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(54) SYSTEM AND METHOD FOR EMPTYING A TALL OIL STORAGE TANK

(57) The present invention relates to a system and a method for emptying a tall oil storage tank (101). The system comprises a container (102) having an inlet port (103) for receiving tall oil into the container (102) and an outlet port (104) for removing tall oil from the container (102), means (111) for generating suction, said means (111) being connected to a suction port (110) of the

container (102), a suction hose (105) having a first end and a second end, the first end being arrangeable inside the tall oil storage tank (101) and the second end being connected to the inlet port (103) of the container (102), and means (109) for heating tall oil inside the tall oil storage tank (101).

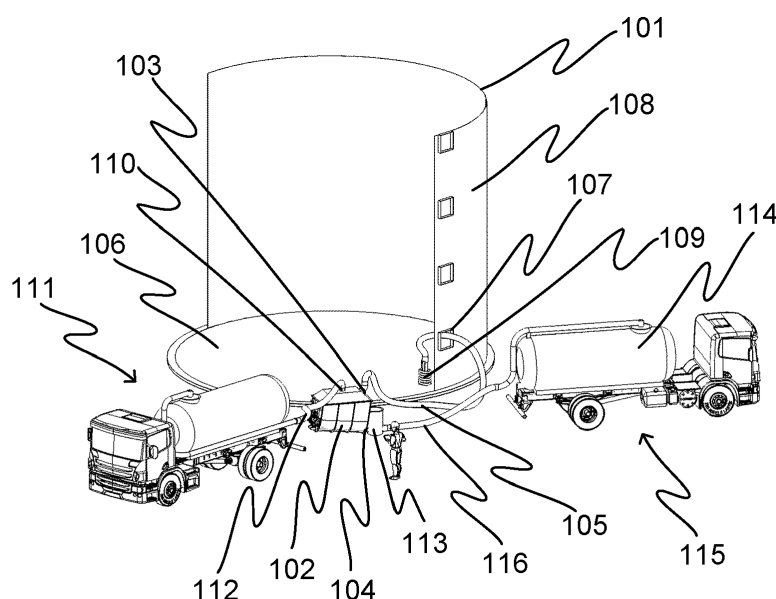


Fig. 1

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Description

TECHNICAL FIELD OF THE INVENTION

[0001] The present invention relates to a system and a method for emptying a tall oil storage tank according to the preambles of the appended independent claims.

BACKGROUND OF THE INVENTION

[0002] Tall oil is a by-product of the pulp and paper industry. In the pulping process, tall oil is isolated from acidified skimming of partially concentrated black liquor. The collected tall oil can be refined to be used in various products such as paints, adhesives, lubricants, and coatings to replace the traditionally used fossil-based substances.

[0003] Tall oil is stored in a tall oil storage tank, which needs to be cleaned from time to time. Before the actual cleaning process, the tall oil storage tank must be emptied from the tall oil. A problem is that some of the tall oil is typically congealed at the bottom of the tall oil storage tank. A known method for the removal of this congealed tall oil is to use steam to liquefy the congealed tall oil. A problem of the use of steam is, however, that because water is mixed with the tall oil, the removed tall oil cannot be exploited without extensive further processing, and thus the removed tall oil usually goes to waste. Another problem is that, because of the added water, the volume of the waste is large and thus its handling is both time-consuming and expensive.

OBJECTIVES OF THE INVENTION

[0004] It is the main objective of the present invention to reduce or even eliminate the prior art problems presented above.

[0005] It is an objective of the present invention to provide a system and a method for emptying a tall oil storage tank. In more detail, it is an objective of the invention to provide a system and a method enabling the removal of congealed tall oil from a tall oil storage tank in such a manner that the removed tall oil can be exploited without further processing and thus it does not go to waste. It is also an objective of the invention to provide a system and a method enabling the removal of congealed tall oil from a tall oil storage tank in an easy and effective manner.

[0006] In order to realise the above-mentioned objectives, the system and the method according to the invention are characterised by what is presented in the characterising portions of the appended independent claims. Advantageous embodiments of the invention are described in the dependent claims.

