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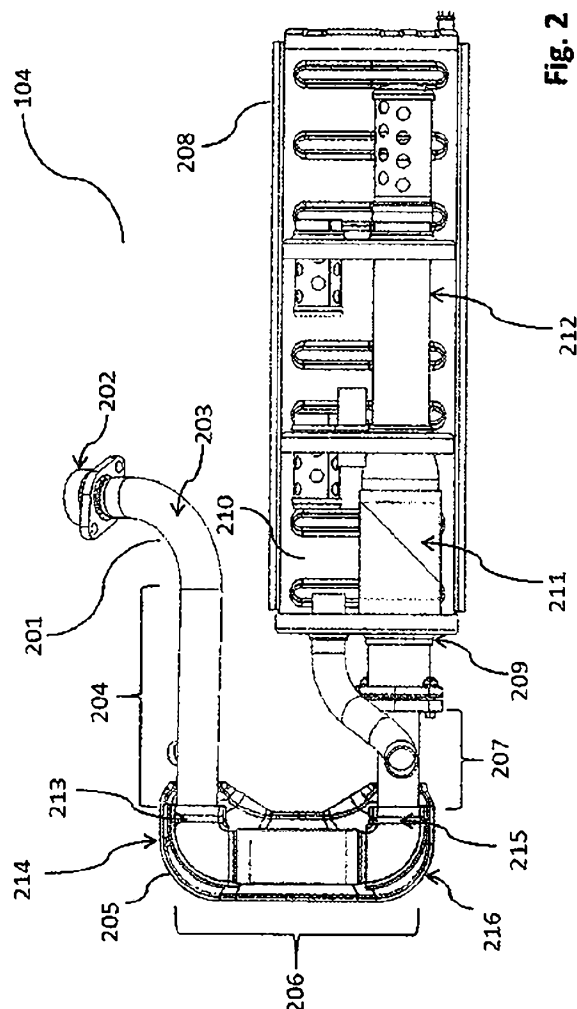
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54 Titre : Exhaust system for a three wheeled vehicle.

57 Abrégé :

The present subject matter discusses about the catalyst mounting arrangements for multi-wheeled vehicle exhaust system. The present subject matter proposes an arrangement for increasing the conversion capacity of catalytic converters which is in general directly proportional to the size of the Catalyst, by implementing two catalytic converters at different locations. The primary catalytic converter is positioned inside the first muffler section and secondary catalytic assembly is located on the exhaust pipe at a pre-determined distance from the engine unit and the muffler inlet. Further, various layout challenges associated with a multi-wheeled vehicle are addressed for implementing the above.

Fig. 2



EXHAUST SYSTEM FOR A THREE-WHEELED VEHICLE

TECHNICAL FIELD

[0001] The present invention relates generally to a multi-wheeled vehicle, and more particularly to an exhaust system of a two or three wheeled vehicle.

BACKGROUND

[0002] Generally, the exhaust system extends from the engine assembly towards a rear portion of the vehicle. In a two wheeled vehicle the exhaust system is typically disposed substantially below the rider & downstream of the engine assembly to ensure no or minimal physical contact of the rider or occupant with the exhaust system. This enables safe operation for the users as well as effective cooling of the exhaust system through aerodynamic effect of wind. In a typical three wheeled vehicle e.g. an auto rickshaw, the power train assembly (engine & transmission system) is disposed at the rear portion downstream of the rider. Often the power train along the exhaust is disposed either under the seat of the passenger or downstream of the passenger seat since this provides for best possible layout packaging for such type of vehicles while enabling ease of service. Typical four wheeled vehicles have powertrain disposed on front side of the vehicle often referred as front engine layout. Such layout has adequate space in the front to configure the disposition of the exhaust system such that a long exhaust pipe extends towards the rear to discharge the exhaust gases. In a four wheeled vehicle with rear engine layout, the wheelbase of the vehicle is relatively higher enabling disposition of the exhaust system at the rear of the seats. Typical three wheeled vehicle provides for higher ground clearance as compared to four wheelers & thus has a challenge of maintaining low center of gravity in disposition of the powertrain cum exhaust components to achieve good dynamic stability & performance. Four wheeled vehicles have low center of gravity with trade-off on relatively lower ground clearance. Collectively, the challenge of achieving compact vehicle size & optimal layout of powertrain system is significantly difficult in a three wheeled vehicle as compared to a four wheeled vehicle. In such aforementioned automotive vehicles, evaporative fuel emission is generated in a fuel tank thereof, particularly when they are parked in sun or exposed to a high temperature.

