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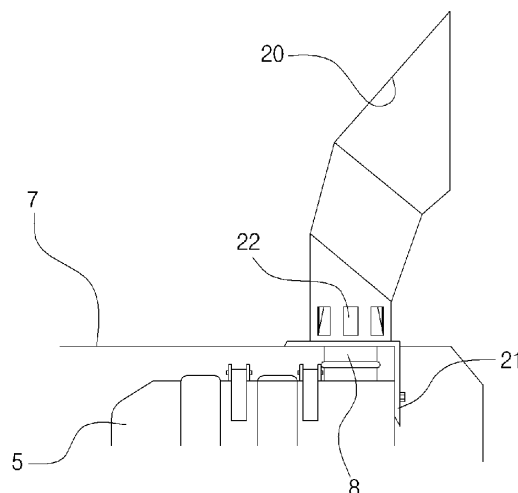
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(54) **EXHAUST GAS TEMPERATURE REDUCTION DEVICE FOR AN ENGINE OF CONSTRUCTION EQUIPMENT**

(57) Disclosed is a hydraulic circuit for controlling booms of construction equipment, wherein working oil which is relieved from a large chamber of a boom cylinder passes through an orifice so as to prevent the boom from lowering if an overload is applied when the boom is not being operated. The hydraulic circuit for controlling booms of construction equipment includes: a boom cylinder which is connected to a hydraulic pump via a first path and a second path; a boom control valve which is mounted on the path between the hydraulic pump and the boom cylinder; a holding valve which is mounted between the boom control valve and the first path of the

boom cylinder and prevents the natural lowering of a boom when the boom control valve is in a neutral position; a port relief valve which is mounted to the first path at the lower side of a holding poppet and relieves working oil when an overload is generated at the first path; and an orifice valve which is mounted at the lower side of the port relief valve, relieves the working oil which passes through the port relief valve when the boom control valve is neutral so as to relieve the working oil through an orifice, and discharges the working oil which passes through the port relief valve to a hydraulic tank at the time of conversion due to boom-up pilot signal pressure which is applied to the boom control valve.

[Fig.2]



Description

[FIELD OF THE INVENTION]

[0001] The present invention relates to an apparatus for reducing the temperature of an exhaust gas for an engine of a construction machine. More particularly, the present invention relates to an improved exhaust gas temperature reduction apparatus for an engine of a construction machine, in which when an exhaust gas generated in the combustion process of a smoke reduction device of an engine, preferably a diesel engine of the construction machine passes through a diffuser and a tail pipe, the exhaust gas is mixed with a cooling fan air flow and an external air so that a low-temperature exhaust gas can be discharged to the outside of an engine room.

[Background of the Invention]

[0002] Conventionally, in a diesel engine employing fossil fuel or a hybrid-type construction machine the fossil fuel along with electric energy, it is general that a smoke reduction device for regeneration and post-treatment of the exhaust gas is employed in the diesel engine or the hybrid-type construction machine.

[0003] In particular, particulate matters (PM) contained in an exhaust gas discharged from the diesel engine of the construction machine provide a cause of environmental and air pollution. In addition, in the case where the particulate matters are sucked into the lung tissue or the respiratory system of the human body, they have a malignant effect on the human body. For this reason, regulation of emissions of particulate matters is reinforced around the world.

[0004] In order to solve a problem involved in such environmental pollution, there is proposed a diesel particulate filter (DPF) as a smoke reduction device that captures and treats particulate matters emitted in the air to prevent the particulate matters generated from a diesel vehicle or the like from being emitted in the air. The diesel particulate filter (DPF) repeatedly performs a process of burning out the filtered smoke or a process of not burning out the filtered smoke but shaking off the filter to regenerate the filter when the particulate matters are captured and then a given time point is reached. However, such a conventional diesel particulate filter (DPF) entails a problem in that the exhaust gas emitted from the engine through the smoke reduction device is discharged to the outside along with a high-temperature air flow, which may cause a fire or a burn.

[0005] In order to solve the above-mentioned problem, a technology is researched and developed which reduces the temperature of the exhaust gas by means of a tail pipe connected to the smoke reduction device. For example, as an example of an exhaust gas temperature reduction apparatus for an engine of a construction machine, there is disclosed Korean Patent Laid-Open Pub-

lication No. 2010-86525 entitled "Apparatus for Reducing Temperature of Overheated Gas of Engine Room" and laid-opened on August 2, 2010.

