Abstract: Disclosed herein is a vehicle emission control system (300) configured to operatively receive exhaust gas from a combustion engine (110) and comprising an EATS (120) configured to operatively clean the received exhaust gas, a burner unit (130) configured to operatively heat the received exhaust gas to a predetermined temperature before the exhaust gas is provided to the exhaust gas after treatment system (120), and a pump unit (140) configured to operatively provide the burner unit (130) with air to be used by the burner unit (130) in a heating process. The pump unit (140) is configured to be operatively propelled by exhaust gas, and the burner unit (130) is arranged upstream the pump unit (140) such that exhaust gas from the burner unit (130) is operatively provided to the pump unit (140) for propelling the pump unit (140).
EXHAUST GAS AFTER TREATMENT SYSTEM WITH TEMPERATURE CONTROL

TECHNICAL FIELD
The present invention relates to an arrangement and a method for controlling the temperature of the exhaust gas from a combustion engine before the exhaust gas is provided to an exhaust gas after treatment system for cleaning.

BACKGROUND OF THE INVENTION

Current emission control regulations for automotive vehicles will normally require the use of an Exhaust gas After Treatment System (EATS) comprising various emission cleaning units. Thus, most modern automotive vehicles, at least heavy vehicles, use an EATS to clean the exhaust gas from the vehicle engine. The emission cleaning units of the EATS may e.g. be various catalysts which may convert carbon monoxide (CO), hydrocarbons (HC), and nitrogen oxides (NOx) produced during the operation of the vehicle engine. Other emission cleaning units may be various filters, e.g. particle filters designed to remove particular matter or soot or similar from the exhaust gas etc.

Vehicles equipped with a diesel engine offer the benefit of increased fuel economy. However, control of NOx emissions from such engines is complicated, i.a. due to the high content of oxygen in the exhaust gas. In this regard, the so-called Selective Catalytic Reduction (SCR) catalyst is a well known emission cleaning unit commonly used in modern ETAS:s to achieve a high NOx conversion efficiency. During operation it is preferred the temperature of the SCR is maintained at a certain working temperature. The working temperature may e.g. be within the interval of approximately 250-400°C, e.g. approximately 300°C. However, the working temperature may vary with the particular SCR that is used. If the temperature is too low then the SCR will be ineffective or less effective. If the temperature is too high then the SCR may be deactivated.

Another well known emission cleaning unit commonly used in modern ETAS:s is the so-called Diesel Oxidation Catalyst (DOC). A typical DOC may oxidise carbon monoxide (CO), gas phase hydrocarbons (HC) and the organic fraction of diesel particulates (SOF).
Typically, a DOC tends to show little or no activity at low exhaust gas temperatures, but as
the temperature increases so does the oxidation rate of CO, HC and SOFs.

Still another well known emission cleaning unit commonly used in modern ETAS:s is the so-called Diesel Particulate Filter (DPF). Typically, a DPF makes use of a process whereby nitrogen monoxide (NO) in the exhaust gas is oxidised to nitrogen dioxide (NO2) and Particulate Matter (PM) on the filter is combusted at temperatures of up to 400°C. However, a possible regeneration of the DPF to clean the DPF from accumulated PM may require temperatures as high as 600°C or above to combust the PM accumulated in the DPF.

Naturally, modern E=ATS may comprise other emission cleaning units than those discussed above, including variation of the emission cleaning units discussed above.

The temperature of the exhaust gas from a combustion engine may indeed vary. For example, a heavy duty diesel engine may produce exhaust gas that exceeds 500°C under high load and/or at high speed. On the other hand, the temperature of the exhaust gas may be quite low under idle conditions and/or under conditions of low load and/or at low speeds and/or at a cold start. Indeed, the temperature of the exhaust gas may occasionally decrease below 200°C or even below 150°C. Thus, the temperature of the exhaust gas from a combustion engine may e.g. vary in the interval of 150°C to 500°C or more.

From the above it should be clear that the temperature of the exhaust gas from a combustion engine may occasionally be outside the working temperature interval of 250-400°C for a typical SCR. The temperature of the exhaust gas may also be outside the working temperature of a typical DOC, since a DOC tends to show little or no activity at low temperatures at or below 200°C or 150°C. In addition, the temperature of the exhaust gas may be lower than the temperatures needed for a DPF to be operational (e.g. for regeneration above 600°C) since the highest temperature of the exhaust gas may not exceed 500°C.
SUMMARY OF THE INVENTION

In view of the above there is a need for an efficient arrangement and an efficient method for controlling the temperature of the exhaust gas from a combustion engine before the exhaust gas are provided to the EATS for cleaning. There is also a need for an efficient arrangement and an efficient method for controlling the temperature of the exhaust gas provided to different emission cleaning units within the EATS.

At least one of the improvements and/or advantages mentioned above has been accomplished according to a first embodiment of the present invention directed a vehicle emission control system configured to operatively receive exhaust gas from a combustion engine. The emission control system comprises an EATS configured to operatively clean the received exhaust gas, a burner unit configured to operatively heat the received exhaust gas to a predetermined temperature before the exhaust gas is provided to the exhaust gas after treatment system, and a pump unit configured to operatively provide the burner unit with air to be used by the burner unit in a heating process therein. The pump unit is configured to be operatively propelled by exhaust gas, and the burner unit is arranged upstream the pump unit such that exhaust gas from the burner unit is operatively provided to the pump unit for propelling the pump unit.

