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(54) **ENGINE HAVING VARIABLE VALVE TIMING DEVICE**

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(57) **ABSTRACT**

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An engine having a variable valve timing device of the present invention may include a valve disposed to open/close a port, an elastic member for supporting the valve elastically to close the port, a first camshaft having a first cam formed thereon for moving the valve to open the port as the first camshaft rotates, a second camshaft having a second cam formed thereon for moving the valve to close the port as the second camshaft rotates, a first variable rotation mechanism for advancing or retarding the rotation of the first camshaft, and a second variable rotation mechanism for advancing or retarding the rotation of the second camshaft.

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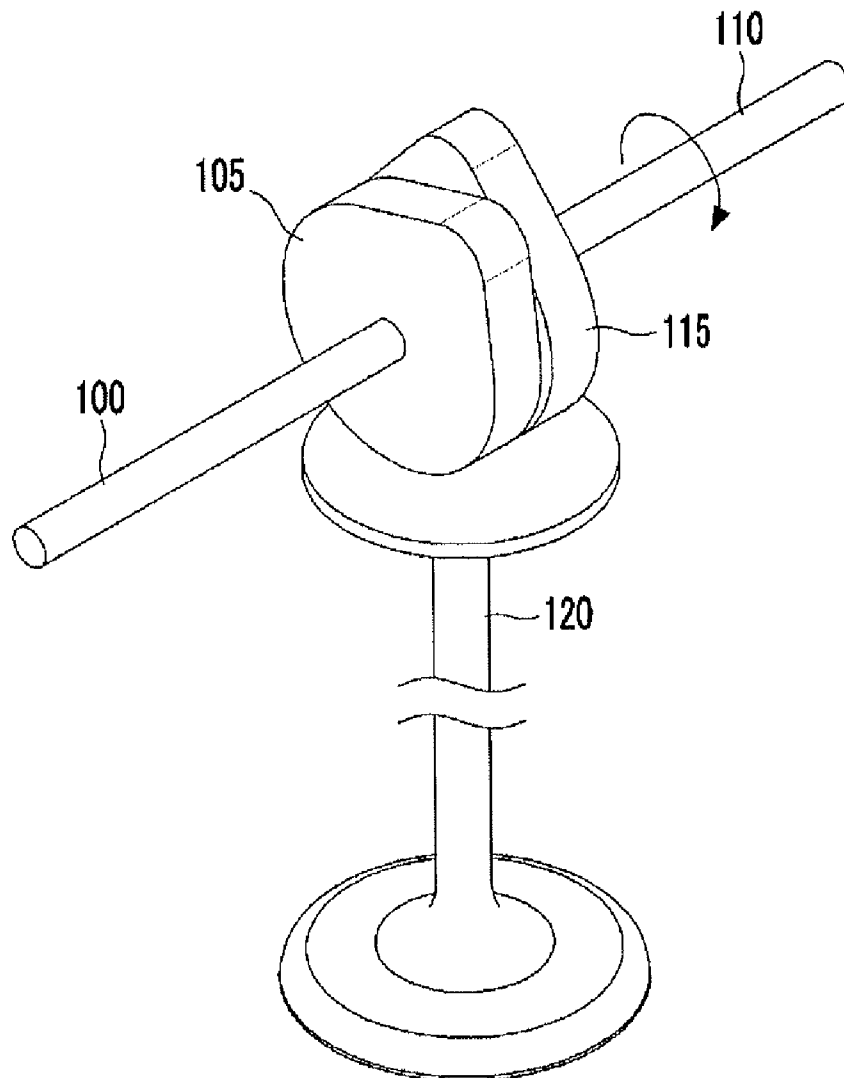