[0006] Fig. 1 is a schematic view showing a state in which a conventional exhaust gas temperature reduction apparatus for an engine of a construction machine is installed at an engine room according to the prior art.

[0007] As shown in Fig. 1, the conventional exhaust gas temperature reduction apparatus for an engine of a construction machine includes: a through-hole 2 penetratingly formed at one side of an engine room 7; a tail pipe 1 having one end connected to the smoke reduction device 6 and the other end extending to the outside of the engine room 7 through the through-hole 2, and configured to discharge an overheated gas that is discharged during regeneration of the smoke reduction device 6 to the outside; a cooling fan 3 provided at one side of an engine room 7 and configured to generate a cooling fan air flow 9 through the inflow of an external air; and a diffuser 4 engaged with the through-hole 2 and configured to surround an outer circumferential surface of the tail pipe 1 to have a space defined between the tail pipe 1 and the diffuser 4, whereby the diffuser is prevented from coming into direct contact with the tail pipe 1 and dispersion of the cooling fan air flow is prevented after suction of the cooling fan air flow to reduce the temperature of the overheated gas.

[0008] This technology enables the exhaust gas of the smoke reduction device 5 and the cooling fan air flow 9 generated by the cooling fan 3 to be mixed with each other in the tail pipe 1 when the exhaust gas having passed through the smoke reduction device 5 is primarily discharged through the tail pipe 1 so that the temperature of the overheated exhaust gas can be reduced.

[0009] However, the conventional exhaust gas temperature reduction apparatus encounters a problem in that since the air flow 9 generated by the cooling fan 3 directly passes by the outer circumferential surface of the tail pipe 1 or the exhaust gas and the air flow 9 are mixed with each other inefficiently in the tail pipe 1, the temperature of the exhaust gas discharged to the outside through the tail pipe 1 reaches high temperature, for example about 500°C.

[0010] As a result, such a high-temperature exhaust gas causes the overheating of the diffuser 4. In addition, although the high-temperature exhaust gas does not come into direct contact with the tail pipe 1, there occurs a problem in that it may bring about a fire or a physical injury through the contact with the diffuser 4.

[Detailed Description of the Invention]

[Technical Problems]

[0011] Accordingly, the present invention has been made to solve the aforementioned problem occurring in the prior art, and it is an object of the present invention to provide an apparatus for reducing a temperature of an

exhaust gas for an engine of a construction machine, in which an external air and a cooling fan air flow generated by a cooling fan are mixed with each other in the diffuser to produce a turbulent flow to cause the tail pipe to be cooled structurally, and furthermore the turbulent flow is efficiently introduced into the tail pipe to reduce the temperature of the exhaust gas having passed through a smoke reduction device in the tail pipe.

[Technical Solution]

[0012] To accomplish the above object, in accordance with an embodiment of the present invention, there is provided an apparatus for reducing a temperature of an exhaust gas for an engine of a construction machine including a diesel engine and a smoke reduction device connected onto an exhaust pipe of the diesel engine to prevent the discharge of particulate matters, the apparatus including:

a cooling fan provided at one side of an engine room and configured to generate a cooling fan air flow through the inflow of an external air;

a tail pipe including a turbulent flow inlet port and a first guide configured to guide the cooling fan air flow to the inside of the apparatus, the tail pipe having one end connected to the smoke reduction device and the other end extending to the outside of the engine room to discharge an overheated gas that is discharged during regeneration of the smoke reduction device to the outside; and

a diffuser including an external air inlet port exposed to the outside of the engine room and a second guide positioned adjacent to the external air inlet port to guide the external air introduced into the engine room to the inside of the apparatus, the diffuser being configured to surround an outer circumferential surface of the tail pipe to have a space defined between the tail pipe and the diffuser, whereby the diffuser is prevented from coming into direct contact with the tail pipe.

[0013] According to a preferable embodiment, the turbulent flow inlet port is arranged in plural numbers at angular intervals of 45° along the circumference of the tail pipe, and the external air inlet port is formed in plural numbers along the inner circumferential surface of the diffuser to correspond to the plurality of turbulent flow inlet ports.

