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(54) **WATER HEATER**

(57) A water heater comprises a tank configured to contain a fluid in an internal volume thereof, a heating element receiving electric energy from a power source, the heating element being configured to transfer the received electric energy to the fluid in the form of thermal energy, and an interfacing element defining an interface

between the tank and the heating element, the interfacing element preventing contact from occurring between the tank and the heating element, the interfacing element being configured to reduce a transfer of electric loads between the tank and the heating element.

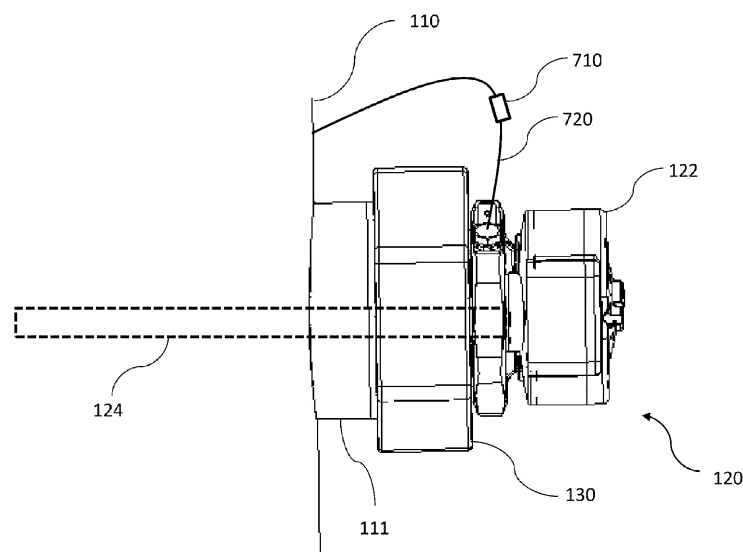


Figure 7

Description

FIELD OF TECHNOLOGY

[0001] The present technology relates to water heaters, heating devices for water heaters, method and use.

BACKGROUND

[0002] Water heaters are used in homes, businesses and in most any establishment having the need for heated water. More generally, heaters are used to heat a fluid which may be conveyed to areas where thermal energy is required or desired. Conventional heaters typically have at least one heating element such as a gas-fired burner and/or electric heating element.

[0003] Recent legislation and standards, particularly in the field of heat pump water heaters has led to a cessation of use of fluids that were previously commonly used. Use of natural fluids that are less dangerous for the environment and for natural warming are now encouraged. However, many of these natural fluids are flammable and/or explosive. This has resulted in new constraints on potential contact between these fluids and ignition sources of the heater, to prevent any explosive reaction from occurring. Architectures of conventional heaters do not take this aspect into consideration.

[0004] There is therefore a desire for a safe water heater which can alleviate at least some of these drawbacks.

SUMMARY

[0005] It is an object of the present technology to ameliorate at least some of the deficiencies of the prior art. Prior art heaters, as discussed below, are not satisfactory at least because they entail new quality risks, due, e.g., to use of a flange. A flange that is screwed onto the tank and that carries an immersed heating element is subject to quality risks such as poor assembly of the flange (e.g., pinching or forgetting the additional seal that is used with such a flange, poor tightening of the screws, poor orientation of the flange), as well as the need to weld a counter-flange to the tank to hold the flange, which can lead to a variety of defects (e.g., deformation of parts that can lead to leaks, risk of leakage on the welds, risk of material breakage in the area of welds when the tank is subjected to pressure, etc.). Additionally, current solutions may limit the materials that can be used for the tank and the heating element. The disclosed technology avoids these difficulties.

[0006] This object is solved by a water heater, in particular a heat pump, according to claim 1. The water heater comprises a tank configured to contain a fluid in an internal volume thereof. The water heater further comprises a heating element receiving electric energy from a power source, the heating element being configured to transfer the received electric energy to the fluid in the form of thermal energy. The water heater also comprises

an interfacing element defining an interface between the tank and the heating element, the interfacing element preventing contact from occurring between the tank and the heating element, the interfacing element being configured to reduce a transfer of electric loads between the tank and the heating element. The heating element is connected to the tank by means of the interfacing element.

[0007] In some embodiments the interfacing element is configured to prevent direct and/or conducting contact from occurring between the tank and the heating element. Alternatively or additionally, the interfacing element is made of an electrically insulating material. In some embodiments, the interfacing element is made of a plastic material, in particular thermoplastic material, preferably a semi-crystalline thermoplastic. Suitable materials comprise polyphthalamide (PPA), in particular polyamide 6 (PA6). Suitable materials preferably have a thermal compatibility for the water heater application and low expansion in the temperature range 0 - 100°C. Suitable materials further preferably have a food contact compatibility according to the regulations in force, in particular by using materials suitable for contact with drinking water compatible for water temperatures ranging from 0°C to 85° in compliance with Directive (EU) 2020/2184 of the European Parliament and of the Council of 16 December 2020 on the quality of water intended for human consumption. Suitable materials further preferably are non-porous materials. In some embodiments, the interfacing element has an electric conductivity below 0.1 siemens per meter (S/m).

[0008] In some embodiments, the tank includes a tank tube extending from an exterior side of the tank, the tank tube having an internal fluid conduit in fluid communication with the internal volume of the tank. In some embodiments, the interfacing element is configured to be coupled to the tank tube on an external end thereof. In some embodiments, the interfacing element defines at least a first thread and/or a second thread configured for coupling the interfacing element to the tank tube and the heating element. The first and/or second threads can be internal and/or external threads. In a particular embodiment, the first thread is an internal thread and is to be mechanically coupled, in particular directly coupled, with the tank, in particular the tank tube. The second thread can be an internal thread and is to be mechanically coupled, in particular directly coupled, with the heating element.

[0009] In some embodiments, the tank is made of enamelled steel. In some embodiments, an outer surface of the heating element, in particular an immersed heating element, is made of copper.

[0010] In some embodiments, the water heater further includes a resisting device in electric connection, in particular in direct or indirect electric connection, with the tank and the heating element. In some embodiments, the resisting device has an impedance of at least 500 Ohms. In some embodiments, the water heater further includes

an electric wire electrically connectable or connected, in particular directly or indirectly, to the heating element and to an external surface of the tank, the resisting device being disposed along the electric wire.

[0011] In some embodiments, the tank includes a fluid inlet and a fluid outlet for respectively receiving the fluid into and discharging the fluid from the internal volume. In some embodiments, the fluid inlet receives the fluid having a first temperature and the fluid outlet discharges the fluid having a second temperature, the second temperature being above the first temperature.

[0012] In some embodiments, the water heater further comprises an electric sensor, in particular a temperature sensor, in particular a thermal probe.

[0013] In some embodiments, the water heater can further comprise means for cathodic protection, in particular an impressed current anode and/or a sacrificial anode.

[0014] In some embodiments, the water heater further comprising at least a thermostat configured to measure and regulate a temperature of the fluid in the internal volume of the tank.

[0015] According to another aspect, a heating device is provided, in particular for a water heater according to the invention, comprising a heating element with a head for mechanical coupling of the heating element to a tank of the water heater and a heating body, characterized in that the heating device further comprises an interfacing element, wherein the interfacing element is configured to reduce or prevent electric load transfer with regard to the heating element and wherein the heating element is connected to the tank by means of the interfacing element.

[0016] In some embodiments, the interfacing element defines a first thread configured for coupling the interfacing element to a tank, in particular a tank tube, and wherein the interfacing element (130) is coupled with the heating element by way of a first or second thread.

[0017] In some embodiments, an outer surface of the heating element, in particular an immersed heating element, comprises or is made of copper.

[0018] In some embodiments, the heating device further comprises a resisting device electrically connectable, in particular directly or indirectly connectable, with the tank and the heating element.

[0019] In some embodiments, the resisting device has an impedance of at least 500 Ohms.

[0020] According to another aspect, a method of connecting a heating device according to the invention with a water heater, in particular according to the invention, comprising the step of coupling a first thread of an interfacing element of the heating device with a tank, in particular with a tank tube.