DESCRIPTION OF THE INVENTION

[0007] A system according to the invention for empty-

ing a tall oil storage tank comprises a container having an inlet port for receiving tall oil into the container and an outlet port for removing tall oil from the container, means for generating suction, said means being connected to a suction port of the container, a suction hose having a first end and a second end, the first end of the suction hose being arrangeable inside the tall oil storage tank and the second end of the suction hose being connected to the inlet port of the container, and means for heating tall oil inside the tall oil storage tank.

[0008] The system according to the invention can be used for emptying a tall oil storage tank that contains tall oil. The system according to the invention is especially suitable for the removal of congealed tall oil from a bottom of the tall oil storage tank. In this text, tall oil encompasses crude tall oil as well as refined tall oil.

[0009] The container is used as an intermediate container for the tall oil that has been removed from the tall oil storage tank. From the container the tall oil can be transferred to another container such as to a container of a suction vehicle. The tall oil is received into the container through the inlet port and removed from the container through the outlet port. The suction that is needed for sucking tall oil from the tall oil storage tank into the container is provided to the system through the suction port of the container. Preferably, the inlet port and the suction port are in an upper part of the container, and the outlet port is in a lower part of the container. The bottom of the container is preferably tilted towards the outlet port. The inlet port, the outlet port and the suction port of the container can be provided with valves that can be operated manually or by using actuators. The actuators can be controlled with a control unit. The container is preferably made of acid-resistant steel. The volume of the container can be, for example, 1-5 m³, 5-10 m³, 10-20 m³, or 1-20 m³.

[0010] The means for generating suction is connected to the suction port of the container and configured to produce the suction that is needed for sucking tall oil from the tall oil storage tank into the container. Preferably, the amount of suction can be controlled, for example, with a control unit. The means for generating suction may comprise a suction pump that is connected to the suction port of the container with a hose. The suction pump can be a suction pump of a suction vehicle.

[0011] Tall oil is sucked from the tall oil storage tank into the container through the suction hose. The first end of the suction hose is meant to be arranged inside the tall oil storage tank and preferably at the bottom of the tall oil storage tank. The suction hose can be led into the tall oil storage tank through a hatch that is arranged on the sidewall of the tall oil storage tank. The tall oil storage tank may comprise a plurality of hatches at different heights on the sidewall. The second end of the suction hose is connected to the inlet port of the container. The suction hose can be made of, for example, rubber or plastic, and it can have a spiral steel wire reinforcement. The length of the suction hose can be, for example, 10-50

m. The inner diameter of the suction hose can be, for example, 10-15 cm.

[0012] The means for heating tall oil inside the tall oil storage tank is preferably arranged in connection with the first end of the suction hose, and more preferably it is attached to the first end of the suction hose. By using the heating means, the congealed tall oil inside the tall oil storage tank can be liquefied so that the tall oil can be sucked through the suction hose into the container. The means for heating tall oil inside the tall oil storage tank can be configured to heat the tall oil to a temperature of at least 60 °C, preferably to a temperature of at least 65 °C, and more preferably to a temperature of at least 70 °C.

[0013] The means for heating tall oil inside the tall oil storage tank is configured to heat tall oil without the tall oil being contaminated by any fluid such as water. The means for heating tall oil inside the tall oil storage tank comprises a heat transfer element through which heat is transferred from a heat source to the tall oil by conduction. A suitable heat source can be, for example, heated liquid or gas, or an electrical heating element that converts electrical energy into heat. Preferably, (water) steam is used as a heat source. The temperature of the steam can be, for example, 120-215 °C.

[0014] The means for heating tall oil inside the tall oil storage tank may comprise a pipe coil that is arranged around the first end of the suction hose. The pipe coil can be connected to a steam source or a heating unit with hoses. The heating unit is configured to heat liquid or gas and to circulate the heated liquid or gas through the pipe coil.

