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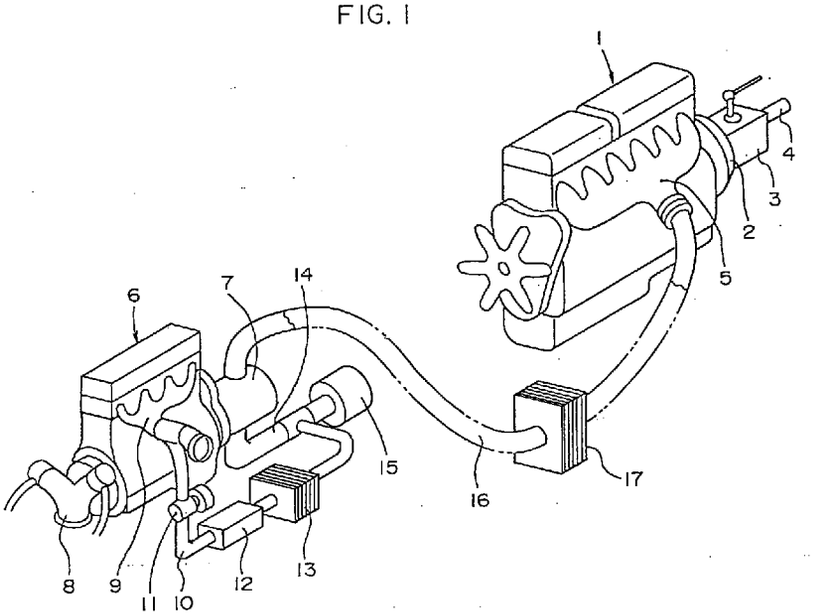
(54) Engine system

(57) An engine system comprises a diesel engine (1) and an Otto cycle engine (6). The diesel engine (1) is the primary source of power for driving a large vehicle, whereas the Otto cycle engine (6) is used to drive a supercharger (7) and provide a source of sulphur free exhaust gas. The exhaust gas from the Otto cycle engine (6) passes through catalytic converter (12) and exhaust cooler (13) to the supercharger (7) where it is mixed with air ingested through air filter (15). The pressurized output from the supercharger (7) is fed along pipe (16) through inlet cooler (17) into the inlet manifold (5) of the diesel engine (1).

FIG. 1



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Description

The present invention relates to an engine system comprising a diesel engine for use as a main device for driving a vehicle, particularly a truck or bus, and a supercharger.

Generally, when dealing with exhaust gas generated from diesel engines, it is known that NOx in the exhaust gas can be decreased if exhaust gas recirculation (hereinafter called EGR) is applied to the exhaust gas of the engine. However, although many suggestions are offered, under the present circumstances, most of them are not realized for practical use because of the following reasons.

First of all, as light oil which is a main fuel for diesel engines contains sulfur(S) which will become $S0_3$ by combustion and H_2SO_4 by combination with moisture in the combustion gas, it will wear and corrode cylinder wall and other engine parts. However, measures to solve this problem are still incomplete.

Also, ashes in the exhaust gas of the diesel engine quicken abrasion by existing between cam and tappet or piston ring and cylinder when it is sucked into the engine by EGR. However, this problem does not have an effective solution.

Then, to cool the exhaust gas by an exhaust cooler during EGR, it is effective to have a good EGR result by decreasing the combustion temperature. At the same time, this situation not only promotes the exhaust gas becoming H_2SO_4 and corrode said exhaust cooler, but also possibly increase wear and corrosion of the cylinder wall and other engine parts by cooled H_2SO_4. However, measures for wear and corrosion by H_2SO_4 have not been solved yet as stated above.

With regard to NOx in the exhaust gas of the diesel engine, although remaining exhaust NOx is decreased to some degree by partial exhaust EGR as mentioned above, partial exhaust NOx which had EGR is discharged as it is, and NOx in the exhaust gas finally cannot be further decreased under the present circumstances.

