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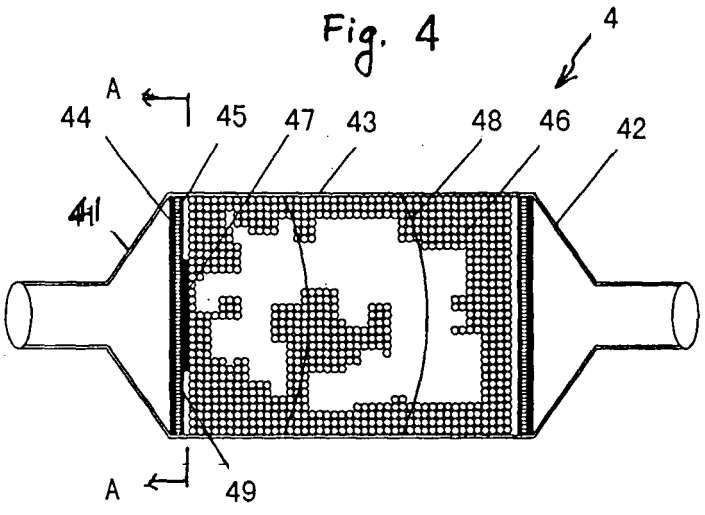
(54) EXHAUST INFRARED PUTITYING DEVICE AND ITS METHOD OF DIESEL ENGINE

(57) An exhaust infrared purifying device and method of a diesel engine are disclosed. The device includes a housing containing a cylinder body (33), filter meshes (34) and porous plates (35) are disposed at the both sides of the cylinder body (33) in a sequence of from inner to outer, and infrared spheres (36) are filled between both porous plates. The character of the device is that a buffer net (37) is disposed at the back of the porous plate (35) located at the inlet side, and at least a layer trap filter mesh (38) is provided in the cylinder body (33). The character of the method is that the inlet of the honeycomb heating purifier (3) is connected with the exhaust vent (101) and the outlet of the honeycomb heating purifier (3) is connected with the exhaust manifold (102). The deleterious pollution in the exhaust gas could be purified effectively.

Fig. 4



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Description

TECHNICAL FIELD

[0001] The present invention relates to an exhaust automatic cyclic regeneration device of a diesel engine, more particularly, to an exhaust infrared purifying device and its method of a diesel engine.

BACKGROUND ART

[0002] Up to now, the most popular technology for post-treating the exhaust gas of a diesel engine in the world is a particulate trap filter which uses cordierite as main material and whose wall surface is made of porous ceramics. In two adjacent channels, one channel's outlet side is blocked and the other channel's inlet side is blocked. This makes the exhaust gas enter into the channel whose inlet is open, through the wall surface made of porous ceramics and into the adjacent channel whose outlet is open, so that the particulates is filtered on the wall opening of the channels. This particulate trap filter has a high filtering efficiency to carbon smoke. However, the particulate trap filter can only filter the particulates from the exhaust gas of a diesel engine and deposit the particulates on the wall of the channels. The particulate trap filter itself cannot remove the particulates, so that with the continuous increasing of the particulates accumulated in the channels, if the particulates are not removed in time, it will inevitably lead to increase of exhaust gas back pressure, influence on scavenging capacity of the diesel engine, extreme reduction of power, increase of fuel consumption, deterioration of combustion and severer exhaust pollution.

[0003] As a result, it is necessary to remove the particulates in the particulate trap filter in time to enable working on. Removing the particulates accumulated in the particulate trap filter is called regeneration. Now there are mainly two kinds of particulate trap regeneration method used in the world:

1. A method and device for purifying the exhaust gas with the heat of the exhaust gas, which is disclosed by Japanese Patent No. 9-280035 with the title "Exhaust Purifying Device of Internal Combustion Engine", whose structure is shown in Fig. 1. The device comprises housing 11, hollow quartz spheres 12 disposed in the housing, and quartz fibre, buffering heat accumulator disposed at the exhaust inlet. This patent has a certain purification effect, however, it has some disadvantage. The patent uses hollow quartz spheres whose diameters are less than 3mm and whose wall thicknesses are only 0.3mm. Because of the thin walls, the transmitting energy of the infrared ray is low and weak, the thermal capacity is small, and the heating temperature in the small device cylinder fluctuates much according to the temperature change of the exhaust gas. Since the quartz spheres are hollow and of thin walls, they trend to break when the gas bubbles are subjected to a high temperature which causes inflating and to the impact by a strong pulsating wave of the exhaust gas. As a result, the whole honeycomb structure filled with weak and hollow quartz spheres is destroyed and cannot overcome the essential disadvantage that the individual hollow sphere is so weak.

2. Using the method of intermittently heating regeneration, i.e. the method of heating with electricity, microwave or combustor to eliminate the particulates each time after the particulate trap been worked a period of time. Fig. 2 shows a regeneration method by heating with electricity. The device comprises a honeycomb ceramic filter core 21 and heating wires 22 disposed at the end of honeycomb holes of the honeycomb ceramic filter core. As is known, the essential elements of the particulates' oxidation are high temperature, oxygen enrichment and oxidation time. For example, even if the oxygen concentration is more than 5% and exhaust temperature is more than 650°C, the particulates' oxidation time should be 2 min. However, the exhaust temperature character of a diesel engine is generally less than 500°C, the exhaust temperature of a vehicle diesel engine at its normal operation in the condition of medium or low load is just less than 400 °C and the exhaust flow rate is high. As a result, in the practical condition, it is hard to combust off the particulates without any technology innovation. If the exhaust temperature of a diesel engine is raised, it often leads to the further deterioration of fuel economical efficiency and exhaust pollution.