[0015] The means for heating tall oil inside the tall oil storage tank may comprise an electrical heating unit that is attached to the first end of the suction hose. The electrical heating unit comprises one or more electrical heating elements that convert electrical energy into heat. The electrical heating unit can be electrically connected to a power supply that supplies electrical energy to the electrical heating element(s).

[0016] The system for emptying a tall oil storage tank may comprise a control unit for controlling the operation of various components of the system. Especially the control unit can be configured to control the means for generating suction and the means for heating tall oil inside the tall oil storage tank.

[0017] An advantage of the system according to the invention is that it enables the removal of congealed tall oil from a tall oil storage tank in such a manner that the removed tall oil can be exploited without further processing and thus it does not go to waste. Another advantage of the system according to the invention is that it enables the removal of congealed tall oil from a tall oil storage tank in an easy and effective manner.

[0018] According to an embodiment of the invention the means for heating tall oil inside the tall oil storage tank comprises a pipe coil arranged around the first end of the suction hose. The pipe coil is preferably attached to the first end of the suction hose. The means for heating tall oil

inside the tall oil storage tank may comprise a heating unit that is connected to the pipe coil with hoses. The heating unit is configured to heat liquid or gas and to circulate the heated liquid or gas through the pipe coil. In the pipe coil, heat is transferred from the liquid or gas to the tall oil inside the tall oil storage tank. Alternatively, the pipe coil can be connected with hoses to a steam source that can be available at a factory. The number of turns in the pipe coil can be, for example, 2-10, or 4-8. The pipe coil can be made of, for example, acid-resistant steel.

[0019] According to an embodiment of the invention the means for heating tall oil inside the tall oil storage tank comprises an electrical heating unit attached to the first end of the suction hose. The electrical heating unit comprises one or more electrical heating elements that convert electrical energy into heat. The means for heating tall oil inside the tall oil storage tank may comprise a power supply that is electrically connected to the electrical heating unit and configured to supply electrical energy to the electrical heating element(s).

[0020] According to an embodiment of the invention the system comprises a grinder screw and/or a rotating brush arranged in connection with the first end of the suction hose. The grinder screw and/or the rotating brush are preferably attached to the first end of the suction hose. The grinder screw and the rotating brush can release congealed tall oil from the bottom of the tall oil storage tank.

[0021] According to an embodiment of the invention the system comprises means for heating tall oil inside the container. The heating means is used to heat the tall oil inside the container so that it stays in a liquid form. The means for heating tall oil inside the container can be configured to keep the tall oil at a temperature of at least 60 °C, preferably at a temperature of at least 65 °C, and more preferably at a temperature of at least 70 °C.

[0022] The means for heating tall oil inside the container is configured to heat tall oil without the tall oil being contaminated by any fluid such as water. The means for heating tall oil inside the container comprises a heat transfer element through which heat is transferred from a heat source to the tall oil by conduction. A suitable heat source can be, for example, heated liquid or gas, or an electrical heating element that converts electrical energy into heat. Preferably, steam is used as a heat source. The system for emptying a tall oil storage tank may comprise a control unit that is configured to control the means for heating tall oil inside the container.

[0023] According to an embodiment of the invention the means for heating tall oil inside the container comprises a piping arranged at the bottom of the container. The means for heating tall oil inside the container may comprise a heating unit that is connected to the piping with hoses. The heating unit is configured to heat liquid or gas and to circulate the heated liquid or gas through the piping. In the piping, heat is transferred from the liquid or gas to the tall oil inside the container. Alternatively, the piping can be connected with hoses to a steam source

that can be available at a factory. The piping can be made of, for example, acid-resistant steel.

[0024] According to an embodiment of the invention the means for heating tall oil inside the container comprises an electrical heating unit arranged at the bottom of the container. The electrical heating unit comprises one or more electrical heating elements that convert electrical energy into heat. The means for heating tall oil inside the container may comprise a power supply that is electrically connected to the electrical heating unit and configured to supply electrical energy to the electrical heating element(s).