To decrease NOx, it is actually thought that a catalyst for an Otto cycle type engine is used. However, with the exhaust gas which contains oxygen of the diesel engine, a catalyst which can remove NOx effectively and economically has not been introduced yet.

Further, an increase of maximum combustion pressure when supercharging with the diesel engine not only improves a mechanical load of the engine but also incurs increase of NOx generation with the combustion temperature rise. This brings a situation that a decrease of compression ratio as a means for the solution will be difficult for an engine start and generate harmful white smoke immediately after the start. With the above situation, although a decrease of compression ratio to 11 or 14 is effective, it is not succeeded under the present condition.

From the above points, along with a fully worked-out plan for combustion chamber and combustion method of the diesel engine, we are continuing several researches for catalysts to effectively remove NOx and measures to prevent corrosion etc. by H_2SO_4. However, this matter is not solved yet.

Still more, on diesel engines, the biggest problem in case of conducting EGR is that the diesel engine output decreases with said EGR.

According to one aspect of the present invention, there is provided an engine system comprising a diesel engine for driving the primary load on the system, and a supercharger for supplying pressurized gas to the diesel engine, the supercharger being driven by an auxiliary spark ignition engine.

According to a second aspect of the present invention, there is provided an engine system comprising a diesel engine for driving the primary load on the system, a supercharger for supplying pressurized gas to the diesel engine, and an auxiliary spark ignition engine, the exhaust outlet of the auxiliary spark ignition engine being in communication with the supercharger such that exhaust gas from the auxiliary spark ignition engine is supplied to the diesel engine.

Preferably, exhaust pollutants in in the exhaust gas from the auxiliary spark ignition engine are removed before the exhaust gas is supplied to the diesel engine. In a preferred embodiment, the exhaust pollutants are removed by a catalytic converter before being pressurized by the supercharger. In an especially preferred embodiment, the supercharger is driven by the auxiliary spark ignition engine.

On the other hand, as is generally known, with the spark ignition engine, which may be an Otto cycle engine, the fuel such as gasoline, propane gas, natural gas etc. does not contain said sulfur and it is not especially needed to take measures for wear and corrosion by H_2SO_4 as mentioned above. Also, besides said EGR, NOx can be removed with other exhaust pollutant (CO, HC) by employing a rhodium catalytic converter. Therefore, the exhaust gas hardly contains NOx and becomes harmless.

The present invention is devised to consider said problems on exhaust gas treatment of the diesel engine and the above phenomenon on the spark ignition engine.

The purpose is to make an engine system that for example on one vehicle, a diesel engine is used for the main device for vehicle driving etc. and also an auxiliary engine which is independently operated from the main device is used for supercharger driving. Thus, we are able to provide an engine system which is possible to decrease NOx generally by circulating said corrosion content which had the exhaust treatment of said auxiliary engine of which treatment is relatively easy and the exhaust gas which contains little NOx into said diesel engine.

Another purpose of the present invention is to offer an engine system which gives an easiness to start the main device diesel engine by driving supercharger with the auxiliary engine and supercharging the discharged air to said diesel engine in the process of decreasing NOx, and to prevent white smoke containing harmful

components easily discharged when starting with low temperature.

Also, another purpose of the present invention is to offer an engine system which is possible to increase main device diesel engine output, decreasing NOx by adjusting a load of the auxiliary engine which drives the supercharger.

Furthermore , still another purpose of the present invention is to offer an engine system which is possible to get higher output, further decreasing NOx and preventing the maximum combustion pressure at the same time by preventing the maximum pressure of the main device diesel engine to decrease compression ratio of the same diesel engine.

An embodiment of the invention will now be described by way of example with reference to the accompanying figure (Figure 1) which shows schematically an engine system embodying the present invention.

In Fig. 1, a diesel engine 1 is a main device installed to truck, bus, etc. for instance, and the output is transmitted to axles (Not shown in the drawing) via clutch 2, transmission 3 and driving shaft 4. The diesel engine 1 has an inlet manifold 5.

