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- **Lai, Wen-Chuan**
Ping Tung City (TW)
- **Chen, Chun-Ching**
Feng Shan City
Kaohsiung Hsien (TW)

(71) Applicant: **Kwang Yang Motor Co., Ltd.**
San-Min Dist.,
Kaohsiung City (TW)

(74) Representative: **Kahlhöfer, Hermann**
KNH Patentanwälte
Kahlhöfer Neumann Herzog Fiesser
Karlstrasse 76
40210 Düsseldorf (DE)

(72) Inventors:
• **Tsai, Meng-Lung**
Tsoying District
Kaohsiung (TW)

(54) **Exhaust gas recycling device for a motorcycle engine**

(57) An exhaust gas recycling device (6) is adapted for a motorcycle engine (3) that includes an air intake system (31) and an exhaust gas system (32). The exhaust gas recycling device (6) includes a normally closed exhaust gas recycling valve (61), an exhaust gas outlet (321', 322') and an air-guiding pipe (62). The exhaust gas recycling valve (61) is mounted on the air intake system (31), and has a gas inlet (611) and a gas outlet (612) that is in fluid communication with the air intake system

(31). The exhaust gas recycling valve (61) is opened so as to allow for gas flow between the gas inlet (611) and the gas outlet (612) when the engine (3) is in an accelerated state. The exhaust gas outlet (321', 322') is formed in the exhaust gas system (32). The air-guiding pipe (62) has one end connected to and in fluid communication with the gas inlet (611), and the other end connected to and in fluid communication with the exhaust gas system (32).

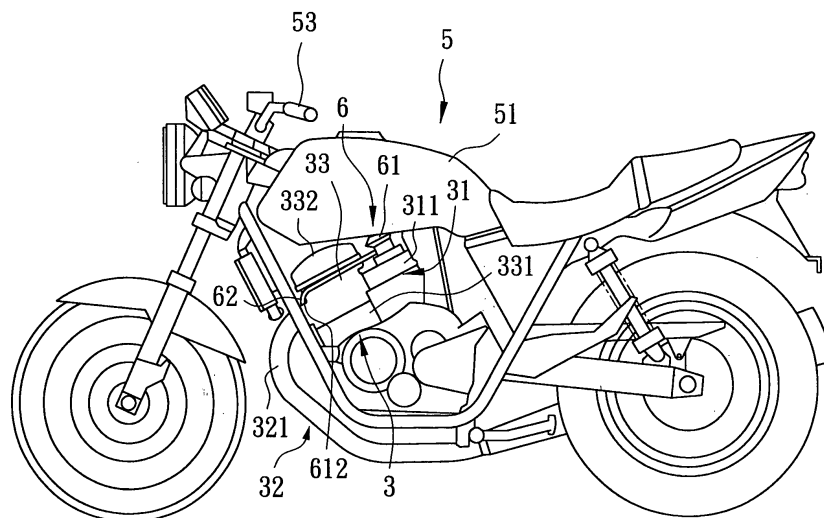


FIG. 2

Description

[0001] The invention relates to an exhaust gas recycling device, more particularly to an exhaust gas recycling device for a motorcycle engine.

[0002] As environmental protection becomes an increasing concern, air pollution generated by vehicle exhausts is receiving much attention as a critical area requiring solutions.

[0003] Referring to Figure 1, which is a schematic diagram of a conventional exhaust gas recycling device used in a car, the exhaust gas recycling device 1 is adapted for connection with a car engine 2 that includes an air intake pipe 22 and an exhaust gas pipe 21. The exhaust gas recycling device 1 includes an exhaust gas recycling valve 11 configured as an electromagnetic valve and mounted on the car body, an electronic control unit (ECU) 12 for controlling opening and closing operations of the exhaust gas recycling valve 11, a first air-guiding pipe 13 in fluid communication with the exhaust gas pipe 21, and a second air-guiding pipe 14 in fluid communication with the air intake pipe 22. When the electronic control unit 12 opens the exhaust gas recycling valve 11, the first air-guiding pipe 13 is in fluid communication with the second air-guiding pipe 14. This allows exhaust gas to flow from the exhaust gas pipe 21 into the air intake pipe 22 via a flow path formed by the first air-guiding pipe 13, the exhaust gas recycling valve 11 and the second air-guiding pipe 14. The exhaust gas mixes with fresh air in the intake pipe 22 for subsequent flow into the car engine 2.

[0004] When the electronic control unit 12 closes the exhaust gas recycling valve 11, the first air-guiding pipe 13 is not in fluid communication with the second air-guiding pipe 14. As such, flow of exhaust gas from the exhaust gas pipe 21 into the air intake pipe 22 via the flow path of the first air-guiding pipe 13, the exhaust gas recycling valve 11 and the second air-guiding pipe 14 is prevented.

[0005] As described above, a portion of the exhaust gas exhausted from the car engine 2 flows back into the air intake pipe 22 to mix with fresh air. Since this portion of exhaust gas includes a large quantity of carbon dioxide (CO₂), which will not oxidize and which can absorb a lot of heat so as to reduce oxygen density in the car engine 2. The maximum combustion temperature of the car engine 2 is lowered to thereby reduce nitrogen oxides (NOx) in the exhaust gas.

[0006] Nevertheless, since an assembly of the first and second air-guiding pipes 13, 14 is long, and the temperature of the exhaust gas generated by the car engine 2 is high, when the exhaust gas is guided to flow through the first and second air-guiding pipes 13, 14, water and carbon are easily accumulated within the first and second air-guiding pipes 13, 14. Therefore, a return flow rate of the exhaust gas is lowered. This results in an uneven density of the exhaust gas fed back into the car engine 2, which adversely affects engine ignition.

