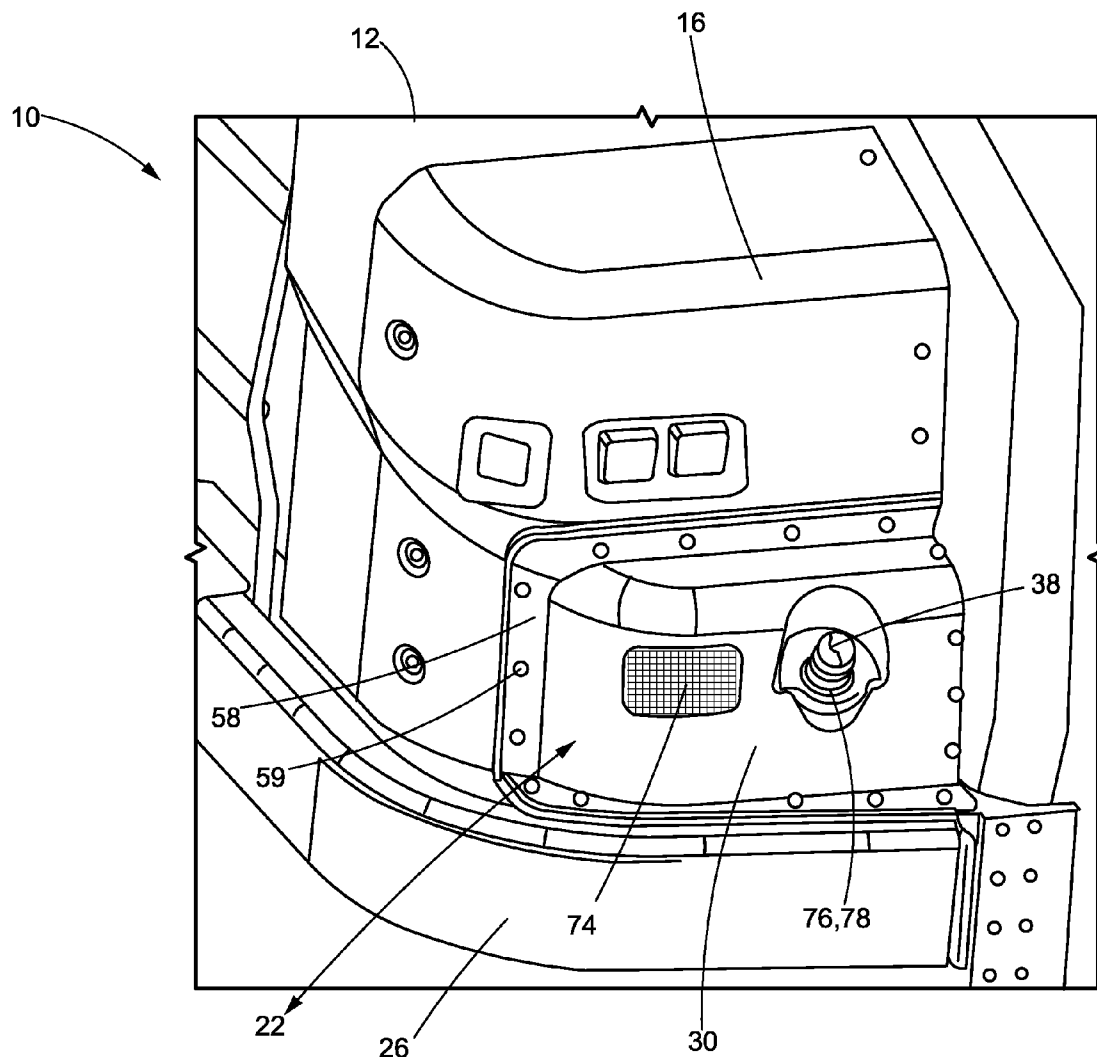




US 20160108793A1

(19) **United States**(12) **Patent Application Publication**
Bezaire et al.(10) **Pub. No.: US 2016/0108793 A1**(43) **Pub. Date: Apr. 21, 2016**(54) **DIESEL EXHAUST FLUID PUMP
ELECTRONICS AND TANK UNIT COOLING****Publication Classification**(71) Applicant: **CATERPILLAR INC.**, Peoria, IL (US)(72) Inventors: **Leon J. Bezaire**, Forsyth, IL (US);
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Chambersburg, PA (US)(73) Assignee: **CATERPILLAR INC.**, Peoria, IL (US)(21) Appl. No.: **14/517,378**(22) Filed: **Oct. 17, 2014**(51) **Int. Cl.**
F01N 13/14 (2006.01)
F01N 3/021 (2006.01)
F01N 3/20 (2006.01)(52) **U.S. Cl.**
CPC **F01N 13/14** (2013.01); **F01N 3/2066**
(2013.01); **F01N 3/021** (2013.01)(57) **ABSTRACT**

A housing for an exhaust fluid pump electronics and tank unit may include a chamber and a deflection flange. The housing may include a removable cover including a vent and a cover flange. The cover flange may be removably coupled to the deflection flange. A duct may be disposed on the housing and capable of fluidly communicating the chamber to a negative pressure source.