[Advantageous Effect]

[0014] The exhaust gas temperature reduction apparatus for an engine of a construction machine in accordance with an embodiment of the present invention as constructed above has the following advantages.

[0015] A cool external air inside the engine room is laterally introduced into the diffuser structurally and then

is supplied to the inside of the tail pipe while producing a turbulent flow together with the air flow generated by the cooling fan, thereby greatly reducing the temperature of the high-temperature exhaust gas having passed through the smoke reduction device.

[0016] In addition, the turbulent flow in which the external air and the cooling fan air flow are mixed with each other collide against the inner circumferential surface of the diffuser and the outer circumferential surface of the tail pipe to perform a heat exchange for cooling, thereby significantly reducing the temperature of the exhaust gas and preventing the overheating of the tail pipe.

[Brief Description of the Drawings]

[0017] The above objects, other features and advantages of the present invention will become more apparent by describing the preferred embodiments thereof with reference to the accompanying drawings, in which:

Fig. 1 is a schematic view showing a state in which a conventional exhaust gas temperature reduction apparatus for an engine of a construction machine is installed at an engine room according to the prior art;

Fig. 2 is a schematic view showing a state in which an exhaust gas temperature reduction apparatus for an engine of a construction machine in accordance with an embodiment of the present invention is installed on an engine room;

Fig. 3 is a schematic perspective view showing an exhaust gas temperature reduction apparatus for an engine of a construction machine in accordance with an embodiment of the present invention;

Fig. 4 is a schematic view showing an operational state in which an air flow generated by an external air and a cooling fan is introduced into a tail pipe while generating a turbulent flow; and

Fig. 5 is a cross-sectional view taken along the line A-A shown in Fig. 4 for the sake of explanation on the installed state of a second guide of a diffuser and a first guide of a tail pipe.

[Preferred Embodiments of the Invention]

[0018] Now, a preferred embodiment of the present invention will be described in detail with reference to the accompanying drawings. In the description of an embodiment of the present invention, repeated additional description for the same elements will be omitted herein. In the following embodiments, the same reference numerals will be used to refer to the same elements.

[0019] Fig. 2 is a schematic view showing a state in which an exhaust gas temperature reduction apparatus for an engine of a construction machine in accordance with an embodiment of the present invention is installed on an engine room, and Fig. 3 is a schematic perspective view showing an exhaust gas temperature reduction ap-

paratus for an engine of a construction machine in accordance with an embodiment of the present invention.

[0020] An exhaust gas temperature reduction apparatus for an engine of a construction machine including a diesel engine 5 and a smoke reduction device 6 connected onto an exhaust pipe of the diesel engine 5 to prevent the discharge of particulate matters in accordance with an embodiment of the present invention, includes:

a cooling fan 3 provided at one side of an engine room 7 and configured to generate a cooling fan air flow 9 through the inflow of an external air;
a tail pipe 10 including a turbulent flow inlet port 14 and a first guide 13a configured to guide the cooling fan air flow 9 to the inside of the tail pipe, the tail pipe having one end connected to the smoke reduction device 6 and the other end extending to the outside of the engine room 7 and configured to discharge an overheated gas that is discharged during regeneration of the smoke reduction device 6 to the outside; and

a diffuser 20 including an external air inlet port 24 exposed to the outside of the engine room 7 and a second guide 23a positioned adjacent to the external air inlet port 24 to guide the external air introduced into the engine room to the inside of the apparatus, the diffuser being configured to surround an outer circumferential surface of the tail pipe 10 to have a space defined between the tail pipe 10 and the diffuser 20, whereby the diffuser is prevented from coming into direct contact with the tail pipe 10.

[0021] In addition, referring to Fig. 4, a plurality of turbulent flow inlet ports 14 is arranged at angular intervals of a predetermined angle along the circumference of the tail pipe 10, and a plurality of external air inlet port 24 is formed along the circumferential surface of the diffuser 20 to correspond to the plurality of turbulent flow inlet ports 14.

[0022] Preferably, the turbulent flow inlet ports 14 of the tail pipe 10 are arranged at angular intervals of 45° along the circumference of the tail pipe 10, the external air inlet ports 24 of the diffuser 20 are arranged to correspond to the angular intervals of the turbulent flow inlet ports 14. In this case, the turbulent flow inlet ports 14 and the external air inlet ports 24 may include heights and sizes different from each other.