[0007] Moreover, due to the high temperature of the exhaust gas of the exhaust gas pipe 21, the exhaust gas

recycling valve 11 is susceptible to damage. If extreme damage occurs, the exhaust gas recycling valve 11 may entirely malfunction, in which case exhaust gas recycling is not possible.

[0008] In developing countries, exhaust gas discharged from motorcycles is one of the primary sources of air pollution, and therefore requires urgent attention.

[0009] The aforesaid excessively long piping problem needs to be resolved in order to make the conventional exhaust gas recycling device applicable to a motorcycle engine. In addition, the manner in which the exhaust gas recycling device 1 may be mounted within the very limited space in a motorcycle is another issue that needs to be addressed.

[0010] Therefore, the object of this invention is to provide an exhaust gas recycling device that can overcome the drawbacks associated with the prior art.

[0011] According to one aspect of the present invention, there is provided an exhaust gas recycling device for an engine of a motorcycle. The motorcycle has a fuel tank. The engine is disposed under the fuel tank, and includes an air intake system and an exhaust gas system. The exhaust gas recycling device includes a normally closed exhaust gas recycling valve, an exhaust gas outlet and an air-guiding pipe.

[0012] The exhaust gas recycling valve is mounted on the air intake system, and has a gas inlet and a gas outlet that is in fluid communication with the air intake system. The exhaust gas recycling valve is opened so as to allow for gas flow between the gas inlet and the gas outlet when the engine is in an accelerated state. The exhaust gas outlet is formed in the exhaust gas system.

[0013] The air-guiding pipe has one end connected to and in fluid communication with the gas inlet, and the other end connected to and in fluid communication with the exhaust gas system through the exhaust gas outlet.

[0014] The exhaust gas recycling valve is disposed under the fuel tank. The air-guiding pipe is disposed between the fuel tank and the exhaust gas system.

[0015] According to another aspect of the present invention, there is provided an exhaust gas recycling device for an engine of a motorcycle. The motorcycle has a fuel tank. The engine is disposed under the fuel tank, and includes an air intake system and an exhaust gas system. The exhaust gas recycling device includes a normally closed exhaust gas recycling valve, an exhaust gas outlet and an air-guiding pipe.

[0016] The exhaust gas recycling valve is mounted on the air intake system, and has a gas inlet and a gas outlet that is in fluid communication with the air intake system. The exhaust gas recycling valve is opened so as to allow for gas flow between the gas inlet and the gas outlet when the engine is in an accelerated state. The exhaust gas outlet is formed in the exhaust gas system.

[0017] The air-guiding pipe has one end connected to and in fluid communication with the gas inlet, and the other end connected to and in fluid communication with the exhaust gas system through the exhaust gas outlet.

[0018] The exhaust gas recycling valve and the air-guiding pipe are disposed under the fuel tank and between the fuel tank and the exhaust gas system. The air-guiding pipe is disposed in proximity to the engine.

[0019] According to yet another aspect of the present invention, there is provided an exhaust gas recycling device for an engine of a motorcycle. The motorcycle has a seat. The engine is disposed under the seat, and includes an air intake system and an exhaust gas system. The exhaust gas recycling device includes a normally closed exhaust gas recycling valve, an exhaust gas outlet and an air-guiding pipe.

[0020] The exhaust gas recycling valve is mounted on the air intake system, and has a gas inlet and a gas outlet that is in fluid communication with the air intake system. The exhaust gas recycling valve is opened so as to allow for gas flow between the gas inlet and the gas outlet when the engine is in an accelerated state. The exhaust gas outlet is formed in the exhaust gas system.

[0021] The air-guiding pipe has one end connected to and in fluid communication with the gas inlet, and the other end connected to and in fluid communication with the exhaust gas system through the exhaust gas outlet.

[0022] The exhaust gas recycling valve is disposed between the seat and the exhaust gas system. The air-guiding pipe is disposed in proximity to the engine.

[0023] Other features and advantages of the present invention will become apparent in the following detailed description of the preferred embodiments with reference to the accompanying drawings, of which:

Figure 1 is a schematic diagram of a conventional exhaust gas recycling device used in a car;

Figure 2 is a schematic side view of a first preferred embodiment of an exhaust gas recycling device according to the present invention, which is incorporated in a motorcycle that is configured as an ordinary motorcycle ;

Figure 3 is a schematic sectional view illustrating a connection between an air-guiding pipe of the first preferred embodiment and an exhaust gas system of a motorcycle engine;

Figure 4 is a schematic sectional view of an exhaust gas recycling valve of the first preferred embodiment; Figure 5 is a schematic sectional view illustrating another connection between the air-guiding pipe of the first preferred embodiment and the exhaust gas system of the engine;

Figure 6 is a schematic side view of a second preferred embodiment of an exhaust gas recycling device according to the present invention, which is incorporated in an all-terrain vehicle; and

Figure 7 is a schematic side view of a third preferred embodiment of an exhaust gas recycling device according to the present invention, which is incorporated in a scooter.

[0024] Before the present invention is described in

greater detail with reference to the accompanying preferred embodiments, it should be noted herein that like elements are denoted by the same reference numerals throughout the disclosure.

[0025] Referring to Figures 2, 3 and 4, a first preferred embodiment of an exhaust gas recycling device 6 according to the present invention is shown to be adapted for an engine 3 of a motorcycle 5. The engine 3 includes an air intake system 31 for taking in fresh air, an exhaust gas system 32 for venting exhaust gas from the engine 3, and a cylinder head 33 interconnecting the air intake system 31 and the exhaust gas system 32. The air intake system 31 includes an air intake pipe 311 and an inlet channel 312 that is formed in the cylinder head 33 and that is in fluid communication with the intake pipe 311. The exhaust gas system 32 includes an exhaust pipe 321 and an outlet channel 322 that is formed in the cylinder head 33 and that is in fluid communication with the exhaust pipe 321. The cylinder head 33 interconnects a cylinder 331 and a cylinder head cover 332.