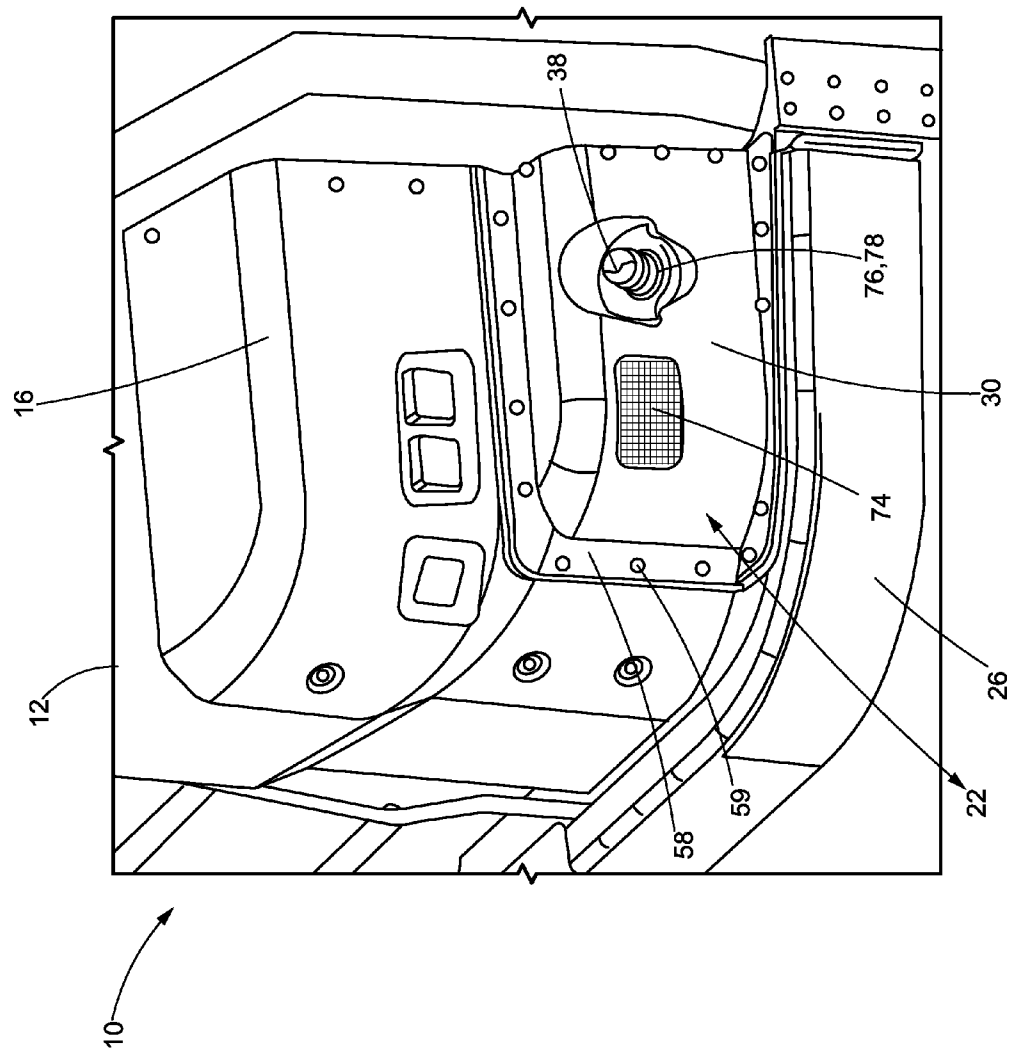


FIG.1

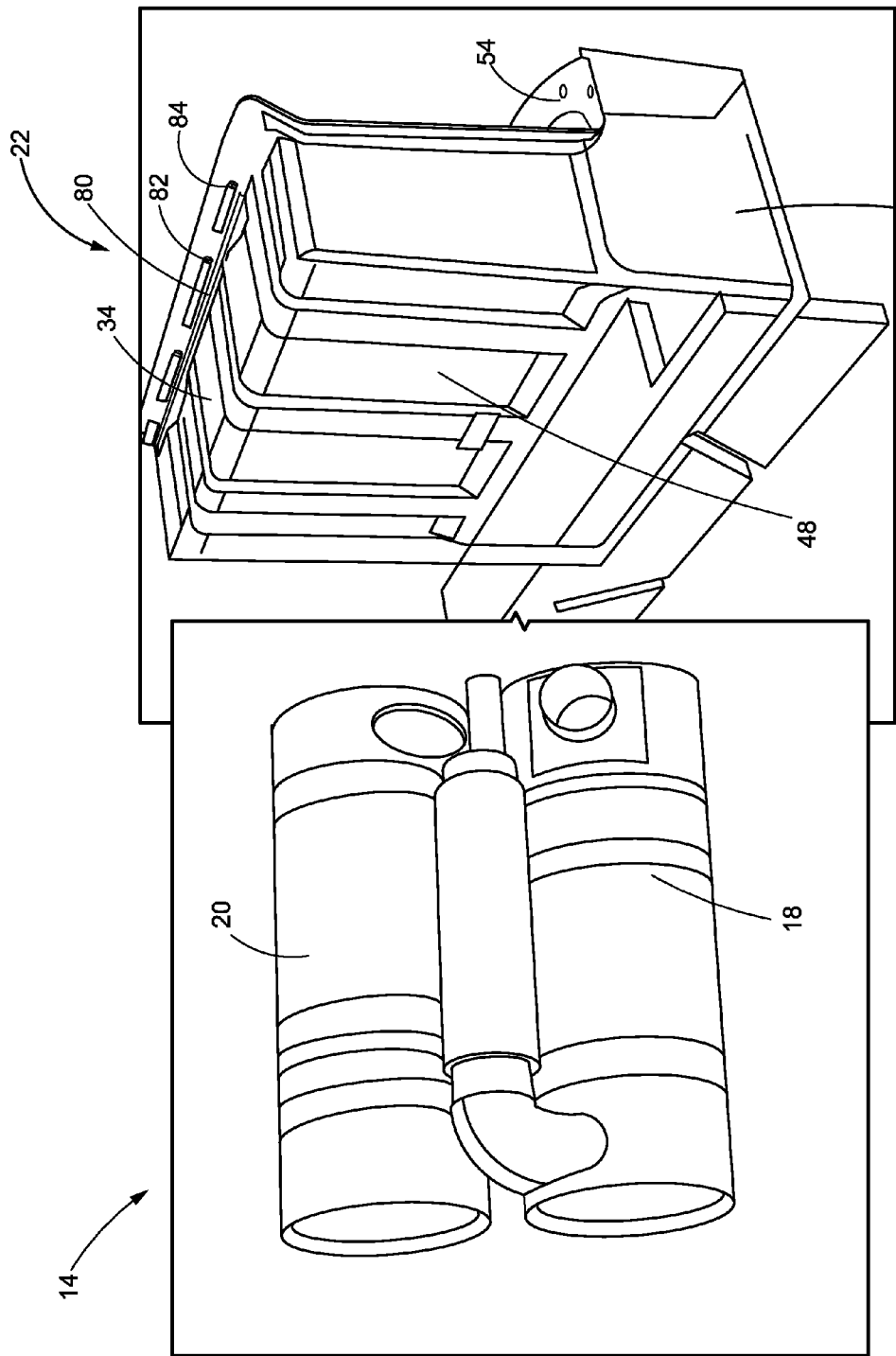