FIG. 1

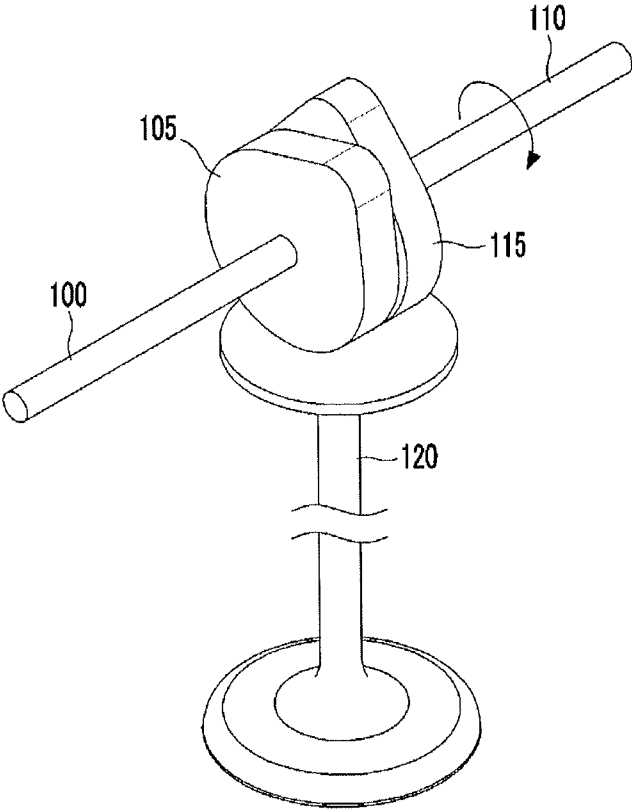
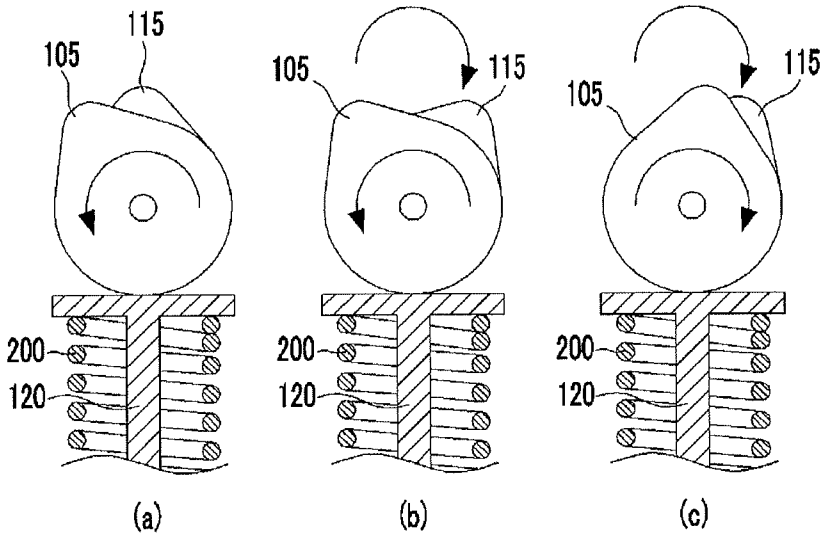