At least one of the improvements and/or advantages mentioned above has been accomplished according to a second embodiment of the present invention directed to a method for controlling the temperature of exhaust gas received from a combustion engine in an exhaust gas after treatment system that is configured to clean the received exhaust gas. The method comprises the actions of receiving exhaust gas from the combustion engine, heating the received exhaust gas in a burner unit to a predetermined temperature before the received exhaust gas is provided to the exhaust gas after treatment system, providing the burner unit with air for a heating process in the burner unit using a pump unit, and propelling the pump unit by exhaust gas from the burner unit.

Further advantages of the present invention and embodiments thereof will appear from the following detailed description of the invention.
It should be emphasized that the term "comprises/comprising" when used in this specification is taken to specify the presence of stated features, integers, steps or components, but does not preclude the presence or addition of one or more other features, integers, steps, components or groups thereof.

It should also be emphasised that the steps of the exemplifying methods described in this specification must not necessarily be executed in the order in which they appear. Moreover, embodiments of the exemplifying methods described in this specification may comprise fewer steps or additional steps compared to those stated herein without departing from the scope of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic illustration of a vehicle emission control system 100 according to an embodiment of the present solution,

Fig. 2 is a schematic illustration of a vehicle emission control system 200 according to another embodiment of the present solution,

Fig. 3 is a schematic illustration of a vehicle emission control system 300 according to another embodiment of the present solution,

Fig. 4 is a schematic illustration of a vehicle emission control system 400 according to another embodiment of the present solution,

Fig. 5 is a schematic illustration of a vehicle emission control system 500 according to another embodiment of the present solution,

Fig. 6 is a schematic illustration of the internal features of embodiments of the pump unit 120 comprising a turbine driven compressor 142,

Fig. 7 is a schematic illustration of embodiments providing cooling air into an emission cleaning unit 124 of the EATS 120,

Fig. 8 is a schematic flowchart illustrating an exemplifying method according to an embodiment of the present invention.
DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Figure 1 is a schematic illustration of an emission control system 100 configured to receive exhaust gas from a combustion engine 110 according to an embodiment of the present solution. The emission control system 100 comprises an EATS 120 configured to operatively clean the exhaust gas received from the engine 110. The EATS 120 is provided with a burner unit 130 configured to operatively heat the received exhaust gas to a predetermined temperature before the gas is provided to the EATS 120, and a pump unit 140 configured to operatively provide the burner unit 130 with air to be used by the burner unit 130 in a heating process therein. The pump unit 140 is generally configured to be operatively propelled by exhaust gas. The burner unit 130 is arranged upstream the pump unit 140 such that the exhaust gas from the burner unit 130 is operatively provided to the pump unit 140 for propelling the pump unit 140.

The use of a separate burner unit 130 for heating exhaust gas from the engine 110 before the gas is provided to the EATS 120 is advantageous, since the temperature of the EATS 120 can be controlled in more detail. The use of a separate pump unit 140 for providing air to the burner unit 130 has the advantage that the burner unit 130 can be provided with air without burdening other parts of the vehicle and/or the vehicle engine 110, e.g. such as an air compressor or turbocharger of the engine 110. Arranging the burner unit 130 upstream the pump unit 140 so as to provide heated exhaust gas from the burner unit 130 to the pump unit 140 for propelling the pump unit 140 is also advantageous, since the energy in the heated exhaust gas from the burner unit 130 can be used to propel the pump unit 140, i.e. the energy added by the burner unit 130 can be used to propel the pump unit 140. This makes the burner unit 130 and the pump unit 140 a self-supporting system. This is particularly so when the burner unit 130 is provided with external fuel in addition to the fuel that may or may not be left in the exhaust gas from the combustion engine 110. Thus, in this way the propelling of the pump unit 140 will not burden or will at least be a lesser burden to other parts of the vehicle and/or the vehicle engine 110.

It is preferred that the combustion engine 110 is a diesel engine or similar. However, the particular kind of combustion engine is not critical for embodiments of the present solution, provided that the exhaust gas from the engine in question benefits from being supplied to an EATS 120 with a burner unit 130 configured to operatively heat the received exhaust gas before the gas is provided to the EATS 120. The combustion engine
110 may be the same or similar in all the emission control arrangements 100, 200, 300, 400, 500 discussed herein with reference to Figures 1, 2, 3, 4, 5 respectively.

The **EATS 120** is configured to operatively clean the exhaust gas from the combustion engine 110. In this respect the **EATS 120** may be provided with various emission control units configured to clean the exhaust gas from the combustion engine 110 or similar exhaust gas. As described in the background section above, the **EATS 120** may e.g. comprise one or several of: an SCR unit and/or a DOC unit and/or a DPF unit. Naturally, the **EATS 120** may additionally or alternatively comprise other emission cleaning units with the same or similar function as the emission cleaning units now mentioned including variations of the emission cleaning units now mentioned. The **EATS 120** may additionally or alternatively comprise other emission cleaning units with other functions than the function of the emission cleaning units now mentioned. The **EATS 120** may be the same or similar in all the emission control arrangements 100, 200, 300, 400, 500 discussed herein with reference to Figures 1, 2, 3, 4, 5 respectively.