[0003] Additionally, the exhaust gases arising out of combustion and burning of air-fuel mixture is discharged to the atmosphere through a muffler wherein the main muffler function is to reduce the noise. The exhaust gases are composed of burnt and unburnt hydrocarbons, which cause air pollution if it is freely emitted into the air. Therefore, it is necessary to prevent it from being emitted or discharged into the atmosphere. Hence, in modern times, vehicles are provided with an exhaust system having catalytic converter in the body of the muffler which enables the oxidation and reduction of the un-burnt gases, away from touch points and environmental factors. For the catalytic converter to operate optimally, a specific temperature range is required. Therefore, the catalytic converter may be disposed in the exhaust pipe so as to maintain the required activation temperature.

[0004] When the temperature of the catalytic converter is lower than the activation temperature needed for the catalytic converter to exhibit its catalytic function, the catalytic converter fails to sufficiently exhibit its exhaust purification function. Therefore, when the temperature of the catalytic converter is lower than the required temperature, it must be increased as soon as possible so as to activate (warm up) the catalytic converter. The disposition of the catalytic converter in the exhaust system layout also plays a very crucial role in achieving required control on the emissions as well as delivering good durability of the exhaust system itself. If the catalytic converter is disposed very close to the combustion chamber viz. close to the exhaust port of the cylinder head assembly, it can result in creation of back pressure thereby hampering the smooth and efficient combustion performance of the engine assembly. Also, placing the catalytic converter very close to the engine will lead to an enormous increase in temperature of the catalytic converter. Such an increase in temperature can result in melting the engine cowl which is typically made of plastic. On the other hand if it is placed too far, a very high activation time will be required which will render the catalytic converter ineffective in reducing the emissions. In the case of a three-wheeled vehicle there arises an additional challenge viz. the rise in temperature of the catalytic converter can heat the muffler, the power train components as well as the engine service cabin thereby causing discomfort to the passenger and can lead to durability failure of one or more of the components of the powertrain.

[0005] For effective reduction in emission, higher size of the catalytic converter is preferred. However, for a given vehicle layout and its powertrain requirements, optimal size needs to be determined considering factors like space, cost, performance, durability, etc. the Conversion capacity of a catalytic converter is directly proportional to the size of the catalyst used, its volume and effective surface area. The volume of the catalyst can be increased by increasing the length or volume of the catalyst. Most standard converters use an inner 'honeycomb' structure with 400 to 600 cells per square inch. If an engine produces more gas at a higher rate, the stock catalytic converter restricts gas flow and won't process the toxins quickly enough thereby making the overall process of breaking down higher levels of toxic gases into less harmful ones, slow. This increases the load on the catalytic converter by addition of excess fuel combustion exhaust gases. Further, there are various layout challenges such as ground clearance, service cabin size, etc. associated which needs to be addressed in a vehicle for implementing the above. Also, typically the size of the muffler is restricted and cannot be increased without facing multiple hindrances. Thus, there is a need to achieve an optimal purification ratio of the exhaust gases while addressing all of the above stated problems.

[0006] Another challenge occurs in order to support the exhaust system including the exhaust pipe and the exhaust muffler at supporting portions on the vehicle body, engine body, etc. As a result of this, the frame becomes large leading to poor compactness of the vehicle and additionally therefore there arises a disadvantage of implementing a large catalytic converter in form of undesirable increase in the weight and cost of the vehicle. It is, therefore, an object of the invention to provide an improved catalytic converter system solving all of the above stated problems.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The detailed description of the present subject matter is described with reference to the accompanying figures. Same numbers are used throughout the drawings to reference like features and components.

[0008] Fig. 1 illustrates a rear side view of an exemplary multi-wheeled vehicle, in accordance with an embodiment of the present subject matter.

[0009] Fig. 2 illustrates an exhaust unit and a muffler assembly.

[00010] Fig. 3 illustrates a graph of temperature of exhaust pipe, 1 min. after engine start-up as a function of distance from exhaust port.

[00011] Fig. 4 illustrates an exploded view of a secondary catalytic converter assembly.

DETAILED DESCRIPTION

[00012] This invention relates to an exhaust system for an engine of a vehicle designed to reduce emissions therefrom. It is aiming to provide an improved catalytic converter system in which at least one catalytic converter is fed with engine exhaust gas containing no Hydro-carbon or the Hydro-carbon content reduced to a value lower than a predetermined value. More specifically, this invention is concerned with overcoming the pollution problems associated with engine. Additionally during start-up the traditional catalytic converter systems would have not reached an efficient operating performance, hydrocarbon gases are discharged by the engine exhaust system in great amounts. The catalysts utilized in catalytic converter systems are generally inefficient or inactive at ambient temperature and must reach high temperatures, often in the range of 300-400° C, before they are activated. Typically, the temperature of the catalyst is elevated by coming into contact with the high-temperature exhaust gases from the engine.