[0023] The external air inlet port 24 is a passage that allows air flowing at the outside of the engine room 7, preferably air flowing above the engine room 7 to be moved into the diffuser 20 therethrough, and the air is guided to the inside of the diffuser 20 and the tail pipe 10 by the second guide 23a during the movement of the air.

[0024] In the meantime, the cooling fan 3 is a device that generates an air flow 9 to drop the temperature of an overheated gas. The cooling fan 3 is positioned at one side of the engine room 7 and sucks in an external air from the front of the engine room 7 to generate the air

flow 9 capable of dropping the temperature of an overheated gas discharged during the filter regeneration of the smoke reduction device 6.

[0025] Preferably, the cooling fan 3 is positioned at the rear of a radiator 8 to maintain the temperature of an air flow 9 at a constant level while excluding the effect of heat generated from a diesel engine 5.

[0026] In order to supply the air flow 9 generated from the cooling fan 3 to the space defined between the diffuser 20 and the tail pipe 10, the diffuser 20 is configured to have a larger diameter or dimension than that of the tail pipe 10 to surround the tail pipe 10.

[0027] In an embodiment of the present invention, preferably, the exhaust gas temperature reduction apparatus may include a connection bracket 21 configured to securely fix a bottom end of the diffuser 20 to the smoke reduction device 6 so as to maintain the space defined between the diffuser 20 and the tail pipe 10. The bottom end of the diffuser 20 is securely fixed to one side of the engine room 7 to maintain an upright state of the diffuser 20 in which the bottom of the diffuser 20 and the external air inlet port 24 are exposed to the outside of the engine room 7.

[0028] The second guides 23a formed on the diffuser 20 constitutes a plural-row structure together with another second guides 23b spaced apart from the smoke reduction device 6. The other second guides 23b are protrudingly formed on the inner circumferential surface of an upper portion of the diffuser 20 whereas the second guide 23a is protrudingly formed on the inner circumferential surface of a lower portion of the diffuser 20 so as to be positioned in proximity to the external air inlet ports 24.

[0029] The other second guides 23b formed on the inner circumferential surface of an upper portion of the diffuser 20 may be formed as a protruded air duct or channel in which the angle of a back slope is adjusted in consideration of an air flow and an exhaust capacity or the required flow rate of the turbulent flow. In this case, preferably, the air duct or channel is formed in a staggered arrangement on the outer surface of the tail pipe 10.

[0030] The second guides 23a may be radially arranged at predetermined intervals in an angle range of from 30° to 90° on the inner circumferential surface of a lower portion of the diffuser 20. In addition, the second guides 23b other than the second guides 23a may be radially arranged at predetermined intervals in an angle range of from 30° to 90° on the inner circumferential surface of an upper portion of the diffuser 20 so that the second guides 23a and 23b can constitute a plural-row structure.

[0031] Meanwhile, the first guides 13a formed on the tail pipe 10 constitutes a plural-row structure together with another first guides 13b spaced apart from the smoke reduction device 6. The other first guides 13b are protrudingly formed on the inner circumferential surface of an upper portion of the tail pipe 10 whereas the first guide 13a is protrudingly formed on the inner circumfer-

ential surface of a lower portion of the tail pipe 10 so as to be positioned in proximity to the turbulent flow inlet ports 14.

[0032] The first guides 13a may be radially arranged at predetermined intervals in an angle range of from 30° to 90° on the inner circumferential surface of a lower portion of the tail pipe 10. In addition, the first guides 13b other than the first guides 13a may be radially arranged at predetermined intervals in an angle range of from 30° to 90° on the inner circumferential surface of an upper portion of the tail pipe 10 so that the first guides 13a and 13b can constitute a plural-row structure.

[0033] The other second guides 13b formed on the inner circumferential surface of an upper portion of the tail pipe 10 may be formed as a protruded air duct or channel of which the angle of a back slope is adjusted in consideration of an air flow and an exhaust capacity or the required flow rate of the turbulent flow. For example, in the case where the exhaust capacity is large, the heat exchange time between the turbulent flow and the exhaust gas can be maintained relatively long through the adjustment of the angle of the back slope of the air duct.

