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(73) **Titulaire(s) :**

Deutsches Zentrum für Luft- und Raumfahrt e.V.,
Linder Höhe,
KÖLN 51147 (DE)

(72) **Inventeur(s) :**

KRAFT, Werner (DE);
LANZ, Tim (DE);
VETTER, Peter (DE) ;
STAHL, Veronika (DE)

(74) **Mandataire : S.C.P AKKUM, AKKUM & Associates, No. 1777, rue 6.261, Yaoundé, Auditorium Jean Paul II, Quartier Mbankolo, B.P. 4966, YAOUNDE (CM).**

(54) **Titre : Portable heat source.**

(57) **Abrégé :**

The invention relates to a portable heat source in the form of a cooking plate (100) and/or a hot plate (200) and/or an oven (300), comprising a heating core (10) containing at least one phase-change material (50) in a housing (40), wherein the heating core (10) is surrounded by a heat insulation (70) at least in some regions, and the phase-change material (50) comprises a metallic or semi-metallic phase-change material (50).

Description

PORTABLE HEATING SOURCE

State of the art

The invention relates to a portable heating source in the form of a cooking plate and/or a warming plate and/or an oven.

It is known to use portable heating sources, for example, in cooler temperatures outdoors in the form of gas-powered mushroom heaters and in the form of grills and gas stoves when camping. Gas cartridges or barbecue charcoal must be stored for this purpose. Indoor use is not intended because of the exhaust fumes from burning gas or coal.

DE102015012017A1 discloses an apparatus for tempering baby bottles with a latent heat PCM material having a melting temperature at 37 °C.

DE102013114507B3 discloses a device for providing a drinking temperature of 60 ° for hot beverages or a temperature of 30 °C for baby food. A mixture containing stearic acid as a PCM material with a melting temperature of 69 °C is used.

US20180084943A1, US20170042373A1 and US20160242598A1 disclose a device such as a drinking vessel in which a PCM material is used to cool a beverage or food that is too hot. Controllable heating elements are provided to warm up a cool or cold beverage. Kerosene is used as the PCM material for cooling.

EP2997865A2 describes a steam cooking insert for a food processor in which water is used as the PCM material.

Disclosure of the invention

The object of the invention is to disclose a portable heating source which, when used, is free from combustion exhaust gases and can be used indoors as well as outdoors.

The object is solved by the features of the independent claim. Favorable embodiments and advantages of the invention are apparent from the further claims, the description and the drawing.

A portable heating source in the form of a cooking plate and/or a warming plate and/or an oven is proposed with a heating core containing at least one phase change material in an enclosure, wherein the heating core is surrounded at least in regions by a thermal insulation The phase change material comprises a metallic or semi-metallic phase change material.

The heating core provides a thermal storage device with which high-temperature heat storage can be realized. In particular, heat storage with the metallic phase change material, also known as mPCM, is achieved via latent heat and sensible heat. During phase transition, the metallic phase change material can absorb thermal energy without temperature change in solid phase until the metallic phase change material is completely melted or release thermal energy in liquid phase until the metallic phase change material is completely solidified.

Heat, and in particular latent and sensible heat, can be stored for a longer period of time via the metallic phase change material. In particular, heat can be stored at a high temperature level, which is, for example at at least 500 °C and in particular at about 600 °C to 650 °C. Depending on the type of metallic phase change material (mPCM), heat can be stored at a temperature level of up to 1500 °C. For example, pure silicon with a phase change temperature of 1414 °C or SiB_3 with a phase change temperature of 1385 °C can be used.

The metallic phase change material is in the liquid state depending on the thermal state, the metallic phase change material is in the liquid state or solid state. A favourable phase change material is, for example, $AlSi_{12}$.

If, for example, $AlSi_{12}$ is used as a metallic phase change material in the temperature range from 25 °C to 600 °C, it has an energy density of approx. 300 Wh/kg or approx. 795 Wh/l.

By comparison, due to the use of relatively small temperature intervals in warm water bottles, for example, only relatively low energy densities can be achieved. The energy density of a warm water bottle filled with water and heated from 25 °C to 95 °C, for example, is around 80 Wh/kg or 80 Wh/l.

