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(54) **EXPLOSION WELDED EVAPORATOR FOR USE IN TWO-PHASE HEAT TRANSFER APPARATUSES**

(71) Applicant: **CAPTHERM SYSTEMS INC.**, Coquitlam, British Columbia (CA)

(72) Inventor: **Timo MINX**, Coquitlam, British Columbia (CA)

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(57) **ABSTRACT**

A two-phase heat transfer apparatus for cooling electronics through an evaporation/condensation cycle, and an evaporator of a heat transfer apparatus are provided. The evaporator or apparatus includes multiple materials to leverage multiple beneficial material properties. A transition between the multiple materials is provided by use of explosion welding. A fluid-containing interior cavity is formed in the evaporator or apparatus such that cavity sidewalls include the transition, which is hermetically sealed due to the explosion weld. The use of multiple materials may be leveraged to incorporate features including a view glass or feed-through connector into the apparatus for viewing the working fluid or incorporating electrical components inside of the hermetic enclosure. In one embodiment, the apparatus base can be made of copper and the condenser can be made out of aluminum containing aluminum tubes, such as multiport tubes.

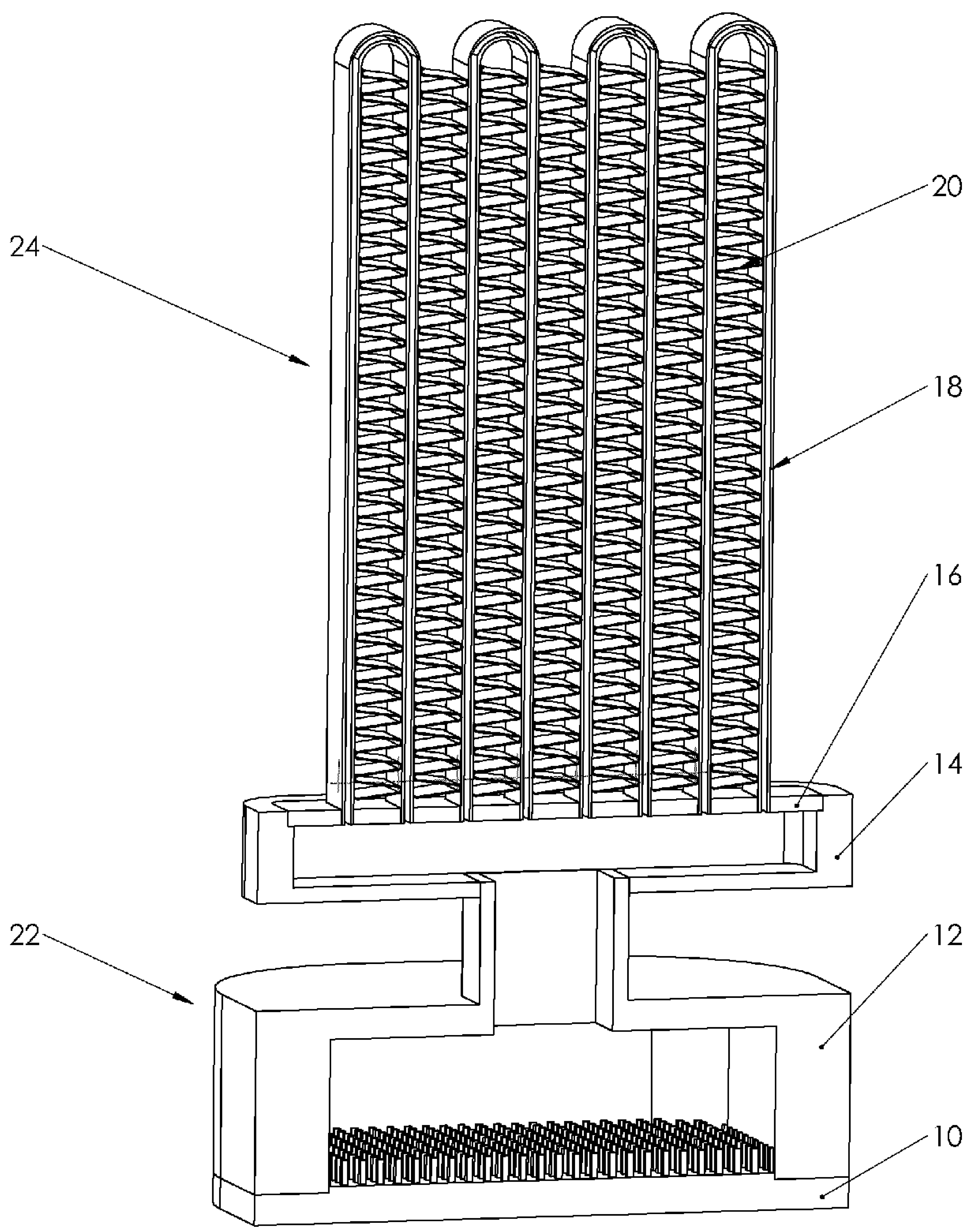

Fig. 1

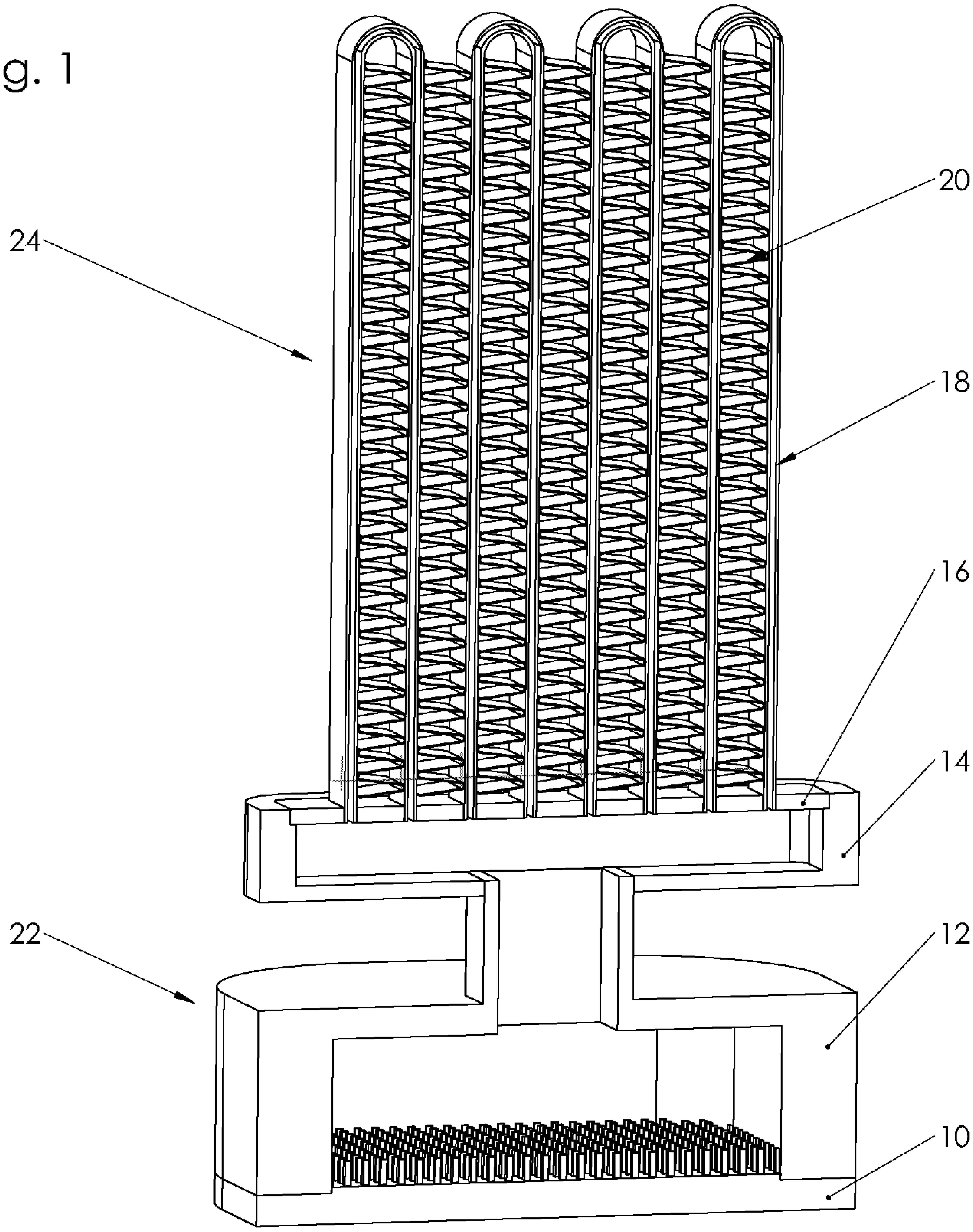

Fig. 2

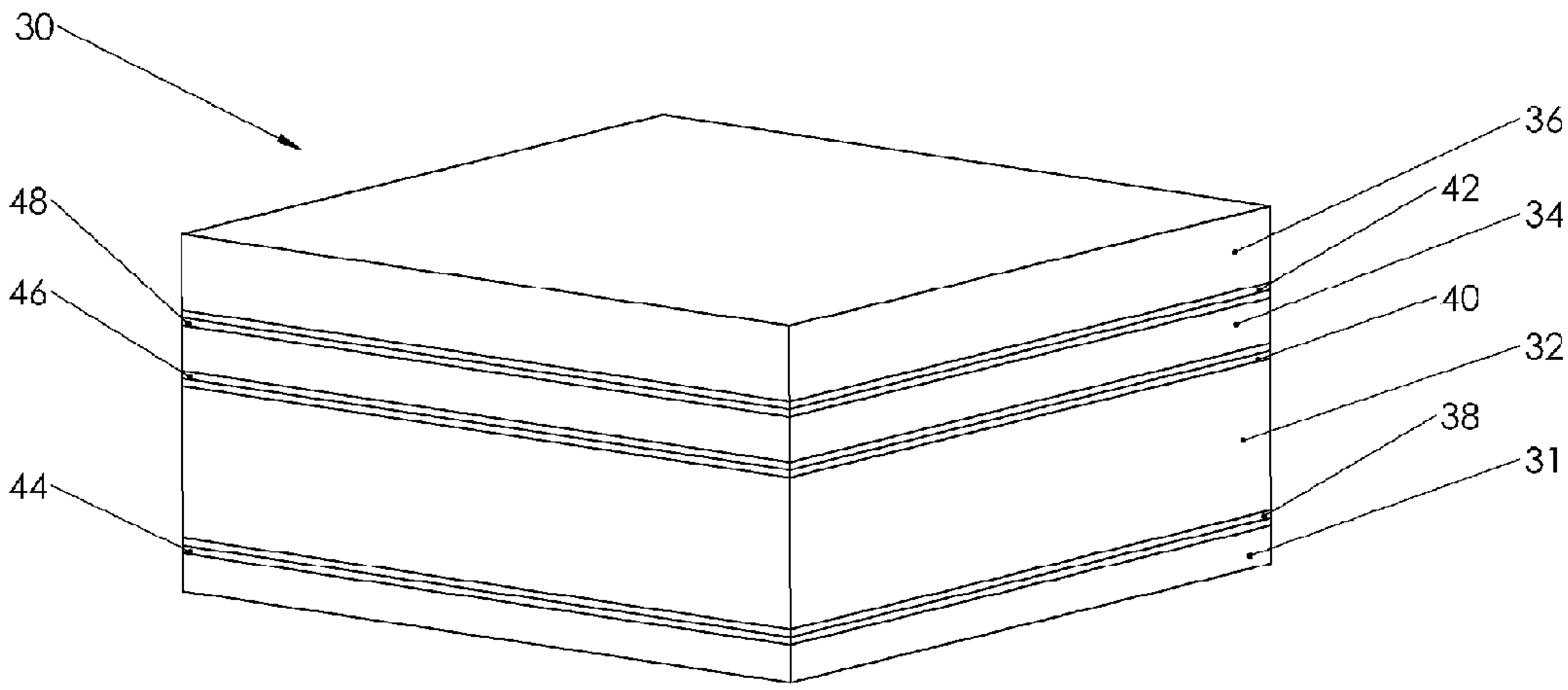

Fig. 3

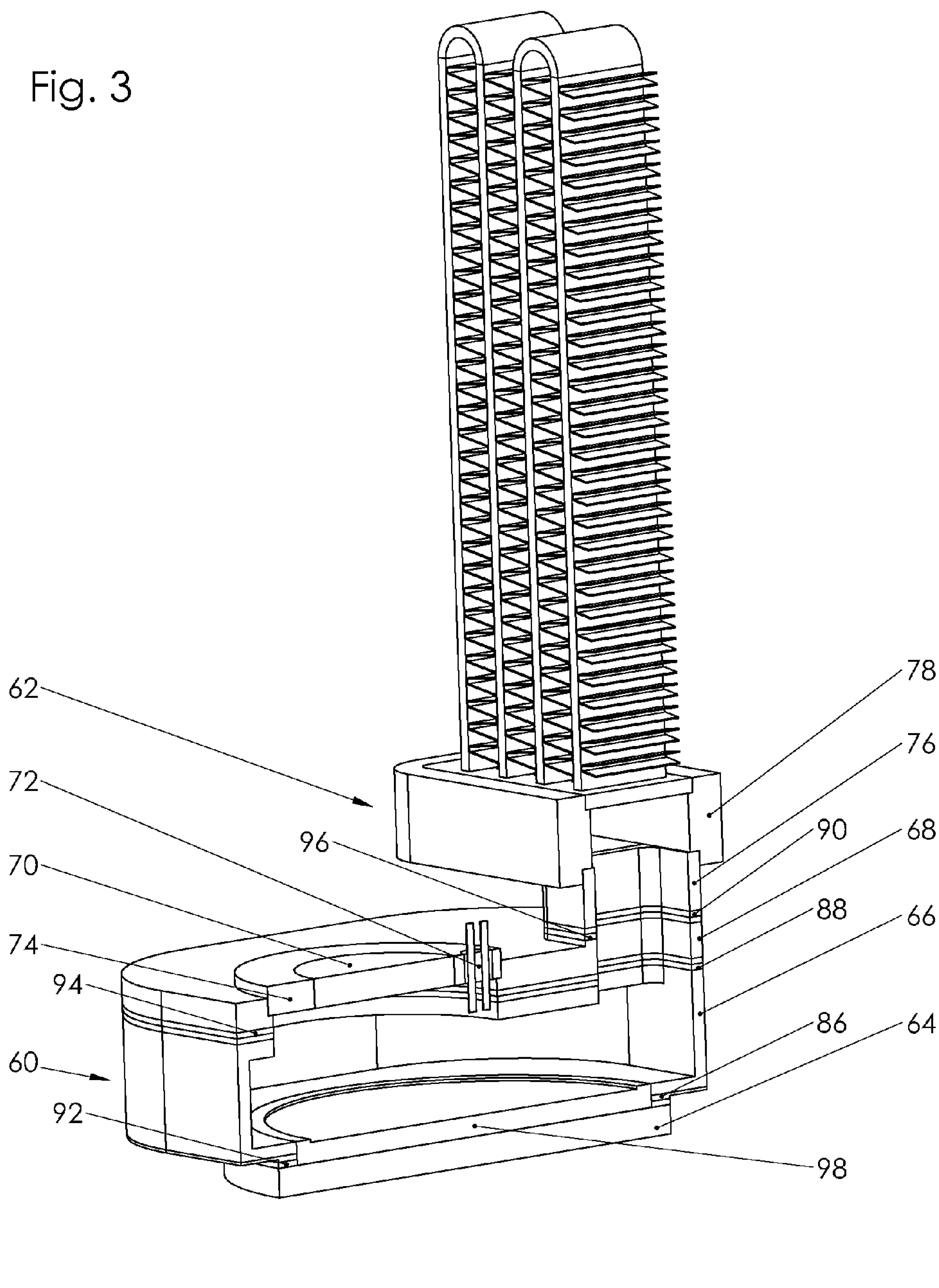

Fig.4

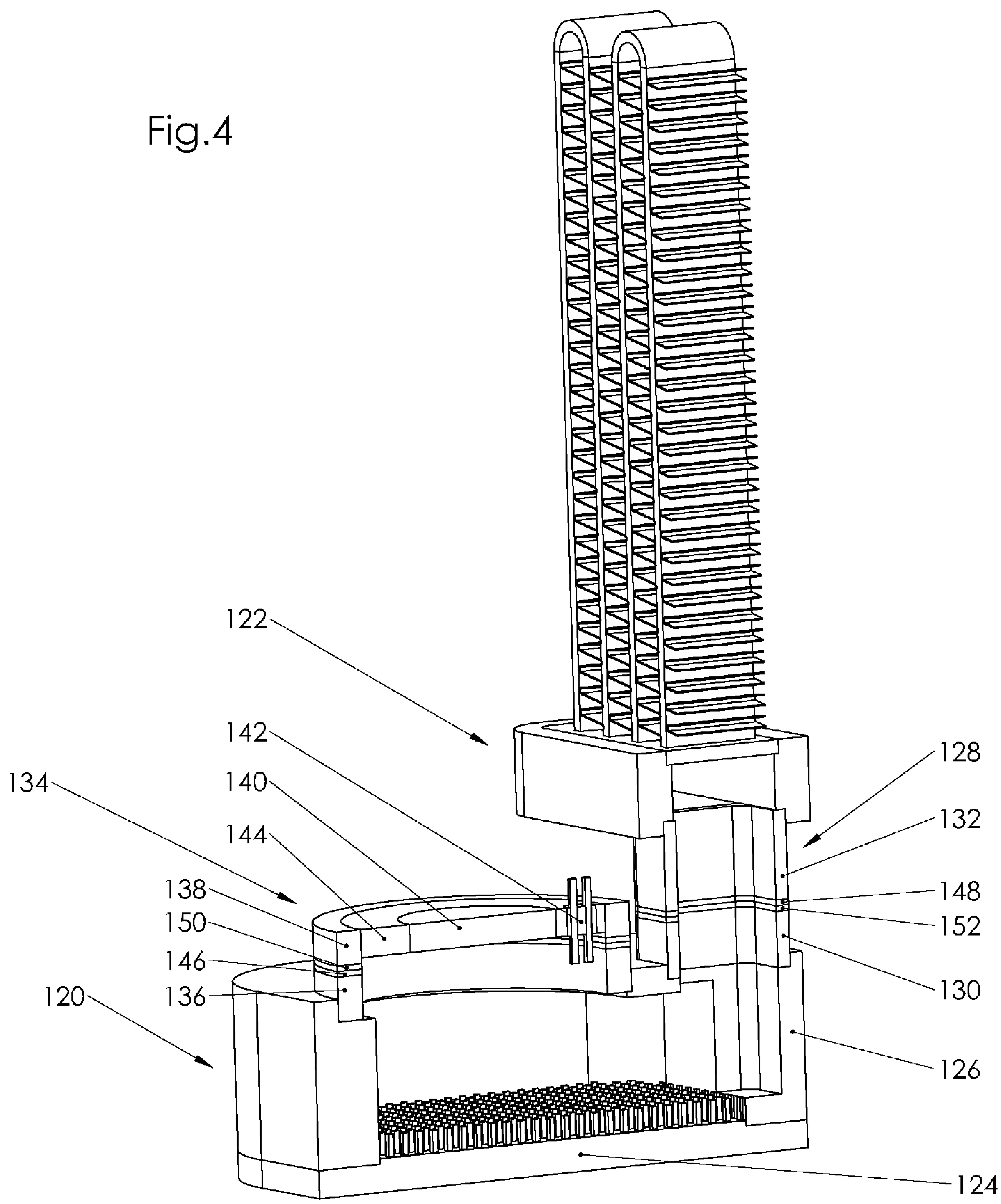
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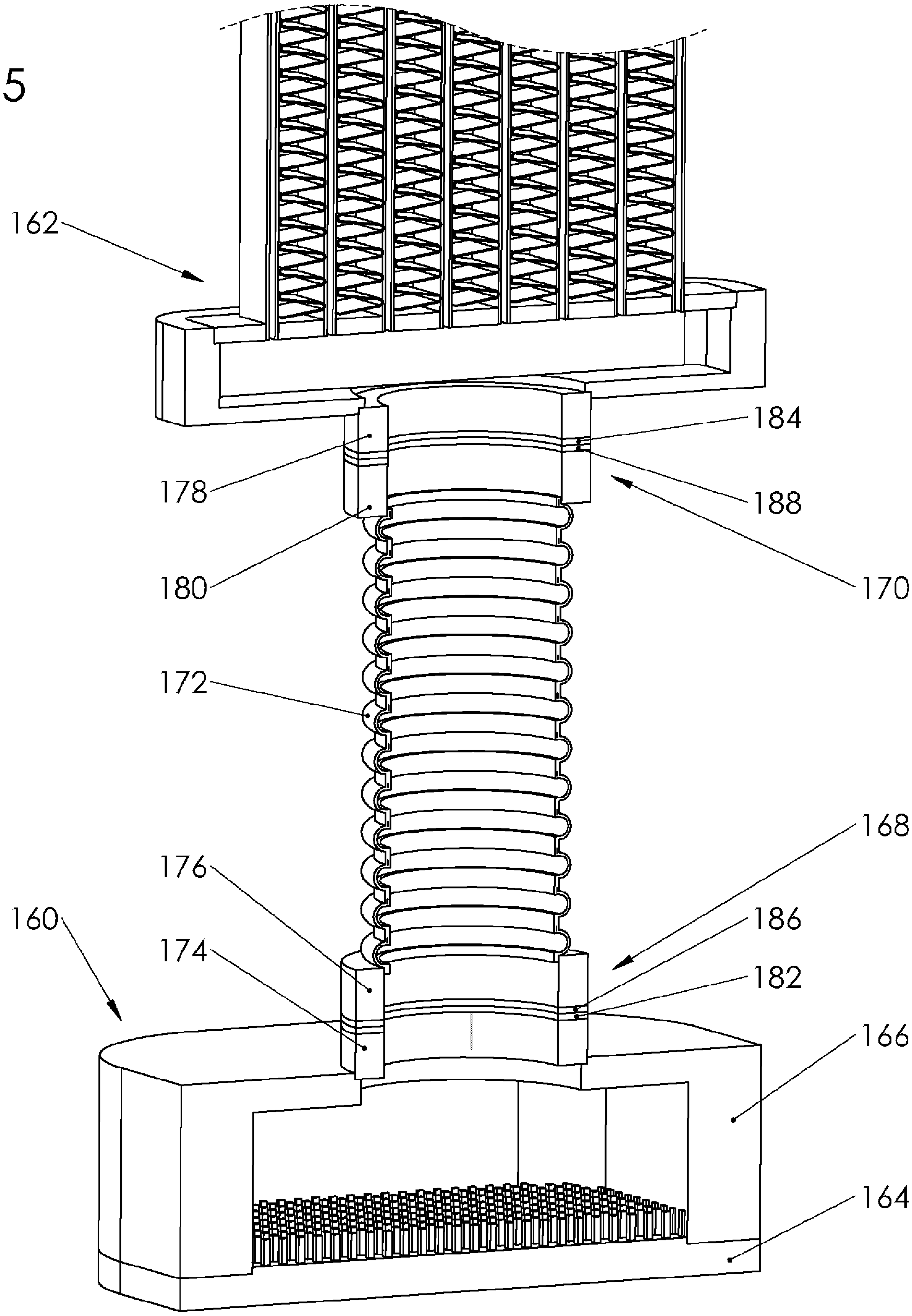
Fig. 5