FIG. 2



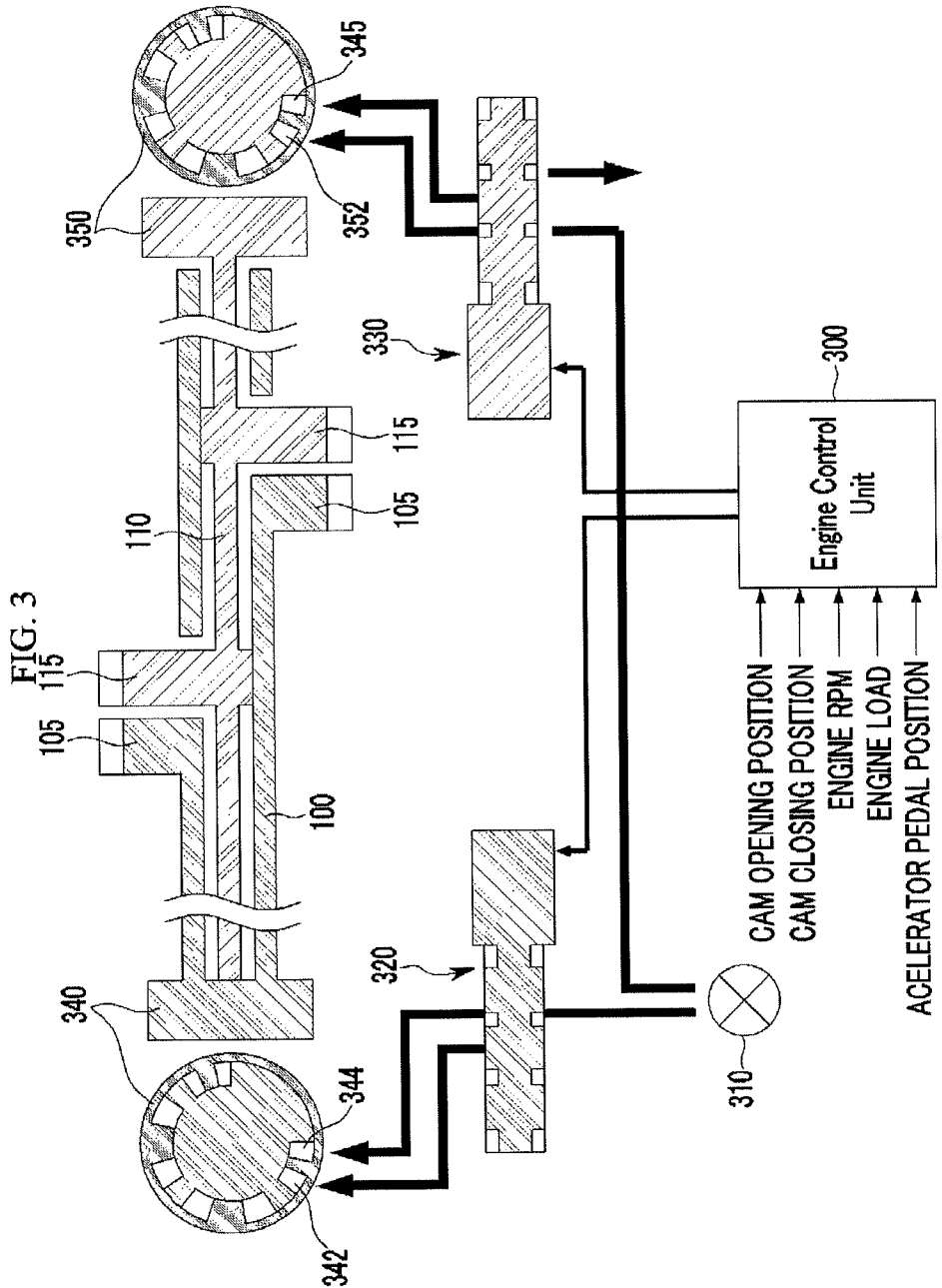
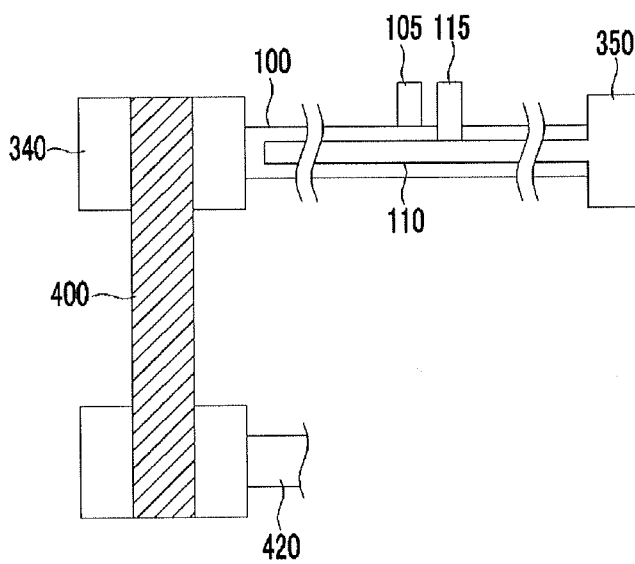