[0004] When using heating regeneration method in practice, it is necessary to provide a whole set of complicated control system and to consume additional energy such as electric energy and many kinds of other energy at the same time, so that the complicated operation cost should be very high. In order to solve the above problems, the applicant provided a new technical proposal in the Chinese Patent Application No. 200520045446.2 with the title "Exhaust Regeneration Filter Purification and Noise Elimination Device of Diesel Engine". The main characters of the technical proposal is shown in Fig. 3. The device comprises honeycomb heating purifier 31, ceramic wall flow filter 32 and mixing oxidation and noise elimination means 33 which are communicated sequentially. Among them, said honeycomb heating purifier 31 comprises housing 311, and honeycomb quartz spheres or sticks or the combination of them 312, said quartz spheres are solid. The Patent of Utility Model uses infrared material quartz and honeycomb structure, heating the exhaust flow by absorbing the exhaust heat to produce high energy infrared ray , combusting and oxidating the particulates, and automatically removing the particulates deposited in the trap filter in time. Though the deleterious pollution in the exhaust gas

could be purified effectively, the effect of purifying the exhaust gas could be further improved.

DISCLOSURE OF THE INVENTION

[0005] The object of the present invention is to overcome the above disadvantages and shortages by providing an exhaust infrared purifying device and its method of a diesel engine, said device absorbing the exhaust heat from the compression ignition type internal combustion engine, making infrared material transmit infrared ray and heat with high energy, making the adhered particulates combust at high temperature so as to oxidate rapidly, so that purifying the deleterious pollution in the exhaust gas effectively.

[0006] In order to solve the above problems, the present invention provides an exhaust infrared purifying device of a diesel engine, comprising a honeycomb heating purifier, the honeycomb heating purifier including a housing which containing an exhaust inlet pipe end cap, an exhaust outlet pipe end cap and an cylinder body connected between the exhaust inlet pipe end cap and the exhaust outlet pipe end cap, filter meshes and porous plates disposed at the both sides of the cylinder body in a sequence of from inner to outer, a cavity provided between the two porous plates, infrared spheres closely filled in the cavity; characterized in that the honeycomb heating purifier further includes a buffer mesh disposed at the back of the porous plate located at the inlet side, and a trap filter mesh disposed in the cylinder body.

[0007] The above exhaust infrared purifying device of a diesel engine, wherein, said buffer mesh is a wire mesh the diameter of which is smaller than that of the porous plates and which is close to the back of the porous plate located at the inlet side.

[0008] The above exhaust infrared purifying device of a diesel engine, wherein, the honeycomb heating purifier further comprises an auxiliary separation mesh close to the back of the porous plate located at the inlet side , said buffer mesh close to the back of the auxiliary separation mesh.

[0009] The above exhaust infrared purifying device of a diesel engine, wherein, said trap filter mesh is hemispherical, disposed in the cylinder body as at least one layer, dividing the cylinder body into at least two chambers, said infrared spheres filled in each chamber respectively.

[0010] The above exhaust infrared purifying device of a diesel engine, wherein, said trap filter mesh is a cylinder with a bottom, secured outside of the buffer mesh.

[0011] The above exhaust infrared purifying device of a diesel engine, wherein, a flange is disposed at the opening of said trap filter mesh, said flange secured outside of the edge of the buffer mesh; infrared spheres are filled in said trap filter mesh.

[0012] The above exhaust infrared purifying device of a diesel engine, wherein, the exhaust infrared purifying device further comprises a ceramic wall flow filter connected to the honeycomb heating purifier, the ceramic wall flow filter including a housing which containing an exhaust inlet pipe end cap, an exhaust outlet pipe end cap and an cylinder body connected between the exhaust inlet pipe end cap and the exhaust outlet pipe end cap, and a honeycomb ceramic filter core disposed in the housing; the exhaust inlet pipe end cap of said ceramic wall flow filter is communicated with the exhaust outlet pipe end cap of the honeycomb heating purifier, forming an assembly of the honeycomb heating purifier and the ceramic wall flow filter; the exhaust inlet pipe of said honeycomb heating purifier is the exhaust inlet pipe of the assembly, and the exhaust outlet pipe of said ceramic wall flow filter is the exhaust outlet pipe of the assembly.

[0013] The above exhaust infrared purifying device of a diesel engine, wherein, said infrared spheres are solid spheres with the diameter of 2mm - 5mm.

[0014] The above exhaust infrared purifying device of a diesel engine, wherein, the materials of said infrared spheres are selected from quartz, alumina, or the mixture whose major constituents are quartz and alumina; alternatively, said infrared spheres are solid spheres mixed by manganese dioxide of 45 - 70%, ferric oxide of 5 - 25% and copper oxide of 5 ~ 15%.

[0015] A purifying method by applying an exhaust infrared purifying device of a diesel engine, characterized in that an input port of said honeycomb heating purifier is connected to an exhaust vent of the engine; and an output port of said honeycomb heating purifier is connected to an exhaust manifold of the engine.

[0016] The above purifying method by applying an exhaust infrared purifying device of a diesel engine, wherein, said one exhaust vent of the one-cylinder engine is connected to one honeycomb heating purifier, and the exhaust outlet pipe of the honeycomb heating purifier is connected to the exhaust manifold of the engine.

[0017] The above purifying method by applying an exhaust infrared purifying device of a diesel engine, wherein, said one exhaust vent of the one-cylinder engine is divided into two paths each connected to one honeycomb heating purifier, and the exhaust outlet pipes of the two honeycomb heating purifiers are parallelly connected to the exhaust manifold of the engine.

[0018] The above purifying method by applying an exhaust infrared purifying device of a diesel engine, wherein, the exhaust vents of said plurality of cylinders are parallelly connected to a honeycomb heating purifier or an assembly of a honeycomb heating purifier and a ceramic wall flow filter, and the exhaust outlet pipe of the honeycomb heating purifier or the assembly of the honeycomb heating purifier and the ceramic wall flow filter is connected to the exhaust manifold of the engine.

[0019] The above purifying method by applying an exhaust infrared purifying device of a diesel engine, wherein, each of the exhaust vents of said plurality of cylinders is respectively connected to a honeycomb heating purifier, the exhaust outlet pipes of the honeycomb heating purifiers are parallelly connected to the exhaust manifold

of the engine.

[0020] The above purifying method by applying an exhaust infrared purifying device of a diesel engine, wherein, each of the exhaust vents of said plurality cylinders is respectively connected to a honeycomb heating purifier, the exhaust outlet pipes of the honeycomb heating purifiers are parallelly connected to a honeycomb heating purifier or an assembly of a honeycomb heating purifier and a ceramic wall flow filter, and the exhaust outlet pipe of the honeycomb heating purifier or the assembly of the honeycomb heating purifier and the ceramic wall flow filter is connected to the exhaust manifold of the engine.