[0026] The exhaust gas recycling device 6 includes an exhaust gas outlet 321' (see Figure 3) formed in the exhaust pipe 321 of the exhaust gas system 32, a normally closed exhaust gas recycling valve 61 (see Figure 4) mounted on the air intake system 31, and an air-guiding pipe 62. The exhaust pipe 321 is in fluid communication with the air-guiding pipe 62 through the exhaust gas outlet 321', as shown in Figure 3. The exhaust gas outlet 321' in the exhaust pipe 321 can be replaced with an exhaust gas outlet 322' (see Fig. 5) in the outlet channel 322 such that the exhaust gas outlet 322' is in fluid communication with the air-guiding pipe 62.

[0027] Referring to Figure 2, the motorcycle 5 includes a fuel tank 51 and a handle 53. The engine 3 is disposed under the fuel tank 51, as is the exhaust gas recycling valve 61. The air-guiding pipe 62 is disposed between the air intake system 31 and the exhaust gas system 32. The air-guiding pipe 62 is disposed in proximity to the engine 3. In this embodiment, the air-guiding pipe 62 extends around the cylinder head 33 of the engine 3. Alternatively, the air-guiding pipe 62 may extend around the cylinder 331 or the cylinder head cover 332.

[0028] Again referring to Figures 2, 3 and 4, the exhaust gas recycling valve 61 is mounted on the air intake system 31, as described above, and has a gas inlet 611 and a gas outlet 612. The gas outlet 612 is in fluid communication with the intake pipe 311, as shown in Fig. 4. Alternatively, the gas outlet 612 is in fluid communication with the inlet channel 312. The exhaust gas recycling valve 61 is connected operatively to an accelerator cable 9 (see Fig. 4). A movable member 64 is disposed in the exhaust gas recycling valve 61, and is biased by a spring 7 to close the gas outlet 612. The accelerator cable 9 can be operated against the biasing action of the spring 7 so as to remove the movable member 64 from the gas outlet 612, thereby allowing for flow of gas through the gas outlet 612 and into the exhaust gas valve 61. When the user operates a throttle (not shown) on the handle

53 to accelerate the motorcycle 5, the exhaust gas recycling valve 61 is opened so as to allow for gas flow between the gas inlet 611 and the gas outlet 612. Hence, the exhaust gas flows from the exhaust pipe 321 into the intake pipe 311 through the exhaust gas recycling valve 61 and the air-guiding pipe 62. This causes the exhaust gas to mix with fresh air within the intake pipe 311, and subsequently flows back into the engine 3.

[0029] When the throttle of the handle 53 is released, the accelerator cable 9 no longer applies a pulling force to the movable member 64. Thus, the spring 7 biases the movable member 64 to close the gas outlet 612 so as to stop flow of the exhaust gas from the exhaust pipe 321 into the intake pipe 311 through the exhaust gas recycling valve 61 and the air-guiding pipe 62.

[0030] As described above, a portion of the exhaust gas exhausted from the car engine 3 flows back into the air intake pipe 311 to mix with fresh air. Since this portion of exhaust gas includes a large quantity of carbon dioxide (CO₂), which will not oxidize and which can absorb a lot of heat so as to reduce oxygen density in the car engine 3, the maximum combustion temperature of the car engine 3 is lowered to thereby reduce nitrogen oxides (NOx) in the exhaust gas.

[0031] Furthermore, since the exhaust gas recycling valve 61 is disposed on the air intake pipe 311, and since the air-guiding pipe 62 is disposed in proximity to the engine 3 and is directly connected to the exhaust pipe 321, the piping of the entire exhaust gas recycling device 6 is effectively shortened. The drawbacks associated with the prior art configurations resulting from excessively long piping, such as a slow return flow rate of exhaust gas, uneven density of exhaust gas fed back into the engine 3, and difficult engine ignition, etc., are therefore overcome.

[0032] Referring to Figures 3, 4 and 6, a second preferred embodiment of an exhaust gas recycling device 6 according to the present invention is adapted for an all-terrain vehicle 5, which has a fuel tank 51 and a handle 53. The engine 3 is disposed under the fuel tank 51, and includes an air intake system 31 and an exhaust gas system 32. The exhaust gas recycling device 6 includes an exhaust gas outlet 321' formed in the intake pipe 321, an exhaust gas recycling valve 61 mounted on the air intake system 31, and an air-guiding pipe 62. The exhaust gas outlet 321' in the intake pipe 321 can be replaced with the exhaust gas outlet 322' (see Fig. 5) in the outlet channel 322 such that the exhaust gas outlet 322' is in fluid communication with the air-guiding pipe 62.

[0033] Unlike the first preferred embodiment, the exhaust gas recycling valve 61 and the air-guiding pipe 62 are disposed under the tank 51 and between the fuel tank 51 and the exhaust gas system 32, the exhaust pipe 321 extends around the engine 3, and the air-guiding pipe 62 is disposed in proximity to the engine 3.

[0034] Referring to Figures 3, 4 and 7, a third preferred embodiment of an exhaust gas recycling device according to the present invention is adapted for a scooter 5,

which has a seat 52 and a handle 53. The engine 3 is disposed under the seat 52. The exhaust gas outlet 321' in the intake pipe 321 can be replaced with the exhaust gas outlet 322' (see Fig. 5) in the outlet channel 322 such that the exhaust gas outlet 322' is in fluid communication with the air-guiding pipe 62.