EXPLOSION WELDED EVAPORATOR FOR USE IN TWO-PHASE HEAT TRANSFER APPARATUSES

FIELD OF THE INVENTION

[0001] The present invention pertains in general to heat transfer devices such as cooling devices for electronics and in particular to sealed two-phase heat transfer devices.

BACKGROUND

[0002] Two-phase heat transfer devices are well suited for electronics cooling applications and use the vapor phase change process inside a sealed space to efficiently transfer heat and mass. This sealed space needs to be hermetically sealed, withstand constant temperature cycling and contain both positive and negative pressures. As a result, conventional designs rely on using similar or same metals for the construction of this sealed space and are unable to properly combine various desirable metals and material properties.

[0003] Therefore there is a need for a two-phase heat transfer device that is not subject to one or more limitations of the prior art.

[0004] This background information is provided for the purpose of making known information believed by the applicant to be of possible relevance to the present invention. No admission is necessarily intended, nor should be construed, that any of the preceding information constitutes prior art against the present invention.

SUMMARY OF THE INVENTION

[0005] An object of the present invention is to provide an explosion welded evaporator of a two-phase heat transfer apparatus, and a two-phase heat transfer apparatus comprising same. In accordance with an aspect of the present invention, there is provided a two-phase heat transfer apparatus comprising: an evaporator comprising a heat input portion for transferring heat from an exterior of the evaporator to a working fluid located in an interior of the evaporator thereby phase changing at least a portion of the working fluid into working fluid vapour; and a condenser comprising a heat output portion for transferring heat from the working fluid vapour located in an interior of the condenser, thereby phase changing the working fluid vapour into working fluid, wherein the interior of the evaporator and the interior of the condenser are in fluidic communication with each other and form at least part of a hermetically sealed interior of the two-phase heat transfer apparatus; and wherein the apparatus comprises an explosion welded portion, the explosion welded portion including a first material explosion welded to a second material, the explosion welded portion forming part of a boundary defining the hermetically sealed interior.

[0006] In accordance with another aspect of the present invention there is provided an evaporator for use in a two-phase heat transfer apparatus, the evaporator comprising: a heat input portion for transferring heat from an exterior of the evaporator to a working fluid located in an interior of the evaporator thereby phase changing at least a portion of the working fluid into working fluid vapour; and a port for transfer of the working fluid vapour to a condenser, wherein the interior of the evaporator and the port are in fluidic communication with each other and form part of a hermetic interior of the two-phase heat transfer apparatus; and wherein the evaporator comprises an explosion welded portion, the explosion welded portion including a first material explosion welded to a second material, the explosion welded portion forming part of a boundary defining the hermetic interior.

BRIEF DESCRIPTION OF THE FIGURES

[0007] These and other features of the invention will become more apparent in the following detailed description in which reference is made to the appended drawings.

[0008] FIG. **1** is a section view of a basic two-phase thermosiphon apparatus.

[0009] FIG. **2** is a perspective view of the explosion welded plate material prior to machining, in accordance with one embodiment of the invention.

[0010] FIG. **3** is a section view of a two-phase thermosiphon apparatus with an explosion welded evaporator, in accordance with one embodiment of the invention.