[00013] Continuous contact with those gases and the exothermic nature of the oxidation reactions occurring at the catalyst combine to maintain the catalyst at an elevated temperature. The temperature at which a catalytic converter can convert 50% of carbon monoxide, hydrocarbons, or NO_x is referred to as the "light-off" temperature of the converter. However, during start-up of commercial engines, the amounts of carbon monoxide and hydrocarbons in the exhaust gas are higher than during normal engine operation. It has been theoretically-preferred practice to have the catalytic converters placed as close to the engine as physically possible to minimize the emission of pollutants during the initial engine start-up.

[00014] The closer the catalyst is to the engine, the hotter will be the exhaust gas when it contacts the catalyst and the more quickly the temperature of the catalyst will be raised to efficient operating level. However, because of limitations of space in most vehicles, locating the total amount of catalyst in the system near the engine is practically not feasible.

[00015] The issue of reaching efficient performance of the exhaust system without over-burdening the catalytic converter can be addressed using two catalytic converters and distributing the load among them. According to a known art, two catalytic converters have been used and the main

catalyst is provided between the upstream bended portion and the downstream portion of the combustion chamber exhaust pipe. Also, it is the main catalyst which is configured to purify most of the gases exhausted from the combustion chamber. Hence, there arises a need to modify the exhaust pipe in order to accommodate the main catalyst. This significantly increases the cross sectional area of the exhaust pipe thereby making it cumbersome to achieve a compact and optimal layout.

[00016] The Conversion capacity of a catalytic converter is directly proportional to the size of the Catalyst used. As per an aspect of the invention in the subject matter, the exhaust system includes a primary catalytic converter and a secondary catalytic converter. The diameter of the secondary catalytic converter is designed in a range suitable for positioning it with the Exhaust pipe without requiring any undesirable modifications and therefore, layout constraint are conveniently addressed. Moreover, the secondary catalytic converter is placed at a pre-determined distance range so as to get minimum activation time for the catalyst and a steep rate for the rise in temperature. As per one aspect of the present invention the pre-determined distance range is between 0 to 60 % of the true length of the pipe as this activation time drops drastically after 60% of the length.

[00017] Hence, the present invention's subject matter aims to provide an exhaust system in which catalytic converter activation time is reduced by the presence of the additional catalytic converter which is placed closer to the exhaust port end (on the exhaust pipe). The aforesaid and other aspects of the present subject matter would be described in greater detail in conjunction with the figures in the following description.

[00018] Figure 1 shows a rear side view of an exemplary three-wheeled vehicle (101), with an exhaust system (104) connected thereof, in accordance with an embodiment of the present subject matter. The present subject matter is applicable for all types of vehicles having three or more wheels with an engine unit (102) disposed at the rear side. Hence, hereinafter it would be referred as three-wheeled vehicle or vehicle. The vehicle comprises of an engine service cabin (103) including an engine unit (102) and an exhaust system (104). In this figure, Figure 1, said engine unit (102) is disposed in said engine service cabin (103) located in rear portion of said vehicle (101). Further, said engine unit (102) includes at one exhaust port end.

[00019] Figure 2 is an enlarged perspective view of said exhaust system (104) as per one embodiment of present invention, said exhaust system (104) consists of an exhaust gas passage pipe (201) which takes away the exhaust gases from said engine unit (102) and a muffler (208) which provides expansion volume for exhaust gases to lose its energy so that noise level is reduced. Further, said exhaust gas passage pipe (201) includes a secondary catalytic converter assembly (205), an incoming portion end (213) and an outgoing portion end (215), wherein said incoming portion end (213) is connected to an exhaust port end (202) of said engine unit (102) and said outgoing portion end (215) connected to a muffler inlet 209 of said muffler 208.

[00020] Furthermore, said muffler (208) comprises of a muffler first portion (210), a muffler inlet passage member (212), and a primary catalytic converter (211). Moreover, said primary catalytic converter (211) is positioned at the proximity of said muffler inlet (209) inside said muffler first portion (210) and on said muffler inlet passage member (212). Figure 2 also illustrates said exhaust gas passage pipe (201) which further includes a first bend (203), an incoming section (204), an incoming portion end (213), a second bend (214), a middle section (206), a third bend (216) and an outgoing portion end (215). Meanwhile, a secondary catalytic converter unit (205) is disposed in said middle section (206) of said exhaust gas passage pipe (201) between said second bend (214) of said exhaust gas passage pipe (201) and said third bend (216) of said exhaust gas passage pipe (201). As per one embodiment said secondary catalytic converter assembly (205) is positioned in said middle section (206) with both being perpendicular to the ground when said three-wheeled vehicle (101) is viewed from rear side. Thus, vehicle level layout constraints can be easily addressed without compromising the purification efficiency of catalytic converters.