[Mode for the Invention]

[0034] The diffuser 20 in accordance with the present invention allows an external air to be mixed with the cooling fan air flow 9 to generate a turbulent flow when an exhaust gas is discharged from the tail pipe 10 through the smoke reduction device 6 and allows a low-temperature turbulent flow to be mixed with a high-temperature exhaust gas inside the tail pipe 10 to discharge the exhaust gas.

[0035] Preferably, the diffuser 20 allows the turbulent flow generated by the collision between the cooling fan air flow 9 and the external air inside the engine room 7 to surround the outer circumferential surface of the tail pipe 10 in the space defined between the tail pipe 10 and the diffuser 20 to cause the outer circumferential surface of the tail pipe 10 to be cooled. Thus, a direct contact between an external structure of the diffuser 20 or the human body and the tail pipe 10 can be prevented to avoid a risk of a fire and a burn.

[0036] More specifically, in the process in which the exhaust gas is discharged from the tail pipe 10 through the smoke reduction device 6, the cooling fan air flow 9 reaches turbulent flow inlet ports 14 of the tail pipe 10 and the external air inlet ports 24 of the diffuser 20. Some of the reached cooling fan air flow 9 collides against the back slopes of the second guides 23a formed on the inner circumferential surface of the lower portion of the diffuser 20 to cause the flow direction of some of the cooling fan air flow 9 to be primarily changed toward the turbulent flow inlet ports 14 of the tail pipe 10.

[0037] In other words, the cooling fan air flow 9 collides with and is mixed with the external air introduced laterally through the external air inlet port 24 of the diffuser 20 to generate the turbulent flow. In this process, the rest (re-

ferring to an air flow component parallel to the inner circumferential surface of the diffuser) of the cooling fan air flow 9 is moved straight ahead beyond the back slopes and the top tips of the second guides 23a of the diffuser 20, and then collides against and is guided by the back slopes of the second guides 23b so that the remaining air flow can be brought into close contact with the outer circumferential surface of the tail pipe 10.

[0038] Ultimately, the turbulent flow in which the cooling fan air flow 9 generated by the cooling fan 3 installed inside the engine room 7 and the external air inside the engine room 7 are mixed violently is introduced into the tail pipe 10. At this time, some of the turbulent flow which is not introduced into the tail pipe 10 flows spirally upwardly along the outer circumferential surface of the tail pipe 10 while surrounding the outer circumferential surface of the tail pipe 10. In this process, the turbulent flow may again collide with the back slopes of the second guides 23b formed on the inner circumferential surface of the upper portion of the diffuser 20 to generate a turbulent flow.

[0039] In the meantime, the shape and arrangement structure of the second guides 23a or 23b protrudingly formed in plural rows on the inner circumferential surface of the diffuser 20 may be modified in various manners within the range of not suppressing a pneumatic flow of the cooling fan air flow 9 and reducing the temperature of the tail pipe 10 and the exhaust gas, if necessary.

[0040] For example, the angle of the back slopes of the second guides 23a or 23b of the diffuser 20 may be adjusted in an angle range from of 15° to 80° and the torsion angle may be additionally applied to the back slopes of the second guides 23a or 23b.

[0041] As described above, in accordance with an embodiment of the present invention, the turbulent flow in which the cooling fan air flow 9 and the external air inside the engine room 7 are mixed with each other is introduced into the tail pipe 1 through the turbulent flow inlet port 14. In this case, the turbulent flow is introduced into the tail pipe 1 more effectively if there is a height difference between the external air inlet ports 24 of the diffuser 20 and the turbulent flow inlet ports 14 of the tail pipe 10.

[0042] For example, in the case where the external air inlet ports 24 of the diffuser 20 are arranged at a lower position which is relatively near from the top surface of the smoke reduction device 6 and the turbulent flow inlet ports 14 of the tail pipe 10 are arranged at a higher position which is a relatively far from the top surface of the smoke reduction device 6, the turbulent flow collides against the back slope of the second guides 23a of the diffuser 20 to cause the flow direction of the turbulent flow to be oriented toward the front of the turbulent flow inlet ports 14 of the tail pipe 10 so that the introduction efficiency of the turbulent flow can be increased.