FIG. 4



**ENGINE HAVING VARIABLE VALVE TIMING DEVICE**

**CROSS-REFERENCE TO RELATED APPLICATION**

**[0001]** The present application claims priority to Korean Patent Application No. 10-2013-0107425 filed on Sep. 6, 2013, the entire contents of which is incorporated herein for all purposes by this reference.

**BACKGROUND OF THE INVENTION**

**[0002]** 1. Field of the Invention

**[0003]** The present invention relates to an engine having a variable valve timing device which controls opening time, duration of opening, and closing time of an intake or an exhaust valve which opens or closes an intake or exhaust port for improving total energy consumption efficiency.

**[0004]** 2. Description of Related Art

**[0005]** An internal combustion engine generates power by receiving and burning fuel and air in a combustion chamber. At the time of intake of the air, a camshaft is driven to operate the intake valve to draw air into the combustion chamber during the intake valve is opened.

**[0006]** In addition, the camshaft is driven to operate the exhaust valve to discharge the air from the combustion chamber during the exhaust valve is opened.

**[0007]** In the meantime, optimum opening/closing times and duration of the opening of the intake valve/exhaust valve vary with operation conditions, such as a rotation speed of the engine or an engine load.

**[0008]** That is, proper timing (lift) or valve opening/closing vary with the rotation speed of the engine.

**[0009]** In the meantime, when one valve is opened/closed with a cam, if the opening time is retarded, the closing time is retarded too, and if the opening time is advanced, the closing time is advanced too. Study for extension/shortening of the duration of opening between the opening time and the closing time is also underway.

**[0010]** A prior art discloses a camshaft having a first cam and a second cam for driving one valve, wherein the camshaft has a structure in which individual advance or retard of the first cam and the second cam is not possible.

**[0011]** The information disclosed in this Background of the Invention section is only for enhancement of understanding of the general background of the invention and should not be taken as an acknowledgement or any form of suggestion that this information forms the prior art already known to a person skilled in the art.

**BRIEF SUMMARY**

**[0012]** Various aspects of the present invention are directed to providing an engine having a variable valve timing device having an advantage of improving total efficiency. An object of the present invention is to provide an engine having a variable valve timing device which can retard or advance an opening time and a closing time of a valve, as well as extend or shorten duration of opening between the opening time and the closing time for improving total efficiency.

**[0013]** In an aspect of the present invention, an engine having a variable valve timing device may include a valve disposed to open or close a port, an elastic member configured for supporting the valve elastically to close the port, a first camshaft having a first cam formed thereon for moving the

valve to open the port as the first camshaft rotates, a second camshaft having a second cam formed thereon for moving the valve to close the port as the second camshaft rotates, a first variable rotation mechanism for advancing or retarding the rotation of the first camshaft, and a second variable rotation mechanism for advancing or retarding the rotation of the second camshaft.

**[0014]** The first variable rotation mechanism or the second variable rotation mechanism is formed at a pulley or a sprocket for having a torque forwarded thereto to rotate the first camshaft and the second camshaft.

**[0015]** The second camshaft is slidably inserted into the first camshaft, and the second cam penetrates the first camshaft to operate the valve.

**[0016]** The first variable rotation mechanism or the second variable rotation mechanism may include an advance angle chamber and a retard angle chamber for advancing rotation of the first camshaft and the second camshaft or retarding rotation of the first camshaft and the second camshaft.

**[0017]** The engine having the variable valve timing device may further may include first and second oil control valves matched to the first variable rotation mechanism and the second variable rotation mechanism for selective forwarding of hydraulic oil to the advance angle chamber or the retard angle chamber, and a hydraulic pump for pumping the hydraulic oil to the first and second oil control valves.