[0011] FIG. **4** is a section view of a two-phase thermosiphon apparatus using a conventional evaporator with explosion welded adapters, in accordance with one embodiment of the invention.

[0012] FIG. **5** is a perspective view of a two-phase thermosiphon apparatus with a conventional evaporator design using explosion welded adapters located on the evaporator subassembly and condenser sub-assembly, and with evaporator sub-assembly and condenser sub-assembly are joined by a flexible stainless steel hose, in accordance with one embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

Definitions

[0013] Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs.

[0014] The present invention generally relates to design aspects of two-phase heat transfer apparatuses and evaporators used in a two-phase heat transfer apparatus, such as thermo-siphon apparatuses, looped thermo-siphon apparatuses, pumped two-phase apparatuses, capillary pumped loop apparatuses and looped heat pipe apparatuses. By using an explosion welding process various different metals and material properties can be combined for use in the evaporator and/or interconnector between the evaporator and condenser. The explosion welded metals may desirably form a hermetically sealed enclosure for a fluid heat transfer medium.

[0015] The explosion welding process allows for the metallurgical bonding of a wide range of metals, including bonding of traditionally incompatible metals and bonding of ferrous and non-ferrous metals. Bonds created by this process may potentially be of exceptionally high quality and/or allow true metallurgical bonding between a variety of metals. Typically, simple shapes are produced using the explosion welding process, but post-processing and machining of explosion welded material allows for parts with complex shapes and features to be produced. In embodiments of the present invention, materials created using the explosion welding process are used in two-phase heat transfer apparatuses in general and in evaporators in particular.

[0016] Various embodiments of the invention may also incorporate bonds between compatible or like materials which are other than explosion welding metallurgical bonds. For example, two components both made of aluminum, stainless steel, or other suitable material may be bonded by for example electron beam welding, CO2/YAG laser welding, friction welding, stir welding, tig/mig welding or other suitable bonding/welding process.

[0017] Explosion welding generally refers to a welding process accomplished by accelerating components toward each other using chemical explosives. For example, an early patent describing an explosion welding process is U.S. Pat. No. 3,137,937, and a related process is the Detaclad™ process currently associated with Dynamic Materials Corporation. Explosion welding may be used to form a block comprising different metals fused together, referred to as a clad. The clad is subsequently machined into a desired shape. In the present invention this comprises machining the clad into a component of a two-phase heat transfer apparatus, the component having an aperture or cavity formed therein with a boundary defined by at least two different metals of the clad, this boundary thus being hermetic at least in part by virtue of the explosion weld.

[0018] Embodiments of the present invention described herein generally relate to two-phase heat transfer apparatuses and evaporators used in two-phase heat transfer apparatuses, including but not limited to two-phase heat transfer apparatuses such as thermo-siphon apparatuses, looped thermo-siphon apparatuses, capillary pumped loop apparatuses, loop heat pipe apparatuses and pumped two-phase apparatuses. While this description is directed primarily at the two-phase thermo-siphon, the principles described in that embodiment can be readily applied to other heat transfer apparatuses.

[0019] In various embodiments, there is provided a two-phase heat transfer apparatus comprising at least an evaporator and a condenser, and possibly other components such as a manifold to allow for liquid and vapor transport between the evaporator and the condenser. The evaporator has a heat input portion for transferring heat from an exterior of the evaporator, for example from a CPU or other electronic unit thermally connected thereto, to a working fluid located in an interior of the evaporator. The heat transfer phase changes the working fluid into working fluid vapour which flows to the condenser. The condenser has a heat output portion for transferring heat from the working fluid vapour located in an interior of the condenser, thereby phase changing the working fluid vapour into working fluid which flows to the evaporator. In this manner the heat generated in the proximity of the evaporator can be extracted and dissipated at the condenser location. The interior of the evaporator and the interior of the condenser are in fluidic communication with each other and form at least part of a hermetically sealed interior of the two-phase heat transfer apparatus. The apparatus comprises an explosion welded portion which includes a first material explosion welded to a second material and forms part of a boundary defining the hermetically sealed interior. The explosion welded portion facilitates the use of multiple materials, such as but not limited to copper and aluminum, or copper and aluminum and stainless steel, while allowing the transition between these materials to form a hermetic portion of the hermetically sealed interior due to the hermetic nature of the explosion weld. Thus, for example, the thermal conductivity of copper can be combined with desirable properties of aluminum, such as lightness, low cost and/or ability to be formed into robust multiport tubes.

[0020] In some embodiments, stainless steel can also be combined with copper to facilitate incorporation of another feature for example a view glass window. For this example a view glass window can be created via glass-to-metal sealing, wherein the view glass window has a frame of stainless steel for example, which may be subsequently be welded to the stainless steel of the clad which forms a boundary of the hermetically sealed interior.

[0021] It is noted that not all connections in the apparatus are necessarily explosion welds. Reliable hermetic bonds can be provided through other means provided same or compatible materials are being bonded. The use of explosion welds is employed to provide hermetic transitions between otherwise incompatible materials. In various embodiments, if it is desired to provide a hermetic transition between a component made of Material A and a component made of Material B, either the two components (or material to be later formed via machining into said components) can be directly coupled via an explosion weld, or the component made of Material A (or material thereof) can be explosion welded to an intermediate portion of Material B, which is then hermetically bonded via another means to the component made of Material B. Alternatively, if available, the intermediate portion can be made of a different material that is nonetheless able to be hermetically bonded with Material B through a non-explosion weld bonding means.

[0022] When the term "hermetic" is used herein to refer to a bond, weld, or the like, it is generally understood that the bond or weld in question comprises an inner surface which is exposed to an interior chamber of the heat transfer apparatus which is to contain the working fluid and thus is to be hermetically sealed.

[0023] Various embodiments of the present invention relate to providing a hermetically sealed enclosure of a two-phase heat transfer apparatus, for hermetically containing a fluid heat transfer medium or working fluid. In particular, the enclosure comprises multiple materials such as copper and aluminum or copper, stainless steel and aluminum, which are traditionally difficult to physically join together in a robust and hermetic manner. For example, electron beam welding, CO2/YAG laser welding, friction welding, stir welding, tig/mig welding, etc. are all unsuitable processes due to the strong reactivity of aluminum at elevated temperatures which cause it to create iron containing brittle interlayers. Embodiments of the present invention relate to a recognition that explosion welding may be advantageously employed for joining dissimilar metals in the desired manner, particularly for use in creating hermetic cavities of a two-phase heat transfer apparatus and/or components thereof

[0024] In some embodiments, in order to incorporate a window or view glass into the apparatus, a ferrous stainless steel frame is provided. The stainless steel frame facilitates providing a hermetic glass-to-metal seal using processes known in the art, for example including wetting molten glass to a metal frame and a closely matched thermal expansion of the glass and metal frame to provide a solid seal as the assembly cools. The ferrous stainless steel frame is directly or indirectly coupled to other materials of the apparatus via an explosion weld material transition. For example, the stainless steel frame may be hermetically bonded to a corresponding stainless steel portion of an adaptor or evaporator body, the corresponding stainless steel portion being previously explosion welded to another material such as copper or aluminum. This approach addresses a problem of how to robustly and hermetically integrate a ferrous stainless steel frame of the window assembly into a two phase heat transfer apparatus, particularly one which is traditionally made of aluminum.