[0035] Unlike the first preferred embodiment, the exhaust gas recycling valve 61 is disposed under the seat 52 and between the seat 52 and the exhaust pipe 321, and the air-guiding pipe 62 extends around the cylinder head cover 332 of the engine 3. Alternatively, the air-guiding pipe 62 may extend around the cylinder 331 or the cylinder head 33 of the engine 3.

[0036] From the foregoing, the exhaust gas recycling device 6 of this invention has the following advantages:

1) quick reaction time:

The exhaust gas recycling device 6 is disposed under the fuel tank 51 or the seat 52, and has only one air-guiding pipe 62 disposed in proximity to the engine 3 or between the air intake system 31 and the exhaust gas system 32. Therefore, the piping in the exhaust gas recycling device 6 is shortened so as to allow for quick return flow of the exhaust gas from the exhaust gas system 32 into the air intake system 31. The problem of water and carbon accumulation inside the air-guiding pipe 62 with the prior art is therefore eliminated.

2) effective space allocation:

This is especially important because the exhaust gas recycling device 6 can be arranged within a very limited space in the motorcycle 5.

3) stable operations:

The exhaust gas recycling valve 61 is controlled mechanically by the accelerator cable 9, and therefore is not affected by the high temperature of exhaust gas. As a result, the exhaust gas recycling device 6 has a long service life.

Claims

1. An exhaust gas recycling device (6) for an engine (3) of a motorcycle (5), the motorcycle (5) having a fuel tank (51), the engine (3) being disposed under the fuel tank (51) and including an air intake system (31) and an exhaust gas system (32), **characterized in that** the exhaust gas recycling device (6) includes:

a normally closed exhaust gas recycling valve (61) mounted on the air intake system (31) and having a gas inlet (611) and a gas outlet (612) that is in fluid communication with the air intake system (31), the exhaust gas recycling valve (61) being opened so as to allow for gas flow between the gas inlet (611) and the gas outlet (612) when the engine (3) is in an accelerated state;

an exhaust gas outlet (321', 322') formed in the exhaust gas system (32); and
 an air-guiding pipe (62) having one end connected to and in fluid communication with the gas inlet (611), and the other end connected to and in fluid communication with the exhaust gas system (32) through the exhaust gas outlet (321', 322');
 wherein the exhaust gas recycling valve (61) is disposed under the fuel tank (51), the air-guiding pipe (62) being disposed between the air intake system (31) and the exhaust gas system (32).

2. An exhaust gas recycling device (6) for an engine (3) of a motorcycle (5), the motorcycle (5) having a fuel tank (51), the engine (3) being disposed under the fuel tank (51) and including an air intake system (31) and an exhaust gas system (32), **characterized in that** the exhaust gas recycling device (6) includes:

a normally closed exhaust gas recycling valve (61) mounted on the air intake system (31) and having a gas inlet (611) and a gas outlet (612) that is in fluid communication with the air intake system (31), the exhaust gas recycling valve (61) being opened so as to allow for gas flow between the gas inlet (611) and the gas outlet (612) when the engine (3) is in an accelerated state;
 an exhaust gas outlet (321', 322') formed in the exhaust gas system (32); and
 an air-guiding pipe (62) having one end connected to and in fluid communication with the gas inlet (611), and the other end connected to and in fluid communication with the exhaust gas system (32) through the exhaust gas outlet (321', 322');

wherein the exhaust gas recycling valve (61) and the air-guiding pipe (62) are disposed under the fuel tank (51) and between the fuel tank (51) and the exhaust gas system (32), the air-guiding pipe (62) being disposed in proximity to the engine (3).

3. An exhaust gas recycling device (6) for an engine (3) of a motorcycle (5), the motorcycle (5) having a seat (52), the engine (3) being disposed under the seat (52) and including an air intake system (31) and an exhaust gas system (32), **characterized in that** the exhaust gas recycling device (6) includes:

a normally closed exhaust gas recycling valve (61) mounted on the air intake system (31) and having a gas inlet (611) and a gas outlet (612) that is in fluid communication with the air intake system (31), the exhaust gas recycling valve (61) being opened so as to allow for gas flow between the gas inlet (611) and the gas outlet

(612) when the engine (3) is in an accelerated state;
 an exhaust gas outlet (321', 322') formed in the exhaust gas system (32); and
 an air-guiding pipe (62) having one end connected to and in fluid communication with the gas inlet (611), and the other end connected to and in fluid communication with the exhaust gas system (32) through the exhaust gas outlet (321', 322');

wherein the exhaust gas recycling valve (61) is disposed under the seat (52) and between the seat (52) and the exhaust gas system (32), the air-guiding pipe (62) being disposed in proximity to the engine (3).

4. The exhaust gas recycling device as claimed in Claim 1, 2, or 3, further **characterized in that** the exhaust gas system (32) includes an outlet channel (322) that is formed in a cylinder head (33), the exhaust gas outlet (322') being also formed in the cylinder head (33) and being in fluid communication with the outlet channel (322).
5. The exhaust gas recycling device as claimed in Claim 1, 2, or 3, further **characterized in that** the exhaust gas system (32) includes an exhaust pipe (321) that is formed with the exhaust gas outlet (321').
6. The exhaust gas recycling device as claimed in Claim 1 or 3, further **characterized in that** the air-guiding pipe (62) extends around a cylinder (331) of the engine (3).
7. The exhaust gas recycling device as claimed in Claim 1 or 3, further **characterized in that** the air-guiding pipe (62) extends around a cylinder head (33) of the engine (3).
8. The exhaust gas recycling device as claimed in Claim 1 or 3, further **characterized in that** the air-guiding pipe (62) extends around a cylinder head cover (332) of the engine (3).
9. The exhaust gas recycling device as claimed in Claim 1, 2, or 3, further **characterized in that** the air intake system (31) includes an air intake pipe (311), the exhaust gas recycling valve (61) being mounted on the air intake pipe (311).