[0021] The present invention adopts the above technical proposal, wherein, a buffer mesh is added at the front end of and in the honeycomb heating purifier, and at least one layer of trap filter mesh which is spherical or a cylinder with a bottom is added in the cavity of the honeycomb heating purifier, therefore in use it is possible to utilize the exhaust heat from the compression ignition type internal combustion engine, permitting the spatial honeycomb structure filled with solid spherical infrared materials rapidly heated to the ignition temperature of 650°C ~ 800°C, combusting the particulates adhered to the infrared spheres' surfaces and the spherical trap filter meshes' surfaces, so that achieving an rapid thermal oxidation and a particulate purification.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] The features and performances of the present invention will be further discussed in the following embodiments and their drawings.

Fig. 1 is a structural schematic view of an exhaust purifying device of an internal combustion engine according to the prior art.

Fig. 2 is a structural schematic view of a particulate trap filter according to the prior art.

Fig. 3 is a schematic view of the whole structure in the Chinese Patent Application No. 200520045446.2 with the title "Exhaust Regeneration Filter Purification and Noise Elimination Device of Diesel Engine".

Fig. 4 is a structural schematic view of the first embodiment of an exhaust infrared purifying device of a diesel engine according to the present invention.

Fig. 5 is a section view taken along line A-A in Fig. 4.

Fig. 6 is a structural schematic view of the second embodiment of the exhaust infrared purifying device of a diesel engine according to the present invention.

Fig. 7 is a section view taken along line A-A in Fig. 6.

Fig. 8 is a side view of the trap filter mesh in the above embodiment.

Fig. 9 is a structural schematic view of the third embodiment of the exhaust infrared purifying device of a diesel engine according to the present invention.

Fig. 10 is a side view of the trap filter mesh in the embodiment of Fig. 9.

Fig. 11 is a structural schematic view of the fourth embodiment of the exhaust infrared purifying device of a diesel engine according to the present invention.

Fig. 12 is a structural schematic view of the first embodiment of a purifying method by applying an exhaust infrared purifying device of a diesel engine according to the present invention to a diesel engine

Fig. 13 is a structural schematic view of the second embodiment of the purifying method by applying an exhaust infrared purifying device of a diesel engine according to the present invention to a diesel engine.

Fig. 14 is a structural schematic view of the third embodiment of the purifying method by applying an exhaust infrared purifying device of a diesel engine according to the present invention to a diesel engine.

Fig. 15 is a structural schematic view of the fourth embodiment of the purifying method by applying an exhaust infrared purifying device of a diesel engine according to the present invention to a diesel engine.

Fig. 16 is a structural schematic view of the fifth embodiment of the purifying method by applying an exhaust infrared purifying device of a diesel engine according to the present invention to a diesel engine.

Fig. 17 is a structural schematic view of the sixth embodiment of the purifying method by applying an exhaust infrared purifying device of a diesel engine according to the present invention to a diesel engine.

BEST MODE FOR CARRYING OUT THE INVENTION

[0023] Refer to Fig. 4. An exhaust infrared purifying device of a diesel engine according to the present invention comprises a honeycomb heating purifier 3, the honeycomb heating purifier including a housing which containing an exhaust inlet pipe end cap 31, an exhaust outlet pipe end cap 32 and an cylinder body 33 connected between the exhaust inlet pipe end cap and the exhaust outlet pipe end cap, filter meshes 34 and porous plates 35 disposed at the both sides of the cylinder body in a sequence of from inner to outer, a cavity provided between the two porous plates 35, infrared spheres 36 closely filled in the cavity (between the two porous plates); the honeycomb heating purifier further including a buffer mesh 37 disposed at the back of the porous plate located at the inlet side, and two layers of trap filter meshes 38 disposed in the cylinder body in a spaced each other relation. Trapping the particulates by the structure is a trapping in an axial flow direction.

[0024] Refer to Fig. 5. The buffer mesh 37 as disclosed in the present invention has a diameter smaller than that of the two porous plates, and is close to the back of the porous plate located at the inlet side.

[0025] Refer to Fig. 6 and Fig. 7, which are structural schematic views of the second embodiment of the exhaust infrared purifying device of a diesel engine according to the present invention. The exhaust infrared purifying device of the diesel engine according to the present invention comprises a honeycomb heating purifier 4, the

honeycomb heating purifier including a housing which containing an exhaust inlet pipe end cap 41, an exhaust outlet pipe end cap 42 and an cylinder body 43 connected between the exhaust inlet pipe end cap and the exhaust outlet pipe end cap, filter meshes 44 and porous plates 45 disposed at the both sides of the cylinder body in a sequence of from inner to outer, a cavity provided between the two porous plates 45, infrared spheres 46 closely filled in the cavity (between the two porous plates); the honeycomb heating purifier further including a buffer mesh 47 disposed at the back of the porous plate located at the inlet side, and two layers of trap filter meshes 48 disposed in the cylinder body in a spaced each other relation. Fig. 7 is a section view taken along line A-A in Fig. 6. In order to prevent the infrared spheres from blocking the holes of the porous plate to influence the gas flow, the present invention further provides an auxiliary separation mesh 49 disposed at the back of the porous plate located at the inlet side , said buffer mesh close to the back of the auxiliary separation mesh 49.

[0026] Refer to Fig. 8. In the above embodiments , the trap filter meshes 38 as disclosed in the present invention are hemispherical, which could be disposed in the cavity of the cylinder body as one layer or two layers. The trap filter meshes of the present embodiment are disposed in the cavity of the cylinder body as two layers in a spaced each other relation, dividing the cavity of the cylinder body into at least three chambers, said infrared spheres closely filled in each chamber respectively.