[0043] In the meantime, the turbulent flow introduced into the tail pipe 10 through the turbulent flow inlet port 14 of the tail pipe 10 and the exhaust gas are mixed with each other and are discharged to the outside via the up-

per portion of the tail pipe 10. The exhaust gas mixed with the turbulent flow in this process collides against the back slopes of the first guides 13b formed on the inner circumferential surface of the upper portion of the tail pipe 10. At this time, the high-temperature exhaust gas is mixed with the low-temperature turbulent flow introduced into the tail pipe 10 through the turbulent flow inlet port 14 and is discharged to the outside through a heat ex-

[0044] Ultimately, the exhaust gas temperature reduction apparatus for an engine of a construction machine in accordance with the present invention allows the cooling fan air flow and the exhaust gas to pass through the external air inlet ports 24 and the second guides 23a or 23b of the diffuser 20 and the turbulent flow inlet ports 14 and the first guides 13a or 13b the tail pipe 10 so that the temperatures of the exhaust gas, the tail pipe 10, and the diffuser 20 can be dropped to a relative low temperature and the low-temperature exhaust gas can be released to the outside of the engine room 7 in the form of the vertical turbulent flow.

[0045] While the present invention has been described in connection with the specific embodiments illustrated in the drawings, they are merely illustrative, and the invention is not limited to these embodiments. It is to be understood that various equivalent modifications and variations of the embodiments can be made by a person having an ordinary skill in the art without departing from the spirit and scope of the present invention. Therefore, the true technical scope of the present invention should not be defined by the above-mentioned embodiments but should be defined by the appended claims and equivalents thereof.

[Industrial Applicability]

[0046] As described above, the exhaust gas temperature reduction apparatus for an engine of a construction machine in accordance with an embodiment of the present invention can be effectively applied to the construction machine used in excavation, transportation, and leveling/flattening works of earth and sand as well as an excavator or a wheel loader.

Claims

1. An apparatus for reducing a temperature of an exhaust gas for an engine of a construction machine including a diesel engine and a smoke reduction device connected onto an exhaust pipe of the diesel engine to prevent the discharge of particulate matters, the apparatus comprising:

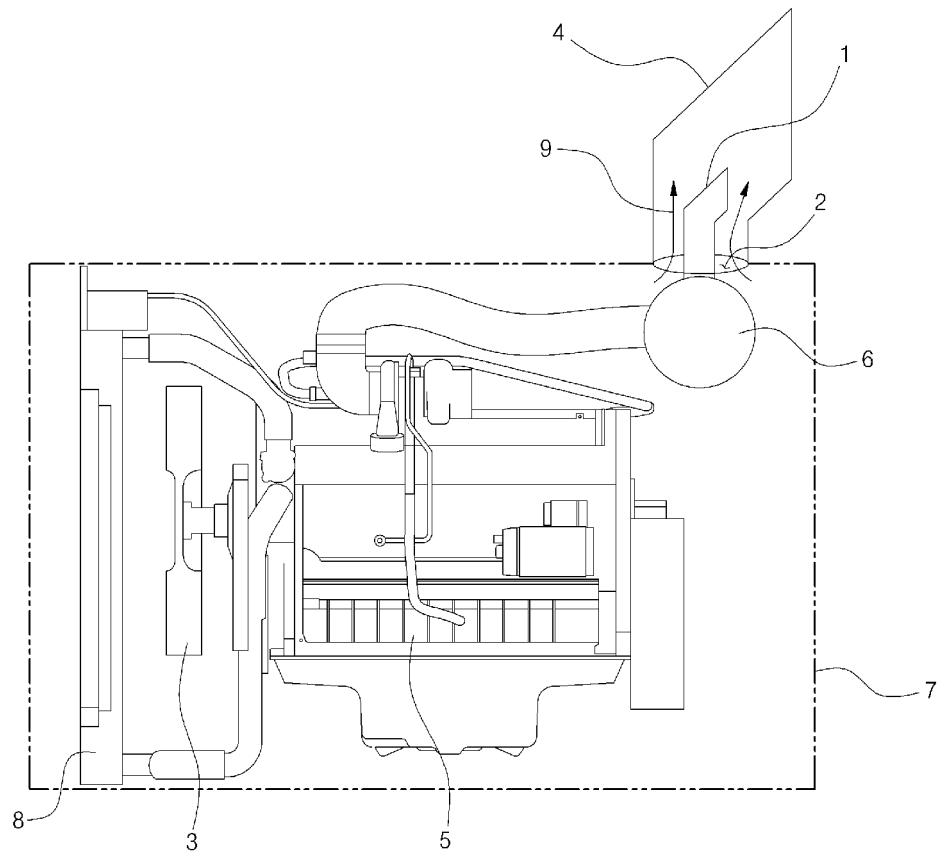
a cooling fan provided at one side of an engine room and configured to generate a cooling fan air flow through the inflow of an external air;
a tail pipe including a turbulent flow inlet port and