An Otto cycle engine 6 is an auxiliary device to be operated independently from said main device diesel engine and it is installed to said truck and bus to drive a mechanical supercharger 7 for said diesel engine and according to the circumstances, an auxiliary device such as a compressor, which generates compressed air for vehicle brake and opening/closing doors, or a cooling fan. In the actual example, said supercharger 7 is driven by the front end of the crank shaft (not shown in the drawing) of the auxiliary device Otto cycle engine 6. Also, compressor 8 is driven by rear end of the same crank shaft. Further, it is better to keep compression ratio of the main device diesel engine 1 low from 10-14 and this situation leads to a further decrease of NOx.

EGR mechanism on the present invention is arranged as follows. The exhaust gas discharged from exhaust manifold 9 of said Otto cycle engine 6 is connected to flow into the middle of inlet pipe 14 via exhaust regulating valve ll, catalytic converter l2 and exhaust cooler 13 by pipe 10. An air cleaner 5 is provided at one end of the inlet pipe 14, the other end of which communicates with the supercharger 7.

The engine system is arranged such that air from said supercharger 7, is sent to inlet manifold 5 of said diesel engine 1 via inlet cooler 17 through pipe 16.

In the engine system of the present embodiment with the above structure, by independently operating said main device diesel engine 1 and said auxiliary device Otto cycle engine 6, inspiration efficiency is improved by sending pressure air to the main device diesel engine 1 from supercharger 7 driven by Otto cycle engine 6, and thereby its torque and output will increase. Therefore, when starting the main device diesel engine 1, the start becomes easier by improving inlet pressure and combustion immediately after the start, and especially, harmful formaldehyde and HC contained in white smoke which is easy to be discharged at low temperature start will decrease.

According to operating condition of the main device diesel engine 1, if a load of the auxiliary device Otto cycle engine 6 is regulated, inlet pressure from said supercharger 7 is also regulated and therefore the output of the main device diesel engine 1 can be increased. Especially in case of defining the main device diesel engine 1 for vehicle-use, the rotation speed and the load of the auxiliary device Otto cycle engine 6 can be improved corresponding to the required low speed and the high torque, regardless of the rotation speed of the main device diesel engine 1.

When performing EGR for the purpose of NOx decrease in the exhaust gas from the main device diesel engine 1, part or all of the exhaust gas of the auxiliary device Otto cycle engine 6 is sucked, by opening said exhaust regulating valve 11, into said supercharger 7 by way of inlet tube 14 via exhaust regulating valve 11, catalytic converter 12 and exhaust cooler 13 by pipe 10 from said exhaust manifold 9. Supercharger 7 compresses the exhaust gas of the auxiliary device otto cycle engine 6 which contains little NOx with air from air cleaner 15, feeds it into the main device diesel engine by way of said inlet manifold 5 via said inlet cooler 17 by pipe 16.

Claims

1. An engine system comprising a diesel engine for driving the primary load on the system, a supercharger for supplying pressurized gas to the diesel engine, and an auxiliary spark ignition engine, the exhaust outlet of the auxiliary spark ignition engine being in communication with the supercharger such that exhaust gas from the auxiliary spark ignition engine is supplied to the diesel engine.

2. Installing a main device diesel engine and an auxiliary spark ignition engine which drives a supercharger, this engine system features that discharged gas from said supercharger is led to an inlet system of said main device diesel engine by a pipe, and exhaust gas from said auxiliary engine is led between an inlet system of said supercharger and an inlet system of said diesel engine.