The **burner unit 130** is configured to operatively heat the received exhaust gas before they are provided to the **EATS 120**. The particular kind of burner is not critical for the embodiments of the present solution, provided that the heating process in the burner unit releases sufficient energy to heat the exhaust gas received from the combustion engine 110, e.g. heat the received exhaust gas from a temperature below 100°C, or below 150°C or 200°C to a temperature above 200°C, or above 250°C, or above 300°C, or above 350°C, or above 400°C, or above 450°C or above 500°C. The heating process in the burner unit 130 may be any suitable reaction between a fuel and oxygen that releases heat. Fuels of interest may include organic compounds (especially hydrocarbons) in the gas, liquid or solid phase. In case the combustion engine 110 is a diesel engine it is preferred that the fuel provided to the burner unit 130 is diesel, though other fuels are clearly conceivable. The burner unit 130 may be the same or similar in all the emission control arrangements 100, 200, 300, 400, 500 discussed herein with reference to Figures 1, 2, 3, 4, 5 respectively.

The **pump unit 140** is configured to operatively provide the burner unit 130 with air to be used by the burner unit 130 in the heating process in the burner unit 130. The particular kind of pump unit is not critical for the embodiments of the present solution, provided that the pump unit 140 is capable of pumping and/or compressing air, and that the pump unit
140 is configured to be operatively propelled by exhaust gas such as the exhaust gas received from the engine 110 and the exhaust gas from the burner unit 130. As can be seen in Figure 5, the pump unit 140 may e.g. comprise a turbine driven compressor 142 configured to be operatively propelled by exhaust gas from the burner unit 130 so as to compress and pump air into the burner unit 130 for the heating process therein. In embodiments of the present solution the pump unit 140 may also be configured to provide air (e.g. surplus air not needed for the burner unit 130) into an emission cleaning unit of the EATS 120 to cool the emission cleaning unit in question. The emission cleaning unit may e.g. be a catalyst unit 124 arranged downstream of an emission cleaning unit in the form of an exhaust gas filter unit 122 in the EATS 120. A surplus air valve 163 may be arranged in the flow of air from the pump unit 140 to the EATS 120 to adjust the amount of air that is provided from the pump unit 140 to the EATS 120. As schematically indicated in Figure 1, it is preferred that air is provided to the pump unit 140 from an air inlet 142. The air inlet 142 may e.g. be the same as the ordinary air inlet that provides air to the combustion engine 110, or it may be a separate air inlet configured to supply the pump unit 140 with air. The pump unit 140 causes the air to flow from the air inlet 142 to the pump unit 140 and from the pump unit 140 to the burner 130. This is preferably done by the pump unit 140 pressurising the air, i.e. causing an increased pressure pushing the air downstream the pump unit 140 resulting in a reduced pressure sucking the air upstream the pump unit 140. As schematically indicated in Figure 1, the air may flow from the air inlet to the pump unit 140 and from the pump unit 140 to the burner 130 by means of some suitable channel arrangement, e.g. in the form of pipes and/or conduits or similar. The flow of air is generally indicated by thin arrows in the emission control arrangements 100, 200, 300, 400, 500 in the Figures 1, 2, 3, 4, 5 respectively. The pump unit 140 may be the same or similar in all the emission control arrangements 100, 200, 300, 400, 500 discussed herein with reference to Figures 1, 2, 3, 4, 5 respectively.

As can be seen in Figure 1, the burner unit 130 and the pump unit 140 of the emission control system 100 are both arranged upstream the EATS 120. It can also be seen that the emission control system 100 comprises a gas directing arrangement 180a (shaded in Figure 1) configured to operatively direct all or nearly all exhaust gas from the engine 110 to the burner unit 130 for heating, and then direct the heated gas from the burner unit 130 to the pump unit 140 for propelling the pump unit 140. The heated gas is then provided from the pump unit 140 to the EATS 120 for cleaning. Preferably, the heated gas is returned to the main flow of exhaust gas from the engine 110 to the EATS 120 before the
gas is provided to the EATS 120. The main flow is indicated by fat arrows in Figure 1. As schematically indicated in Figure 1, some suitable channel arrangement, e.g. in the form of pipes and/or conduits or similar, may be used to let the exhaust gas flow from the engine 110 to the burner unit 130, from the burner 130 to the pump unit 140 and from the pump unit 140 to the EATS 120. This is the same for both the main flow and the flow through gas direct arrangement 180a in Figure 1.