[0027] Refer to Fig. 9, which shows another embodiment of the exhaust infrared purifying device of a diesel engine according to the present invention. The exhaust infrared purifying device of the diesel engine according to the present invention comprises a honeycomb heating purifier 5, the honeycomb heating purifier including a housing which containing an exhaust inlet pipe end cap 51, an exhaust outlet pipe end cap 52 and an cylinder body 53 connected between the exhaust inlet pipe end cap and the exhaust outlet pipe end cap, filter meshes 54 and porous plates 55 disposed at the both sides of the cylinder body in a sequence of from inner to outer, an auxiliary separation mesh 49 disposed at the back of the porous plate, a cavity provided between the two porous plates 55, infrared spheres 56 closely filled in the cavity; the honeycomb heating purifier further including a buffer mesh 57 disposed at the back of the porous plate located at the inlet side, and a trap filter mesh 58 disposed outside of the buffer mesh. Trapping the particulates by the structure is a trapping both in an axial flow direction and in a radial flow direction.

[0028] Refer to Fig. 10. The trap filter mesh 58 is a cylinder with a bottom, a flange 581 disposed at the opening of the cylinder, said flange secured outside of the edge of the buffer mesh; infrared spheres filled in said trap filter mesh.

[0029] Refer to Fig. 11. A still another embodiment of the exhaust infrared purifying device of the diesel engine according to the present invention further comprises a ceramic wall flow filter 7 connected to a honeycomb heating purifier 6, forming an assembly 8 of the honeycomb heating purifier and the ceramic wall flow filter. The ceramic wall flow filter including a housing which containing an exhaust inlet pipe end cap 71, an exhaust outlet pipe end cap 72 and an cylinder body 73 connected between the exhaust inlet pipe end cap and the exhaust outlet pipe end cap, and a honeycomb ceramic filter core 74 disposed in the housing. The exhaust inlet pipe end cap of the ceramic wall flow filter is communicated with the exhaust outlet pipe end cap of the honeycomb heating purifier. The exhaust inlet pipe of said honeycomb heating purifier is the exhaust inlet pipe 81 of the assembly, and the exhaust outlet pipe of said ceramic wall flow filter is the exhaust outlet pipe 82 of the assembly.

[0030] Of course, the post stage of the embodiment as shown in Fig. 9 could also be connected to a ceramic wall flow filter, forming an assembly of the honeycomb heating purifier and the ceramic wall flow filter. The structure is similar to that in Fig. 9 so that its description will be omitted.

[0031] After the purifying device according to the present invention is connected to a ceramic wall flow filter, the gas flow purified by the preceding stage with a high temperature flows into the cavity of the wall flow filter, combusting rapidly with the particulates temporarily trapped in the filter, so that recovering the function and effect of the trap filter, achieving an automatic heating regeneration purification. The particulate purification efficiency is more than 95%.

[0032] The filter meshes and the buffer meshes in the above embodiments could adopt the wire meshes with their sieve number of 100 - 400. The trap filter meshes could adopt the wire meshes with their sieve number of 500 ~ 1400. The individual hole of the porous plate has a diameter slightly smaller than that of the solid infrared sphere. However, in the condition of adopting the auxiliary separation mesh, the individual hole of the porous plate could have a diameter larger than that of the solid infrared sphere, and the auxiliary separation mesh disposed at the back of the porous plate which is in contact with the solid infrared spheres has a mesh opening diameter smaller than that of the solid infrared sphere.

[0033] In the above embodiments of the exhaust infrared purifying device of a diesel engine according to the present invention, said infrared spheres are comprised of infrared materials with the solid spheres' diameter of 2mm ~ 5mm. The materials could be quartz, alumina, and the mixture whose major constituents are quartz and alumina. Of course, the solid spheres could be made of black infrared materials and black substances such as the mixture of MnO 60%, FeO 20%, CuO 10% and CO 10%. Preferably, the present invention adopts the quartz spheres.

[0034] The device according to the present invention could substitute for the noise eliminator of the vehicle, both achieving an exhaust purification and an excellent noise elimination.

[0035] The operation principles of the device according to the present invention are as follows:

1. The pressure of the exhaust flow forms a static high pressure as passing through the device according to the present invention, permitting the temperature of the infrared spheres in the cylinder body to ascend , rapidly heated to the ignition temperature of 650 °C - 800°C, combusting the particulates adhered to the infrared spheres' surfaces and the spherical trap filter meshes' surfaces, so that achieving an rapid thermal oxidation and a regeneration purification.
2. When an engine is idle, the device according to the present invention is in an operating condition of trap filtering the particulates.

[0036] A purifying method by applying an exhaust infrared purifying device of a diesel engine according to the present invention comprises connecting an input port of said honeycomb heating purifier to an exhaust vent of the engine; and connecting an output port of said honeycomb heating purifier to an exhaust manifold of the engine.

[0037] Subsequently, the features and advantages of the purifying method according to the present invention will be further discussed in detail in several preferable embodiments.

[0038] Refer to Fig. 12. This is the first embodiment of a purifying method by applying an exhaust infrared purifying device of a diesel engine according to the present invention. In this embodiment, said one exhaust vent 101 of an one-cylinder engine is connected to one honeycomb heating purifier 3, and the exhaust outlet pipe of the honeycomb heating purifier is connected to the exhaust manifold 102 of the engine.

[0039] Refer to Fig. 13. This is the second embodiment of the purifying method by applying an exhaust infrared purifying device of a diesel engine according to the present invention. In this embodiment, said one exhaust vent 201 of an one-cylinder engine is divided into two paths each connected to one honeycomb heating purifier 3 - 1, 3 - 2, and the exhaust outlet pipes of the two honeycomb heating purifiers are parallelly connected to the exhaust manifold 202 of the engine.

[0040] Refer to Fig. 14. This is the third embodiment of the purifying method by applying an exhaust infrared purifying device of a diesel engine according to the present invention. In this embodiment, six exhaust vents 301 - 1 ~ 301 - 6 of six cylinders are at 302 parallelly connected to a honeycomb heating purifier 3, and the exhaust outlet pipe of the honeycomb heating purifier is connected to the exhaust manifold 303 of the engine.

[0041] Refer to Fig. 15. This is the fourth embodiment of the purifying method by applying an exhaust infrared purifying device of a diesel engine according to the present invention. In this embodiment, six exhaust vents 401 - 1 ~ 401 - 6 of six cylinders are at 402 parallelly connected to an assembly 8 of a honeycomb heating purifier and a ceramic wall flow filter, and the exhaust outlet pipe of the assembly 8 of the honeycomb heating purifier and the ceramic wall flow filter is connected to the exhaust manifold 403 of the engine.