a first guide configured to guide the cooling fan air flow to the inside of the tail pipe, the tail pipe having one end connected to the smoke reduction device and the other end extending to the outside of the engine room to discharge an overheated gas that is discharged during regeneration of the smoke reduction device to the outside; and

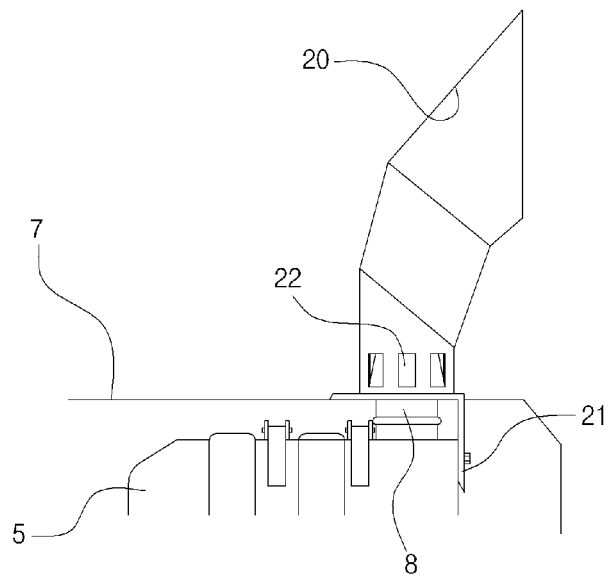
a diffuser including an external air inlet port exposed to the outside of the engine room and a second guide positioned adjacent to the external air inlet port to guide the external air introduced into the engine room to the inside of the apparatus, the diffuser being configured to surround an outer circumferential surface of the tail pipe to have a space defined between the tail pipe and the diffuser, whereby the diffuser is prevented from coming into direct contact with the tail pipe.

2. The apparatus for reducing a temperature of an exhaust gas for an engine of a construction machine according to claim 1, wherein the turbulent flow inlet port is arranged in plural numbers at angular intervals of 45° along the circumference of the tail pipe, and the external air inlet port is arranged in plural numbers along the circumference of the diffuser to correspond to the plurality of turbulent flow inlet ports.
3. The apparatus for reducing a temperature of an exhaust gas for an engine of a construction machine according to claim 1 or 2, wherein the second guide is formed in plural rows on the diffuser in such a manner as to be spaced apart from the smoke reduction device.
4. The apparatus for reducing a temperature of an exhaust gas for an engine of a construction machine according to claim 1 or 2, wherein the first guide is formed in plural rows on the tail pipe in such a manner as to be the smoke reduction device.
5. The apparatus for reducing a temperature of an exhaust gas for an engine of a construction machine according to claim 1 or 2, further comprising a connection bracket configured to securely fix a bottom end of the diffuser to the smoke reduction device so as to maintain the space defined between the diffuser and the tail pipe.

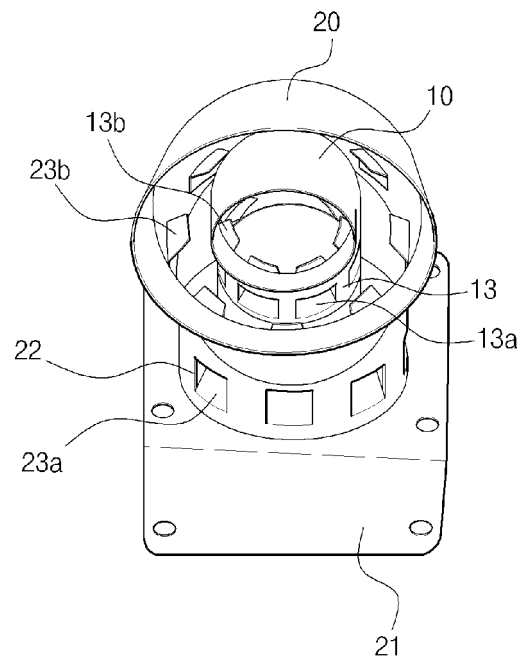
[Fig.1]