[0021] According to another aspect, a use of an interfacing element together with a heating element in a water heater, in particular according to the invention, is provided.

[0022] Embodiments of the present technology each have at least one of the above-mentioned object and/or

aspects, but do not necessarily have all of them. It should be understood that some aspects of the present technology that have resulted from attempting to attain the above-mentioned object may not satisfy this object and/or may satisfy other objects not specifically recited herein.

[0023] Additional and/or alternative features, aspects and advantages of embodiments of the present technology will become apparent from the following description, the accompanying drawings and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] For a better understanding of the present technology, as well as other aspects and further features thereof, reference is made to the following description which is to be used in conjunction with the accompanying drawings, where:

FIG. 1 is a perspective view of a heating element mounted on a flange of a tank according to the prior art;

FIG. 2 is a perspective view of a heating element in a sheath according to the prior art;

FIG. 3 is a schematic representation of a water heater according to some implementations of the present technology;

FIG. 4 is a perspective view of the water heater of FIG. 3;

FIG. 5 is a perspective view of a heating element of said water heater mounted on an interfacing element of said water heater;

FIG. 6 is a perspective view of the interfacing element of FIG. 5;

FIG. 7 is a side view of the heating element coupled to a tank of the water heater via said interfacing element according to some implementations of the present technology;

FIG. 8 is a cross section view of FIG. 7, according to some implementations of the present technology;

FIG. 9 shows a cross section of a greater portion of the water heater than FIG. 8;

FIG. 10 shows a cross section of the water heater as shown in FIG. 4

FIG. 11 shows a front view on the head of the heating element; and

FIG. 12 shows a perspective view on the head of the

heating element.

DETAILED DESCRIPTION

[0025] Broadly speaking, water heaters rely on heating elements to provide thermal energy to fluid contained in a tank. An element ensuring the heating of the fluid in the tank is based on the use of a heat pump, consisting of at least two heat exchangers, a compressor and an expansion valve connected fluidically and/or mechanically to each other and in which a refrigerant circulates. Calories are extracted from a source, usually air or water, and are conveyed by the refrigerant to the fluid to be heated in the tank using the thermodynamic principle of a heat pump. A heating element, generally an electrical resistance based on the Joule effect, is commonly added to the thermodynamic water heater. This is used to compensate for potential limitations of the heat pump such as heating power is too low, failure of the heat pump system, operating conditions of the heat pump are not met. The heating element can heat the fluid directly by being immersed in the tank or indirectly through a wall separating the heating element from the fluid to be heated.

[0026] FIG. 1 depicts a heating element 10 found in the prior art. The heating element comprises a heating body 12 being, in use, immersed in a tank for providing thermal energy to a fluid therein. The heating element 10 further comprises a flange 16 and a head 14. The flange 16 may be mounted on a surface of the tank such that the heating body 12 is in an internal volume thereof, and the head 14 is on an exterior side of the tank. The head 14 is integrally connected to the heating body 12 such that the head 14 and the heating body 12 may be pulled from or inserted into the flange 16 together. For example, the flange 16 is screwed on to the tank and carries the heating body 12 and the head 14.

[0027] The developers of the present technology have realized that the heating element 10 has several drawbacks. Notably, integration of the heating element 10 onto a tank requires that said tank comprises a counter-flange for holding the flange 16. Said counter-flange may cause various defects, such as deformation of components (e.g. the flange 16, said counter-flange and/or welds thereof) which can increase a risk of leakage. In addition, use of the flange 16 and the corresponding counter-flange creates a large area where thermal insulation with an outside environment of the tank may be drastically reduced.

[0028] FIG. 2 depicts a heating element 20 comprising a heating body encapsulated in a sheath 22 of a tank of a heater. A rest of the tank is not illustrated on FIG. 2 for clarity purposes. The sheath 22 extends into the tank from a flange 26 of the tank. The heating element 20 also comprises a head 24 affixed to the heating body such that the heating body may be pulled from or inserted into the sheath 22 by manipulating the head 24. However, the developers of the present technology have realized

that, in this configuration, air within the sheath 22 may come into contact with the heating element, which can reach a temperature of around 800°C. As a result, said air may be a potential source of ignition if an explosive environment is present (e.g. presence of flammable refrigerant in the heater). This solution is therefore not compatible with a water heater using a flammable refrigerant given that, in the event of a leak in the system, there is a risk of explosion if the air loaded with fluid meets the heating body.

[0029] The developers of the present technology have devised a system that alleviate at least some of the drawbacks found in the prior art.

[0030] FIG. 3 illustrates a water heater 100 in accordance with an implementation of the present technology, the water heater 100 being suitable for implementing non-limiting embodiments of the present technology. It is to be expressly understood that the water heater 100 as depicted is merely an illustrative implementation of the present technology. Thus, the description thereof that follows is intended to be only a description of illustrative examples of the present technology. This description is not intended to define the scope or set forth the bounds of the present technology. In some cases, what are believed to be helpful examples of modifications to the water heater 100 may also be set forth below. This is done merely as an aid to understanding, and, again, not to define the scope or set forth the bounds of the present technology. These modifications are not an exhaustive list, and, as a person skilled in the art would understand, other modifications are likely possible. Further, where this has not been done (i.e., where no examples of modifications have been set forth), it should not be interpreted that no modifications are possible and/or that what is described is the sole manner of implementing that element of the present technology. As a person skilled in the art would understand, this is likely not the case. As persons skilled in the art would understand, various implementations of the present technology may be of a greater complexity. As will be described herein, the water heater 100 is configured for receiving fluid and providing thermal energy thereto. The fluid may be water, thermal oil, water-glycol solutions, or any other fluid that may be suitably heated by the water heater 100. This aspect is not limited.

[0031] In this implementation, the water heater 100 comprises a tank 110 having an internal volume for receiving the fluid to be heated. For example, the water heater 100 may be a heat pump water heater using a flammable refrigerant. In this example, the tank 110 may be a domestic water tank.

[0032] In use, the fluid may enter at a tank inlet 112. The tank inlet 112 may be located on a bottom portion of the tank 110. A flow of the fluid at the tank inlet 112 may be adjusted by actuating an inlet valve 114. Once the fluid has received thermal energy, the tank 110 may discharge the heated fluid at a tank outlet 116. The tank outlet 116 may be located on a top portion of the tank

110. A flow of the fluid at the tank outlet 116 may be adjusted by actuating an outlet valve 118. The inlet valve 114 and the outlet valve 118 may be, for example and without limitation, actuated by a controller (not shown) communicably connected thereto. The tank 110 may be a corrosion-susceptible tank made of a corrosive material. In this implementation, the tank 110 is made of enamelled steel. It should be noted that teachings of the present disclosure are particularly suitable for the assembly of immersed heating elements in a thermodynamic water heater tank made of enamelled steel. Other materials are contemplated in alternative implementations.

[0033] The water heater 100 also comprises a heating element 120 configured to provide thermal energy to the fluid in the tank 110. Broadly speaking, the heating element 120 comprises a heating body 124 receiving electric energy from an external source (not shown) such as household electric power. The heating body 124 is configured to convert the received electric energy in thermal energy, said thermal energy being further collected by the fluid in the tank 110. As an example, the heating body 124 may comprise a conventional resistive heating element. The heating element 120 also comprises a head 122 for mechanical coupling of the heating element 120. The head 122 electrically connects to the heating body 124 to provide the electrical energy required for its operation. This connection is made without generating an ignition source, as contact between air and potential arcing is made impossible by a direct connection in a closed environment.

[0034] In this implementation, the water heater 100 comprises an interfacing element 130 for mounting the heating element 120 on the tank 110. The interfacing element 130 is described in greater detail below. Broadly speaking, the interfacing element 130 is configured to prevent or reduce electric load transfer between the heating element 120 and the tank 110. To do so, the interfacing element prevents mechanical contacts between the heating element 120 and the tank 110 and has a low electrical conductivity. In this implementation, the interfacing element 130 is made of an insulating material such as plastic. As an example, the interfacing element 130 may have an electric conductivity below 0.1 S/m.