[00022] Figure 2 shows that the structure formed by said incoming section (204), said second bend (214), said middle section (206), said third bend (216) and said outgoing section (207) has a U-shaped profile. Further, as shown in Figure 2 said secondary catalytic converter assembly (205) is disposed in said middle section (206) of said exhaust gas passage pipe (201). As shown the bend radius of curvature of said second bend (214) and said third bend (216) is purposely at least twice the diameter of said exhaust gas passage pipe (201) because of the layout constraints of said multi-wheeled vehicle (101). The bend radius of curvature of said second bend (214) and said third bend (216) is same. Also, it must be noted that the diameter of said exhaust gas passage pipe (201)

ranges between 20-25 mm. Further, in one embodiment this diameter range is selected in order to accommodate a secondary catalytic converter (302) without requiring any modifications. Hence, additional cost incurred for positioning catalytic converter inside said exhaust gas passage pipe (201) is avoided. Furthermore, rigidity of the overall structure with U-shaped profile as described above is improved.

[00023] Next, as per another embodiment of the present invention, in Figure 2 the vertical distance between said incoming section (204) and said outgoing portion end (207) ranges from 100 to 150 mm. The position of said secondary catalytic converter assembly (205) in said exhaust gas passage pipe (201) plays a very crucial role in determining the purification performance of secondary catalytic converter assembly (205) because if it is placed very close to said engine unit (102) it can result in creation of undesirable back pressure. Also, placing secondary catalytic converter assembly (205) very close to said engine unit (102) will lead to an enormous increase in temperature of the catalytic converter. Such an increase in temperature can result in melting of the engine cowl of said engine unit (102). On the other hand if it is placed too far, a very high activation time will be required for the catalytic converter and temperature can adversely affect the performance of the muffler (208) by heating said muffler (208) and the engine service cabin (103), thereby causing discomfort to the passenger. Hence, in one embodiment said secondary catalytic converter assembly (205) is disposed at an optimum distance from said exhaust port end (202) and said muffler (208). Furthermore, there is an activation temperature needed for catalytic converters to exhibit their catalytic function therefore, in one embodiment said secondary catalytic converter assembly (205) is positioned in proximity with said engine unit (102) in order to achieve the required temperature in a convenient and fast manner.

[00024] Figure 3 shows a graph for temperature of exhaust pipe, within pre-determined time t seconds after engine start-up as a function of distance from said exhaust port end (202). Moreover, in one embodiment said secondary catalytic converter (205) is placed at a pre-determined range of 0-60% of the true length of said exhaust gas passage pipe (201) so as to get the activation time for the catalyst more steeply, which generally drops drastically at 60% of the length as shown in Figure

3. Hence, said secondary catalytic converter (205) with afore explained configuration is disposed within a pre-determined distance (curvilinear) range for additional purification performance by said secondary catalytic converter (205).

5 [00025] Figure 4, is an exploded view of said secondary catalytic converter assembly (205) as per one embodiment of present invention, said secondary catalytic converter assembly (205) includes an assembly sleeve (301), an upstream bend adaptor member (303), a downstream bend adaptor member (304), and a secondary catalytic converter (302). In an embodiment, said upstream bend adaptor member (303) is formed by welding at least two sheet metal parts (303a, 303b). Further,
 10 in one embodiment, said downstream bend adaptor member (304) is formed by welding at least two sheet metal parts (304a, 304b). Furthermore, said upstream bend adaptor member (303), said downstream bend adaptor member (304) and said secondary catalytic converter (302) is purposely encapsulated within said assembly sleeve (301) because it is important to prevent the heat dissipation from said secondary catalytic converter (302). Thus, said assembly sleeve (301) serves
 15 to deliver two functions. Firstly, it prevents the increase in the cabin temperature and hence passenger discomfort is avoided. Secondly, it serves to maintain the optimum temperature required for the catalytic converter to perform purification in an efficient manner. In an embodiment, said assembly sleeve 301 is formed by welding at least two sheet metal parts (301a, 301b). In one embodiment said assembly sleeve (301) is separated from said secondary catalytic converter (302),
 20 said upstream bend adaptor member (303) and said downstream bend adaptor member (304) by an air gap which further enhances its function of preventing heat dissipation as discussed above and additionally provide rigidity to the structure.

25 [00026] It is to be understood that the aspects of the embodiments are not necessarily limited to the features described herein. Many modifications and variations of the present subject matter are possible in the light of above disclosure. Therefore, within the scope of claims of the present subject matter, the present disclosure may be practiced other than as specifically described.