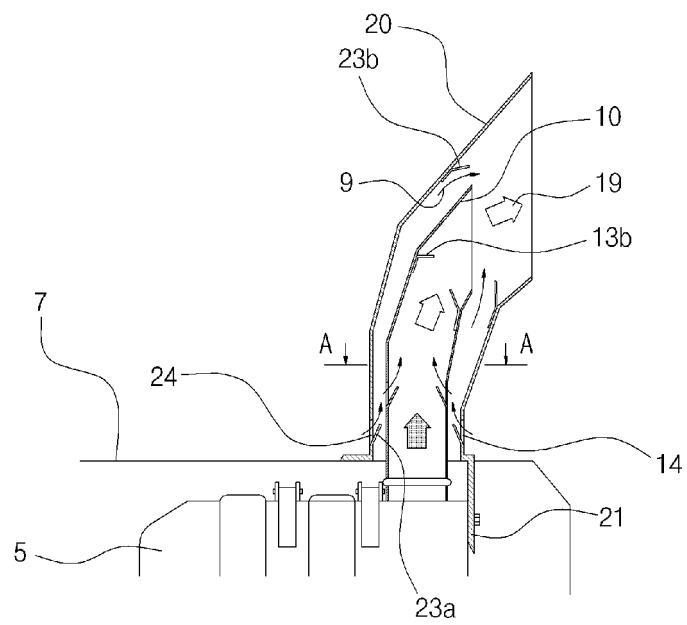
[Fig.2]



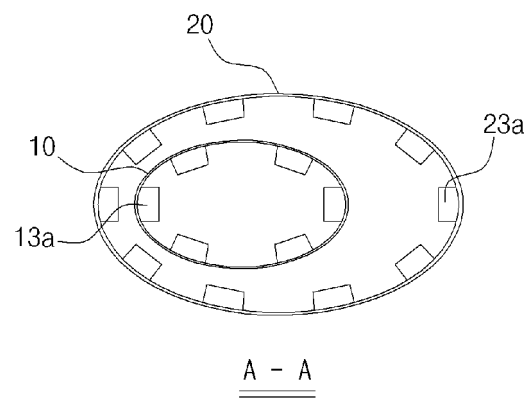
[Fig. 3]



[Fig. 4]



[Fig. 5]



INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2011/002445**A. CLASSIFICATION OF SUBJECT MATTER*****F01N 3/023(2006.01)i, F01N 3/02(2006.01)i***

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)

F01N 3/023; F01N 13/08; F02M 35/02; F01N 7/20; F02M 35/022; F01N 7/08; F01N 3/035

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

Korean Utility models and applications for Utility models: IPC as above

Japanese Utility models and applications for Utility models: IPC as above

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

eKOMPASS (KIPO internal) & Keywords: cooling, picture

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 1911944 A2 (INTERNATIONAL ENGINE INTELLECTUAL PROPERTY COMPANY, LLC.) 16 April 2008 See paragraphs<15>-<19>, figure 1	1-5
Y	KR 10-2010-0086525 A (VOLVO CONSTRUCTION EQUIPMENT AB) 02 August 2010 See claims 1-4, figures 1-4	1-5
A	JP 57-054661 U (HITACHI CONSTRUCTION MACHINERY CO., LTD.) 30 March 1982 See the claims and figures 1-3	1-5
A	JP 01-174516 U (YUTANI HEAVY INDUSTRY CO., LTD.) 12 December 1989 (See the claims and figure 1)	1-5

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search

20 DECEMBER 2011 (20.12.2011)

Date of mailing of the international search report

22 DECEMBER 2011 (22.12.2011)

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EP 2 696 046 A1**INTERNATIONAL SEARCH REPORT**
Information on patent family members

International application No.

PCT/KR2011/002445

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Form PCT/ISA/210 (patent family annex) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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