[0035] Electric decoupling between the heating element 120 and the tank 110 improves a cathodic protection of the tank 110. Indeed, were there a strong electric coupling between the heating element 120 and the tank 110, the cathodic protection would mainly target the heating element 120, identifying said heating element 120 as a defect (i.e., a foreign cathode) since it has no protection. As a result, the tank 110 would no longer benefit from sufficient protection and a life of the tank 110 may be degraded.

[0036] In this implementation, the water heater 100 has cathodic protection in the form of at least one impressed current cathodic protection. In other words, one or more anodes connected to an external power source may be immersed in the tank 110 to provide a perpetual source

of electrical flow to prevent corrosion by converting anodic sites of the metallic surfaces of the water heater 100 into cathodic sites by supplying electrical current from said external power source. The water heater 100 could also comprise a galvanic anode instead of an impressed current anode. The water heater 100 could also comprise both solutions, with said at least one cathodic protection and one impressed current cathodic protection, thereby forming a hybrid solution for cathodic protection.

[0037] As shown on FIG. 3, the heating element 120 is coupled to the interfacing element 130 (e.g. screwed therein) and the interfacing element 130 is coupled to the tank 110 such that the heating body 124 is immersed in the fluid within the tank 110. More specifically, the interfacing element 130 is mechanically coupled to an external end of a tank tube 111 extending from an exterior surface of the tank 110. In this implementation, the tank tube 111 is a threaded or tapped tube welded to the tank 110.

[0038] The interfacing element 130 may be, for example and without limitation, screwed onto the tank tube 111. It should be understood that, in this implementation, the head 122 of the heating element 120 thus seals the internal volume of the tank 110. As such, it can be said that the heating body 122 is inserted into the tank 110 through a surface thereof and provides thermal energy to the fluid therein.

[0039] In the same or alternative implementations, mechanical coupling between the heating element 120 and the interfacing element 130 may be made by using connecting devices such as direct or indirect clipping connectors, quick coupling connectors, force fitting connectors, quarter-turn screws, clamping connectors, any other connecting device suitable to couple the heating element 120 and the interfacing element 130, or a combination thereof. Mechanical coupling between the tank 110 (e.g. the tank tube 111) and the interfacing element 130 may also be made by using one or more of the aforementioned connecting devices.

[0040] Additionally or optionally, the water heater 100 may comprise a thermostat for measuring a temperature of the fluid within the tank 110. The thermostat may for example be disposed close to the heating element 120. The thermostat may also be connected to the heating element 120 so as to control its operation in order to ensure that the fluid to be heated is kept at the correct temperature.

[0041] FIG. 4 is a perspective view of the water heater 100. In this implementation, the water heater 100 may further comprise an upper module 140 comprising, for example and without limitation part of the heat pump module, namely one or more fans, a compressor, a heat exchanger, an expansion valve and a piping network connecting these elements, a refrigerant fluid circulating in this piping. This module is connected to the tank via a condenser, the role of which is to transmit the calories recovered by the heat pump module 140 to the fluid in the tank to be heated.

[0042] With reference to FIG. 5, the heating element 120 is inserted and mechanically coupled to the interfacing element 130. As shown on FIG. 5, the head 122 is screwed in the interfacing element 130.

[0043] In this implementation, the heating body 124 is a bent metallic U-shaped rod extending, in use, along a main length L in the tank 110. The heating body 124 may be a straight or bent rod in an alternative embodiment, this aspect is not limitative. The heating body 124 may be made of a corrosive element covered with an external surface, or a coating, made of copper. In this implementation, the heating body 124 is an electric heating body and receives electric energy from an external source. The heating body 124 thus converts electric energy into thermal energy such that fluid within the tank may collect said thermal energy. For example, the heating body 124 may comprise resistive elements that generate thermal energy due to the Joule effect.

[0044] In this implementation, the heating body 120 further comprises a sacrificial anode (not shown) extending from the head 122 and along the heating body 124. The sacrificial anode can be a metal rod and may be made of magnesium or aluminium to attract particles of iron, limestone or other minerals present in the fluid through an electrochemical process. As such, the sacrificial anode corrodes in place of the tank 110. In other words, the sacrificial anode "sacrifices" itself to extend a potential use duration of the water heater 100. Alternatively or additionally to the sacrificial anode, an impressed current anode can be used which has the same advantages as the sacrificial anode but is not limited in its lifetime, as long as it is energised. FIG. 5 further shows a tube 505 in which a safety temperature sensor is placed and which allows the heating body to be cut off electrically if too much overheating is measured to prevent that the water could vaporise and the tank could explode due to the build up of pressure.

[0045] FIG. 6 is a perspective view of the interfacing element 130 according to some implementations of the present technology. In this implementation, the interfacing element 130 is made of a plastic material having an electric conductivity below 0.1 S/m. The interfacing element 130 may be formed using, for example and without limitation, injection molding techniques. In some embodiments, the interfacing element is made of a plastic material, in particular thermoplastic material, preferably a semi-crystalline thermoplastic. Suitable materials comprise polyphthalamide (PPA), in particular polyamide 6 (PA6). Suitable materials preferably have a thermal compatibility for the water heater application and low expansion in the temperature range 0 - 100°C. Suitable materials further preferably have a food contact compatibility according to the regulations in force, in particular by using materials suitable for contact with drinking water compatible for water temperatures ranging from 0°C to 85°

sumption. Suitable materials further preferably are non-porous materials. In some embodiments, the interfacing element has an electric conductivity below 0.1 siemens per meter (S/m).

[0046] In this implementation, the interfacing element 130 defines a first internal thread 132 and a second internal thread 134. Screw threads of the first and second internal threads 132, 134 are not shown for clarity of FIG. 6. In use, the interfacing element 130 is screwed directly onto the tank tube 111, the tank tube defining a thread matching the first internal thread 132 on an external surface thereof. It can be said that the tank tube 111 and the interfacing element 130 form a male-female connection. Definition of the thread on an external surface of the tank tube 111 may facilitate avoidance of presence of defects related to an enamelling process.

[0047] In this implementation, the head 122 of the heating element 120 is, in use, screwed into the interfacing element 130. More specifically, the head 122 may define a thread on an external surface thereof, said thread matching the second thread 134 of the interfacing element 130. As a result, the interfacing element 130 is, in use, mechanically coupled to the tank 110, *via* the tank tube 111, and the heating element 120, *via* the head 122. Other connecting devices may be used to couple the tank 110, the interfacing element 130 and the heating element 120, such as direct or indirect clipping connectors, quick coupling connectors, force fitting connectors, quarter-turn screws, and/or clamping connectors. It should also be noted that, in use, the interfacing element 130 prevents any mechanical contact from occurring between the tank 110 and the heating element 120. In a non-shown embodiment, a seal can be placed between the tank tube 111 and the interfacing element 130, additionally or alternatively a further seal can be placed between the interfacing element 130 and heating element 120.

[0048] FIG. 7 is a side view of the heating element 120 coupled to the tank 110 of the water heater 100 *via* the interfacing element 130 according to some implementations of the present technology. As shown, the interfacing element 130 is mounted on (e.g. screwed onto) the tank tube 111, and the heating element 120 is mounted in (e.g. screwed into) the interfacing element 130. The heating body 124 is oriented toward the internal volume of the tank 110 and immersed therein to provide thermal energy to the fluid. As such, the heating element 120, and, more specifically, the head 122, seals the tank 110 at the tank tube 111.

[0049] As previously described, the interfacing element is used to reduce electric conduction between the heating element 120 and the tank 100. However, entirely breaking an electrical continuity of the water heater 100 between the tank 110 and the heating element 120 may introduce a risk of corrosion. Indeed, chemical reaction within the water heater 100 may consider the heating element 120 as a foreign cathode and electric current may be concentrated from said foreign cathode on the tank 110, in a vicinity of insulated connection between

the foreign cathode and the tank 110 (i.e. at the tank tube 111). This phenomenon is called "stray current corrosion".