[0025] According to an embodiment of the invention the system comprises a mixing screw arranged inside the container. The mixing screw is preferably arranged at the bottom of the container. The mixing screw is used for mixing tall oil to keep it in a liquid form. The mixing screw comprises a shaft to an end of which is connected an electric motor with a suitable coupling that allows the electric motor to be arranged outside the container. The electric motor can preferably rotate the mixing screw in both directions. The rotational speed of the mixing screw is preferably adjustable, and it can be adjusted, for example, based on the temperature of the tall oil inside the container. The rotational speed can be, for example, 20-100 rpm. The system for emptying a tall oil storage tank may comprise a control unit that is configured to control the electric motor.

[0026] According to an embodiment of the invention the system comprises a temperature sensor arranged inside the container. The temperature sensor is preferably arranged at the bottom of the container. The temperature sensor is used for measuring the temperature of tall oil inside the container. The temperature value can be utilised in controlling the heating of tall oil in the container and the tall oil storage tank as well as adjusting the rotational speed of the mixing screw.

[0027] According to an embodiment of the invention the system comprises a safety valve attached to the container to relief pressure when the pressure inside the container exceeds a predetermined threshold.

[0028] According to an embodiment of the invention the system comprises a grinder pump having an input and an output, the input of the grinder pump being connected to the outlet port of the container. The grinder pump is used for pumping tall oil away from the container. The input of the grinder pump can be connected directly or with a hose to the outlet port of the container. The output of the grinder pump can be connected to a container of a suction vehicle with a hose.

[0029] According to an embodiment of the invention the output of the grinder pump is selectively connected to another container or to a circulation port of the container. The grinder pump can be used for pumping tall oil from the container either to another container or back to the container. The selection can be done manually or with a suitable component such as a three-way valve having one input and two outputs. The input of the three-way

valve is connected to the output of the grinder pump, one of the outputs is connected to another container, and the other output is connected to the circulation port. The three-way valve is preferably operated by using an actuator, which can be controlled with a control unit. Another container can be a container of a suction vehicle.

[0030] The circulation port of the container is preferably located in an upper part of the container. The circulation port can be provided with a valve that can be operated manually or by using an actuator. The actuator can be controlled with a control unit. In some cases, the inlet port of the container can be used as the circulation port.

[0031] According to an embodiment of the invention the means for generating suction comprises a suction vehicle having a suction pump that is connected to the suction port of the container. The suction pump is connected to the suction port with a hose.

[0032] The present invention also relates to a method for emptying a tall oil storage tank by using a system according to the invention. The method according to the invention comprises the steps of arranging the first end of the suction hose inside the tall oil storage tank, heating the tall oil inside the tall oil storage tank, and sucking tall oil from the tall oil storage tank into the container by generating suction in the container.

[0033] An advantage of the method according to the invention is that congealed tall oil can be removed from a tall oil storage tank in such a manner that the removed tall oil can be exploited without further processing and thus it does not go to waste. Another advantage of the method according to the invention is that congealed tall oil can be removed from a tall oil storage tank in an easy and effective manner.

[0034] According to an embodiment of the invention the first end of the suction hose is arranged at a bottom of the tall oil storage tank.

[0035] According to an embodiment of the invention the tall oil inside the tall oil storage tank is heated to a temperature of at least 60 °C. The tall oil inside the tall oil storage tank is heated preferably to a temperature of at least 65 °C, and more preferably to a temperature of at least 70 °C.

[0036] The exemplary embodiments of the invention presented in this text are not interpreted to pose limitations to the applicability of the appended claims. The verb "to comprise" is used in this text as an open limitation that does not exclude the existence of also unrecited features. The features recited in the dependent claims are mutually freely combinable unless otherwise explicitly stated.

BRIEF DESCRIPTION OF THE DRAWINGS

[0037]

Fig. 1 illustrates a system according to an embodiment of the invention for emptying a tall oil sto-

- rage tank,
- fig. 2 illustrates a cross-sectional view of an exemplary container,
- fig. 3 illustrates an exemplary suction hose with heating means, and
- fig. 4 illustrates an arrangement for circulating tall oil.