FIG. 2

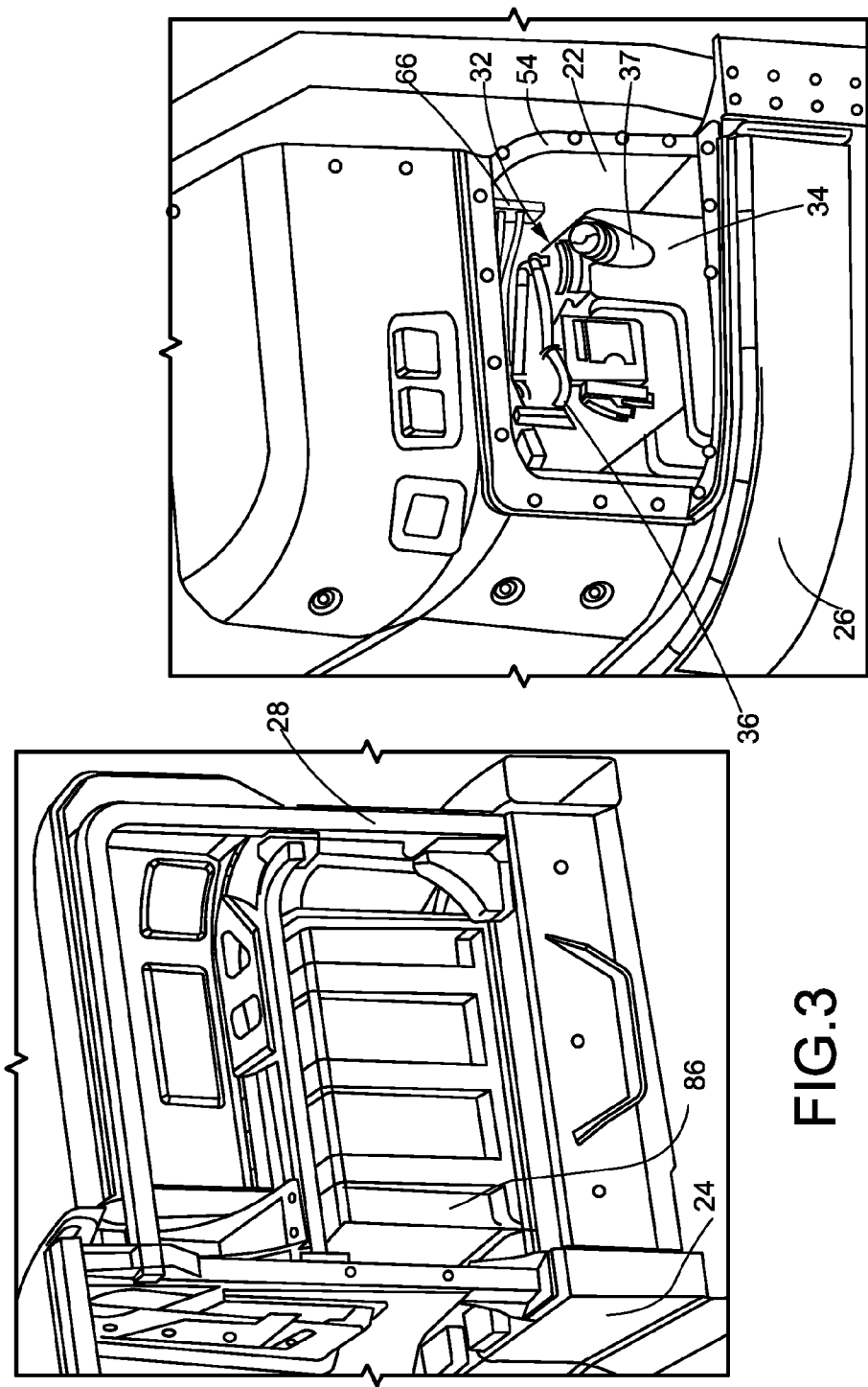
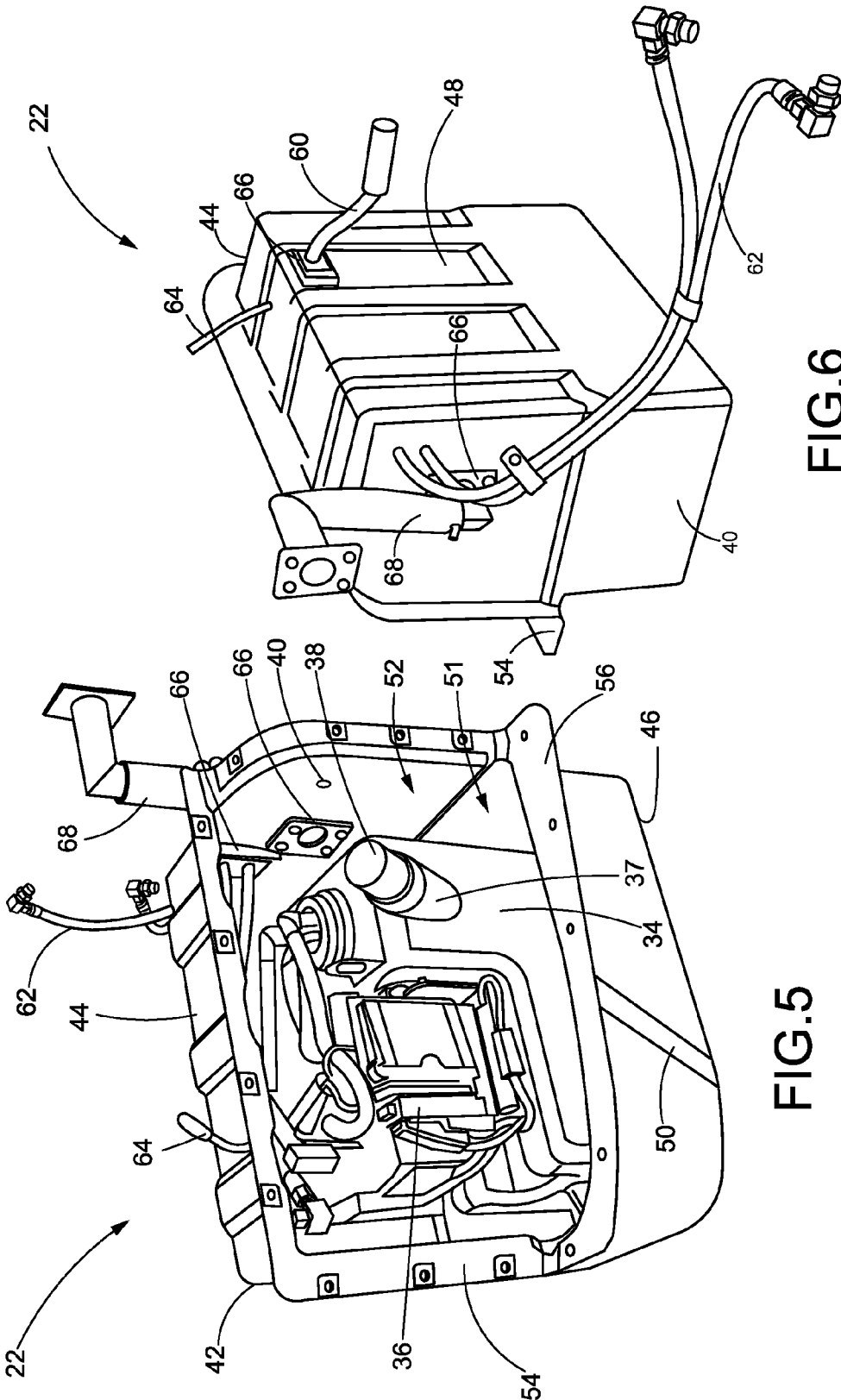