[0050] To compensate and/or counter the stray current corrosion phenomenon, the water heater 100 may further comprise a resisting device 710 electrically connected to the tank 110 and the heating body 122 (i.e. the foreign cathode). In this implementation, the resisting device 710 comprises at least one compensating differential resistor, the resisting device having an impedance of at least 500 Ohms, implemented along an electric wire 720. The electric wire 720 is connected directly or indirectly to an external surface of the tank 100 on one end and to the heating body 122 on the other end (through the head 122 on FIG. 7).

[0051] As such, the resisting device 170 ensures that the electrical continuity of the water heater 100 is not completely broken, thus avoiding the stray current corrosion phenomenon. It should also be understood that the use of the resisting device 170 maintains insulating effects of the interfacing element 130. More specifically, anodes immersed in the tank 110 for cathodic protection (e.g. impressed current cathodic protection and/or galvanic anodes) may still actively provide protection to the tank 110 and not the heating body 122 despite the presence of the resisting device 710.

[0052] FIG. 8 is a cross section view of FIG. 7, according to some implementations of the present technology in an enlarged view. FIG. 9 shows a cross section of a greater portion of the water heater than FIG. 8.

[0053] FIG. 10 shows a cross section of the water heater as shown in FIG. 4.

[0054] FIG. 11 shows a front view on the head of the heating element and FIG. 12 shows a perspective view on the head of the heating element.

[0055] While this embodiment of the water block assembly 10 includes more components (i.e., an additional plate member), similar benefits to those described above can be obtained in terms of assuring redundancy in the water block assembly 10, albeit with a reduced efficiency. Notably, the embodiment of the water block assembly 10 illustrated in Figs. 1 to 4 is simpler to assemble as it includes fewer components, and provides a greater efficiency as the heat transfer interface between the lower and upper water block units 12, 14 is constituted by the material of one of the plate members (intermediate plate member 300).

[0056] Modifications and improvements to the above-described embodiments of the present technology may become apparent to those skilled in the art. The foregoing description is intended to be exemplary rather than limiting. The scope of the present technology is therefore intended to be limited solely by the scope of the appended claims.

Claims

1. A water heater (100), in particular a heat pump, comprising:

a tank (110) configured to contain a fluid, in particular water, in an internal volume thereof;
a heating element (120) for receiving energy, in particular electric energy, from a power source, the heating element (120) being configured to transfer the received energy to the fluid in the form of thermal energy; and
an interfacing element (130) defining an interface between the tank (110) and the heating element (120),
wherein the heating element (120) is connected to the tank (110) by means of the interfacing element (130).

2. The water heater (100) of claim 1,

(a) wherein the interfacing element (130) is configured to prevent direct and/or conducting contact from occurring between the tank (110) and the heating element (120); and/or
(b) wherein the interfacing element (130) is made of an electrically insulating material.

3. The water heater (100) of claims 1 or 2, wherein

(a) the interfacing element (130) comprises or is made of a plastic material, in particular thermoplastic material and/or wherein
(b) the interfacing element (130) has an electric conductivity below 0.1 siemens per meter (S/m).

4. The water heater (100) of any one of claims 1 to 3, wherein the tank (110) comprises a tank tube (111) extending from an exterior side of the tank (110), the tank tube (111) having an internal fluid conduit in fluid communication with the internal volume of the tank (110).

5. The water heater (100) of claim 4, wherein the interfacing element (130) is configured to be coupled to the tank tube (111) on an external end thereof.

6. The water heater (100) of claim 4 or 5, wherein the interfacing element (130) defines at least a first thread (132) and/or a second thread (134) configured for coupling the interfacing element (130) to the tank tube (111) and the heating element (120).

7. The water heater (100) of any one of claims 1 to 6, wherein

(a) the tank (110) is made of enamelled steel and/or wherein

- (b) an outer surface of the heating element (120), in particular an immersed heating element (810), comprises or is made of copper.
8. The water heater (100) of any one of claims 1 to 7, further comprising a resisting device (710) in electric connection with the tank (110) and the heating element (120). 5
9. The water heater (100) of claim 8, wherein the resisting device (710) has an impedance of at least 500 Ohms. 10
10. The water heater (100) of claim 1 to 9, further comprising an electric wire electrically (720) connectable to the heating element (120) and to an external surface of the tank (110), the resisting device (710) being disposed along the electric wire (720). 15
11. The water heater (100) of any one of claims 1 to 10, wherein the water heater (100) further comprises an electric sensor, in particular a temperature sensor, in particular a thermal probe. 20
12. The water heater (100) of claim 11, wherein the water heater (100) comprises means for cathodic protection, in particular an impressed current anode and/or a sacrificial anode. 25
13. The water heater (100) of any one of claims 1 to 12, further comprising a thermostat, configured to measure and regulate a temperature of the fluid in the internal volume of the tank (110). 30
14. Heating device (150), in particular for a water heater (100) according to any of the preceding claims, comprising a heating element (120) with a head (122) for mechanical coupling of the heating element (120) to a tank (110) of the water heater (100) and a heating body (124), **characterized in that** the heating device (150) further comprises an interfacing element (130), wherein the interfacing element (130) is configured to reduce or prevent electric load transfer with regard to the heating element (120) and wherein the heating element (120) is connected to the tank (110) by means of the interfacing element (130). 35 40 45
15. Heating device (150) according to claim 14, wherein
- (a) the interfacing element (130) defines a first thread (132) configured for coupling the interfacing element (130) to a tank (110), in particular a tank tube (111), and wherein the interfacing element (130) is coupled with the heating element (120) by way of a first or second thread (132, 134) and/or wherein 50
- (b) an outer surface of the heating element (120), in particular an immersed heating element (810), comprises or is made of copper and/or wherein 55
- (c) the heating device further comprises a resisting device (710) electrically connectable with the tank (110) and the heating element (120), in particular wherein the resisting device (710) has an impedance of at least 500 Ohms.
16. Method of connecting a heating device (150) according to claim 14 or 15 with a water heater (100), in particular according to claims 1 to 13, comprising the step of coupling a first thread (132) of an interfacing element (130) of the heating device (150) with a tank (110), in particular with a tank tube (111).
17. Use of a interfacing element (130) together with a heating element (120) in a water heater (100) according to claims 1 to 13.