[0042] Refer to Fig. 16. This is the fifth embodiment of the purifying method by applying an exhaust infrared purifying device of a diesel engine according to the present invention. In this embodiment, three exhaust vents 501 - 1 - 501 - 3 of three cylinders are respectively connected to a honeycomb heating purifier 3 - 1 ~ 3 - 3, the exhaust outlet pipe of each honeycomb heating purifier is at 502 parallelly connected to a honeycomb heating purifier 3 - 4, and the exhaust outlet pipe of the honeycomb heating purifier is connected to the exhaust manifold 503 of the engine.

[0043] Refer to Fig. 17. This is the sixth embodiment of the purifying method by applying an exhaust infrared purifying device of a diesel engine according to the present invention. In this embodiment, four exhaust vents 601 - 1 ~ 601 - 4 of four cylinders are respectively connected to a honeycomb heating purifier 3 - 1 ~ 3 - 4, the exhaust outlet pipe of each honeycomb heating purifier is at 602 parallelly connected to an assembly 8 of a honeycomb heating purifier and a ceramic wall flow filter, and the exhaust outlet pipe of the assembly 8 of the honeycomb heating purifier and the ceramic wall flow filter is connected to the exhaust manifold 603 of the engine.

[0044] The honeycomb heating purifiers as disclosed in the above embodiments comprise the embodiments as shown in Fig. 4, Fig. 6 and Fig. 9, however, in order to explain clearly, only the embodiment of the honeycomb heating purifier in Fig. 4 will be explained as a example.

[0045] When the engine is idle or at low speed, the device according to the present invention is in a condition of trap filtering the particulates. When the engine is in normal operation, the exhaust temperature is raised and the device according to the present invention absorbs the exhaust heat rapidly, turning into a condition of automatic regeneration. The principles of the exhaust infrared purifying device of a diesel engine according to the present invention are as follows:

[0046] The pressure of the exhaust flow forms a static high pressure as passing through the device according to the present invention, passes through the honeycomb structures made of spherical infrared materials and the trap filters between the honeycomb structures, permitting the temperature in the cavity of the cylinder body to ascend. The spherical infrared materials transmit infrared ray with high energy after absorbing the heat, permitting the temperature in the cylinder body to rapidly ascend to 600°C - 850°C and more, rapidly combusting and purifying the particulates which are adhered to the spheres' surface and temporarily left on the trap filter meshes, so that achieving an automatic regeneration.

INDUSTRIAL APPLICABILITY

[0047] The exhaust infrared purifying device of a diesel engine according to the present invention is simple in structure and convenient in use, has a good effect of long time purification and a long lifetime, needs not any maintenance, do not cause a high back pressure, and do not produce a saturation. After the matching design according to the displacement and emission level of the diesel engine, the purification index of the device could fulfill the current new emission standard prescribed by PRC and the futural more severe Europe IV emission standard and its limit request.

Claims

1. An exhaust infrared purifying device of a diesel engine, comprising a honeycomb heating purifier, the honeycomb heating purifier including a housing which containing an exhaust inlet pipe end cap, an exhaust outlet pipe end cap and an cylinder body connected between the exhaust inlet pipe end cap and the exhaust outlet pipe end cap, filter meshes and porous plates disposed at the both sides of the cylinder body in a sequence of from inner to outer, a cavity provided between the two porous plates, infrared spheres closely filled in the cavity; **characterized in that** the honeycomb heating purifier further includes a buffer mesh disposed at the back of the porous plate located at the inlet side, and a trap filter mesh disposed in the cylinder body.

2. The exhaust infrared purifying device of a diesel engine according to claim 1, **characterized in that** said buffer mesh is a wire mesh the diameter of which is smaller than that of the porous plates and which is close to the back of the porous plate located at the inlet side.

3. The exhaust infrared purifying device of a diesel engine according to claim 2, **characterized in that** the honeycomb heating purifier further comprises an auxiliary separation mesh close to the back of the porous plate located at the inlet side , said buffer mesh close to the back of the auxiliary separation mesh.

4. The exhaust infrared purifying device of a diesel engine according to claim 1, **characterized in that** said trap filter mesh is hemispherical, disposed in the cylinder body as at least one layer, dividing the cylinder body into at least two chambers, said infrared spheres filled in each chamber respectively.

5. The exhaust infrared purifying device of a diesel engine according to claim 1, **characterized in that** said trap filter mesh is a cylinder with a bottom, secured outside of the buffer mesh.

6. The exhaust infrared purifying device of a diesel engine according to claim 5, **characterized in that** a flange is disposed at the opening of said trap filter mesh, said flange secured outside of the edge of the buffer mesh; infrared spheres are filled in said trap filter mesh.

7. The exhaust infrared purifying device of a diesel engine according to claim 1, **characterized in that** the exhaust infrared purifying device further comprises a ceramic wall flow filter connected to the honeycomb heating purifier, the ceramic wall flow filter including a housing which containing an exhaust inlet pipe end cap, an exhaust outlet pipe end cap and an cylinder body connected between the exhaust inlet pipe end cap and the exhaust outlet pipe end cap, and a honeycomb ceramic filter core disposed in the housing; the exhaust inlet pipe end cap of said ceramic wall flow filter is communicated with the exhaust outlet pipe end cap of the honeycomb heating purifier, forming an assembly of the honeycomb heating purifier and the ceramic wall flow filter; the exhaust inlet pipe of said honeycomb heating purifier is the exhaust inlet pipe of the assembly, and the exhaust outlet pipe of said ceramic wall flow filter is the exhaust outlet pipe of the assembly.

8. The exhaust infrared purifying device of a diesel engine according to claim 1, **characterized in that** said infrared spheres are solid spheres with the diameter of 2mm - 5mm.