[0025] Various embodiments of the present invention use copper, silver, or another material with high thermal conductivity for thermal performance, for example by use of a copper or silver base plate for conducting heat into the evaporator. At the same time, the use of aluminum is desirable for certain portions of the apparatus as it is lightweight, low cost, and also amenable to forming multiport tubes through an extrusion process, whereas copper is generally too brittle to form reliable multiport tubes. Such aluminum multiport tubes are useful for forming the condenser of the apparatus. In some embodiments, the use of multiport tubes effectively reduces the surface area so their operating and burst pressure may be at least 20 to 50 times higher than flat brass or copper tubes. For example, multiport aluminum tubes may have burst pressures between 1,000 and at least 4,000 PSI. It is noted that multiphase devices offer considerably higher performance with medium and high pressure working fluids.

[0026] Referring now to FIG. **1** there is shown a basic overview of a two-phase thermo-siphon apparatus having an evaporator base **10**, evaporator body **12**, a manifold **14** or other means to allow for liquid and vapour transport between the evaporator to the condenser, a tube sheet **16**, condenser tubes **18** and heat exchange fins **20**. Together with a refrigerant (working fluid) these components form a two-phase heat transfer apparatus. Suitable refrigerants may include but are not limited to R134a (Tetrafluoroethane), 8290, Hydrofluoroethers, Acetone, Isobutane, Water and R717 (Ammonia). By utilizing the phase changes of the refrigerant from a liquid phase to a vapor phase and back to a liquid phase, heat can be absorbed by the evaporator sub-assembly **22** and discharged by the condenser sub-assembly **24**.

[0027] FIG. **2** is a perspective view of an explosion welded plate **30** prior to machining into a suitable evaporator shape. This embodiment shows one of many possible combinations of metals and layers. In this example, the explosion welded plate **30** includes copper **31** providing high thermal conductivity, aluminum **32** used as material for a low weight evaporator body, stainless steel **34** for bonding various components such as sight-glasses and feed-through connectors, and a layer of aluminum **36** to allow for easy connection to a light weight heat exchangers such as a brazed aluminum condenser. In this embodiments, layers of **1100** grade pure aluminum **38**, **40** & **42** and titanium **44**, **46** & **48** are used to provide intermetallic compatibility and improve joint ductility. The layers of aluminum **38**, **40** & **42** and titanium **44**, **46** & **48** are just one example and other suitable metals for these purposes include but are not limited to Tantalum, Niobium and Molybdenum. The layers **38**, **40**, **42**, **44**, **46** & **48** may potentially be made thin, for example on the order of micrometers or tens of micrometers. As illustrated, the plate **30** is horizontally stratified into its different layers, this representing one of a variety of design options.

[0028] A variety of other metal combinations are possible, including an increased and decreased number of layers. As an example, the copper layer **31** could also be made out of silver for increased thermal conductivity. As another example, the aluminum layer **32** could also be made out of brass. As another example, the stainless steel layer **34** could also be made out of Kovar™ or similar alloy such as a Fernico (iron, nickel cobalt) or nickel-cobalt ferrous alloy to allow for the joining of other components that require bonding to this material. As another example, the aluminum layer **36** can be changed to accommodate different types and metals of liquid- and vapor transport tubes, or serve as a means to directly attach various types of heat exchangers. Other material combinations are possible and may be chosen depending on design requirements and refrigerant (working fluid) compatibility. Compatibilities between material and working fluid would be readily understood by a worker skilled in the art.

[0029] In some embodiments, an explosion welded plate comprises at least a first layer of a first metal providing high thermal conductivity, such as copper, and a second layer of a second, different metal for facilitating connection to a heat exchanger, such as aluminum in the case of an aluminum heat exchanger/condenser. One or more layers of additional material may be interposed between the first layer and the second layer, for example similarly to the layers **38**, **40**, **42**, **44**, **46** & **48** described above. For example, in one embodiment, the uppermost layers **40**, **46**, **34**, **48**, **42** and **36**, as illustrated in FIG. **2**, are omitted.

[0030] In various embodiments, the condenser comprises multi-port tubes, such as multi-port extruded aluminum tubes, or multi-port tubes of another material, for flow of the fluid heat transfer medium or working fluid. Such tubes have various desirable properties for use in heat transfer applications, for example being tolerant to suitable internal pressures from the fluid. Since aluminum is generally a suitable material for such multi-port tubes the condenser may be formed of aluminum. Thus the explosion welded interface provides a means for hermetically interconnecting an aluminum condenser section to an evaporator which at least in part includes different materials such as copper.

[0031] FIG. **3** is a section view of a two-phase thermo-siphon apparatus with an explosion welded evaporator sub-assembly **60** combining various different metals and material properties. In this example, the layers include copper **64** providing high thermal conductivity, aluminum **66** used as a material for a low weight evaporator body, stainless steel **68** for bonding of the sight glass **70** and the feed-through connector **72** housed in a stainless steel frame **74**. The sight glass **40** can allow for observation of the boiling process (namely phase transfer from liquid to vapour of the working fluid) inside the evaporator. In some embodiments a feed-through connector **72** can provide an electrical connection for an internal device, for example an LED to illuminate the boiling process (not shown). The sight glass **40** may be useful for example for facilitating verification that the heat transfer apparatus is operating, that fluid leakage or breaking of the hermetic seal has occurred, or the like. The sight glass **40** may also be useful for conveying optical signals. The following aluminum layer **76** is used to allow easy joining to a heat exchanger such as a brazed-aluminum condenser sub-assembly **62**. A sintered boiling enhancement coated copper plate **98** is bonded to the inside copper surface of the evaporator sub-assembly **60** and may operate to increase heat transfer coefficient, increase critical heat flux and/or reduce surface super heat. The copper layer **64** can protect the sintered and thus annealed and soft copper plate **98** from possible deformation during installation and operation of the thermo-siphon apparatus. The aforementioned sintered copper plate **98** is just one of several ways of potentially modifying and/or increasing performance of the apparatus. Various embodiments include features such as but not limited to roughened surfaces, organic boiling enhancement coatings and paints and machined structures like pins, waves and fins or a combination thereof Layers of **1100** grade pure aluminum **86**, **88** & **90** and titanium **92**, **94** & **96** may be used to provide intermetallic compatibility and improve joint ductility. The layers of aluminum **86**, **88** & **90** and titanium **92**, **94** & **96** are just one example and other suitable metals for these purposes include but are not limited to Tantalum, Niobium and Molybdenum.