An advantage of arranging both the burner unit 130 and the pump unit 140 upstream the EATS 120 in the emission control system 100 is that a possible pressure increase in the EATS 120 caused by the compressed air from the pump unit 140 and/or the energy from the heating process in the burner unit 130 may at least partly be absorbed by the pump unit 140 arranged downstream of the burner unit 130. Already the presence of the pump unit 140 in the main flow of heated exhaust gas from the burner unit 130 to the EATS 120 will cause a pressure drop. In addition, the propelling of the pump unit 140 by the heated gas from the burner unit 130 will reduce the energy in the heated gas provided form the burner unit 130 to the EATS 120 which also causes a pressure drop. Thus, a pressure increase in the EATS 120 caused by the burner unit 130 and/or the pump unit 140 may be reduced or avoided by arranging both the burner unit 130 and the pump unit 140 upstream the EATS 120 as in the emission control system 100. In addition, in the emission control system 100 all or nearly all the heat energy produced by the burner unit 130 is provided to the pump unit 140 for propelling the pump unit 140. However, a drawback in the emission control system 100 is that the propelling of the pump unit 140 by the heated exhaust gas from the burner unit 130 causes a temperature drop in the exhaust gas provided from the burner unit 130 to the EATS 120. Thus, the heating efficiency of the burner unit 130 is reduced. In addition, both the burner unit 130 and the pump unit 140 are arranged in the main flow of the exhaust gas from the vehicle engine 110 to the EATS 120. This causes unnecessary obstacles in the main flow of exhaust gas, particularly when the burner unit 130 is not required to heat the exhaust gas from the engine 110.

At least some of the drawbacks of the emission control system 100 have been reduced or avoided in the emission control system 200 shown in Figure 2. The emission control system 200 is essentially the same as the emission control system 100. However, the emission control system 200 comprises a gas directing arrangement 180b (shaded in Figure 2) configured to operatively direct all or nearly all exhaust gas from the engine 110
to the pump unit 140 for propelling the pump unit 140 without passing the burner unit 130, and then from the pump unit 140 to the EATS 120 for cleaning. In other words, the exhaust gas from the engine 110 is not provided to the burner unit 130 for heating. Instead, the exhaust gas from the engine 110 is indirectly heated by the exhaust gas from the burner unit 130 provided into the main flow of exhaust gas from the engine 110 to the EATS 120. The main flow is indicated by fat arrows in Figure 2. This reduces the obstacles in the main flow of exhaust gas. As can be seen in Figure 2, this makes it possible to arranged the burner unit 130 outside the main flow of exhaust gas from the engine 110 to the EATS 120. Thus, in the emission control system 200 there is no burner unit 130 that creates an obstacle in the main flow of exhaust gas from the engine 110 to the EATS 120. However, even if the gas directing arrangement 180b in Figure 2 bypasses the burner unit 130 and directs the exhaust gas from the combustion engine 110 directly to the pump unit 140 it will still leave the pump unit 140 arranged in the main flow of the exhaust gas from the vehicle engine 110 to the EATS 120. Thus, the pump unit 140 will still be an obstacle in the ordinary flow of exhaust gas from the engine 110 to the EATS 120.

At least some of the drawbacks of the emission control systems 100, 200 have been reduced or avoided in the emission control system 300 shown in Figure 3. The emission control system 300 is essentially the same as the emission control systems 100, 200, e.g. the burner unit 130 and the pump unit 140 are both arranged upstream the exhaust gas after treatment system 120. However, there are some differences.

As can be seen in Figure 3, the emission control system 300 comprises a gas directing arrangement 150a (shaded in Figure 3) configured to operatively direct a portion of the exhaust gas from the engine 110 to the burner unit 130 and the pump unit 140. This does not preclude that the gas directing arrangement 150a may occasionally direct none, or all, or nearly all of the exhaust gas from the engine 110 to the burner unit and the pump unit 140 as will be elaborated further below. The exhaust gas is preferably directed to the burner unit 130 and the pump unit 140 from the main flow of exhaust gas from the engine 110 to the EATS 120. The main flow of exhaust gas has been indicated by fat arrows in Figure 3. The exhaust gas from the engine 110 is heated in the burner unit 130 and the heated gas is then provided via the gas directing arrangement 150a to the pump unit 140 for propelling the pump unit 104, and from the pump unit 140 to the EATS 120 for cleaning. Preferably, the heated gas is returned to the main flow of exhaust gas before it
is provided to the EATS 120. As schematically indicated in Figure 3, some suitable channel arrangement, e.g. in the form of pipes and/or conduits or similar, may be used to let the exhaust gas flow from the combustion engine 110 to the EATS 120, and from the combustion engine 110, to the burner unit 130, from the burner 130 to the pump unit 140 and from the pump unit 140 to the EATS 120. This is the same for both the main flow and the flow through gas directing arrangement 150a in Figure 3. As can be seen in Figure 3, it is preferred that the burner unit 130 and the pump unit 140 are arranged in the channels of the gas directing arrangement 150a.

Before proceeding it should be noted that, as will be further explained below, the embodiments shown in Figure 4 and 5 comprises a first gas directing arrangement for the pump unit 140, and a second gas directing arrangement for the burner unit 130. Since the gas directing arrangement 150a now discussed serves both the burner unit 130 and the pump unit 140 it may be regarded as both a first and a second gas directing arrangement in this respect.