List of Reference Signs

- 101 Multi-wheeled vehicle
- 30 102 Engine unit

- 103 Engine service cabin
- 104 Exhaust system
- 201 Exhaust gas passage pipe
- 202 Exhaust port end
- 5 203 First bend
- 204 Incoming section
- 205 Secondary catalytic converter assembly
- 206 Middle section
- 207 Outgoing section
- 10 208 Muffler
- 209 Muffler inlet
- 210 Muffler first portion
- 211 Primary catalytic converter
- 212 Muffler inlet passage member
- 15 213 Incoming portion end
- 214 Second bend
- 215 Outgoing portion end
- 216 Third bend
- 301 Assembly sleeve
- 20 302 Secondary catalytic converter
- 303 Upstream bend adaptor member
- 304 Downstream bend adaptor member

We Claim:

1. An exhaust system (104) for a three-wheeled vehicle (101), said vehicle (101) comprises an engine unit (102) disposed at the rear side,

said engine unit (102) includes an exhaust port end (202);

5 said exhaust system (104) comprising:

a muffler (208) including a muffler inlet (209), a muffler first portion (210), a muffler inlet passage member (212), and a primary catalytic converter (211); and

10 an exhaust gas passage pipe (201) includes a secondary catalytic converter assembly (205), an incoming portion end (213) and an outgoing portion end (215), wherein said incoming portion end (213) is connected to said exhaust port end (202) and said outgoing portion end (215) connected to said muffler inlet (209);

15 wherein said secondary catalytic converter assembly (205) disposed in a middle section (206) of said exhaust gas passage pipe (201) between a second bend (214) of said exhaust gas passage pipe (201) and a third bend (216) of said exhaust gas passage pipe (201).

2. The exhaust system (104) as claimed in claim 1, wherein said muffler (208) is mounted at hind side of said engine unit (102).

20 3. The exhaust system (104) as claimed in claim 1, wherein said exhaust gas passage pipe (201) includes a first bend (203), an incoming section (204), said second bend (214), a middle section (206), said third bend (216) and an outgoing section (207).

25 4. The exhaust system (104) as claimed in claim 1, wherein said secondary catalytic converter assembly (205) disposed in said middle section (206) of said exhaust gas passage pipe (201) is perpendicular to the ground when said multi-wheeled vehicle (101) is viewed from the rear direction.

5. The exhaust system (104) as claimed in claim 3, wherein the bend radius of curvature of said second bend (214) and said third bend (216) is at least twice the diameter of said exhaust gas passage pipe (201).
- 5 6. The exhaust system (104) as claimed in claim 6, wherein the diameter of said exhaust gas passage pipe (201) ranges between 20-25 mm.
7. The exhaust system (104) as claimed in claim 6, wherein the bend radius of curvature of said second bend (214) and said third bend (216) is same.
- 10 8. The exhaust system (104) as claimed in claim 5, wherein the structure formed by said incoming section (204), said second bend (215), said middle section (206), said third bend (216) and said outgoing section (207) has a U-shaped profile.
- 15 9. The exhaust system (104) as claimed in claim 6, wherein the vertical distance between said incoming section (204) and said outgoing section (207) ranges between 100-150 mm.
- 20 10. The exhaust system (104) as claimed in claim 1, wherein said secondary catalytic converter assembly (205) includes an assembly sleeve (301), an upstream bend adaptor member (303), a downstream bend adaptor member (304), and a secondary catalytic converter (302).
- 25 11. The exhaust system (104) as claimed in claim 4, wherein said secondary catalytic converter assembly (205) is positioned in a range of 0-60 per cent of the true length of said exhaust gas passage pipe (201).
12. The exhaust system (104) as claimed in claim 4, wherein said secondary catalytic converter (302) covers at least 65-70 per cent of said middle section (206).
- 30 13. The exhaust system (104) as claimed in claim 4, wherein said assembly sleeve (301) is made up of at least two sheet metal parts (301a, 301b).

14. The exhaust system **(104)** as claimed in claim 13, wherein said assembly sleeve **(301)** encompasses said upstream bend adaptor member **(303)** made up of at least two sheet metal parts **(303a, 303b)**.

5

15. The exhaust system **(104)** as claimed in claim 17, wherein said upstream bend adaptor member **(303)** is connected on one end to said incoming section **(204)** of said exhaust gas passage pipe **(201)** and on other end connected to said secondary catalytic converter **(302)**.

10

16. The exhaust system **(104)** as claimed in claim 13, wherein said assembly sleeve **(301)** encompasses said downstream bend adaptor member **(304)** made up of at least of two sheet metal parts **(304a, 304b)**.

15

17. The exhaust system **(104)** as claimed in claim 19, wherein said downstream bend adaptor member **(304)** is connected on one end to said outgoing section **(207)** of said exhaust gas passage pipe **(201)** and on other end connected to said secondary catalytic converter **(302)**.

20

18. The exhaust system **(104)** as claimed in claim 1, wherein said primary catalytic converter **(211)** is disposed in proximity of said muffler inlet **(209)** on said muffler inlet passage member **(212)**.

25

19. The exhaust system **(104)** as claimed in claim 1, wherein said primary catalytic converter **(211)** is positioned in said muffler first portion **(210)** of said muffler **(208)**.