[0032] In one embodiment, the feed through connector comprises metallic conductors passing through a glass structure similar to but typically smaller than the sight glass **40**. The glass operates as an insulator and is also hermetically bonded to both the metallic conductors and the edges of the aperture formed in the frame **74** for housing same. In various embodiments, one or both of the feed through connector and the sight glass may be omitted. In one embodiment the feed through connector and the sight glass may be incorporated, with the conductors of the feed through connector being routed through optically transparent sight glass.

[0033] In some embodiments, optical signals may be routed through the sight glass to and/or from an exterior and/or interior optical transmitter and/or receiver. In some embodiments, a visual indicator such as an LED display may be provided inside the device and visible through via the sight glass.

[0034] A wide variety of other metal combinations are possible, including an increased and decreased number of layers. As an example, the copper layer **64** could also be made out of silver for increased thermal conductivity. As another example, the aluminum layer **66** could also be made out of brass. As another example yet, the stainless steel layer **68** could also be made out of Kovar™ or similar alloy such as a Fernico (iron, nickel cobalt) or nickel-cobalt ferrous alloy to allow for the joining of other components that require bonding to this material. Other material combinations are possible and may be chosen depending design requirements and refrigerant compatibility.

[0035] FIG. **4** is a section view of a two-phase thermosiphon apparatus using a conventional evaporator sub-assembly **120**. In this example, the evaporator base **124** and evaporator body **126** are made out of copper. Explosion welded adapters **128** & **134** are used to connect components with different metals to the evaporator sub-assembly **120**. The first explosion welded adapter **128** includes a layer of copper **130** that is joined to the evaporator sub-assembly **120** and a layer of aluminum **132** that is joined to a heat exchanger such as a brazed aluminum condenser sub-assembly **122**. The second explosion welded adapter **134** includes a layer of copper **136** and a layer of stainless steel **138**. The copper layer **136** of explosion welded adapter **134** is joined to the evaporator sub-assembly **120** and the stainless steel layer **138** is used to connect a sight- glass **140** and feed through connector **142** housed inside of a stainless steel frame **144**. Layers of **1100** grade pure aluminum **146** & **148** and titanium **150** & **152** are used to provide intermetallic compatibility and improve joint ductility. The layers of aluminum **146** & **148** and titanium **150** & **152** are just one example and other suitable metals for these purposes include but are not limited to Tantalum, Niobium and Molybdenum. In one embodiment one of the two explosion welded adapters **128** & **134** are provided. In another embodiment both of the explosion welded adapters **128** & **134** are provided.

[0036] In various embodiments, the explosion welded adaptors provide a means for functionally interconnecting components of different materials such that some or all of the physical interfaces between different, potentially incompatible materials are explosion welded physical interfaces.

[0037] A wide variety of other metal combinations are possible, including an increased and decreased number of layers. As an example, the evaporator sub-assembly **120** can also be made out of other metals like aluminum. In this instance the copper layers on the explosion welded adapters **128** & **134** would be changed to aluminum. As another example, the stainless steel layer **138** could be changed to Kovar™ or similar alloy such as a Fernico (iron, nickel cobalt) or nickel-cobalt ferrous alloy in case other components require bonding to this type of material. In this instance the stainless steel layer **138** of explosion welded adapter **134** would be changed to Kovar™ or the similar alloy. Other material combinations are possible and may be chosen depending design requirements and refrigerant compatibility.

[0038] FIG. **5** is a section view of a two-phase thermosiphon apparatus with a conventional evaporator sub-assembly **160** and a condenser sub-assembly **162**. In this example, the evaporator base **164** and evaporator body **166** are made out of copper. Explosion welded adapters **168** & **170** are used to connect the copper evaporator sub-assembly **160** via a flexible stainless steel hose **172** to the condenser sub-assembly **162**. The first explosion welded adapter **168** includes a layer of copper **174** that is joined to the copper evaporator sub-assembly **160** and a layer of stainless steel **176** that is joined to the stainless steel hose **172**. The second explosion welded adapter **170** includes a layer of aluminum **178** that is joined to the condenser sub-assembly **162** and a layer of stainless steel **180** that is connected to the flexible stainless steel hose **172**. Layers of **1100** grade pure aluminum **182** & **184** and titanium **186** & **188** are used to provide intermetallic compatibility and improve joint ductility. The layers of aluminum **182** & **184** and titanium **186** & **188** are just one example and other suitable metals for these purposes include but are not limited to Tantalum, Niobium and Molybdenum. In one embodiment, a view glass may be hermetically incorporated into the stainless steel hose.

[0039] As illustrated in FIGS. **1**, **3**, **4** and **5**, the condenser comprises tubes formed in a switched back configuration with heat transfer fins integrated therebetween and in thermal communication, for enhancement of thermal transfer from the condenser. In addition, as illustrated in these figures, the end of the condenser distal to the evaporator can be formed in an open ended type configuration which can enhance heat transfer.

[0040] A wide variety of other metal combinations are possible, including an increased and decreased number of layers. As an example, the flexible stainless steel hose **172** could be changed to flexible brass hose or stainless, copper or aluminum piping. As another example, the evaporator sub-assembly **160** can be made out of other materials like aluminum. In these instances the materials of explosion welded adapters **168** & **170** should be changed to be compatible with chosen materials. As another example, the evaporator sub-assembly **160** can be connected to a wide variety of heat exchangers including but not limited to air and liquid cooled heat condensers such as brazed plate heat exchangers and various other heat exchanger types. Other material combinations are possible and may be chosen depending design requirements and refrigerant (working fluid) compatibility.

[0041] It is readily understood that a wide variety of metals and layer combinations is possible and this description only outlines some possible combinations of materials.

[0042] While particular embodiments have been described in the foregoing, it is to be understood that other embodiments are possible and are intended to be included herein. It will be clear to any person skilled in the art that modifications of and adjustments to the foregoing embodiments, not shown, are possible.

[0043] Moreover, it is obvious that the foregoing embodiments of the invention are examples and can be varied in many ways. Such present or future variations are not to be regarded as a departure from the scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.

1. A two-phase heat transfer apparatus comprising:

an evaporator comprising a heat input portion for transferring heat from an exterior of the evaporator to a working fluid located in an interior of the evaporator thereby phase changing at least a portion of the working fluid into working fluid vapour; and

a condenser comprising a heat output portion for transferring heat from the working fluid vapour located in an interior of the condenser, thereby phase changing the working fluid vapour into working fluid,

wherein the interior of the evaporator and the interior of the condenser are in fluidic communication with each other and form at least part of a hermetically sealed interior of the two-phase heat transfer apparatus; and

wherein the apparatus comprises an explosion welded portion, the explosion welded portion including a first material explosion welded to a second material, the explosion welded portion forming part of a boundary defining the hermetically sealed interior.