As an advantage over systems that use gas as fuel, for example, as is the case with a mushroom heater or camping stove, fossil fuels can be dispensed with. In any case, there is at least a local absence of emissions, so that indoor as well as outdoor use is possible.

In the case of regeneration of the metallic phase change material, in which the phase change material is melted, loading can be carried out with electrical energy from renewable energy sources or loading can be carried out by means of concentrated solar radiation, so that global freedom from emissions can also be advantageously achieved.

The mobile provision of thermal energy by the portable heating source is particularly advantageous. The mobile provision can be realized by loading the heating core of the heating source at a certain location and releasing this heat at another location where no infrastructure is available for loading.

It is also possible to have a significant time offset between the loading and the release of the thermal energy. The metallic phase material is discharged passively, i.e. by convection, thermal conduction or thermal radiation due to a temperature gradient.

The mobile heating source can be used for the preparation or heating of food or for the direct heating of persons or rooms in buildings or also tents or caravans.

Advantageously, a heating source with a high energy density can be provided.

According to a favorable embodiment, the phase change material of the portable heating source may comprise a metallic alloy or semi-metallic alloy having one or more of aluminium, silicon, copper, magnesium, boron, zinc, in particular an AlSi alloy, preferably $AlSi_{12}$. Favorable alloys are eutectic alloys and intermetallic compounds, for example various silicides, in which the phase change takes place with the absorption or release of latent heat.

Further favorable are in particular binary alloys or ternary alloys and alloy systems with more than three components, with a eutectic composition or an intermetallic composition with at least one of the above mentioned components Al, Si, Cu, Mg, B, Zn.

Some advantageous examples among a variety of known such systems are $AlSi_{12}$ with T_S = 577 °C; $AlCu_{27}Si_5$ with T_S = 522 °C; $AlMg_{28}Zn_{13}$ with T_S = 461 °C; $Al_{61}Mg_{39}$ with T_S = 466 °C; $MgZn_{52}$ with Ts=346 °C; $ZnAl_4Mg_2$ with T_S = 351 °C; $CuCa_{30}Al_{14}$ with T_S = 294 °C, where T_S is the respective phase change temperature.

Suitable materials for different temperature ranges may be selected.

According to a favorable embodiment, a heat conducting device may be arranged in the enclosure, in particular within an area with phase change material. The heat conduction device can advantageously enable the supply of heat into the metallic phase change material or the release of heat from the metallic phase change material and provide for stable thermal conditions, for example in the heating core during loading with solar radiation and in the area of the heat transfer surface, e.g. a cooking plate, during unloading from the heating core. For example, the heat conduction device may have heat conduction lamellae that extend into the phase change material.

According to a favorable embodiment, the phase change material may have a greater thermal expansion coefficient than a material of the enclosure.

Alternatively or additionally, the phase change material may be in thermal contact with the heat conducting device at least in certain areas. In particular, the phase change material may have a greater thermal expansion coefficient than a material of the heat conducting device at least in the region of contact with the heat conducting device. An intimate thermal contact between the phase change material and/or the enclosure or the heat conducting device can be ensured.

According to a favorable embodiment, the enclosure and/or the heat conducting device may be formed of fibre-reinforced ceramic material. In particular, the enclosure and/or the heat conducting device may be formed of a fibre-reinforced non-oxide ceramic material. In particular, the fibre-reinforced non-oxide ceramic material may be formed of carbon fibre-reinforced carbon and/or carbon fibre-reinforced silicon carbide and/or silicon carbide fibre-reinforced carbon and/or silicon carbide fibre-reinforced silicon carbide (SiC).

Other possible enclosure materials include ceramics, for example, alumina, zirconia, boron nitride, silicon oxide, aluminium nitride, silicon carbide, boron carbide, graphite, and the like.

This provides a simple means of achieving a reduced coefficient of thermal expansion compared to the metallic phase change material. The enclosure can advantageously be realized in lightweight construction. Particularly thin walls of the enclosure can be formed by fibre reinforcement. A corresponding enclosure can thus be used in an advantageous manner for accommodating materials when repeated heating of a corresponding accommodated material under high heating rates and cooling under high cooling rates is to take place.