**[0018]** The engine having the variable valve timing device may further may include a control unit for sensing rotation positions of the first cam and the second cam, and an RPM of a crankshaft, and determining an engine load, and sensing a position of an accelerator pedal, and controlling the first and second oil control valves according to operation information sensed thus.

**[0019]** The first variable rotation mechanism is disposed to one end of the first camshaft, and the second variable rotation mechanism is disposed to the other end of the second camshaft.

**[0020]** The first variable rotation mechanism may have a torque forwarded thereto from the crankshaft to rotate the first camshaft, and the second variable rotation mechanism rotates the second camshaft by rotation of the first camshaft to advance or retard the second camshaft with reference to the first camshaft.

**[0021]** To achieve the object of the present invention, the opening time of the valve may be retarded or advanced with the first camshaft and the first cam, and the closing time of the valve may be retarded or advanced with the second camshaft and the second cam.

**[0022]** Along with this, the duration of opening of the valve may be controlled easily by controlling the opening time and the closing time of the valve, individually.

**[0023]** The methods and apparatuses of the present invention have other features and advantages which will be apparent from or are set forth in more detail in the accompanying drawings, which are incorporated herein, and the following Detailed Description, which together serve to explain certain principles of the present invention.

**BRIEF DESCRIPTION OF THE DRAWINGS**

**[0024]** FIG. 1 illustrates a schematic perspective view of a part of an engine having a variable valve timing device in accordance with an exemplary embodiment of the present invention.

[0025] FIGS. 2A~2C illustrate side views of a part of an engine having a variable valve timing device in accordance with an exemplary embodiment of the present invention.

[0026] FIG. 3 illustrates a schematic diagram of an engine having a variable valve timing device in accordance with an exemplary embodiment of the present invention.

[0027] FIG. 4 illustrates a schematic diagram of an engine having a variable valve timing device in accordance with an exemplary embodiment of the present invention.

[0028] It should be understood that the appended drawings are not necessarily to scale, presenting a somewhat simplified representation of various features illustrative of the basic principles of the invention. The specific design features of the present invention as disclosed herein, including, for example, specific dimensions, orientations, locations, and shapes will be determined in part by the particular intended application and use environment.

[0029] In the figures, reference numbers refer to the same or equivalent parts of the present invention throughout the several figures of the drawing.

#### DETAILED DESCRIPTION

[0030] Reference will now be made in detail to various embodiments of the present invention(s), examples of which are illustrated in the accompanying drawings and described below. While the invention(s) will be described in conjunction with exemplary embodiments, it will be understood that the present description is not intended to limit the invention(s) to those exemplary embodiments. On the contrary, the invention(s) is/are intended to cover not only the exemplary embodiments, but also various alternatives, modifications, equivalents and other embodiments, which may be included within the spirit and scope of the invention as defined by the appended claims.

[0031] An exemplary embodiment of the present invention will hereinafter be described in detail with reference to the accompanying drawings.

[0032] FIG. 1 illustrates a schematic perspective view of a part of an engine having a variable valve lift timing device in accordance with an exemplary embodiment of the present invention.

[0033] Referring to FIG. 1, the engine includes a first camshaft 100, a second camshaft 110, a first cam 105 and a second cam 115. The first camshaft 100 and the second camshaft 110 have a structure in which the first camshaft 100 and the second camshaft 110 are disposed and rotate on the same axis.

[0034] The first camshaft 100 has one end with the first cam 105 formed thereon, and the second camshaft 110 has the other end with the second cam 115 formed thereon, wherein the first cam 105 and the second cam 115 may be disposed adjacent to each other.

[0035] In an exemplary embodiment of the present invention, the first cam 105 and the second cam 115 open or close one valve 120, and the first camshaft 100 is rotated in retard or advance by a crankshaft to rotate the first cam 105 in retard or advance.