The gas directing arrangement 150a now discussed may also comprises a pump valve arrangement 152a configured to operatively adjust the portion of the exhaust gas provided from the combustion engine 110 to the pump unit 140. Here, the pump valve arrangement 152a is also configured to operatively adjust the portion of the exhaust gas provided from the combustion engine 110 to the burner unit 130 and the valve arrangement 152a may therefore alternatively be denoted burner valve arrangement. By adjusting the pump valve arrangement 152a it is possible to change the portion of the exhaust gas provided from the engine 110 to the burner unit 130 and the pump unit 140. For example, if no heating of the exhaust gas from the engine 110 is required then the valve arrangement 152a may be fully open so as to enable as much exhaust gas as possible to flow from the engine 110 to the EATS 120 in the main flow, and as little as possible through the channels of the gas directing arrangement 150a. On the other hand, e.g. at a cold start of the engine 110 extra heating of the exhaust gas from the engine 110 may be required. Then it may be preferred to close or nearly close the valve arrangement 152a so as to enable as much exhaust gas as possible to flow through the channels of the gas directing arrangement 150a and the burner unit 130 and as little as possible through the main flow of the exhaust gas from the engine 110 to EATS 120.
The advantages of the emission control system 300 are similar to the advantages of the emission control systems 100, 200 previously described. For example, a common feature is that the burner unit 130 and the pump unit 140 are arranged upstream the EATS 120, which means that a possible pressure increase in the EATS 120 caused by the pump unit 140 and/or the burner unit 130 may be absorbed by the pump unit 140. Another common advantage is that all or nearly all heat energy produced by the burner unit 130 is provided to the pump unit 140 for propelling the pump unit 140. The drawbacks of the emission control systems 100, 200, 300 are also similar. For example, a common drawback is that the propelling of the pump unit 140 by the heated exhaust gas from the burner unit 130 causes a temperature drop in the exhaust gas provided from the burner unit 130 to the EATS 120. However, an advantage of the emission control system 300 compared to the emission control systems 100, 200 is that neither the burner unit 130 nor the pump unit 140 are arranged in the main flow of the exhaust gas from the engine 110 to the EATS 120. Instead, the burner unit 130 and the pump unit 140 are arranged in the channels of the gas directing arrangement 150a. Thus, the burner unit 130 and the pump unit 140 will not cause any obstacles in the main flow of exhaust gas from the engine 110 to the EATS 120.

The emission control system 400 shown in Figure 4 is essentially the same as the emission control system 300 discussed above. However, the emission control system 400 comprises two separate gas directing arrangements 150b and 160a (shaded in Figure 4).

The first gas directing arrangement 150b is configured to operatively direct only a portion of the exhaust gas from the engine 110 to the pump unit 140 for propelling the pump unit 104. This does not preclude that the gas directing arrangement 150b may occasionally direct none, or all, or nearly all of the exhaust gas from the engine 110 to the pump unit 140. It is preferred that the exhaust gas is directed by the gas directing arrangement 150b to the pump unit 140 from the main flow of exhaust gas flowing from the engine 110 to the EATS 120, and then provided from the pump unit 140 to the main flow again to be further transported to the EATS 120 for cleaning. The main flow of gas has been indicated by fat arrows in Figure 4. It should be noted that the burner unit 130 is arranged upstream of the pump unit 140. It follows that the portion of exhaust gas directed to the pump unit 140 from the main flow is heated by the burner unit 130 when the heating process in the burner unit 140 is activated. As schematically indicated in Figure 4, some suitable channel arrangement, e.g. in the form of pipes and/or conduits or similar, may be
used to let the exhaust gas flow from the engine 110 to the EATS 120, and from the engine 110 to the pump unit 140 and from the pump unit 140 to the EATS 120. This is the same for both the main flow and the flow through gas directing arrangement 150a in Figure 4. As can be seen in Figure 4, the pump unit 140 is arranged in the channels of the first gas directing arrangement 150b.

In addition, the first gas directing arrangement 150b may comprise a pump valve arrangement 152b configured to operatively adjust the portion of the exhaust gas provided from the engine 110 to the pump unit 140. It is preferred that valve arrangement 152b is arranged in the main flow of exhaust gases in a position downstream the inlet to the pump unit 140 and upstream the outlet from the pump unit 140. The valve arrangement 152b may e.g. be used to direct a larger portion of the exhaust gas from the engine 110 to the pump unit 140 for propelling the pump unit 140 if the burner unit 130 has not reached its full heating capacity after start-up. The pump unit 140 may need a lesser portion of the exhaust gas from the engine 110 once the temperature of the exhaust gas from the engine 110 becomes hotter by heating from the burner unit 130. The gas directing arrangement 150b may then be actuated accordingly. Indeed, if no heating of the exhaust gas from the engine 110 and thus no air pumping effect is required then the valve arrangement 152b may be fully open so as to enable as much exhaust gas as possible to flow from the engine 110 to the EATS 120 in the main flow, and as little as possible through the channels of the gas directing arrangement 150b.