10. The exhaust gas recycling device as claimed in Claim 1, 2, or 3, further **characterized in that** the exhaust gas recycling valve (61) is connected operatively to an accelerator cable (9), the exhaust gas recycling valve (61) being opened upon actuation of an accelerator cable (9) so as to allow for gas flow between the air intake system (31) and the exhaust

gas system (32) through the exhaust gas recycling valve (61) and the air-guiding pipe (62).

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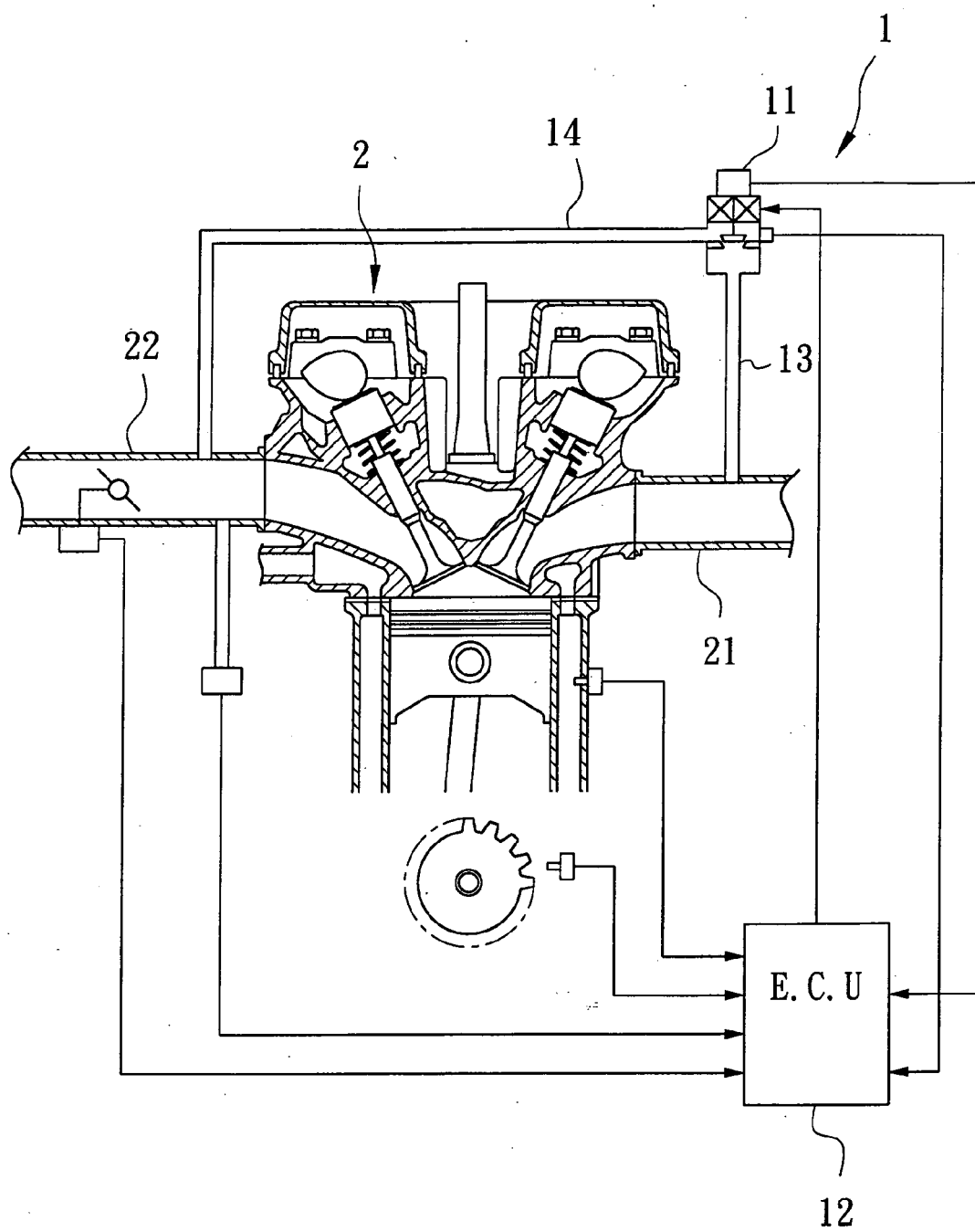