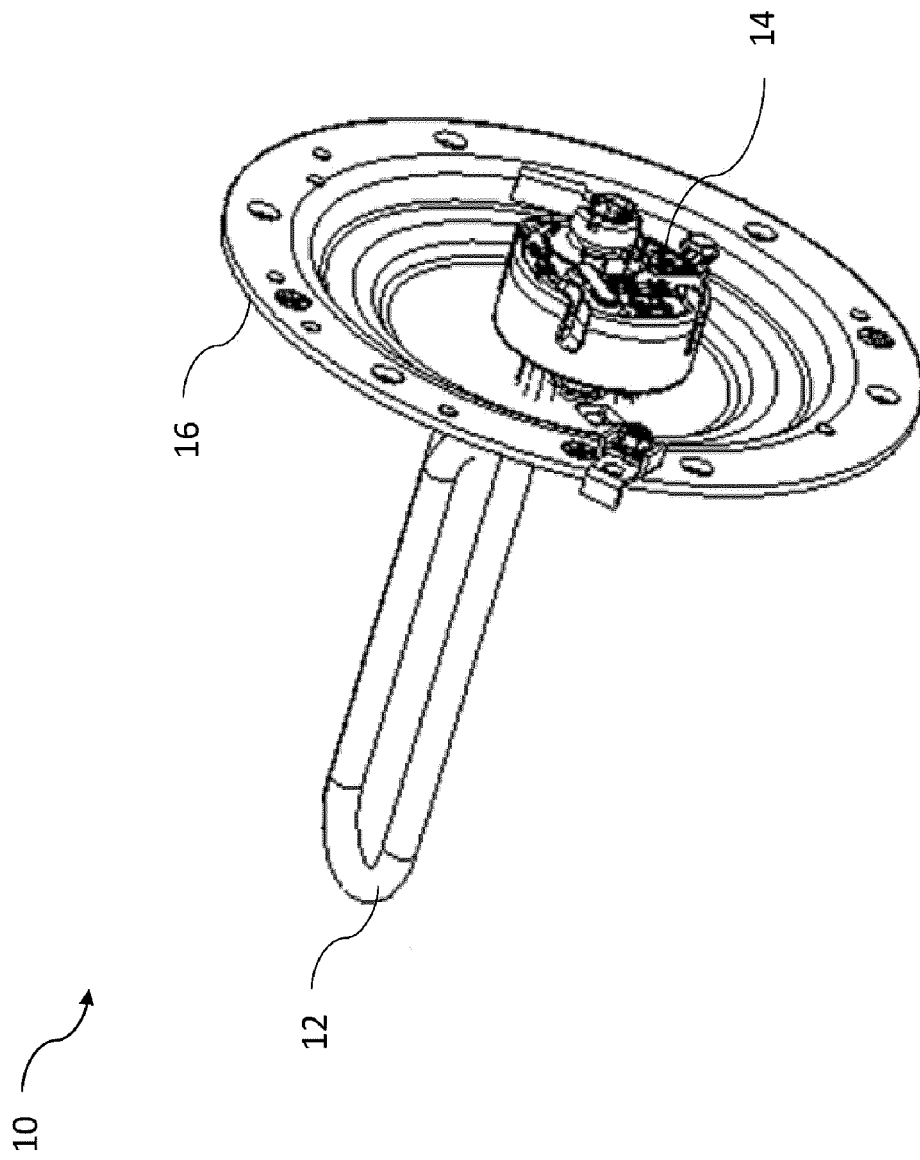


Figure 1 (Prior Art)

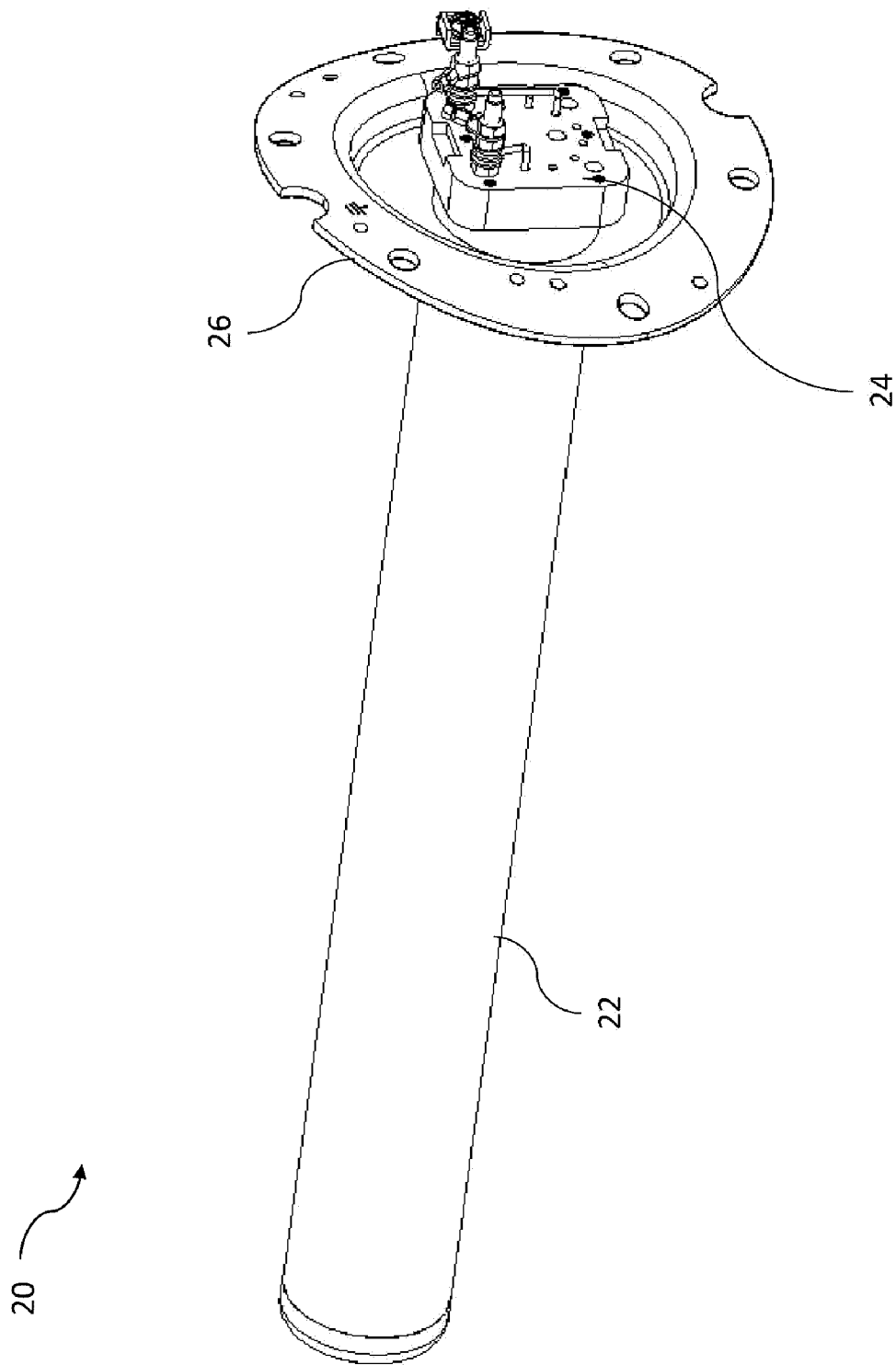


Figure 2 (Prior Art)