The second gas directing arrangement 160a of the emission control system 400 is configured to operatively direct a portion of the exhaust gas from the engine 110 to the burner unit 130. This does not preclude that the gas directing arrangement 160a may occasionally direct none, or all, or nearly all of the exhaust gas from the engine 110 to the burner unit 130. It is preferred that the exhaust gas is directed to the burner unit 130 from the main flow of exhaust gas flowing from the engine 110 to the EATS 120. The exhaust gas from the engine 110 is heated in the burner unit 130 and the heated gas is then provided via the gas directing arrangement 160a from the burner unit 130 to the main flow to be further transported to the EATS 120 for cleaning. As schematically indicated in Figure 4, some suitable channel arrangement, e.g. in the form of pipes and/or conduits or similar, may be used to let the exhaust gas flow from the main flow to the burner unit 130 and from the burner unit 130 back to the main flow again. As can be seen in Figure 4, the
burner unit 130 is arranged in the channels of the second gas directing arrangement 160a.

In addition, the second gas directing arrangement 160a may comprise a **burner valve arrangement 162a** configured to operatively adjust the portion of the exhaust gas provided from the engine 110 to the burner unit 130. It is preferred that valve arrangement 162a is arranged in the main flow of exhaust gases in a position downstream the inlet to the burner unit 130 and upstream the outlet from the burner unit 130. If no heating of the exhaust gas from the engine 110 is required then the valve arrangement 162a may be fully open so as to enable as much exhaust gas as possible to flow from the engine 110 to the EATS 120 in the main flow, and as little as possible through the channels of the gas directing arrangement 160a. On the other hand, when extra heating of the exhaust gas from the engine 110 is required, e.g. at a cold start of the engine 110, then it may be preferred to close or nearly close the valve arrangement 162a so as to enable as much exhaust gas as possible to flow through the channels of the gas directing arrangement 160a and the burner unit 130, and as little as possible through the main flow of the exhaust gas from the engine 110 to EATS 120.

The advantages of the emission control system 400 are the same or similar as the advantages of the emission control system 300 previously described. However, the use of a pump valve arrangement 152c and burner valve arrangement 162b provides a greater flexibility in the emission control system 400 compared to the single valve arrangement 152a used in the emission control system 300.

The **emission control system 500** shown in Figure 5 is essentially the same as the emission control system 400 discussed above. In particular, the emission control system 500 comprises the same gas directing arrangements 150b and 160a (shaded in Figure 5) as the emission control system 400. However, the first gas directing arrangement 150b is arranged downstream the EATS 120 and not upstream the EATS 120 as in the emission control system 400. The first gas directing arrangement 150b is nevertheless configured to operatively direct a portion of the exhaust gas from the combustion engine 110 to the pump unit 140 in the same manner as in the emission control system 400. However, the exhaust gas from the engine 110 has now flown through the EATS 120 before it reaches the first gas directing arrangement 150b, possibly after being heated by the burner unit 130 being arranged upstream the EATS 120. Thus, here it is preferred that the exhaust
gas is directed by the gas directing arrangement 150b to the pump unit 140 from the main flow of exhaust gas flowing from the engine 110 via the EATS 120, and then provided from the pump unit 140 to the main flow down stream the EATS 120 again. The main flow of gas has been indicated by fat arrows in Figure 5.

A drawback with the having the burner unit 130 arranged upstream and the pump unit 140 downstream the EATS 120 in the emission control system 500 is that a possible pressure increase in the EATS 120 caused by the compressed air from the pump unit 140 feeding the burner unit 130 and the energy from the heating process in the burner unit 130 will not be absorbed by the pump unit 140 as in the other arranged the emission control systems 100, 200, 300, 400 having both the burner unit 130 and the pump unit 140 arranged upstream the EATS 120. However, an advantage of the emission control system 500 compared to the emission control systems 100, 200, 300, 400 is that heated gases from the burner unit 130 will always be provided to the EATS 120 without passing the pump unit 140. In the other emission control arrangements 100, 200, 300, 400 at least a part of the heated gases from the burner unit 130 will always pass through the pump unit 140, which will cause a temperature drop in the exhaust gas provided form the burner unit 130 to the EATS 120.

The operation of the burner 130, the pump 140 and the various valve arrangements 152a, 152b, 152c, 162a, 162b may be controlled by software that is programmed into the memory or similar of an Electronic Control Unit (ECU) 170 located at a suitable location or at suitable locations within the vehicle in question. The ECU 170 and the signal paths to and from the ECU 170 and the hardware devices it controls can be thought of as forming a data network that is included within the vehicle. For the sake of simplicity of the present text and the accompanying drawings it is assumed that one and the same ECU 170 may be configured to be operatively connected to and to operatively control any of the emission control systems 100, 200, 300, 400, 500 discussed above. However, nothing prevents that each of the emission control systems 100, 200, 300, 400, may be provided with its own particular ECU being configured to operatively control only the emission control system 100, 200, 300, 400 or 500 in question.

The attention is now directed to the flowchart shown in Figure 8 illustrating the operation of an embodiment of the present solution. The operation of embodiments of the present solution controls the temperature in the EATS 120 being configured to clean exhaust gas
received from the combustion engine 110. It is preferred that the operation of the embodiments is performed by the ECU 170 controlling the various arrangements or similar as described herein.