9. The exhaust infrared purifying device of a diesel engine according to claim 8, **characterized in that** the materials of said infrared spheres are selected from quartz, alumina, or the mixture whose major constituents are quartz and alumina; alternatively, said infrared spheres are solid spheres mixed by manganese dioxide of 45 - 70%, ferric oxide of 5 - 25% and copper oxide of 5 - 15%.

10. A purifying method by applying an exhaust infrared purifying device of a diesel engine, **characterized in that** an input port of said honeycomb heating purifier is connected to an exhaust vent of the engine; and an output port of said honeycomb heating purifier is connected to an exhaust manifold of the engine.

11. The purifying method by applying an exhaust infrared purifying device of a diesel engine according to claim 10, **characterized in that** said one exhaust vent of the one-cylinder engine is connected to one honeycomb heating purifier, and the exhaust outlet pipe of the honeycomb heating purifier is connected to the exhaust manifold of the engine.

12. The purifying method by applying an exhaust infrared purifying device of a diesel engine according to claim 10, **characterized in that** said one exhaust vent of the one-cylinder engine is divided into two paths each connected to one honeycomb heating purifier, and the exhaust outlet pipes of the two honeycomb heating purifiers are parallelly connected to the exhaust manifold of the engine.

13. The purifying method by applying an exhaust infrared purifying device of a diesel engine according to claim 10, **characterized in that** the exhaust vents of said plurality of cylinders are parallelly connected to a honeycomb heating purifier or an assembly of a honeycomb heating purifier and a ceramic wall flow filter, and the exhaust outlet pipe of the honeycomb heating purifier or the assembly of the honeycomb heating purifier and the ceramic wall flow filter is connected to the exhaust manifold of the engine.

14. The purifying method by applying an exhaust infrared purifying device of a diesel engine according to claim 10, **characterized in that** each of the exhaust vents of said plurality cylinders is respectively connected to a honeycomb heating purifier, the exhaust outlet pipes of the honeycomb heating purifiers are parallelly connected to a honeycomb heating purifier or an assembly of a honeycomb heating purifier and a ceramic wall flow filter, and the exhaust outlet pipe of the honeycomb heating purifier or the assembly of the honeycomb heating purifier and the ceramic wall flow filter is connected to the exhaust manifold of the engine.