FIG. 1

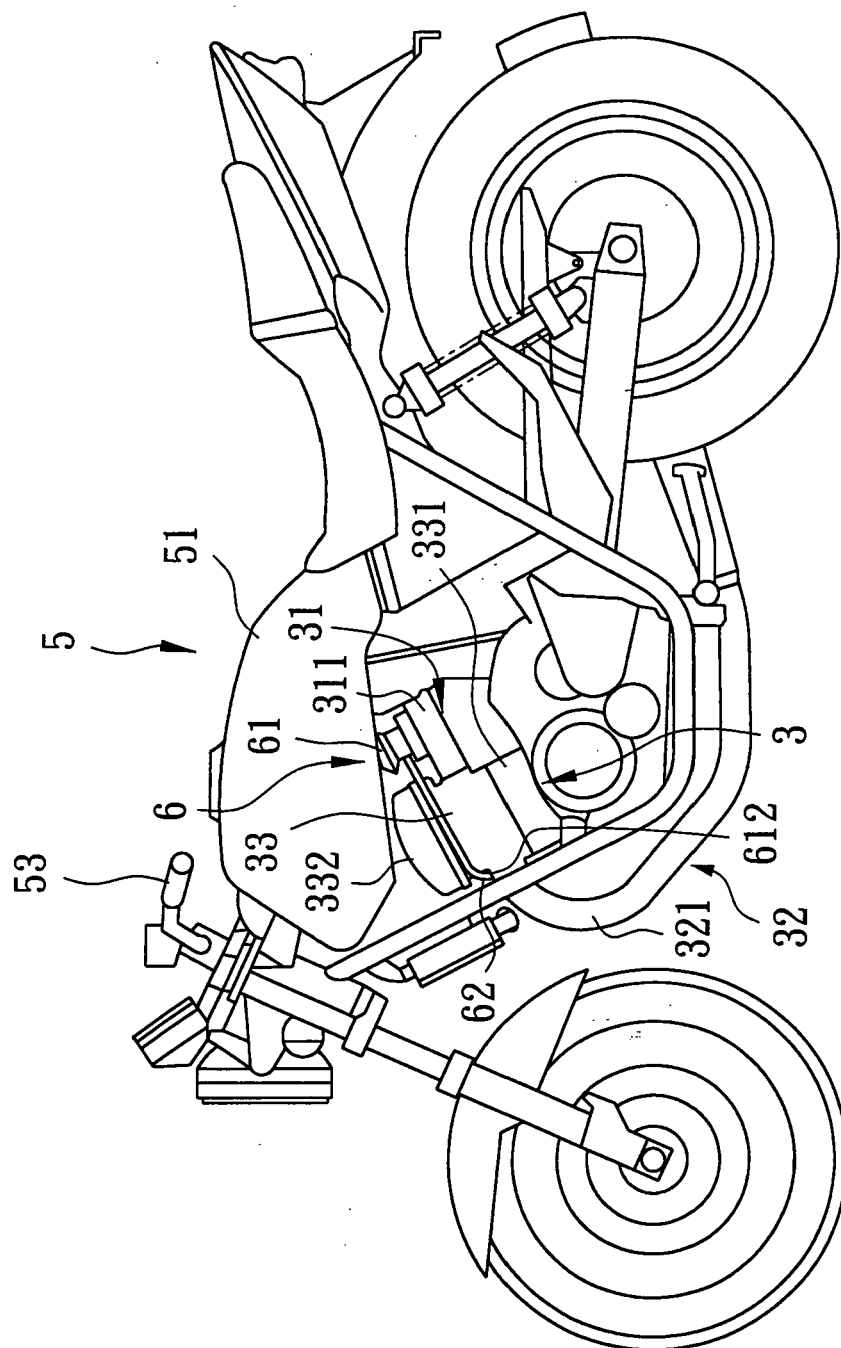


FIG. 2

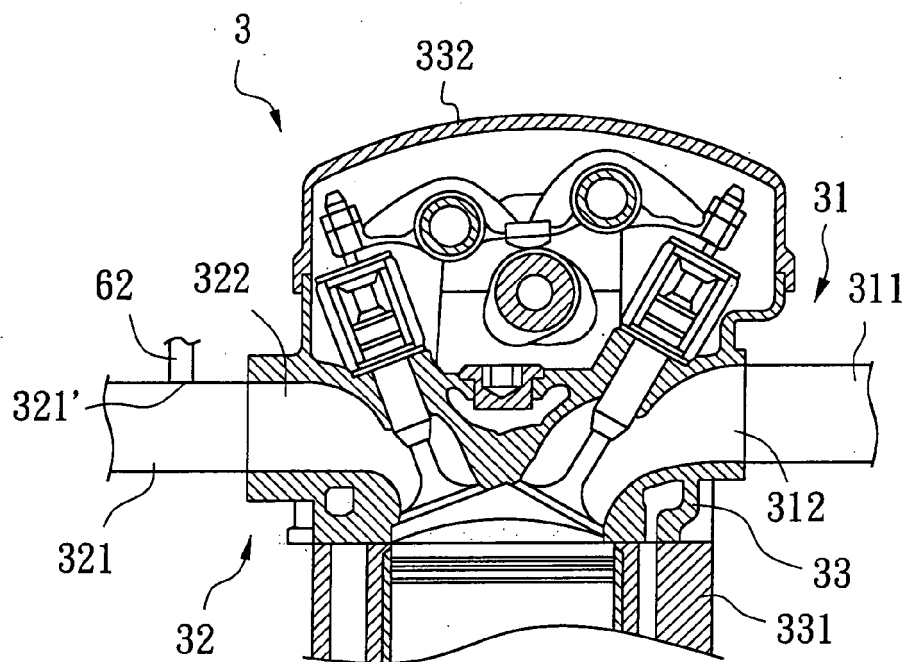


FIG. 3

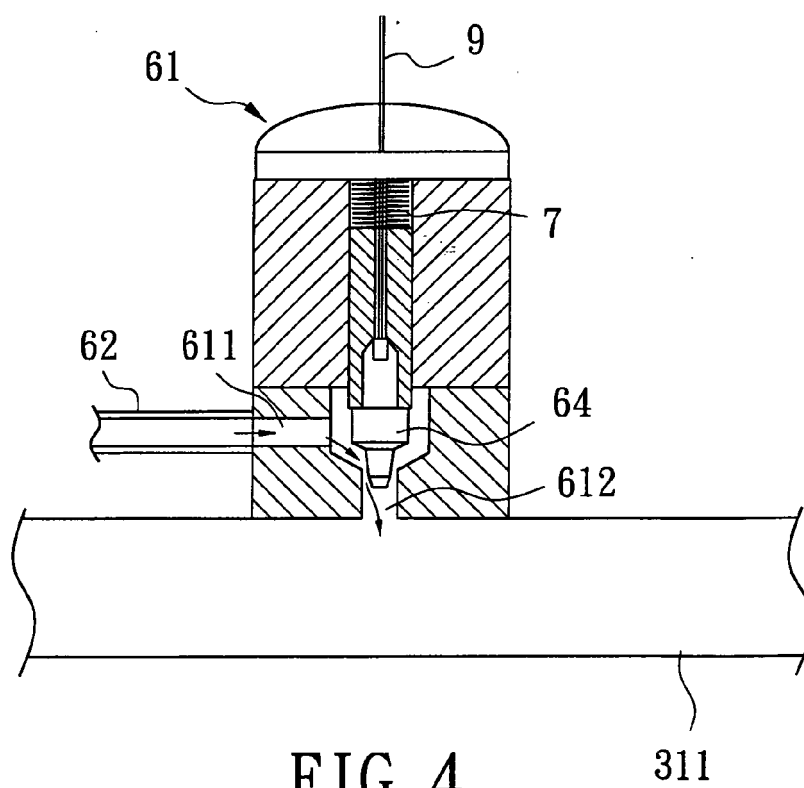


FIG. 4

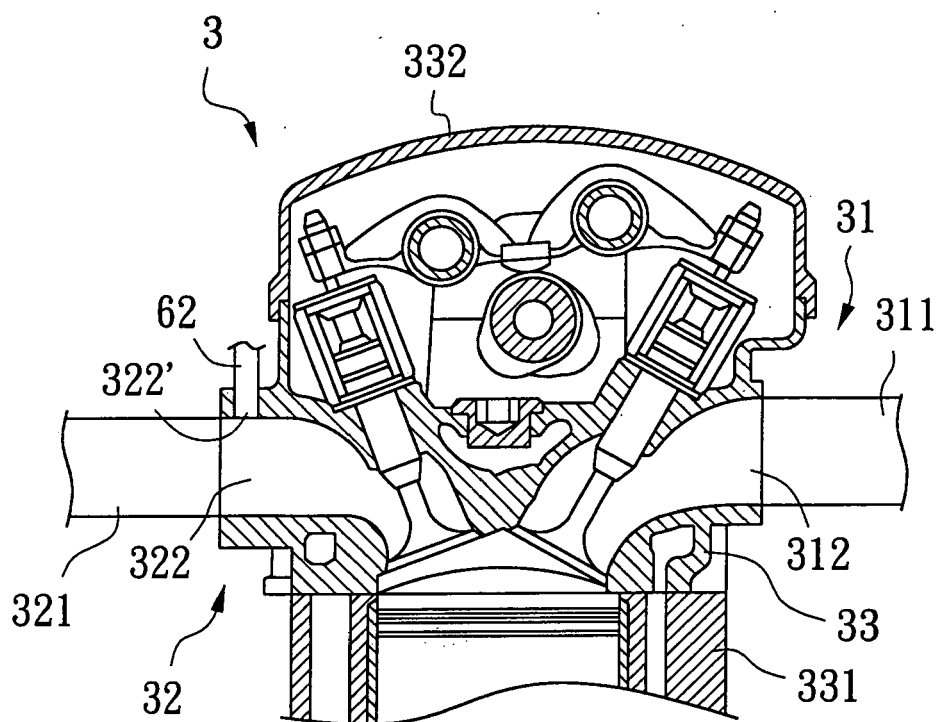


FIG. 5

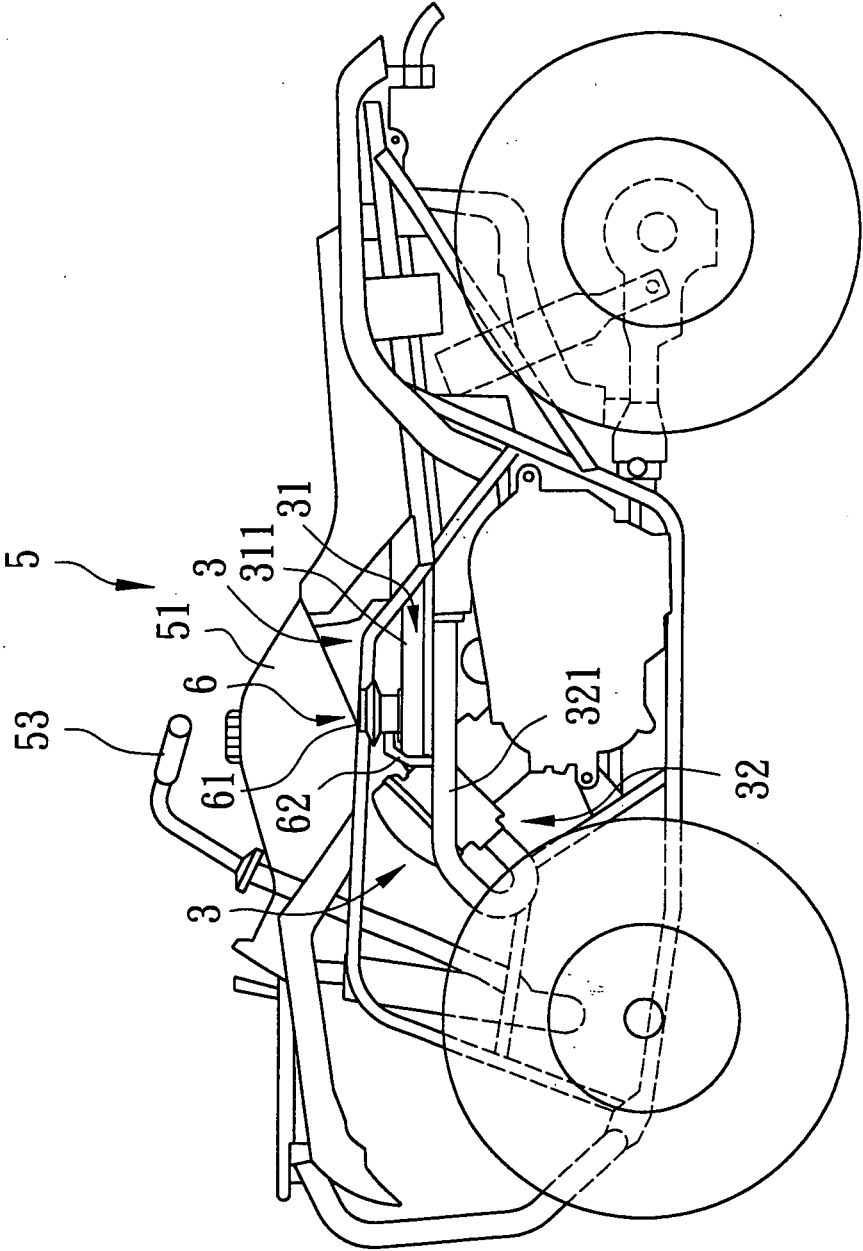