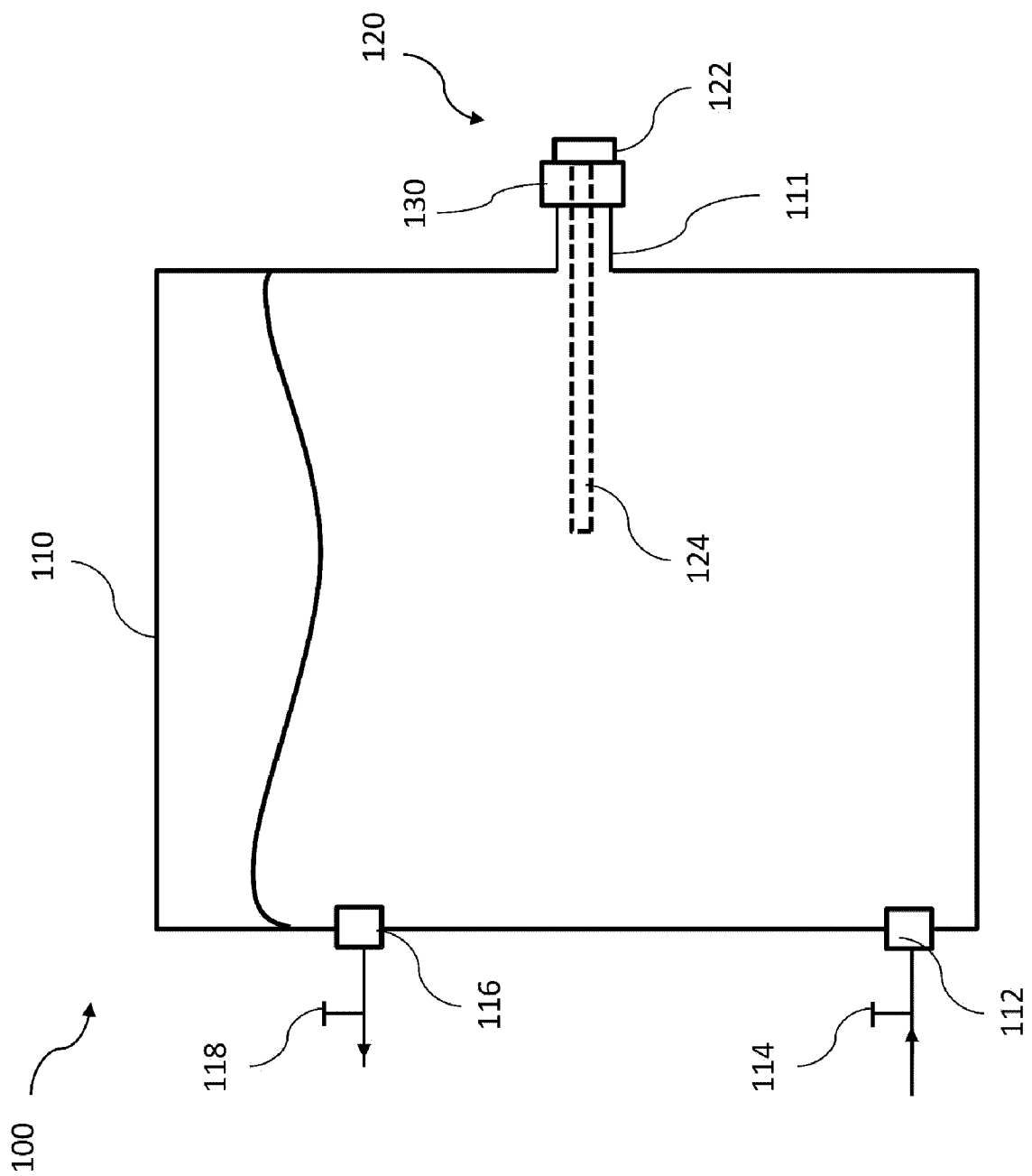


Figure 3

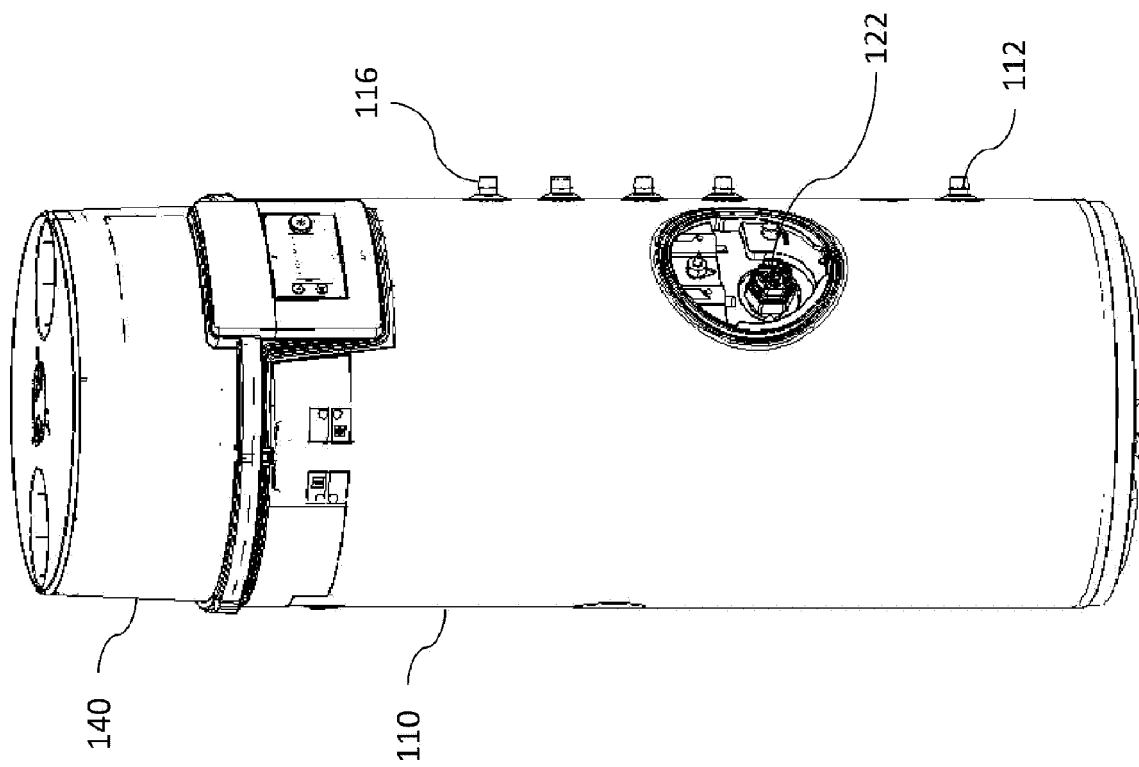


Figure 4

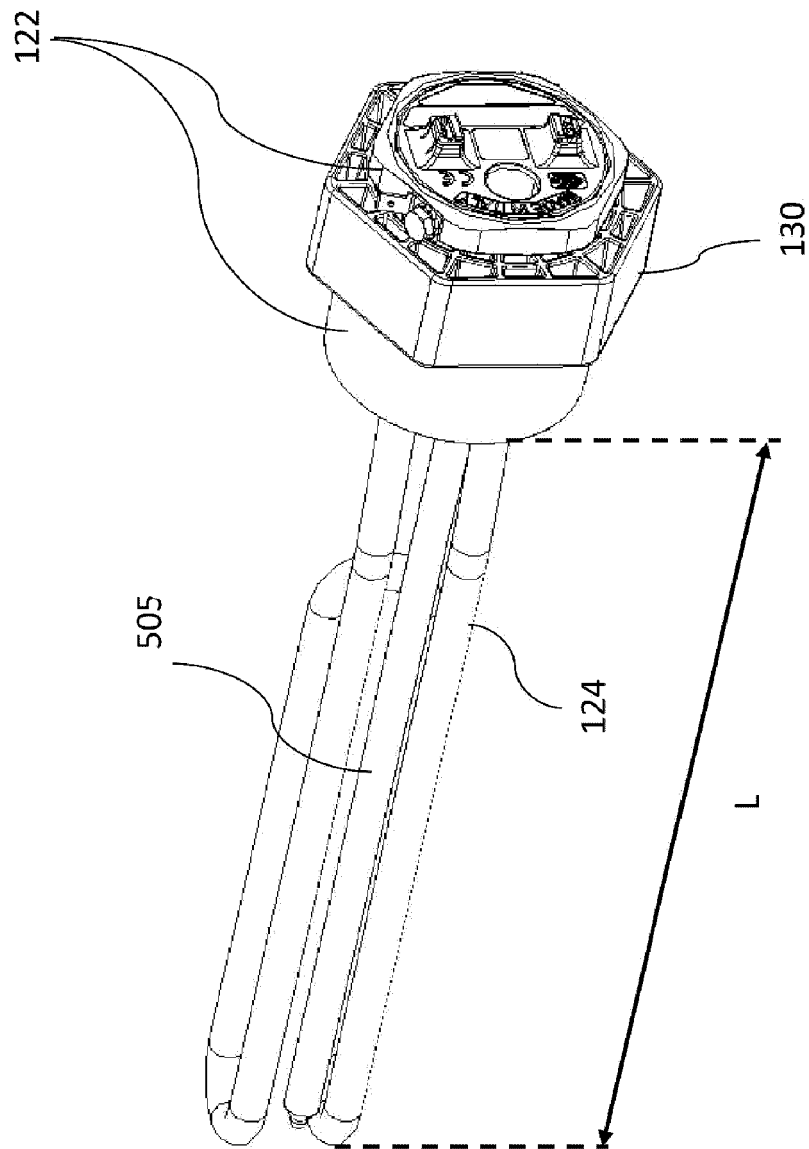


Figure 5

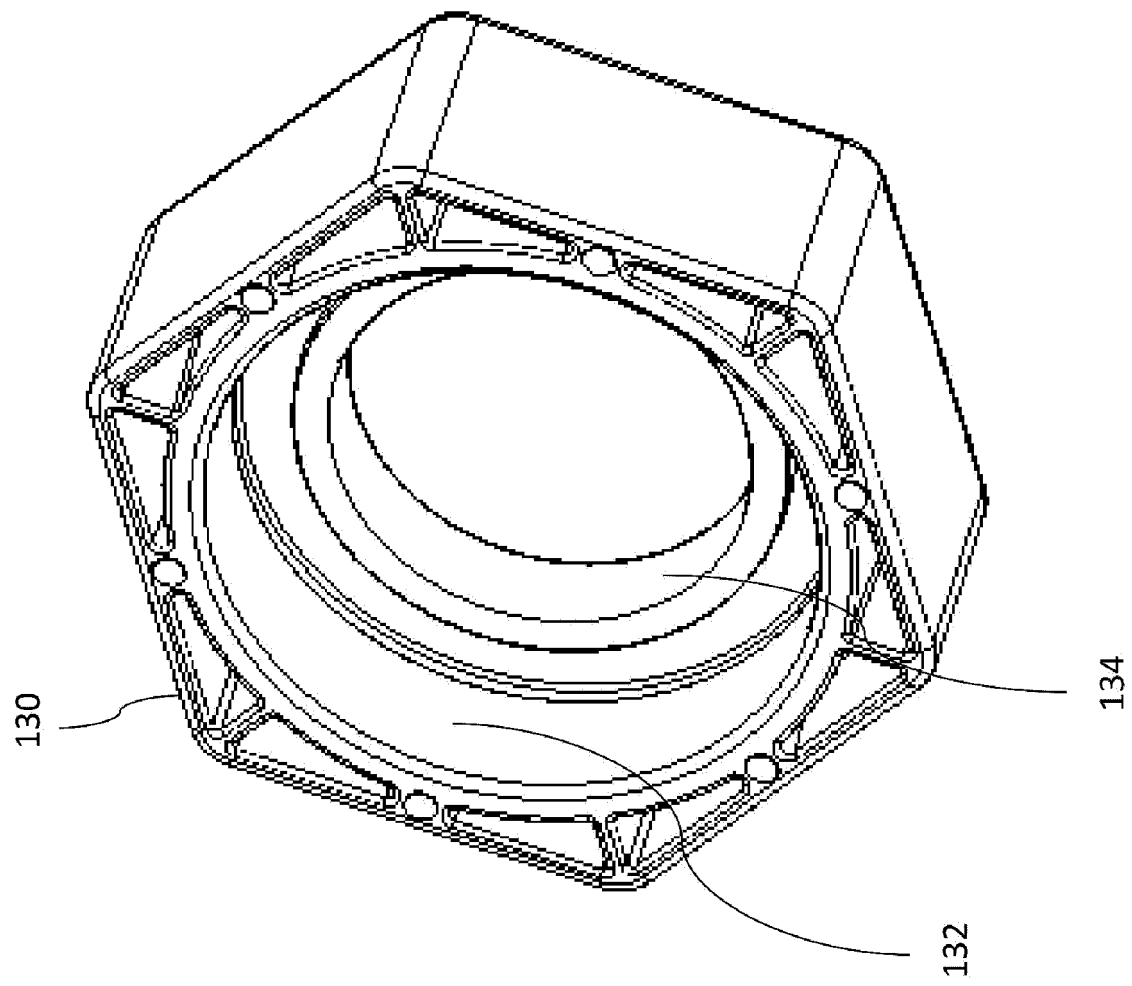


Figure 6

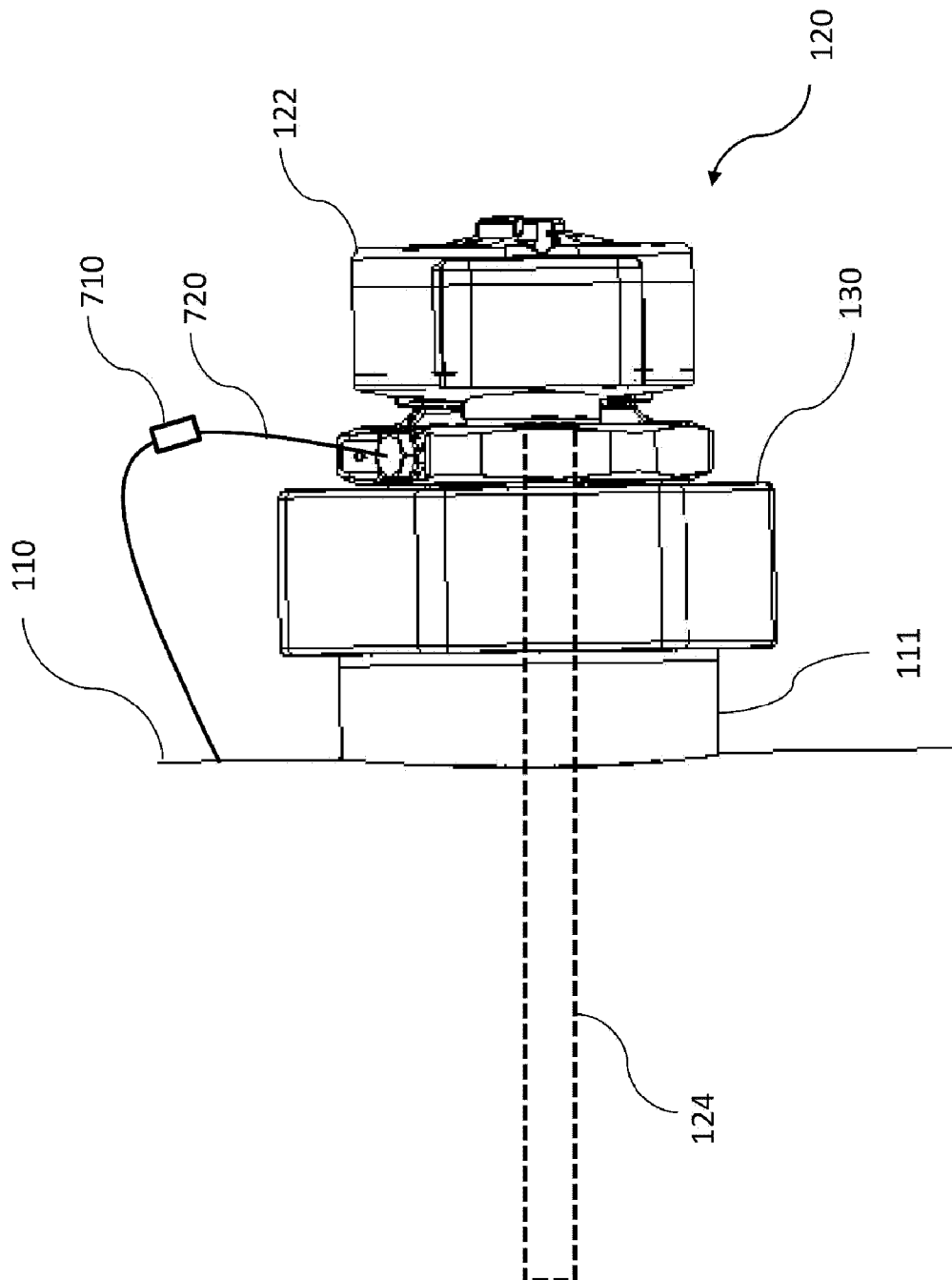


Figure 7

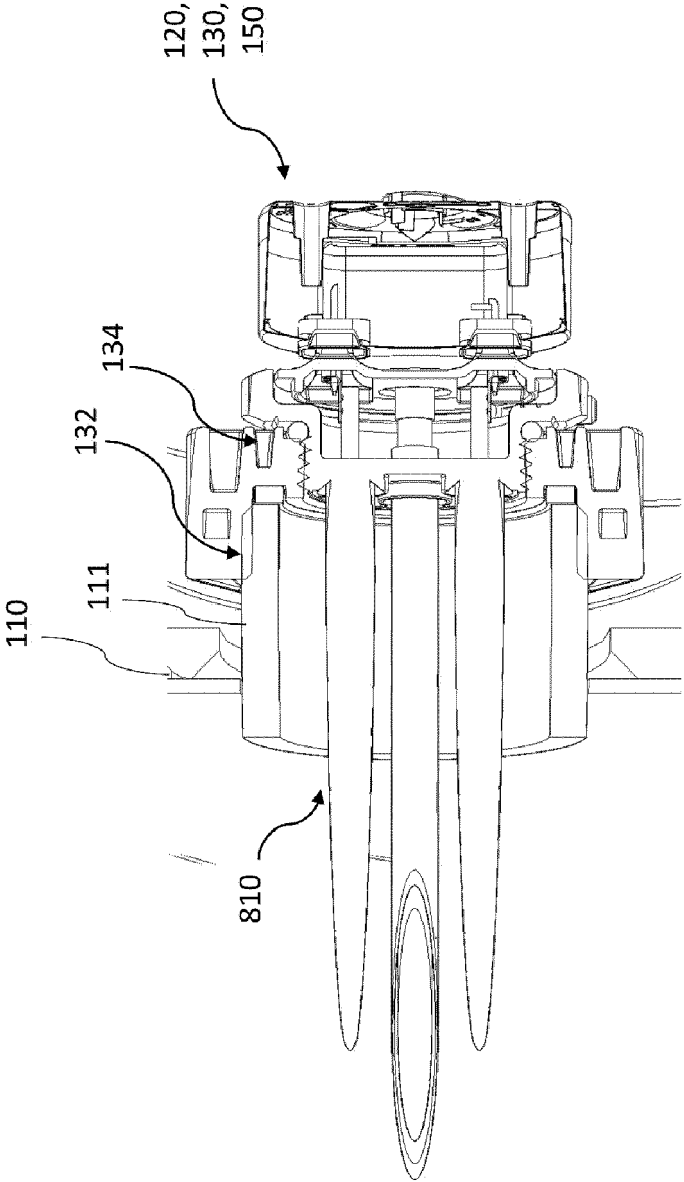


FIG. 8