[0036] Along with this, the second camshaft 110 may be rotated in retard or advance by the crankshaft to rotate the second cam 115 in retard or advance.

[0037] FIGS. 2A~2C illustrate side views of a part of an engine having a variable valve timing device in accordance with an exemplary embodiment of the present invention.

[0038] Referring to FIG. 2, the first cam 105 and the second cam 115 are disposed on a top side, and the valve 120 is

disposed under the first cam 105 and the second cam 115. Further, an elastic member 200 supports the valve 120 upward elastically to bring the valve 120 into close contact with the first and second cams 105 and 115.

[0039] Referring to FIG. 2A, since both of the first cam 105 and the second cam 115 are retarded, both of the opening time and the closing time of the valve 120 are retarded, and the duration of opening of the valve 120 becomes short.

[0040] Referring to FIG. 2B, since the first cam 105 is retarded and the second cam 115 is advanced, the opening time of the valve 120 is advanced, the closing time of the valve 120 is retarded, and the duration of the opening is extended.

[0041] Referring to FIG. 2C, since both of the first cam 105 and the second cam 115 are advanced, both of the opening time and the closing time are advanced, and the duration of opening of the valve 120 is shortened.

[0042] FIG. 3 illustrates a schematic diagram of an engine having a variable valve timing device in accordance with an exemplary embodiment of the present invention.

[0043] Referring to FIG. 3, the engine having a variable valve timing device includes a control unit 300, a hydraulic pump 310, a first oil control valve 320, a second oil control valve 330, a first variable rotation mechanism 340, a second variable rotation mechanism 350, a first camshaft 100, a second camshaft 110, a first cam 105 and a second cam 115

[0044] The first camshaft 100 has a left side end with the first variable rotation mechanism 340 disposed thereto, and the second camshaft 110 inserted therein. In addition, the second camshaft 110 has a right side end with the second variable rotation mechanism 350 disposed thereto.

[0045] The first cam 105 is formed protruded from one side of an outside circumference of the first camshaft 100, and the second cam 115 is formed protruded from one side of an outside circumference of the first camshaft 100 passed through the first camshaft 100.

[0046] In an exemplary embodiment of the present invention, the first cam 105 and the second cam 115 may be formed to the same heights from the outside circumference of the first camshaft 100, respectively.

[0047] The first variable rotation mechanism 340 makes the first cam 105 to retard or advance through the first camshaft 100, and the second variable mechanism 350 makes the second cam 115 to retard or advance through the second camshaft 110.

[0048] The first variable rotation mechanism 340 has a retard angle chamber 342 or 352 and an advance angle chamber 344 or 345 formed therein, and the first oil control valve 320 supplies oil to the retard angle chamber 342 or 352 and the advance angle chamber 344 or 345 for retarding or advancing the first camshaft 100.

[0049] Along with this, the second variable rotation mechanism 350 has a retard angle chamber 342 or 352 and an advance angle chamber 344 or 345 formed therein, and the second oil control valve 330 supplies oil to the retard angle chamber 342 or 352 and the advance angle chamber 344 or 345 for retarding or advancing the second camshaft 110.

[0050] The hydraulic pump 310 pumps the oil to the first oil control valve 320 and the second oil control valve 330 at a preset pressure.

[0051] Further, the control unit 300 controls the first oil control valve 320 and the second oil control valve 330 to retard or advance the first cam 105 and the second cam 115 individually according to operation information including a position of an opening cam (The first cam), a position of a

closing cam (The second cam), the engine rotation speed (RPM), an engine load and a position of an accelerator pedal.

[0052] FIG. 4 illustrates a schematic diagram of an engine having a variable valve timing device in accordance with an exemplary embodiment of the present invention.

[0053] Referring to FIG. 4, the crankshaft 420 in the engine generates a torque, and the first variable rotation mechanism 340 has the torque forwarded thereto from the crankshaft 420 through a chain or a belt 400, to rotate the first camshaft 100. Along with this, the first variable rotation mechanism 340 makes the rotation of the first camshaft 100 retarded or advanced.

