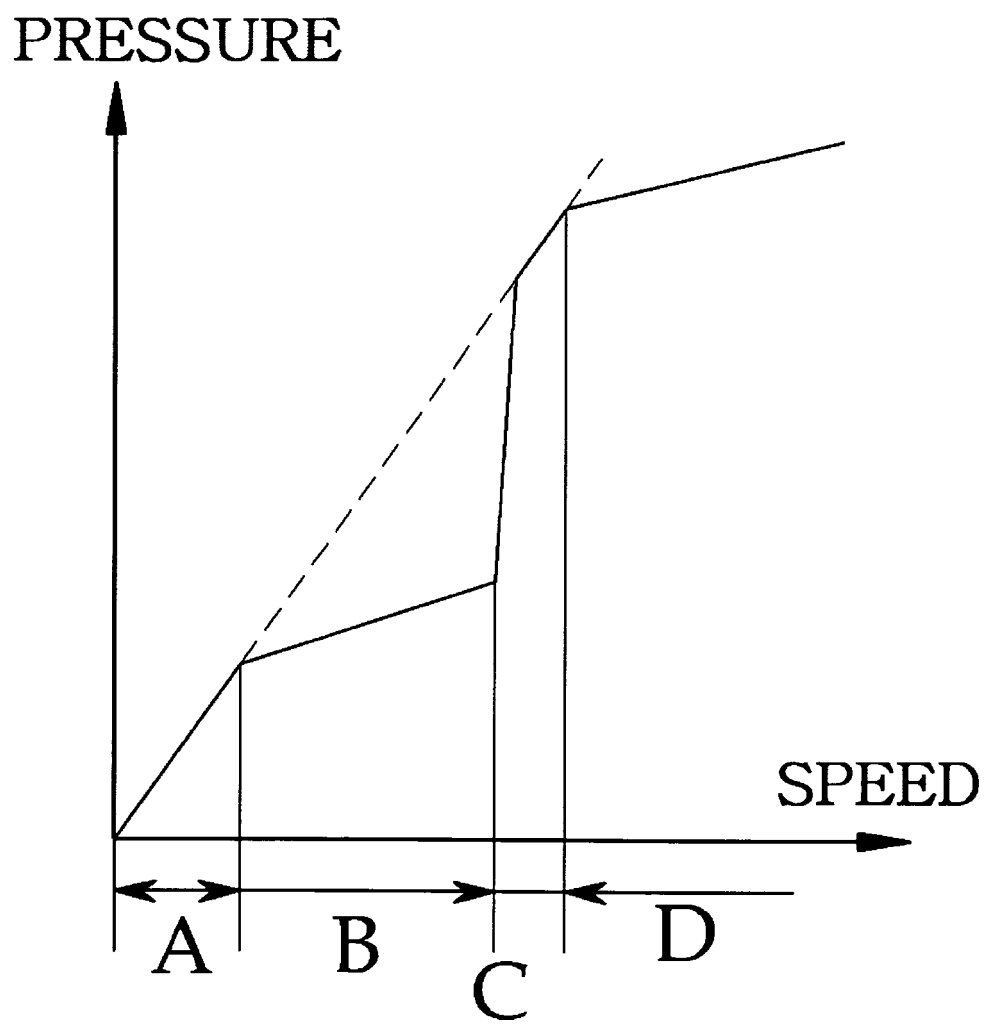


FIG. 3



REFERENCES CITED IN THE DESCRIPTION

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