5 Action S1

In this action S1 the EATS 120 receives exhaust gas from the combustion engine 120. This may be accomplished in any manner describe above, e.g. involving main flows of exhaustion gas from the engine 110 to the EATS 120 and/or involving various gas directing arrangements and/or valve arrangements or similar etc.

Action S2

In this action S2 the exhaust gas received from the engine 110 is heated in the burner unit 130 to a predetermined temperature before the exhaust gas is provided to the EATS 120. The predetermined temperature may e.g. be set based on the working temperature required by an emission cleaning units of the EATS 120, e.g. by the working temperature required by the DPF 122 or the SCR 124 shown as emission cleaning units of the EATS 120 in Figure 7. The predetermined temperature may also be set based on some sort of regeneration or similar required by the emission cleaning units of the EATS 120, e.g. by the DPF 122. Naturally, the predetermined temperature may be set in any other suitable manner. In addition, the predetermined temperature may be static or it may be continuously changed during the operation of the EATS 120, e.g. depending on the different working conditions of the EATS 120 and/or the combustion engine 110. To be able to determine if the exhaust gas from the engine 110 has been heated to the predetermined temperature by the burner unit 130 the emission control systems 100, 200, 300, 400, 500 may e.g. use a temperature measuring device (not shown in the figures) arranged at a suitable position, e.g. at or near the inlet to the EATS 120. The temperature measuring device may e.g. be configured to operatively inform the ECU 170 about the current temperature of the heated exhaust before the gas enters the EATS 120.

Action S3

In this action S3 the burner unit 130 is provided with air from the pump unit 140 for the heating process in the burner unit 130. This may be accomplished according to any
manner describe above, e.g. involving an air inlet and/or some suitable channel arrangement or similar etc.

**Action S4**

5  
In this action S4 the pump unit 140 is propelled by exhaust gas from the burner unit 130. Here it should be emphasised that the pump unit 140 may be propelled by exhaust gas from the burner unit 130 alone or by exhaust gas from the burner unit 130 also comprising exhaust gas from the combustion engine 110 that have been heated by the burner unit 130. The pump unit 140 is propelled by an amount of exhaust gas from the burner unit 130 in both cases.

The operation of other embodiments of the present solution may involve the following:

15  
Directing a portion of the exhaust gas from the combustion engine 110 to the pump unit 140 for propelling the pump unit 140.

Adjusting the portion of the exhaust gas provided from the combustion engine 110 to the pump unit 140.

Directing a portion of the exhaust gas from the combustion engine 110 to the burner unit 140 for heating.

25 Adjusting the portion of exhaust gas provided from the combustion engine 110 to the burner unit 140.

Providing the received exhaust gas heated by the burner unit 130 from the burner unit 130 to the EATS 120 being arranged downstream of the burner unit 130 and the pump unit 140.

Providing the received exhaust gas heated by the burner unit 130 from the burner unit 130 to the EATS 120 being arranged downstream of the burner unit 130 and upstream the pump unit 140.
Providing air from the pump unit 140 into an emission control unit 124 of the EATS 120 so as to cool the emission control unit 124.

The emission cleaning unit 124 may be an exhaust gas filter unit (e.g. a DPF) arranged downstream of an emission cleaning catalyst unit 122 (e.g. a SCR) in the EATS 120.

The present invention has now been described with reference to exemplifying embodiments. However, the invention is not limited to the embodiments described herein. On the contrary, the full extent of the invention is only determined by the scope of the appended claims.
CLAIMS

1. A vehicle emission control system (100, 200, 300, 400, 500) configured to operatively receive exhaust gas from a combustion engine (110) and comprising an exhaust gas after treatment system (120) configured to operatively clean the received exhaust gas, a burner unit (130) configured to operatively heat the received exhaust gas to a predetermined temperature before the exhaust gas is provided to the exhaust gas after treatment system (120), and a pump unit (140) configured to operatively provide the burner unit (130) with air to be used by the burner unit (130) in a heating process, wherein:
   - the pump unit (140) is configured to be operatively propelled by exhaust gas, and
   - the burner unit (130) is arranged up-stream the pump unit (140) such that exhaust gas from the burner unit (130) is operatively provided to the pump unit (140) for propelling the pump unit (140).

2. A vehicle emission control system (300, 400, 500) according to claim 1 comprising a first gas directing arrangement (150a; 150b) configured to operatively direct at least a portion of the exhaust gas from the combustion engine (110) to the pump unit (140) for propelling the pump unit (140).

3. A vehicle emission control system (300, 400, 500) according to claim 2, wherein: the first gas directing arrangement (150a; 150b) comprises a pump valve arrangement (152a; 152b) configured to operatively adjust the portion of the exhaust gas provided from the combustion engine (110) to the pump unit (140).

4. A vehicle emission control system (300, 400, 500) according to claim 1 comprising a second gas directing arrangement (150a; 160a) configured to operatively direct a portion of exhaust gas from the combustion engine (110) to the burner unit (140) for heating.