FIG. 6

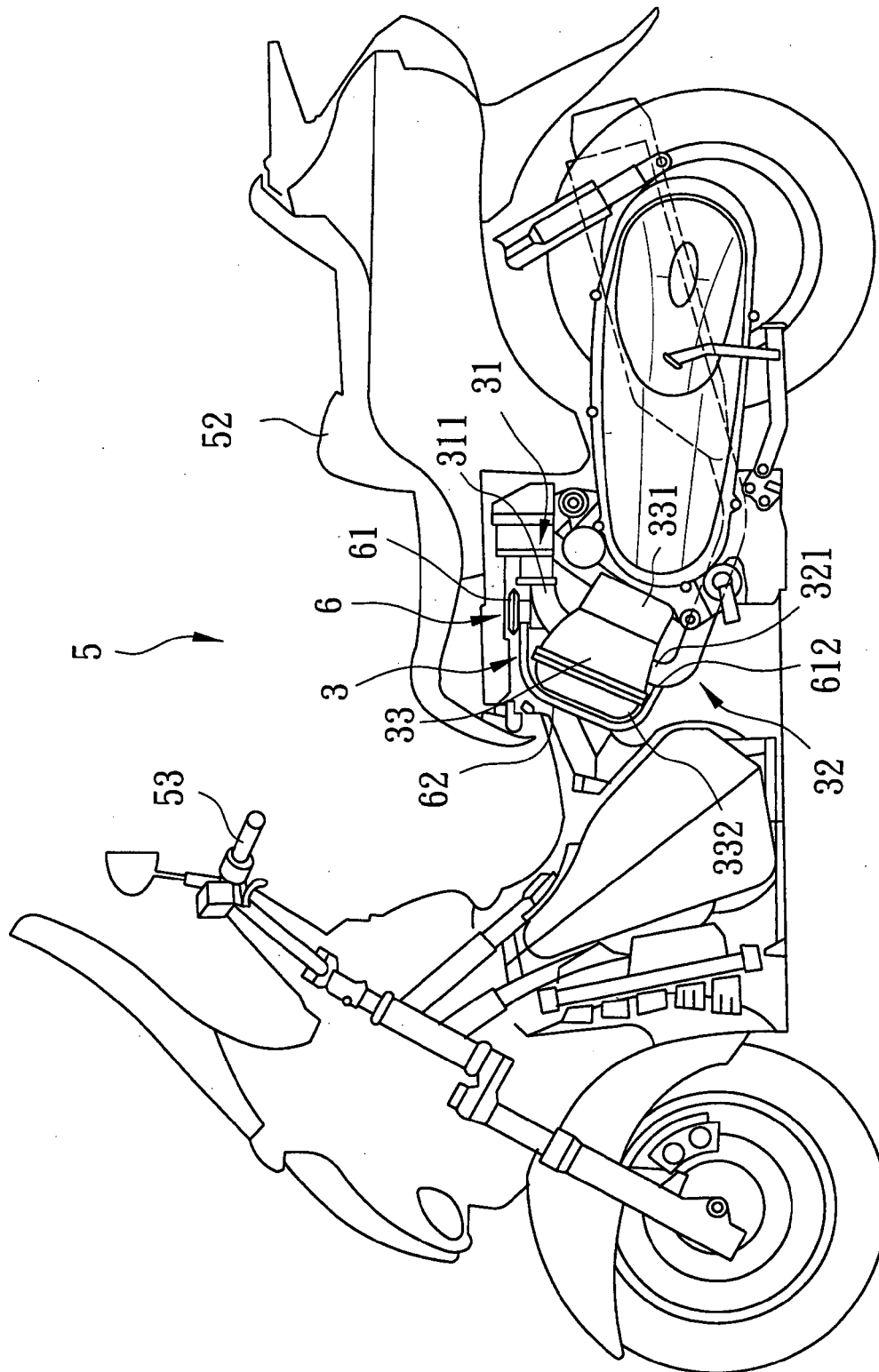


FIG. 7



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 03 1001

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 30 May 2005	Examiner Döring, M
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 04 03 1001

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
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30-05-2005

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