DETAILED DESCRIPTION OF THE DRAWINGS

[0038] The same reference signs are used of the same or like components in different embodiments.

[0039] Fig. 1 illustrates a system according to an embodiment of the invention for emptying a tall oil storage tank 101. The tall oil storage tank 101 is shown in fig. 1 in cross-section.

[0040] The system comprises a container 102 that is used as an intermediate container for the tall oil that has been removed from the tall oil storage tank 101. The container 102 comprises an inlet port 103 through which tall oil is received into the container 102 and an outlet port 104 through which tall oil is removed from the container 102. The inlet port 103 is in an upper part of the container 102, and the outlet port 104 is in a lower part of the container 102.

[0041] Tall oil is conveyed from the tall oil storage tank 101 into the container 102 through a suction hose 105. A first end of the suction hose 105 is arranged at a bottom 106 of the tall oil storage tank 101. The suction hose 105 is led into the tall oil storage tank 101 through a hatch 107 that is on a sidewall 108 of the tall oil storage tank 101. A second end of the suction hose 105 is connected to the inlet port 103 of the container 102.

[0042] A pipe coil 109 is arranged around and attached to the first end of the suction hose 105. A steam source (not shown in fig. 1) is connected to the pipe coil 109 and configured to convey steam inside the pipe coil 109. The pipe coil 109 heats the tall oil at the bottom 106 of the tall oil storage tank 101 so that the tall oil can be sucked through the suction hose 105 into the container 102.

[0043] The container 102 has a suction port 110 to which is connected a suction pump (not shown in fig. 1) of a suction vehicle 111 with a hose 112. The suction pump generates suction that is used for sucking tall oil from the tall oil storage tank 101 through the suction hose 105 into the container 102. The suction port 110 is in the upper part of the container 102.

[0044] The system comprises a grinder pump 113 for pumping tall oil away from the container 102. An input of the grinder pump 113 is connected to the outlet port 104 of the container 102. An output of the grinder pump 113 is connected to a container 114 of a suction vehicle 115 with a hose 116.

[0045] Fig. 2 illustrates a cross-sectional view of an exemplary container. The container 102 is used as an

intermediate container for tall oil. The container 102 comprises an inlet port 103 through which tall oil can be received into the container 102 and an outlet port 104 through which tall oil can be removed from the container 102. A bottom 117 of the container 102 is tilted towards the outlet port 104. The container 102 comprises a suction port 110 through which the suction that is needed for sucking tall oil into the container 102 is provided. The inlet port 103 and the suction port 110 are in an upper part of the container 102, and the outlet port 104 is in a lower part of the container 102.

[0046] Inside the container 102, there is a piping 118 that is used for heating tall oil. When steam is conveyed inside the piping 118, heat is transferred from the steam through the wall of the piping 118 to the tall oil. Inside the container 102, there is also a mixing screw 119 that is used for mixing tall oil. The mixing screw 119 comprises a shaft 120 to which is attached a plurality of paddles 121. An electric motor 122 is attached to an end of the shaft 120 with a coupling 123 that allows the electric motor 122 to be arranged outside the container 102. The electric motor 122 can rotate the mixing screw 119 in both directions with adjustable rotational speed. Heating and mixing of the tall oil inside the container 102 enable to keep the tall oil in a liquid form.

[0047] Fig. 3 illustrates an exemplary suction hose with heating means. In fig. 3, there is shown a suction hose 105 to an end of which is attached a pipe coil 109 with an attachment plate 124. The pipe coil 109 is arranged around the end of the suction hose 105. Ends of the pipe coil 109 are connected to hoses 125 and 126 that can be connected to a steam source (not shown in fig. 3). When the pipe coil 109 is arranged in contact with tall oil and steam is conveyed inside the pipe coil 109, heat is transferred from the steam through the wall of the pipe coil 109 to tall oil.