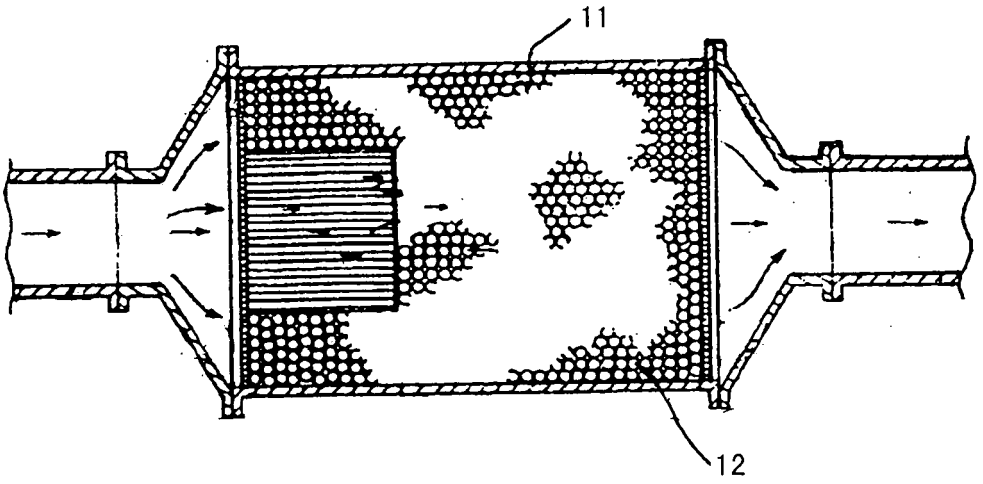

Fig. 1

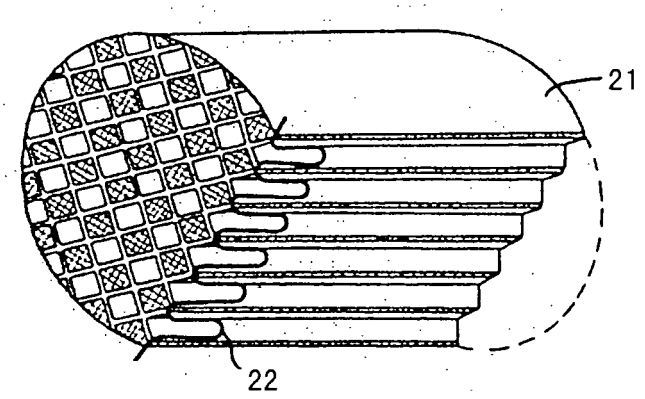

Fig. 2

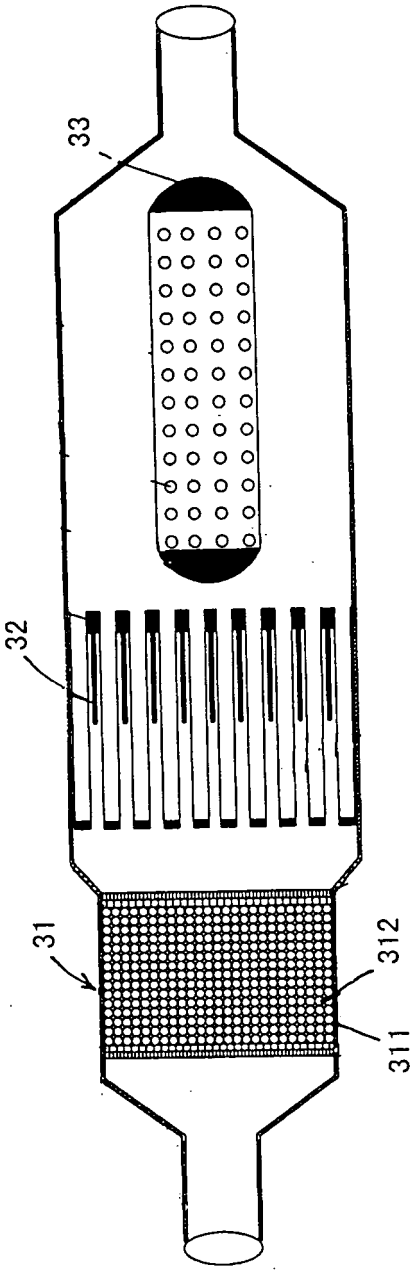

Fig.3

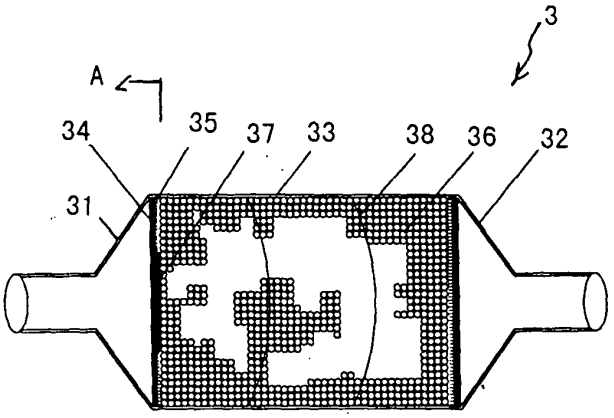

Fig. 4

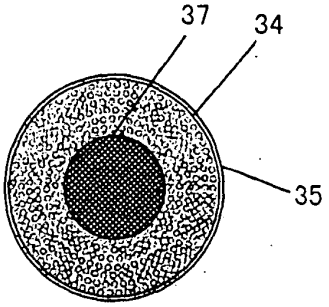

Fig. 5

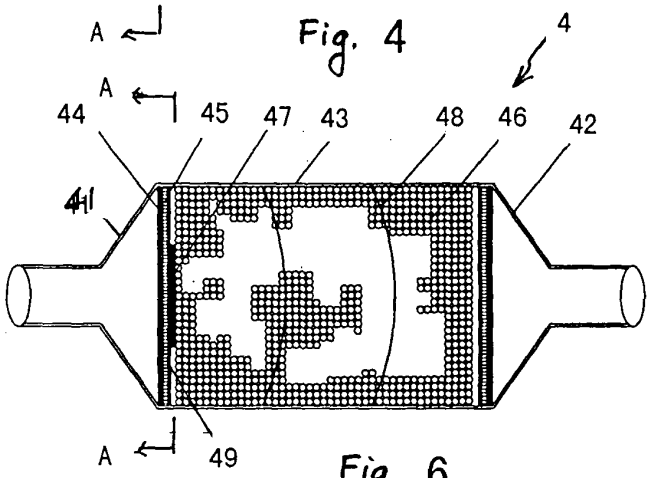

Fig. 6

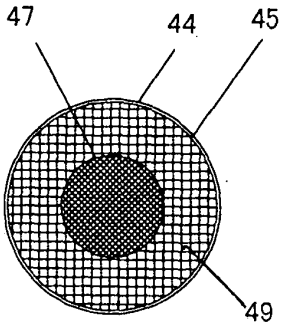

Fig. 7

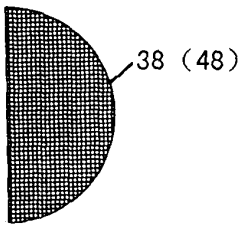

图 Fig. 8

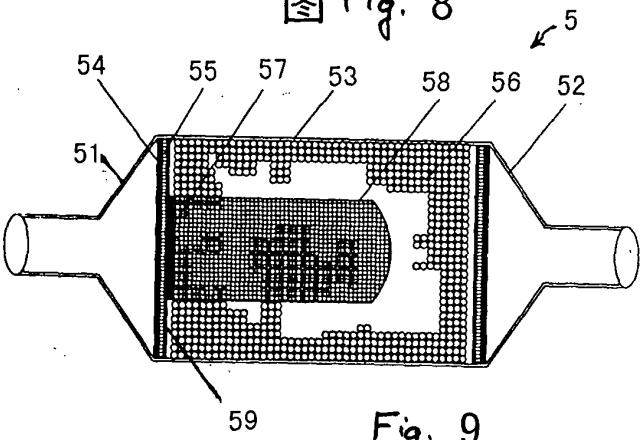

Fig. 9

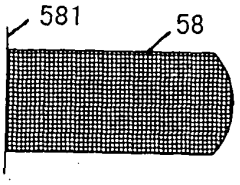

Fig. 10

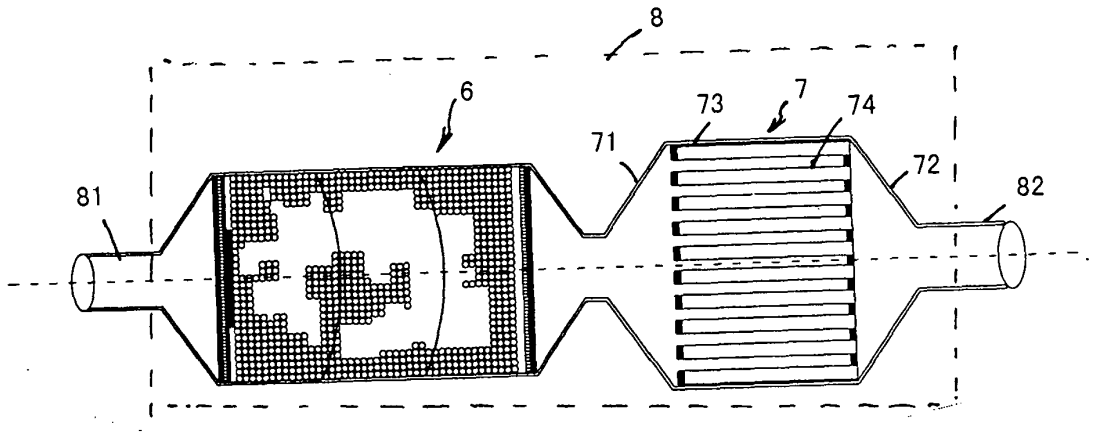

Fig. 11

Fig. 12

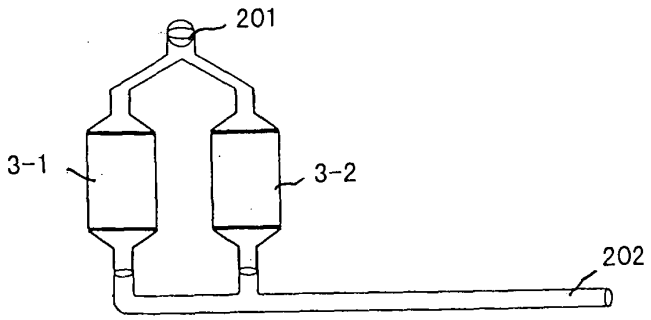

Fig. 13

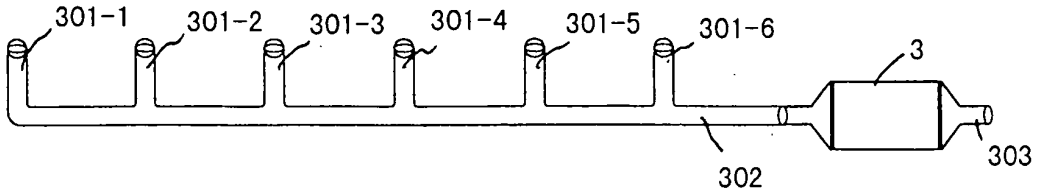

Fig. 14

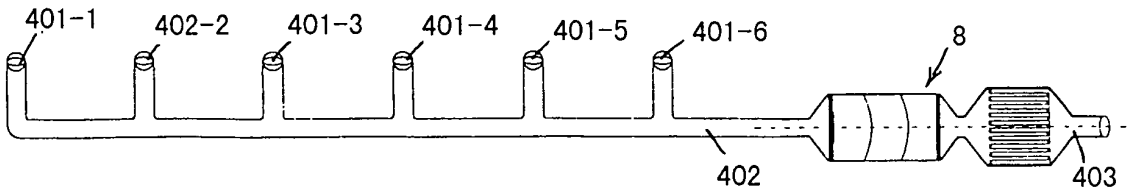

Fig. 15

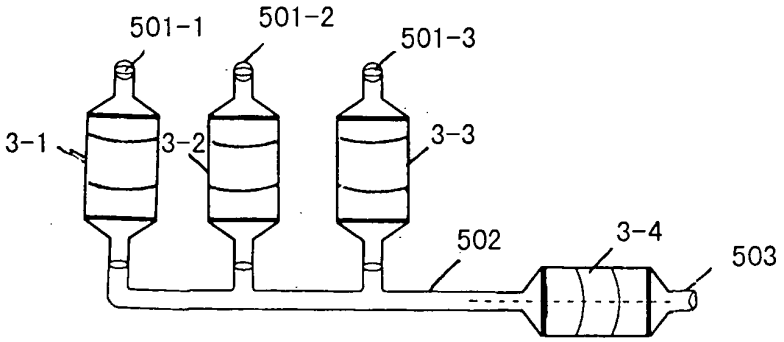

Fig. 16

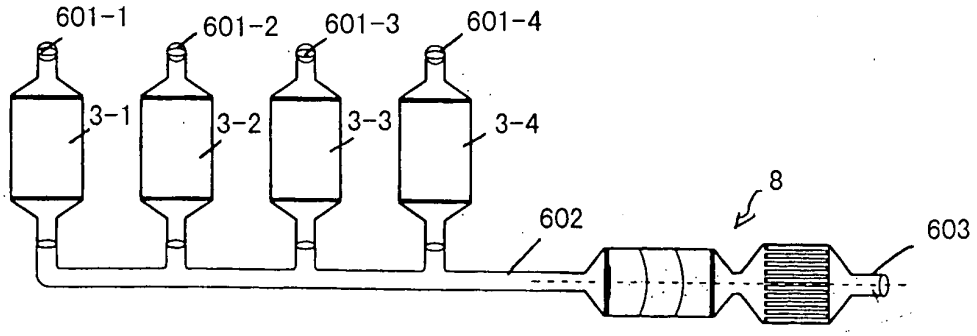

Fig. 17

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2007/000597

A. CLASSIFICATION OF SUBJECT MATTER

SEE EXTRA SHEET

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: F01N3/+, B01D53/+

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC,PAJ,WPI,CNPAT,CNKI,INFRARED,COMBUST+,BURN+,FIR+,FILTER,FILTRAT+,MESH,NET,WEB, CERAMIC,QUARTZ,ALUMINA,BALL,SPHER+,GLOB+,HEAT+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP9-280035A(SUISO ENERGY KAIHATSU KENKYUSHO KK) 28.Oct.1997(28.10.1997)see paragraphs 0014-0019,0022 and fig. 1	1-9
X	Cited in the application	10-14
Y	CN2363066Y(DENG,Xiwei)09.Feb.2000(09.02.2000)see page 1 lines 19-21 and fig.1	1-9