FIG.4

FIG.3



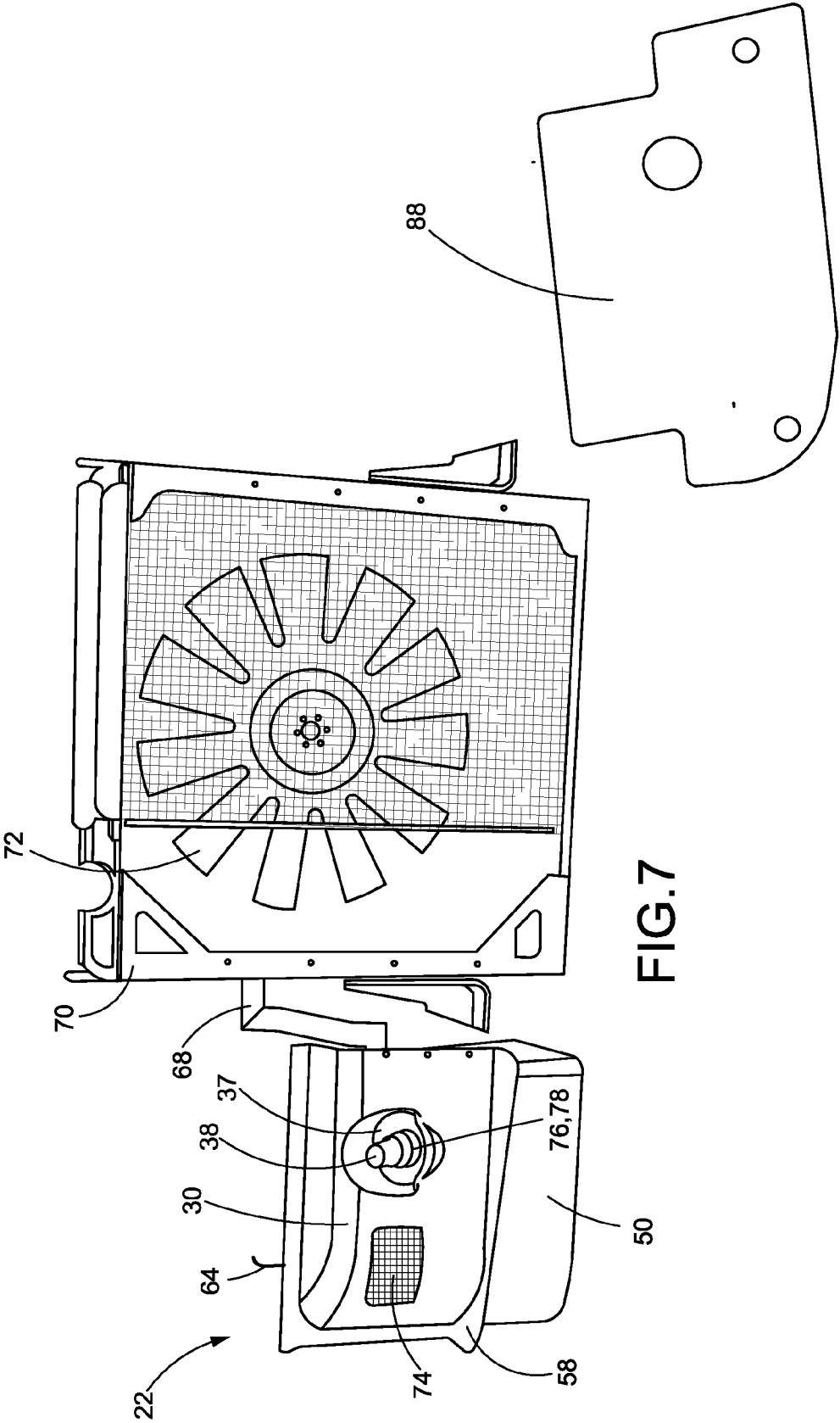


FIG.7

FIG.8

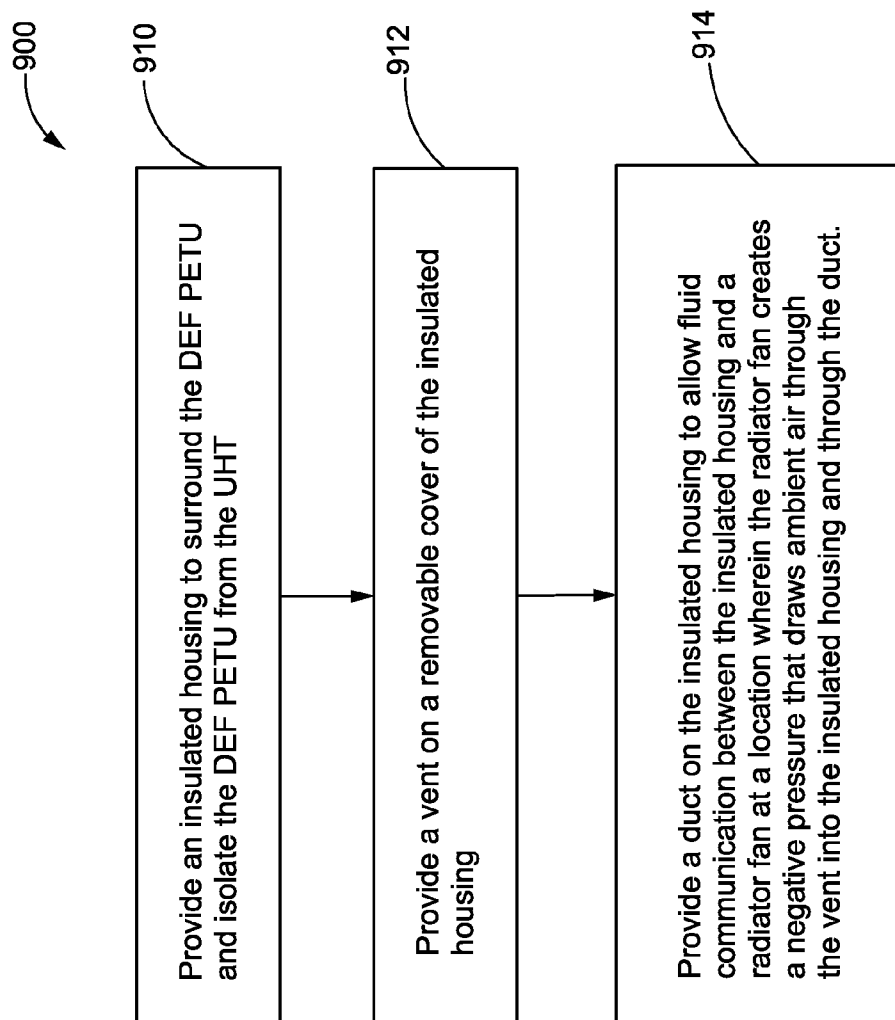


FIG.9

DIESEL EXHAUST FLUID PUMP ELECTRONICS AND TANK UNIT COOLING

TECHNICAL FIELD

[0001] The present disclosure relates generally to diesel-fueled construction vehicles and, more particularly, to diesel exhaust fluid pump electronics and tank units for such vehicles.

BACKGROUND

[0002] Many diesel-fueled vehicles are equipped or retrofitted to utilize selective catalytic reduction (SCR) processes in order to improve diesel exhaust emissions and meet regulations such as Tier 4 Final regulations. Part of the SCR process involves injecting diesel exhaust fluid (DEF), typically a solution of urea and deionized water, as a mist into the high-temperature exhaust stream to reduce NO_x emissions from being released into the atmosphere. In particular, the DEF mist reacts in the exhaust stream to form ammonia and carbon dioxide. The NO_x are catalytically reduced, within the SCR catalyst, by the ammonia into water and nitrogen gas, which are both then released through the vehicle exhaust.

[0003] The DEF is commonly stored in a DEF tank of a DEF pump electronics and tank unit (DEF PETU) located on the diesel-fueled vehicle. For some diesel-fueled vehicles, the DEF PETU is traditionally located underneath an engine hood and proximate to the engine and the clean emissions module (CEM), which may include an SCR module and a diesel particulate filter (DPF) module. The close proximity of the DEF PETU at the CEM is typically required due to maximum distance specifications between the DEF PETU and the DEF injector to the CEM, vehicle space limitations, and mounting and accessing serviceability requirements. The DEF and the electronics unit must operate below a maximum temperature. For example, the DEF degrades faster as it is exposed to higher temperatures and will have no material usability once exposed to its maximum operating temperature. However, the close proximity of the DEF PETU to the CEM and the vehicle engine exposes it to high temperatures in excess of its maximum operating temperature.