[0048] Fig. 4 illustrates an arrangement for circulating tall oil. The arrangement comprises a container 102 that is used as an intermediate container for tall oil that has been removed from a tall oil storage tank 101. The container 102 comprises an inlet port 103 through which tall oil can be received into the container 102 and an outlet port 104 through which tall oil can be removed from the container 102. The inlet port 103 is in an upper part of the container 102, and the outlet port 104 is in a lower part of the container 102.

[0049] The arrangement comprises a grinder pump 113. An input of the grinder pump 113 is connected to the outlet port 104 of the container 102 with a hose 127, and an output of the grinder pump 113 is connected the inlet port 103 of the container 102 with a hose 128. The grinder pump 113 can circulate tall oil by pumping tall oil from the container 102 through the hoses 127 and 128 back to the container 102, which enables to keep the tall oil in a liquid form.

[0050] Only advantageous exemplary embodiments of the invention are described in the figures. It is clear to a person skilled in the art that the invention is not restricted

only to the examples presented above, but the invention may vary within the limits of the claims presented hereafter. Some possible embodiments of the invention are described in the dependent claims, and they are not to be considered to restrict the scope of protection of the invention as such.

Claims

1. A system for emptying a tall oil storage tank, **characterised in that** the system comprises:

- a container having an inlet port for receiving tall oil into the container and an outlet port for removing tall oil from the container,
- means for generating suction, said means being connected to a suction port of the container,
- a suction hose having a first end and a second end, the first end of the suction hose being arrangeable inside the tall oil storage tank and the second end of the suction hose being connected to the inlet port of the container, and
- means for heating tall oil inside the tall oil storage tank.

2. The system according to claim 1, **characterised in that** the means for heating tall oil inside the tall oil storage tank comprises a pipe coil arranged around the first end of the suction hose.

3. The system according to claim 1 or 2, **characterised in that** the means for heating tall oil inside the tall oil storage tank comprises an electrical heating unit attached to the first end of the suction hose.

4. The system according to any of the preceding claims, **characterised in that** the system comprises a grinder screw and/or a rotating brush arranged in connection with the first end of the suction hose.

5. The system according to any of the preceding claims, **characterised in that** the system comprises means for heating tall oil inside the container.

6. The system according to claim 5, **characterised in that** the means for heating tall oil inside the container comprises a piping arranged at the bottom of the container.

7. The system according to claim 5 or 6, **characterised in that** the means for heating tall oil inside the container comprises an electrical heating unit arranged at the bottom of the container.

8. The system according to any of the preceding claims, **characterised in that** the system comprises

a mixing screw arranged inside the container.

9. The system according to any of the preceding claims, **characterised in that** the system comprises a temperature sensor arranged inside the container.

10. The system according to any of the preceding claims, **characterised in that** the system comprises a safety valve attached to the container to relief pressure when the pressure inside the container exceeds a predetermined threshold.

11. The system according to any of the preceding claims, **characterised in that** the system comprises a grinder pump having an input and an output, the input of the grinder pump being connected to the outlet port of the container.

12. The system according to claim 11, **characterised in that** the output of the grinder pump is selectively connected to another container or to a circulation port of the container.

13. The system according to any of the preceding claims, **characterised in that** the means for generating suction comprises a suction vehicle having a suction pump that is connected to the suction port of the container.

14. A method for emptying a tall oil storage tank using a system according to any of the preceding claims, **characterised in that** the method comprises:

- arranging the first end of the suction hose inside the tall oil storage tank,
- heating the tall oil inside the tall oil storage tank, and
- sucking tall oil from the tall oil storage tank into the container by generating suction in the container.

15. The method according to claim 14, **characterised in that** the first end of the suction hose is arranged at a bottom of the tall oil storage tank.