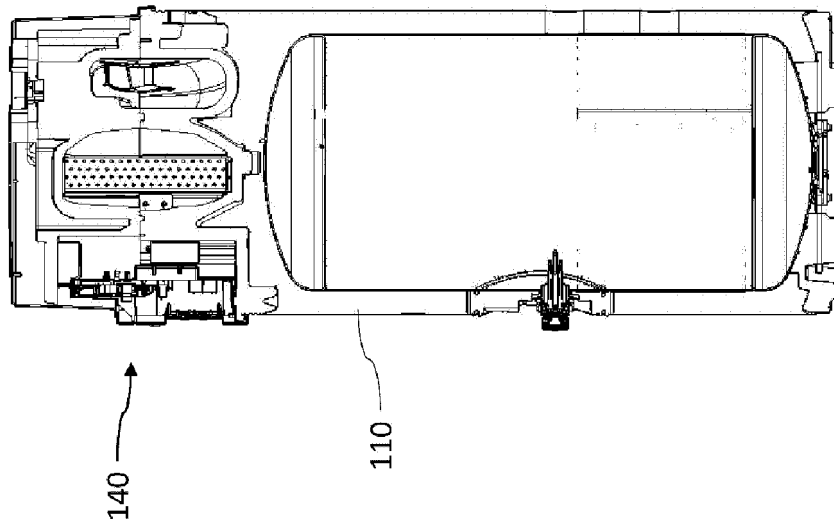


FIG. 10

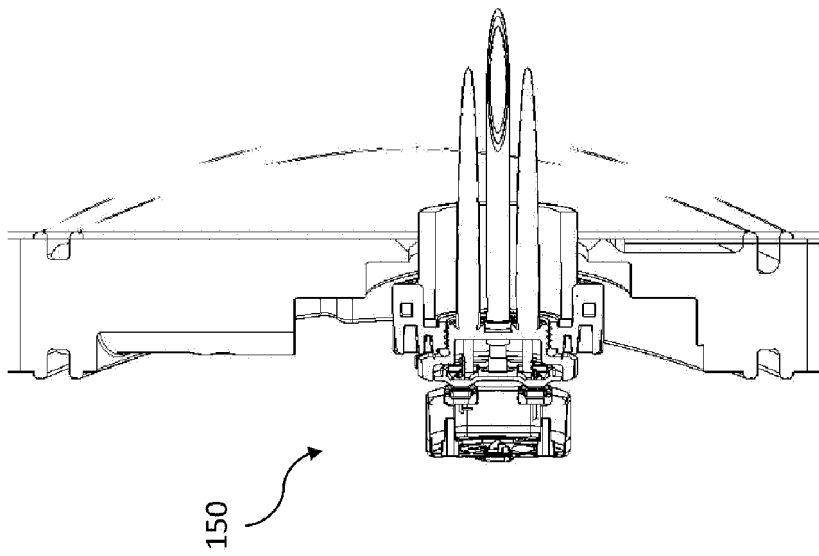


FIG. 9

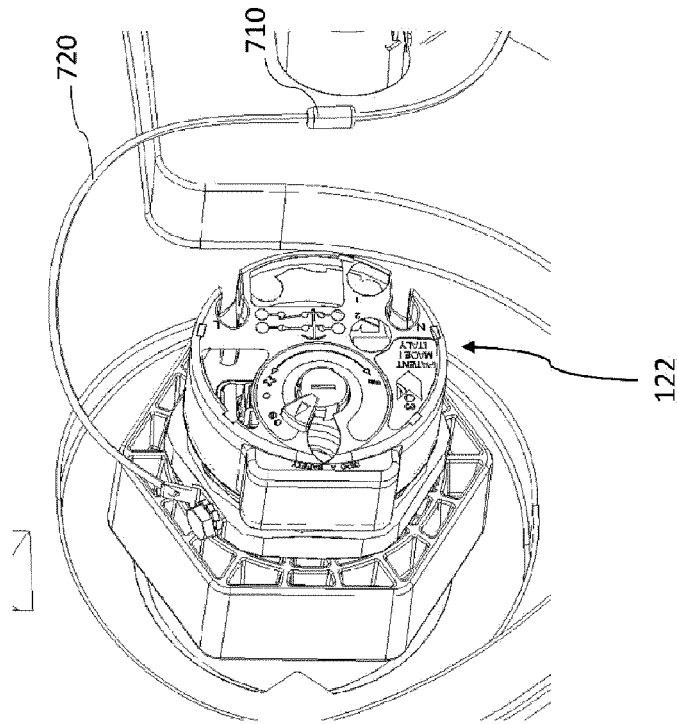


FIG. 12

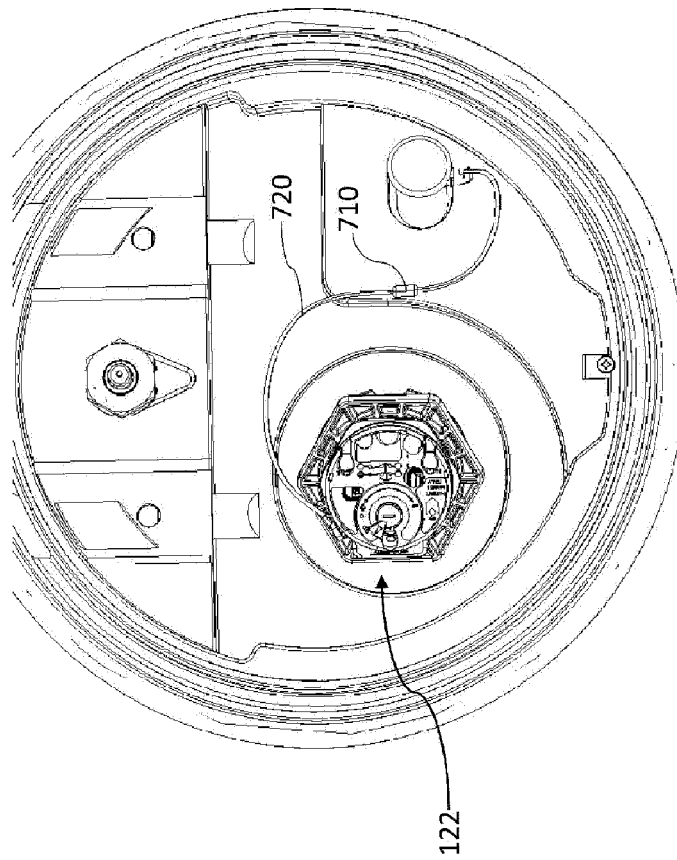


FIG. 11



EUROPEAN SEARCH REPORT

Application Number

EP 22 16 6408

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			F24H H05B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 15 September 2022	Examiner Schwaiger, Bernd
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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The members are as contained in the European Patent Office EDP file on
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