5. A vehicle emission control system (300, 400, 500) according to claim 4, wherein: the second gas directing arrangement (150a; 160a) comprises a burner valve arrangement (152a; 162a) configured to operatively adjust the portion of exhaust gas provided from the combustion engine (110) to the burner unit (140).
6. A vehicle emission control system (100, 200, 300, 400) according to any one of claim 1, 2, 3, 4 or 5, wherein:
the burner unit (130) and the pump unit (140) are both arranged up-stream the exhaust gas after treatment system (120).

7. A vehicle emission control system (500) according to any one of claim 1, 2, 3, 4 or 5, wherein:
the burner unit (130) is arranged up-stream the exhaust gas after treatment system (120) and the pump unit (140) is arranged downstream the exhaust gas after treatment system (120).

8. A vehicle emission control system (100, 200, 300, 400, 500) according to any one of claim 1, 2, 3, 4, 5, 6 or 7, wherein:
the pump unit (140) comprises a turbine driven compressor (142) configured to be operatively propelled by exhaust gas from the burner unit (130) so as to compress and pump air into the burner unit (130) for the heating process therein.

9. A vehicle emission control system (100, 200, 300, 400, 500) according to any one of claim 1, 2, 3, 4, 5, 6, 7 or 8, wherein:
the pump unit (140) is configured to operatively provide surplus air into an emission cleaning unit (124) of the exhaust gas after treatment system (120) so as to cool the emission cleaning unit (124).

10. A vehicle emission control system (100, 200, 300, 400, 500) according to claim 9, wherein:
the emission cleaning unit (124) is an emission cleaning catalyst unit arranged downstream of an exhaust gas filter unit (122) in the exhaust gas after treatment system (120).
11. A method for controlling the temperature of exhaust gas received from a
combustion engine (110) in an exhaust gas after treatment system (120) that is
calculated to clean the received exhaust gas, the method comprising:
- receiving exhaust gas from the combustion engine (110),
- heating the received exhaust gas in a burner unit (130) to a predetermined
temperature before the received exhaust gas is provided to the exhaust gas
after treatment system (120),
- providing the burner unit (130) with air for a heating process in the burner unit
(130) using a pump unit (140),
- propelling the pump unit (140) by exhaust gas from the burner unit (130).

12. The method according to claim 11, the method comprising:
   directing a portion of the exhaust gas from the combustion engine (110) to the
   pump unit (140) for propelling the pump unit (140).

13. The method according to claim 12, the method comprising:
   adjusting the portion of the exhaust gas provided from the combustion engine
   (110) to the pump unit (140).

14. The method according to any one of claim 11, 12 or 13, the method comprising:
   directing a portion of exhaust gas from the combustion engine (110) to the burner
   unit (140) for heating.

15. The method according to claim 14, the method comprising:
   adjusting the portion of exhaust gas provided from the combustion engine (110) to
   the burner unit (140).

16. The method according to any one of claim 11, 12, 13, 14 or 15, the method
   comprising:
   providing the received exhaust gas heated by the burner unit (130) from the burner
   unit (130) to the exhaust gas after treatment system (120) being arranged
downstream of the burner unit (130) and the pump unit (140).
17. The method according to any one of claim 11, 12, 13, 14 or 15, the method comprising:
providing the received exhaust gas heated by the burner unit (130) from the burner unit (130) to the exhaust gas after treatment system (120) being arranged downstream of the burner unit (130) and upstream the pump unit (140).

18. The method according to claim to any one of claim 11, 12, 13, 14, 15, 16 or 17, the method comprising:
providing air from the pump unit (140) into an emission control unit (124) of the exhaust gas after treatment system (120) so as to cool the emission control unit (124).

19. The method according to claim 19, wherein:
the emission cleaning unit (124) is an exhaust gas filter unit arranged downstream of an emission cleaning catalyst unit (122) in the exhaust gas after treatment system (120).
Air from Pump 140

Exhaustion Gases from Engine 110

Heated exhaustion gases to EATS 120

Fig. 6
Fig. 7

Exhaust Gases from Engine 110 and/or Furnace 130

Air from Pump 140

122 DPF

124 SCR

120 EATS
Fig. 8

START

S1. Receiving exhaust gas from the combustion engine 110

S2. Heating the received exhaust gas in a burner unit 130 to a predetermined temperature before the exhaust gas is provided to the EATS 120

S3. Providing the burner unit 130 with air for a heating process in the burner unit 130 using a pump unit 140

S4. Propelling the pump unit 140 by exhaust gas from the burner unit 130

END
A. CLASSIFICATION OF SUBJECT MATTER

IPC: 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: FOIN

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

SE, DK, FI, NO classes as above

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

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>A</td>
<td>US 20080223023 Al (M. J. ROBEL), 18 Sept 2008 (18.09.2008), figure 1, abstract, paragraphs (0017)-(0019)</td>
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<td>A</td>
<td>EP 1882831 Al (MANN-HUMMEL GMBH), 30 January 2008 (30.01.2008), figure 1, abstract, paragraphs (0027), (0028)</td>
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<td>US 20060021332 Al (G. Gaiser), 2 February 2006 (02.02.2006), figure 1, abstract, paragraphs (0020), (0021)</td>
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**INTERNATIONAL SEARCH REPORT**

**International application No.**
PCT/SE2010/000150

**C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT**

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International patent classification (IPC)

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