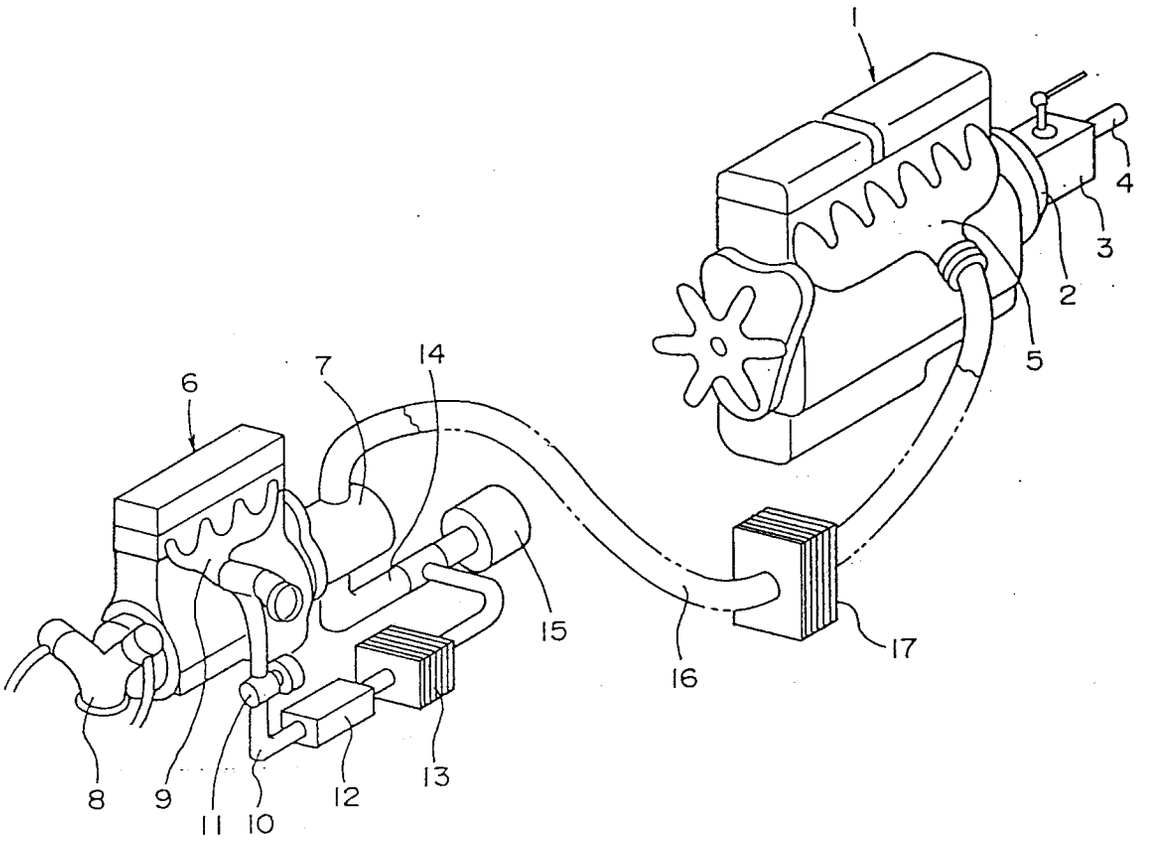
3. Said engine system as claimed in Claim 2 features that after exhaust air from said auxiliary engine is treated via exhaust regulating valve, it is led between an inlet system of said supercharger and an inlet system of said diesel engine, and the regulating valve is regulated according to operating condition of said diesel engine.

4. Said engine system as claimed in Claim 3 or 4 features that by regulating a load of said auxiliary engine, discharged air pressure of the supercharger is changed and the output of the main device diesel engine is regulated.

5. The engine system as claimed in Claim 2, 3 or 4 features that compression ratio of said main device diesel engine should be 10 or 14.

6. An engine system according to any preceding Claim in which the auxiliary engine is an Otto cycle engine.

FIG. 1



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EUROPEAN SEARCH REPORT

Application Number
EP 94 30 9683

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	FR-A-1 142 556 (CITRÖEN) * the whole document * ---	1	F02B73/00 F02B75/10
A	FR-A-1 588 970 (BERLIET) 16 March 1970 * the whole document * ---	1	
A	US-A-4 611 466 (KEEDY EDGAR L) 16 September 1986 ---		
A	EP-A-0 235 390 (BBC BROWN BOVERI & CIE) 9 September 1987 -----		

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

F02B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	28 April 1995	Mouton, J

CATEGORY OF CITED DOCUMENTS

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