ABSTRACT

The present subject matter discusses about the catalyst mounting arrangements for multi-wheeled vehicle exhaust system. The present subject matter proposes an arrangement for increasing the conversion capacity of catalytic converters which is in general directly proportional to the size of the Catalyst, by implementing two catalytic converters at different locations. The primary catalyst converter is positioned inside the first muffler section and secondary catalytic assembly is located on the exhaust pipe at a pre-determined distance from the engine unit and the muffler inlet. Further, various layout challenges associated with a multi-wheeled vehicle are addressed for implementing the above.

Fig. 2

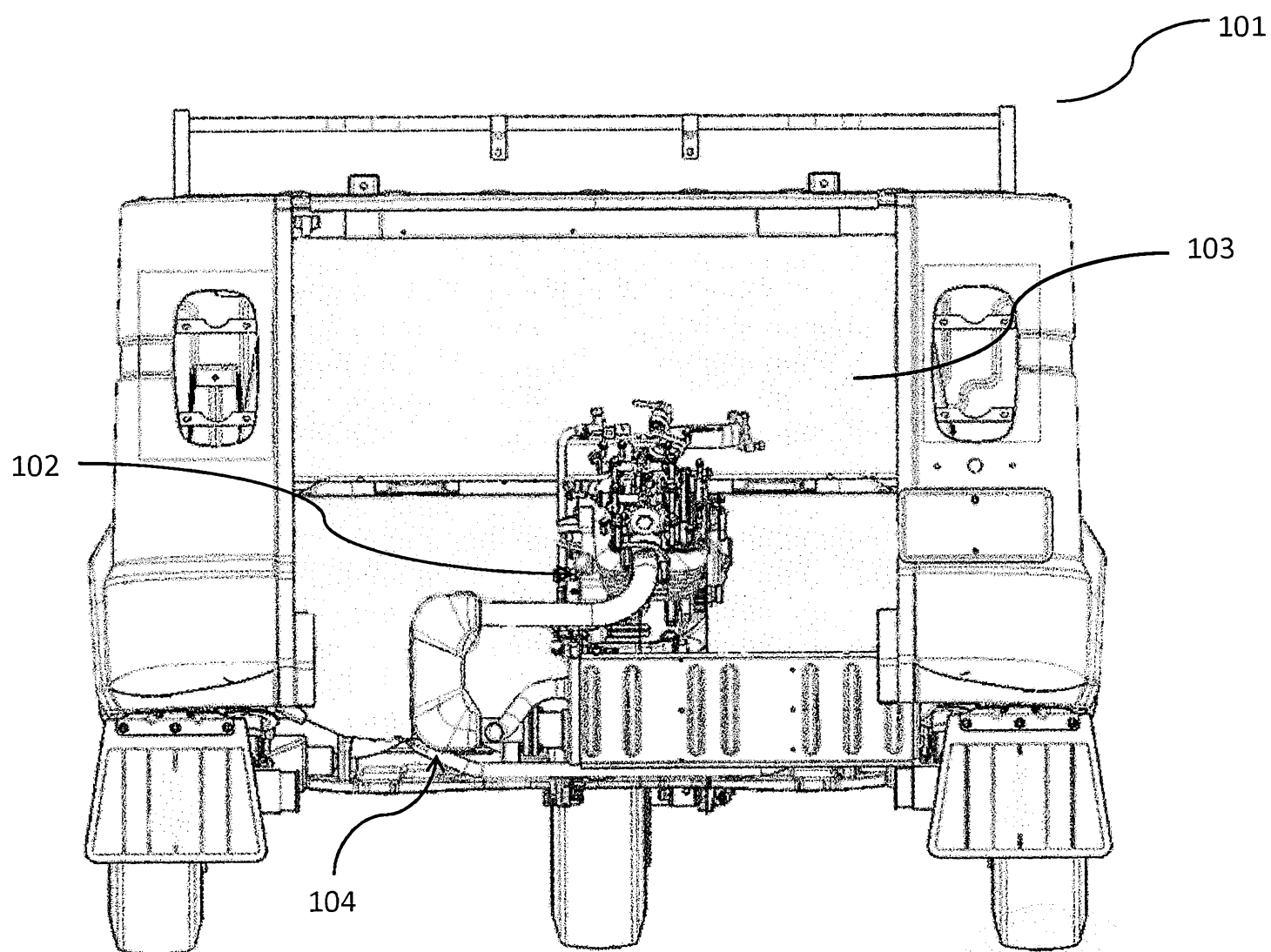


Fig. 1

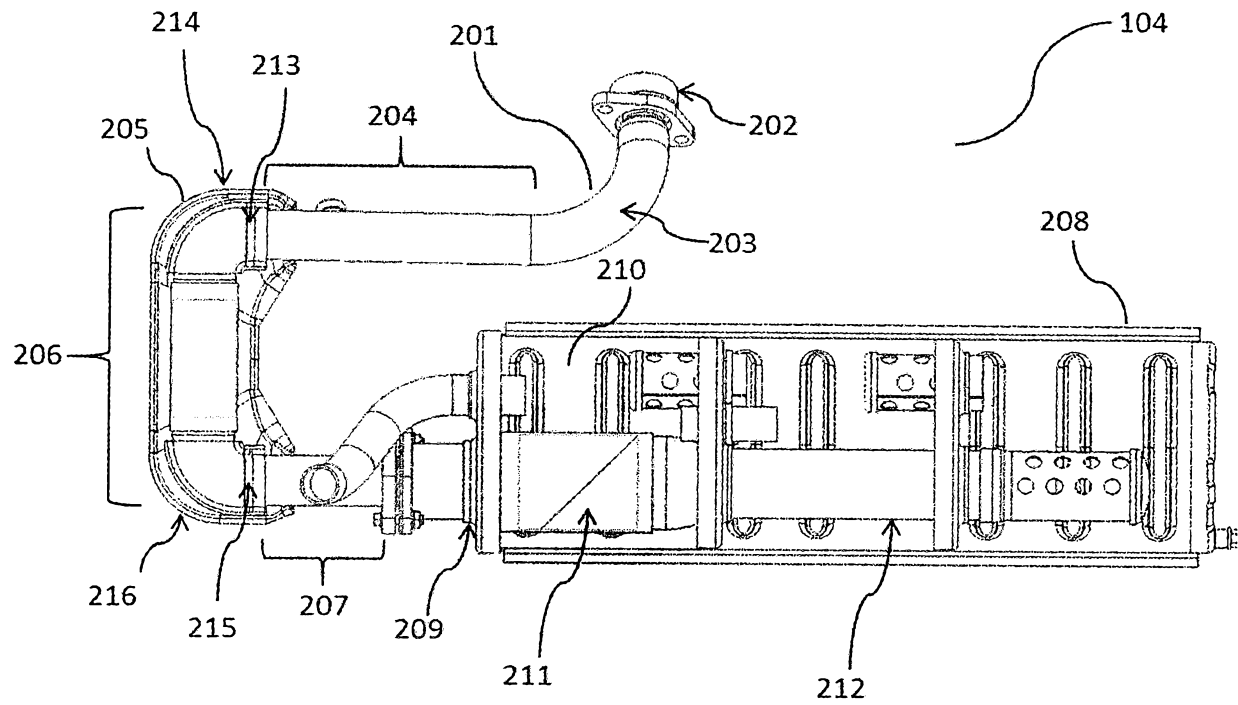


Fig. 2

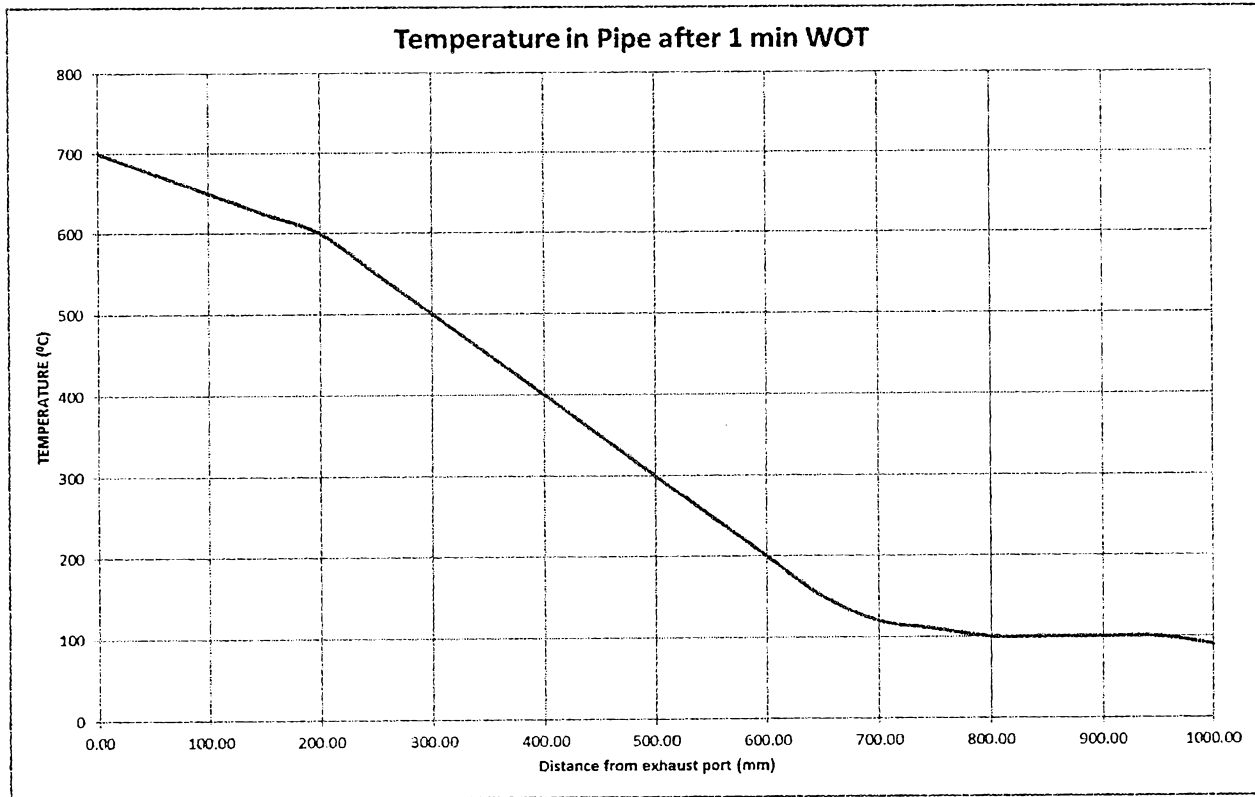


Fig. 3

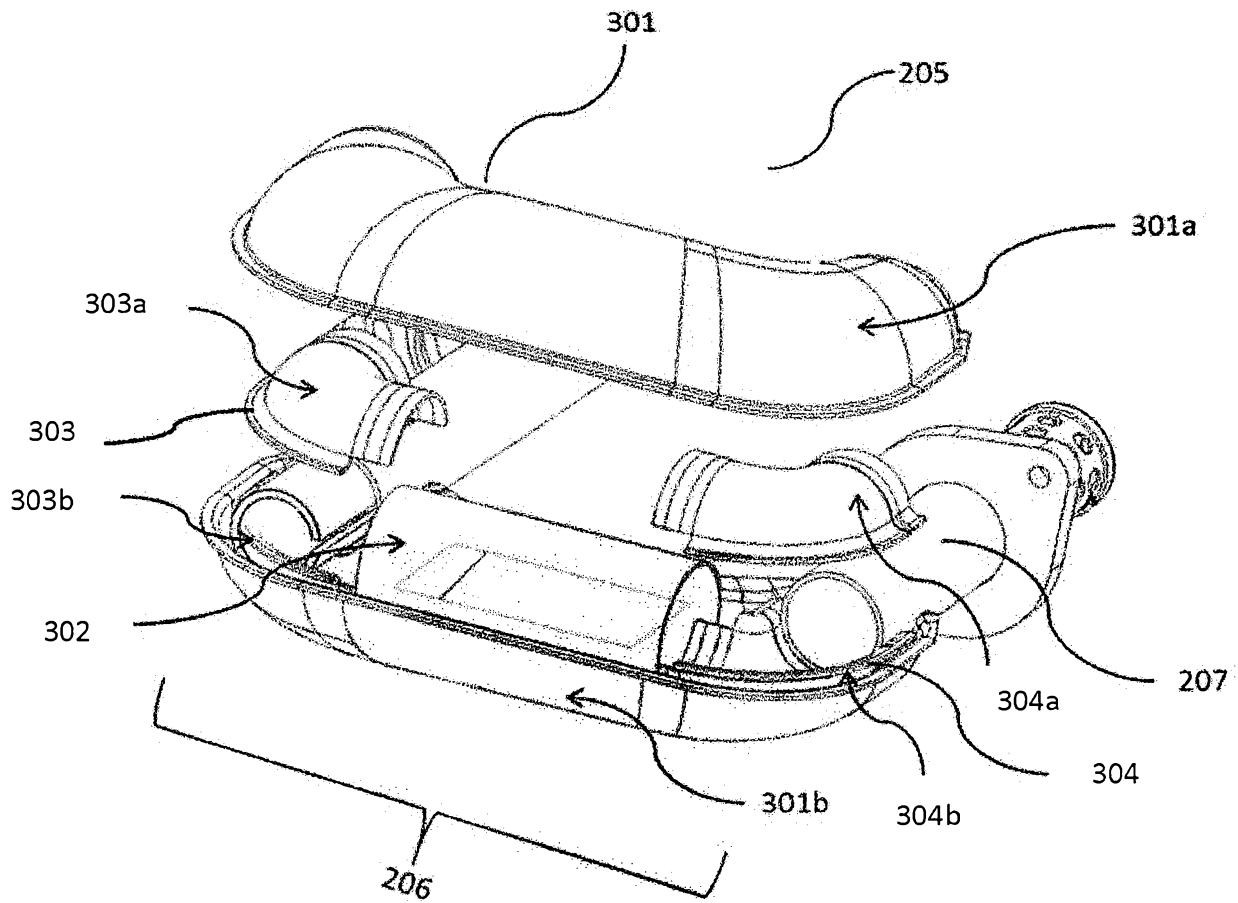


Fig. 4