Enclosure materials with high thermal shock resistance, high oxidation resistance, high mechanical stability and especially high corrosion resistance are favorable. Long-term stable enclosure of phase change materials can be achieved, which are at least temporarily metal melts.

Metal melts can be encased with long-term stability by means of enclosure with appropriate wall material.

This results in high corrosion resistance. As a result, the enclosure can be used in connection with molten metals whose temperature can be in the range of, for example, up to about 600 °C or 650 °C, or even up to 1500 °C.

The metallic phase change material can be encased in an enclosure chamber, or encased in multiple enclosure segments, or encased macro-encapsulated, or encased microencapsulated.

In principle, the molten metal received by the enclosure may be in the liquid state all the time, or it may be in the liquid state only intermittently. For example, the enclosure accommodates a metallic phase change material which, for example, is present in the liquid state during thermal loading and is present in the solid state after thermal unloading. Both latent and sensible heat can then be stored, for example.

It is favorable if a wall thickness of a wall region made of the wall material of fibre-reinforced SiC material is at least 1 mm, in particular at least 2 mm and at least in particular 2.5 mm and is, for example, about 3 mm. Preferably, the wall thickness is at most 5 mm. Thus, a mechanically stable wall can be provided, whereby a high thermal shock resistance is achieved. Furthermore, the wall thickness can be kept relatively low, so that the container device can be formed with a small weight.

According to a favorable embodiment, energy can be supplied to the phase change material by electrical energy and/or solar radiation. In this way, loading of the phase change material can be performed.

According to a favorable embodiment, the heat conducting device may be coupled or couplable to a heating device or may comprise a heating device. In particular, the heating device may be an electric heating device. Optionally, a resistance heating device or an inductive heating device may be provided. Further, alternatively or additionally, a loading may be provided by means of concentrated solar radiation.

According to a favorable embodiment, the thermal insulation may comprise, for example, fumed silica. Other materials, such as mineral wool, calcium silicate, ceramic fibre (e.g., calcium magnesium silicates), mica, or even vacuum insulation, may be used equally advantageously. Other materials that have higher thermal conductivity but are less expensive may also be optionally used.

According to a favorable embodiment, in an embodiment of the portable heating source as a cooking plate, the thermal insulation may have an opening through which a heat transfer surface of the heating core is accessible. Advantageously, the opening may be closable by a thermally insulating cover, for example a lid with a handle or the like. The lid may be removed for heating a vessel or for exposure to sunlight for heating the metallic storage material. Advantageously, the lid may have the same material as the heat insulation around the heating core.

The heat transfer surface may itself serve as a storage surface and contact surface for a vessel, or indirect coupling between the vessel and the heat transfer surface may be provided, for example via plate-shaped adapters placed on the heat transfer surface of the heating core.

According to a favorable embodiment, an adjustment device may be provided to adjust a variable distance between the heat transfer surface and a heating surface. The vessel to be heated can be placed on the storage surface of the adjustment device, which serves as a heating surface. Depending on the distance of the storage surface, the vessel can be heated more or less.

In this way, different cooking levels can be realized with the cooking plate. Furthermore, the adjustment device can also be provided in the form of a grill grate, in which the food to be cooked can be brought more or less close to the heat transfer surface.

According to a favorable embodiment, the opening can accommodate interchangeable adapters in the intended state of use. In particular, different adapters can have different heights and/or different distances from the heating core and/or different thermal conductivities and/or different diameters. This allows different cooking levels to be reproducibly set or suitable adapters to be selected for vessels of different sizes without waste heat from the heating source being lost unused.

According to a favorable embodiment, in an embodiment of the portable heating source as a warming plate, the heating core can be arranged in a cavity of the thermal insulation, wherein the thermal insulation can be designed to be divisible. Advantageously, the heating core can be partially exposed for heating the metallic phase change material by opening the thermal insulation. The heating core of the warming plate can be relatively small and particularly well insulated to exhibit a long-lasting, moderately elevated temperature on its outer surface. Advantageously, the temperature on the outside may be limited so that a risk of injury to the outside may be avoided.