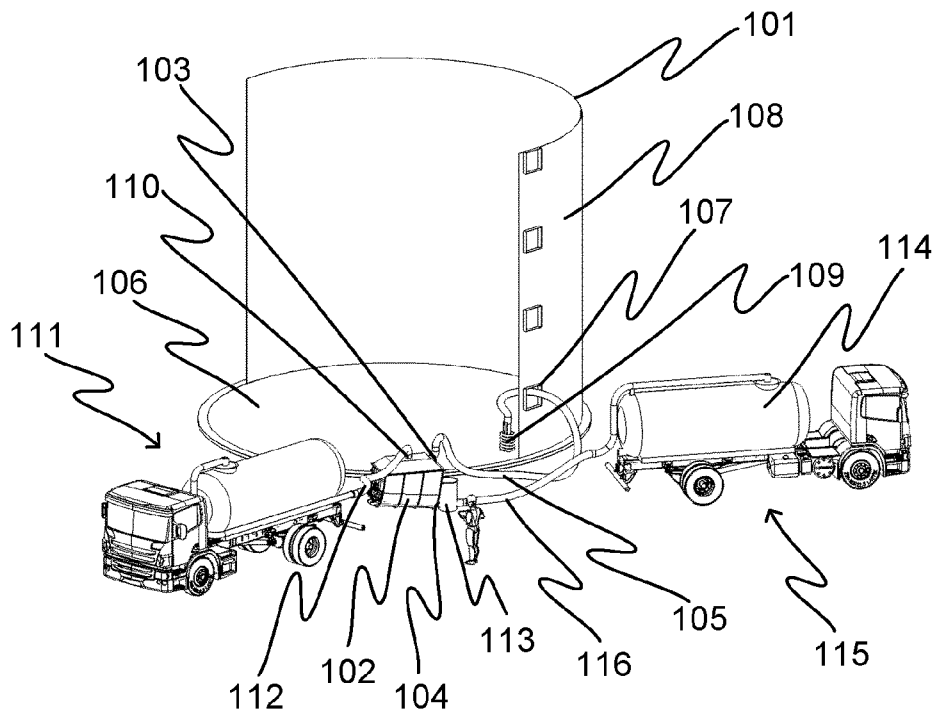


Fig. 1

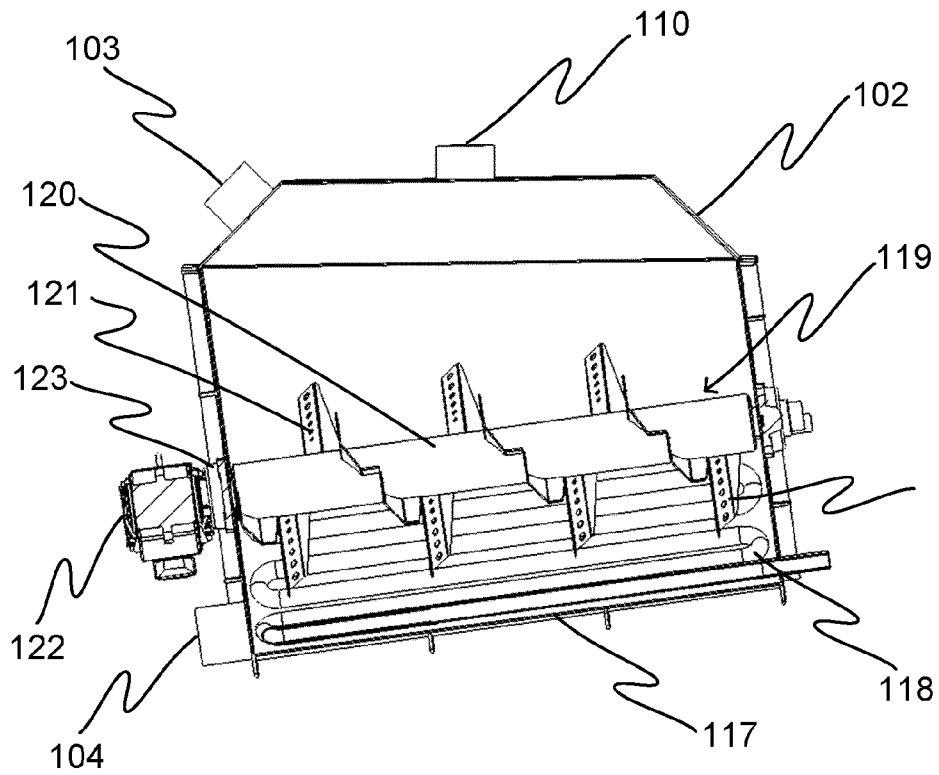


Fig. 2

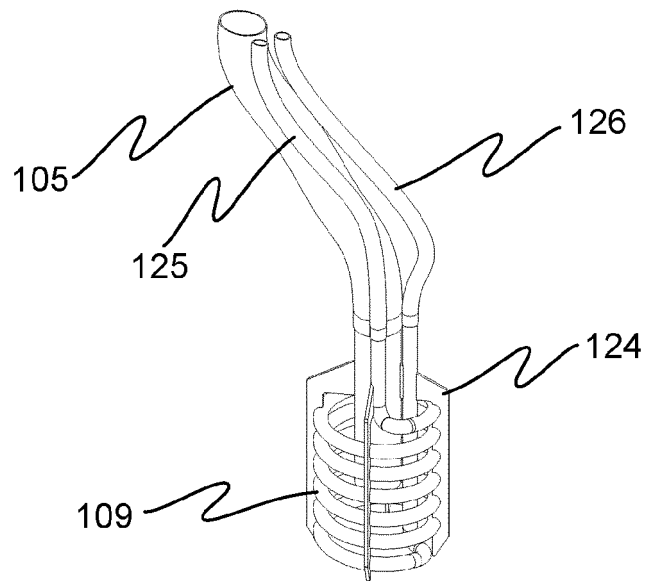


Fig. 3

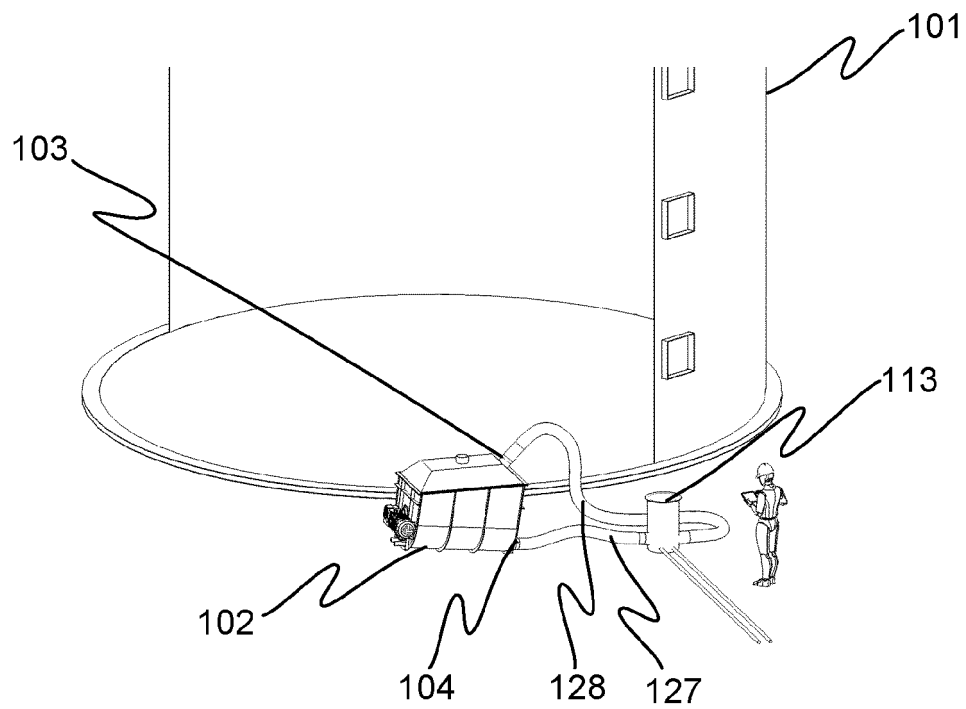


Fig. 4



EUROPEAN SEARCH REPORT

Application Number

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DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 10 October 2023	Examiner Desittere, Michiel
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82