[0054] The second variable mechanism 350 is rotated by the first camshaft 100, and the second variable rotation mechanism 350 may make the second camshaft 110 to be retarded or advanced with reference to the first camshaft 100.

[0055] Though FIG. 4 illustrates the first variable rotation mechanism 340 having a torque forwarded thereto from the crankshaft 420, and the second variable rotation mechanism 350 having a torque forwarded thereto from the first camshaft 100, the second variable rotation mechanism 350 may have the torque forwarded thereto from the crankshaft 420, and the first variable rotation mechanism 340 may have the torque forwarded thereto from the second camshaft 420.

[0056] Along with this, the first variable rotation mechanism 340 and the second variable rotation mechanism 350 may have the torque forwarded thereto from the crankshaft 420, individually.

[0057] For convenience in explanation and accurate definition in the appended claims, the terms "upper", "lower", "inner" and "outer" are used to describe features of the exemplary embodiments with reference to the positions of such features as displayed in the figures.

[0058] The foregoing descriptions of specific exemplary embodiments of the present invention have been presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the invention to the precise forms disclosed, and obviously many modifications and variations are possible in light of the above teachings. They are not intended to be exhaustive or to limit the invention to the precise forms disclosed, and obviously many modifications and variations are possible in light of the above teachings as well as various alternatives and modifications thereof. It is intended that the scope of the invention be defined by the Claims appended hereto and their equivalents.

What is claimed is:

- 1. An engine having a variable valve timing device comprising:
  - a valve disposed to open or close a port;
  - an elastic member configured for supporting the valve elastically to close the port;
  - a first camshaft having a first cam formed thereon for moving the valve to open the port as the first camshaft rotates;

- a second camshaft having a second cam formed thereon for moving the valve to close the port as the second camshaft rotates;
  - a first variable rotation mechanism for advancing or retarding the rotation of the first camshaft; and
  - a second variable rotation mechanism for advancing or retarding the rotation of the second camshaft.
- 2. The engine having the variable valve timing device of claim 1, wherein the first variable rotation mechanism or the second variable rotation mechanism is formed at a pulley or a sprocket for having a torque forwarded thereto to rotate the first camshaft and the second camshaft.
  - 3. The engine having the variable valve timing device of claim 1, wherein the second camshaft is slidably inserted into the first camshaft, and the second cam penetrates the first camshaft to operate the valve.
  - 4. The engine having the variable valve timing device of claim 1, wherein the first variable rotation mechanism or the second variable rotation mechanism includes an advance angle chamber and a retard angle chamber for advancing rotation of the first camshaft and the second camshaft or retarding rotation of the first camshaft and the second camshaft.
  - 5. The engine having the variable valve timing device of claim 4, further comprising:
    - first and second oil control valves matched to the first variable rotation mechanism and the second variable rotation mechanism for selective forwarding of hydraulic oil to the advance angle chamber or the retard angle chamber; and
    - a hydraulic pump for pumping the hydraulic oil to the first and second oil control valves.
  - 6. The engine having the variable valve timing device of claim 4, further comprising:
    - a control unit for sensing rotation positions of the first cam and the second cam, and an RPM of a crankshaft, and determining an engine load, and sensing a position of an accelerator pedal, and
    - controlling the first and second oil control valves according to operation information sensed thus.
  - 7. The engine having the variable valve timing device of claim 1, wherein the first variable rotation mechanism is disposed to one end of the first camshaft, and the second variable rotation mechanism is disposed to the other end of the second camshaft.
  - 8. The engine having the variable valve timing device of claim 3,
    - wherein the first variable rotation mechanism has a torque forwarded thereto from the crankshaft to rotate the first camshaft, and
    - the second variable rotation mechanism rotates the second camshaft by rotation of the first camshaft to advance or retard the second camshaft with reference to the first camshaft.

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