2. The apparatus of claim **1**, wherein the apparatus further comprises at least one additional explosion welded portion, each of the at least one additional explosion welded portion including two different materials explosion welded together and forming part of the boundary defining the hermetically sealed interior.

3. The apparatus of claim **1**, wherein the explosion welded portion is integral with the heat input portion of the evaporator.

4. The apparatus of claim **1**, wherein the first material of the explosion welded portion is hermetically bonded, via a bond other than an explosion weld, to a bonding site of the evaporator, the bonding site integral with the heat input portion, the first material and a material at the bonding site being materials amenable to said hermetic bonding.

5. The apparatus of claim **4**, wherein the explosion welded portion forms an integral part of an adaptor hermetically bonded to the bonding site of the evaporator, the adaptor further hermetically bonded to another component of the apparatus.

6. The apparatus of claim **5**, wherein the adapter further comprises an additional explosion welded portion including two different materials explosion welded together and forming part of the boundary defining the hermetically sealed interior.

7. The apparatus of claim **1**, wherein a lower part of the evaporator is formed of the first material, the first material being copper or silver, and wherein the explosion welded portion facilitates a transition from the first material to the second material.

8. The apparatus of claim **1**, wherein an upper part of the evaporator is formed of the second material, the second material being stainless steel, Fernico, aluminum or brass, and wherein the explosion welded portion facilitates a transition from the second material to the first material.

9. The apparatus of claim **1**, wherein the explosion welded portion further includes at least one transition layer of a third material explosion welded between the first material and the second material.

10. The apparatus of claim **1**, further comprising a sight glass hermetically bonded to a metallic frame and forming part of the boundary defining the hermetically sealed interior.

11. The apparatus of claim **10**, wherein the metallic frame is hermetically bonded to a predetermined part of the evaporator via a bond other than an explosion weld, said predetermined part of the evaporator being a material amenable to said hermetic bonding, and wherein said predetermined part of the evaporator is integral with the explosion welded portion.

12. The apparatus of claim **11**, wherein said predetermined part of the evaporator is integral with the heat input portion, or coupled to the heat input portion via one or more explosion welds, or coupled to the heat input portion via one or more hermetic bonds other than explosion welds, or coupled to the heat input portion via a combination of explosion welds and hermetic bonds other than explosion welds.

13. The apparatus of claim **12**, wherein the metallic frame and the predetermined part of the evaporator are stainless steel.

14. The apparatus of claim **1**, wherein the heat output portion of the condenser comprises multi-port aluminum tubes.

15. The apparatus of claim **1**, further comprising one or more electrical conductors hermetically encased in glass, the glass hermetically bonded to a metallic frame and forming part of the boundary defining the hermetically sealed interior.

16. The apparatus of claim **1**, wherein the heat input portion is formed of copper, said copper being the first material of the explosion welded portion and comprising an inside surface facing the interior of the cavity, the apparatus further comprising a sintered copper plate bonded to the inside surface.

17. The apparatus of claim **16**, wherein the copper of the heat input portion is non-annealed and protects the sintered copper plate.

18. The apparatus of **1**, wherein an end of the condenser distal to the evaporator is open ended type configuration formed having an open ended type configuration.

19. An evaporator for use in a two-phase heat transfer apparatus, the evaporator comprising:

a heat input portion for transferring heat from an exterior of the evaporator to a working fluid located in an interior of the evaporator thereby phase changing at least a portion of the working fluid into working fluid vapour; and

a port for transfer of the working fluid vapour to a condenser,

wherein the interior of the evaporator and the port are in fluidic communication with each other and form part of a hermetic interior of the two-phase heat transfer apparatus; and

wherein the evaporator comprises an explosion welded portion, the explosion welded portion including a first material explosion welded to a second material, the explosion welded portion forming part of a boundary defining the hermetic interior.

20. The evaporator of claim **19**, wherein the evaporator further comprises at least one additional explosion welded portion, each of the at least one additional explosion welded portions including two different materials explosion welded together and forming part of the boundary defining the hermetic interior.

21. The evaporator of claim **19**, wherein the explosion welded portion is integral with the heat input portion.

22. The evaporator of claim **19**, wherein the first material of the explosion welded portion is hermetically bonded, via a bond other than an explosion weld, to a bonding site of the evaporator, the bonding site integral with the heat input portion, the first material and a material at the bonding site being materials amenable to said hermetic bonding.

23. The evaporator of claim **22**, wherein the explosion welded portion forms an integral part of an adaptor hermetically bonded to the bonding site of the evaporator, the adaptor either being further hermetically bonded to another component of the evaporator or being configured for hermetic bonding to another component of the two-phase heat transfer apparatus.

24. The evaporator of claim **23**, wherein the adapter further comprises an additional explosion welded portion including two different materials explosion welded together and forming part of the boundary defining the hermetic interior.

25. The evaporator of claim **19**, wherein a lower part of the evaporator is formed of the first material, the first material being copper or silver, and wherein the explosion welded portion facilitates a transition from the first material to the second material.

26. The evaporator of claim **19**, wherein an upper part of the evaporator is formed of the second material, the second material being stainless steel, Fernico, aluminum or brass, and wherein the explosion welded portion facilitates a transition from the second material to the first material.

27. The evaporator of claim **19**, wherein the explosion welded portion further includes at least one transition layer of a third material explosion welded between the first material and the second material.

28. The evaporator of claim **19**, further comprising a sight glass hermetically bonded to a metallic frame and forming part of the boundary defining the hermetic interior.

29. The evaporator of claim **28**, wherein the metallic frame is hermetically bonded to a predetermined part of the evaporator via a bond other than an explosion weld, said predetermined part of the evaporator being a material amenable to said hermetic bonding, and wherein said predetermined part of the evaporator is integral with the explosion welded portion.

30. The evaporator of claim **29**, wherein said predetermined part of the evaporator is either integral with the heat input portion, coupled to the heat input portion via one or more explosion welds, coupled to the heat input portion via one or more hermetic bonds other than explosion welds, or coupled to the heat input portion via a combination of explosion welds and hermetic bonds other than explosion welds.

31. The evaporator of claim **30**, wherein the metallic frame and the predetermined part of the evaporator are stainless steel.

32. The evaporator of claim **19**, further comprising one or more electrical conductors hermetically encased in glass, the glass hermetically bonded to a metallic frame and forming part of the boundary defining the hermetic interior.

33. The evaporator of claim **19**, wherein the heat input portion is formed of copper, said copper being the first material of the explosion welded portion and comprising an inside surface facing the interior of the cavity, the evaporator further comprising a sintered copper plate bonded to the inside surface.

34. The evaporator of claim **33**, wherein the copper of the heat input portion is non-annealed and protects the sintered copper plate.

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