[0004] Various approaches have been implemented to reduce or eliminate high temperature exposure to the DEF PETU such as utilizing an electrical motor-powered cooling fan or remotely mounting the DEF PETU in a cooler environment far from the CEM and vehicle engine. While effective, such approaches may incur additional costs like requiring a larger alternator, circuit protection, and controls for the cooling fan, requiring extra labor intensive wiring and piping when remotely mounting the DEF PETU, or requiring extra costs to provide remote fill provisions to fill the tank in an inaccessible location. Accordingly, it is desirable to maintain the DEF PETU in close proximity to the CEM and vehicle engine while isolating it from the high temperatures.

[0005] German Patent Application No. DE102006041108A1 (the '108 application) discloses the implementation of a hood-like element to partially cover a vehicle exhaust system to create a flow channel between the hood-like element and the vehicle exhaust system. While the '108 application introduces air into a partially covered vehicle exhaust system for cooling, it fails to teach isolating and cooling a DEF PETU from high temperatures.

SUMMARY

[0006] In accordance with an aspect of the disclosure, a housing for an exhaust fluid pump electronics and tank unit of a vehicle may include a chamber. The chamber may be formed collectively of a first and a second side wall, an upper wall, a lower wall, an aft wall, and a fore wall. The first and the second side wall, the upper wall, and the fore wall may collectively form an opening. A deflection flange may extend outwardly from each of the first and the second side wall, the upper wall, and the fore wall proximate the opening. A removable cover may include a vent and a cover flange. The cover flange may be removably coupled to the deflection flange. A duct may be disposed on the first side wall. The duct may be capable of fluidly communicating the chamber to a negative pressure source.