Y	JP2002-38919A(HATANAKAT)06.Feb.2002(06.02.2002)see column 3 lines 49-50	8-9
X		10-14

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"&"document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22.May2007(22.05.2007)	**07 Jun. 2007 (07.06.2007)**
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer YANG,Yonghong Telephone No. (86-10)62085388

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2007/000597

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,Y	CN2821170Y(WU,Xiongliang)27.Sep.2006(27.09.2006)see pages 4-7 and figs 3,8	1-9
P,X	Cited in the application	10-14
X	JP2003-20934A(MAKITA H)24.Jan.2003(24.01.2003)see abstract and its figure	10-14
A		1
A	CN1500957A(MITSUBISHI FUSO TRUCK & BUS)02.Jun.2004(02.06.2004) See abstract and its figure	10-14
E	CN2893172Y(WU,Xiongliang)25.Apr.2007(25.04.2007)see the whole document	1-14

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2007/000597

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
JP9-280035A	28-10-1997	none	
CN2363066Y	09-02-2000	none	
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		KR100536865B	16-12-2005
		CN1272530C	30-08-2006
CN2893172Y	25-04-2007	none	

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2007/000597

CLASSIFICATION OF SUBJECT MATTER

F01N3/023(2006.01)i

F01N3/08(2006.01)i

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- JP 9280035 A **[0003]**
- CN 200520045446 **[0004] [0022]**