[0007] In accordance with another aspect of the disclosure, a diesel-fueled vehicle may include a housing. The housing may be formed collectively of a first and a second side wall, an upper wall, a lower wall, an aft wall, and a fore wall. The first and the second side wall, the upper wall, and the fore wall may collectively form an opening. A deflection flange may extend outwardly from each of the first and the second side wall, the upper wall, and the fore wall proximate the opening. A removable cover may include a vent and a cover flange. The cover flange may be removably coupled to the deflection flange. A diesel exhaust fluid (DEF) pump electronics and tank unit (PETU) may be disposed in the housing. A radiator fan shroud may surround a radiator fan. A duct may couple the housing to the radiator fan shroud at a location wherein the radiator fan creates a negative pressure.

[0008] In accordance with yet another aspect of the disclosure, a method of insulating and cooling a diesel exhaust fluid (DEF) pump electronics and tank unit (PETU) from high temperatures of a diesel-fueled vehicle is provided. The method may entail providing an insulated housing to surround the DEF PETU and isolate the DEF PETU from the high temperatures. Another step may be providing a vent on a removable cover of the insulated housing. Yet another step may be providing a duct on the insulated housing to allow fluid communication between the insulated housing and a radiator fan at a location wherein the radiator fan creates a negative pressure that draws ambient air through the vent into the insulated housing and through the duct.

[0009] Other aspects and features of the disclosed systems and methods will be appreciated from reading the attached detailed description in conjunction with the included drawing figures. Moreover, selected aspects and features of one example embodiment may be combined with various selected aspects and features of other example embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] For further understanding of the disclosed concepts and embodiments, reference may be made to the following detailed description, read in connection with the drawings, wherein like elements are numbered alike, and in which:

[0011] FIG. 1 is a perspective view of a vehicle with portions broken away to show details in accordance with the teachings of the present disclosure;

[0012] FIG. 2 is a perspective view of a housing for a diesel exhaust fluid (DEF) pump electronics and tank unit adjacent a clean emissions module (CEM) of a diesel-fueled vehicle with portions broken away to show details in accordance with the teachings of the present disclosure;

[0013] FIG. 3 is a perspective view of a vehicle illustrating a housing for a DEF PETU with portions of the diesel-fueled vehicle broken away to show details in accordance with the teaching of the present disclosure;

[0014] FIG. 4 is a perspective view of a vehicle illustrating a housing for a DEF PETU with the housing cover removed, constructed in accordance with the teachings of this disclosure;

[0015] FIG. 5 is a detailed perspective view of the housing in FIG. 4, constructed in accordance with the teachings of this disclosure;

[0016] FIG. 6 is a perspective view of the housing in FIG. 5, constructed in accordance with the teachings of this disclosure;

[0017] FIG. 7 is a perspective view of a housing for a DEF PETU in association with a radiator fan of a diesel-fueled vehicle with portion of the vehicle broken away to show details in accordance with the teaching of this disclosure;

[0018] FIG. 8 is a top view of a mat, constructed in accordance with the teachings of this disclosure; and

[0019] FIG. 9 is a flowchart illustrating a sample sequence of steps which may be practiced in accordance with the teachings of this disclosure.

[0020] It is to be noted that the appended drawings illustrate only typical embodiments and are therefore not to be considered limiting with respect to the scope of the disclosure or claims. Rather, the concepts of the present disclosure may apply within other equally effective embodiments. Moreover, the drawings are not necessarily to scale, emphasis generally being placed upon illustrating the principles of certain embodiments.

DETAILED DESCRIPTION

[0021] The present disclosure provides systems and methods for insulating and protecting a diesel exhaust fluid (DEF) pump electronics and tank unit (PETU) from high temperatures. Such systems and methods may also induce cool ambient air to flow across the DEF PETU to further dissipate hot air, such as thermal transfer into the system from hot under hood air, and ensure the DEF PETU environment operates at appropriate working temperatures.

[0022] Referring now to FIGS. 1-3, a vehicle constructed in accordance with the present disclosure is generally referred to by reference numeral 10. The vehicle 10 may be any type of vehicle such as, but not limited to, diesel-fueled vehicles known in the earth-moving, construction and agricultural industries such as, but not limited to, scrapers, loaders, graders, tractors, and dump trucks. The vehicle 10 may include a hood 12 for housing a clean emissions module (CEM) 14 (FIG. 2) and an engine (not shown). The hood 12 may include a removable panel 16 for access to the CEM 14. The CEM 14 may include a selective catalytic reduction (SCR) module 18 and a diesel particulate filter (DPF) module 20 (both shown in FIG. 2). The vehicle 10 may also include an insulated housing 22, which may be coupled to a chassis 24 of the vehicle 10 proximate a vehicle bumper 26. A frame 28 may extend from the chassis 24 to further support the panel 16.

[0023] The insulated housing 22 may include a removable cover 30. As best seen in FIG. 4 with the cover 30 removed, the insulated housing 22 houses a diesel exhaust fluid (DEF) pump electronics and tank unit (PETU) 32. The DEF PETU 32 may be coupled to the housing 22 and may include a DEF tank 34 and a pump and electronics unit 36, which may be coupled to the DEF tank 34. The DEF tank 34 may include a

neck 37 with a removable cap 38, which may be removed in order to fill the DEF tank 34 with DEF.

[0024] With particular reference to FIGS. 5-6, the insulated housing 22 may be formed of first and second side walls 40, 42, an upper wall 44, a lower wall 46, an aft wall 48, and a fore wall 50 collectively defining a chamber 51. The first and second side walls 40, 42, the upper wall 44, and the fore wall 50 may be arranged to form an access opening 52 into the chamber 51 of the insulated housing 22. The insulated housing 22 may be disposed on the diesel-fueled vehicle 10 such that the exterior of the aft wall 48 may face the CEM 14, as shown in FIG. 2. Referring back to FIGS. 5-6, a deflection flange 54 may extend outwardly from each of the first and second side walls 40, 42, the upper wall 44, and the fore wall 50 proximate the access opening 52. The removable cover 30 may include a gasket seal 55 and may be removably coupled to the deflection flange 54. In particular, the deflection flange 54 may be contoured to complementarily receive a cover flange 56 of the removable cover 30 (FIG. 1) such that the cover flange 56, which may include the gasket seal 55, may be coupled in sealable fashion to the deflection flange 54. The removable cover 30 may be coupled to the deflection flange 54 with a plurality of fasteners 58 such as, but not limited to, nut clips, nuts and bolts, or other fasteners known in the industry. A lace trim 59 may be coupled along the edges of the cover flange 56 and may extend from the cover flange 56 such that it seats smoothly against the panel 16 and the vehicle bumper 26. The lace trim 59 may provide an aesthetically appealing look as well as prevent dirt and debris from collecting in a clearance gap between the deflection flange 54 and the panel 16.

[0025] The pump and electronics unit 36 may include a DEF line 60, coolant lines 62, and wiring 64. The DEF line 60 may pass through the aft wall 48 of the insulated housing 22 so that the pump and electronics unit 36 of the DEF PETU 32 is in fluid communication with the SCR module 18 of the CEM 14. The coolant lines 62 may pass through the first side wall 40 of the insulated housing 22 so that the pump and electronics unit 36 is in fluid communication with the engine of the vehicle 10. Similarly, the wiring 64 may pass through the upper wall 44 of the insulated housing 22 so that the pump and electronics unit 36 is in electrical communication with the engine. Although the DEF line 60, the coolant lines 62, and the wiring 64 have been described to pass through specific walls of the insulated housing 22, it should be understood that the lines 60, 62 and the wiring 64 may pass through any wall of the insulated housing 22. Furthermore, each of the lines 60, 62 and the wiring 64 may be sealed to the insulated housing 22 by one or more sealing gland plates 66 to prevent air transfer through any of the apertures disposed on the insulated housing 22 that the lines 60, 62 and the wiring 64 pass through. In particular, the gland plates 66 prevent high temperature air, which may be generated from the vehicle 10 components and has positive pressure, from leaking into the insulated housing 22. The gland plates 66 may be disposed on the interior and/or exterior of the insulated housing 22 while surrounding the outer diameters of the lines 60, 62 and the wiring 64.

[0026] As best seen in FIGS. 5-7, a duct 68 may have one end disposed on the first side wall 40 of the insulated housing 22 and the other end coupled to a negative pressure source such as a radiator fan shroud 70 surrounding a radiator fan 72 of the vehicle 10. The duct 68 may be sealed to the insulated housing 22 by one or more duct sealing gaskets 73, which

may be disposed on the interior and/or exterior of the insulated housing 22. The duct 68 allows for fluid communication between the chamber 51 of the insulated housing 22 and the radiator fan 72.

[0027] With particular reference to FIGS. 1 and 7, the cover 30 may include a vent 74 and an aperture 76 for receiving the neck 37 of the DEF tank 34. A positioning seal 78 may be disposed in the aperture 76 to prevent air from flowing between the neck 37 and the aperture 76. The vent 74 may be, as non-limiting examples, meshed or grilled.

[0028] Referring back to FIG. 2, a bracket 80 may be coupled to the exterior of the upper wall 44 of the insulated housing 22 in such a manner to create a channel 82 between the bracket 80 and the deflection flange 54. The channel 82 may receive the panel 16. The bracket 80 may include bulb seals 84 for gap adjustment when the panel 16 is inserted within the channel 82. The bracket 80 and bulb seals 84 align and locate the panel 16 within the channel 82 relative to the insulated housing 22 and also retain the panel 16 to the insulated housing 22 in compliance with manufacturing, assembly, and part-to-part movement tolerances.

[0029] As illustrated in FIG. 3, the insulated housing 22 may also include an insulating blanket 86 such as, but not limited to, a ceramic wool insulating blanket having a reflective exterior surface and an alkaline silicate blanket. The insulating blanket 86 may surround the exterior of the insulated housing 22 to prevent the insulated housing 22 from exposure to high temperatures. The insulating blanket 86 may cover the first and second side walls 40, 42, the upper wall 44, and the aft wall 48 of the insulated housing 22.

[0030] An elastomeric mat 88, such as rubber or other resilient material, as illustrated in FIG. 8, may be disposed between the interior of the lower wall 46 of the insulated housing 22 and the DEF tank 34 to cushion and minimize movement of the DEF tank 34.

[0031] FIG. 9 illustrates a flowchart 900 of a sample sequence of steps which may be performed to insulate and cool a diesel exhaust fluid (DEF) pump electronics and tank unit (PETU) from high temperatures of a diesel-fueled vehicle. Box 910 shows the step of providing an insulated housing to surround the DEF PETU and isolate the DEF PETU from the high temperature. Another step, as illustrated in box 912, may be providing a vent on a removable cover of the insulated housing. As illustrated in box 914, another step may be providing a duct on the insulated housing to allow fluid communication between the insulated housing and a radiator fan at a location wherein the radiator fan creates a negative pressure that draws ambient air through the vent into the insulated housing and through the duct. Another step may be providing an insulating blanket around the insulated housing. Yet another step may be providing a deflection flange on the insulated housing to redirect a hot air flow away from the insulated housing. A further step may be providing at least one gland plate to seal at least one line to the insulated housing wherein the at least one line provides communication between the DEF PETU and a vehicle component.

[0032] While the present disclosure has shown and described details of exemplary embodiments, it will be understood by one skilled in the art that various changes in detail may be effected therein without departing from the spirit and scope of the disclosure as defined by claims supported by the written description and drawings. Further, where these exemplary embodiments (and other related derivations) are described with reference to a certain number of elements it

will be understood that other exemplary embodiments may be practiced utilizing either less than or more than the certain number of elements.

INDUSTRIAL APPLICABILITY

[0033] Based on the foregoing, it can be seen that the present disclosure sets forth systems and methods for insulating and protecting DEF PETU from high temperatures as well as inducing cool ambient air to flow across the DEF PETU to further dissipate hot air from the system and ensure the DEF PETU environment operates at appropriate working temperatures.

[0034] During vehicle 10 operation, high temperatures are generated underneath the hood 12 from various vehicle 10 components such as the SCR module 18, the DPF module 20, the radiator fan 72, and the engine. On account of the DEF PETU 32 being housed in the insulated housing 22 with the cover 30 sealed thereto and the insulating blanket 86 surrounding the insulated housing 22, the DEF PETU 32 is insulated from such high temperatures. In particular, any conductive heat from the chassis 24, convective heat from the radiator fan 72, and radiant heat from the SCR module 18 and DPF module 20 is prevented from transferring into the housing 22 and to the DEF PETU 32 housed therein. The deflection flange 54 further outwardly deflects any hot air leakage that may escape from under the hood 12 due to a possible incomplete seal between the housing 22 and the panel 16 and thus may redirect the hot air leakage away from the access opening 52. The insulating blanket 86, which may surround the housing 22, further insulates the DEF PETU 32 from exposure to the hot under hood air. Moreover, the sealing gland plates 66 seal the DEF line 60, the coolant lines 62, and the wiring 64 to the insulated housing 22 to seal and prevent hot air leakage from the CEM 14 and vehicle 10 engine entering into the insulated housing 22.

[0035] The duct 68 is coupled to the radiator fan shroud 70 at a location where a negative pressure is created between the radiator fan shroud 70 and the blades of the radiator fan 72. Consequently, the negative pressure provides suction to the housing 22 such that ambient air is drawn through the vent 74 into the housing 22 and across the DEF PETU 32. The ambient air is then vacuumed through the duct 68 and out to the radiator fan 72 so as to remove any heat gains within the housing 22. The introduction of cool ambient air into the housing 22 and removal of any hot air from the housing 22 provides an environment in which the DEF tank 34 and the pump and electronics unit 36 operate at appropriate working temperatures.

[0036] Moreover, the teachings of this disclosure may be employed so that the DEF PETU 32 may be disposed in close proximity to the CEM 14 and vehicle 10 engine, which is desired due to distance requirements between the DEF PETU 32 and the CEM 14, space availability on the vehicle 10, and access ability of the DEF PETU 32 for refilling, while also being isolated from the high temperatures and further cooled to appropriate operating temperatures. The ability to remove the removable cover 30 from the insulated housing 22 provides accessibility to the DEF PETU 32 to service and maintain components. Additionally, the access opening 52 of the insulated housing 22 may be sized so that the DEF PETU 32 may be installed as a complete assembly, which reduces vehicle assembly time and labor costs. As the lace trim 59 of the removable cover 30 may seat smoothly against the panel 16 and the vehicle bumper 26, an aesthetically appealing look

is provided as well as assurance that dirt and debris are prevented from collecting therebetween.

What is claimed is:

1. A housing for an exhaust fluid pump electronics and tank unit of a vehicle, the housing comprising:

a chamber formed collectively of a first and a second side wall, an upper wall, a lower wall, an aft wall, and a fore wall, the first and the second side wall, the upper wall, and the fore wall collectively forming an opening;

a deflection flange extending outwardly from each of the first and the second side wall, the upper wall, and the fore wall proximate the opening;

a removable cover including a vent and a cover flange, the cover flange removably coupled to the deflection flange; and

a duct disposed on the first side wall, the duct capable of fluidly communicating the chamber to a negative pressure source.

2. The housing of claim 1, further including a ceramic wool insulating blanket surrounding the first and the second side wall, the upper wall, and the aft wall.

3. The housing of claim 1, wherein the cover flange includes a gasket.

4. The housing of claim 1, further including at least one gland plate disposed on one of the first and the second side wall, the upper wall, and the aft wall.

5. The housing of claim 1, wherein the removable cover includes an aperture for receiving a neck of a diesel exhaust fluid (DEF) tank.

6. A diesel-fueled vehicle, the vehicle comprising:

a housing formed collectively of a first and a second side wall, an upper wall, a lower wall, an aft wall, and a fore wall, the first and the second side wall, the upper wall, and the fore wall collectively forming an opening;

a deflection flange extending outwardly from each of the first and the second side wall, the upper wall, and the fore wall proximate the opening;

a removable cover including a vent and a cover flange, the cover flange removably coupled to the deflection flange; a diesel exhaust fluid (DEF) pump electronics and tank unit (PETU) disposed in the housing;

a radiator fan shroud surrounding a radiator fan; and a duct coupling the housing to the radiator fan shroud at a location wherein the radiator fan creates a negative pressure.

7. The vehicle of claim 6, further including a ceramic wool insulating blanket surrounding the housing.

8. The vehicle of claim 6, further including a clean emissions module (CEM) disposed proximate the housing.

9. The vehicle of claim 8, further including a DEF line disposed through the housing and connecting the DEF PETU in fluid communication with the CEM.

10. The vehicle of claim 9, wherein the DEF line is sealed to the housing with at least one gland plate.

11. The vehicle of claim 6, further including a bracket coupled to the housing wherein a channel is defined between the bracket and the deflection flange, the channel receiving a panel.

12. The vehicle of claim 6, further including coolant lines disposed through the housing and connecting the DEF PETU in fluid communication with an engine of the vehicle, the coolant lines sealed to the housing with at least one gland plate.

13. The vehicle of claim 6, further including a wiring disposed through the housing and connecting the DEF PETU in electrical communication with an engine of the vehicle, the wiring sealed to the housing with at least one gland plate.

14. The vehicle of claim 6, further including an elastomeric mat disposed between the lower wall of the housing and the DEF PETU.

15. The vehicle of claim 6, wherein the cover flange includes a gasket.

16. The vehicle of claim 6, wherein the removable cover includes an aperture for receiving a neck of the DEF PETU, the aperture including a positioning seal.

17. A method of insulating and cooling a diesel exhaust fluid (DEF) pump electronics and tank unit (PETU) from high temperatures of a diesel-fueled vehicle, the method comprising:

providing an insulated housing to surround the DEF PETU and isolate the DEF PETU from the high temperatures; providing a vent on a removable cover of the insulated housing; and

providing a duct on the insulated housing to allow fluid communication between the insulated housing and a radiator fan at a location wherein the radiator fan creates a negative pressure that draws ambient air through the vent into the insulated housing and through the duct.

18. The method of claim 17, further including providing a ceramic wool insulating blanket around the insulated housing.

19. The method of claim 17, further including providing a deflection flange on the insulated housing to redirect a hot air flow away from the insulated housing.

20. The method of claim 17, further including providing at least one gland plate to seal at least one line to the insulated housing, the at least one line communicating between the DEF PETU and a vehicle component.

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