According to a favorable embodiment, the cooking plate or warming plate may include one or more handle arrangements. The portable heating source can be easily carried from one location to another, for example, between a location where the metallic phase change material is heated and a location where the heating source is used for cooking or keeping warm.

According to a favorable embodiment, the heating core may be formed as a substantially flat disk having a diameter greater than its height. This allows for a compact and handy shape of the heating source. It may be advantageous, when loading by means of concentrated solar radiation through a parabolic mirror, to shade the latter as little as possible. Then a cylindrical shape with a height equal to or greater than the diameter may be advantageous.

According to a favorable embodiment, when the portable heating source is designed as an oven, the enclosure may be arranged in a mobile transport cart. Thus, even a larger unit can be easily transported from one location to another. The oven can be flexibly used for heating a building, for example a garden hut or hiker's hut or a tent or caravan.

According to a favorable embodiment, the thermal insulation may comprise a hollow space in which the heating core is arranged and the first thermal insulation is surrounded by a second thermal insulation. The temperature on the outside of the heater may be limited to a range that is safe for humans. Optionally, only one thermal insulation may be provided.

According to a favorable embodiment, a recess may be arranged as a heat-retaining area in the first and/or second thermal insulation. This enables, for example, the heating of water, or other beverages, the slow cooking of food, or the keeping warm of food.

According to a favorable embodiment, the heating core may be formed as a cylinder whose diameter is smaller than its height. Advantageously, a space-saving heating source can be provided.

Advantageously, a mobile heating source is provided, which can be loaded electrically or also by means of concentrated solar radiation. Electric charging results in a locally emission-free system. With the expansion of renewable energies and the further increase of the share of renewable energies in the energy mix, an increasingly globally emission-free system for the mobile provision of thermal energy can also be provided. In the version with loading by concentrated solar radiation a system results, which can be operated already at the current time completely with renewable energies. At the same time, the portable heating source provides significantly higher energy densities than previously available mobile heating sources that do not rely on fossil fuels.

The portable heating source can be manufactured in favorable dimensions and favorable weight.

Portable heating sources with storage unit including attachments, which are to be carried by persons, should not exceed a weight of 15 kg to 55 kg, but better 10 kg to 30 kg. Portable heating sources which are to be transported by means of carts or trolleys should not exceed a total mass of 55 kg to 500 kg, corresponding to the maximum load capacity of heavy-duty hand trucks. Depending on the application, however, storage units can also be realized with a total mass of less than 15 kg. The volume required for this essentially results from the storage capacity required for the respective application, the phase change temperature and the respective permissible self-discharge rate. In the simplest form, discharge begins immediately after loading, so that the amount of insulation required can be reduced. The insulation can be designed, for example, to minimize storage losses or to limit the surface temperature, especially for handling reasons.

For a favorable design of the heating source as a cooking plate, it is assumed that cooking is to be performed over 2 hours with an average power of 1 kW, for which a total of 2 kWh of storage capacity is required. This requires approximately 7 kg of storage material. With enclosure, insulation and other components, the heating plate can then have a total mass of approximately 10 to 12 kg. 7 kg of storage material occupy a volume of approx. 2.7 l. This corresponds to a cylindrical disk with a diameter of 22 cm for a medium cooking plate and a height of about 7 cm. With an insulation thickness of about 3 cm and assuming an enclosure thickness of 1 cm in all directions, this then results in a cylindrical disk with a diameter of 30 cm and a height of 15 cm. This corresponds to a total volume of 10.6 l. The insulation would have a volume of about 6 l and would thus account for about 57 % of the total volume.

For an initial application as an oven in the manner of a heat box, about 4 kWh of storage capacity would be required for a heating capacity of 0.5 kW over a period of about 8 hours, assuming a favorable design. This requires about 14 kg of storage material, which has a volume of about 5.4 l.

With enclosure, electric heater and insulation, without transport rack, the heating plate then weighs about 22 to 25 kg. A cylindrical container with an enclosure thickness of 1 cm and an insulation thickness of 4 cm can therefore have a diameter of 26 cm and a height of 37 cm, for example. The container would then have a total volume of approx. 20 l. The insulation would have a volume of approx. 12 l and would thus account for about 60 % of the volume.

For a second application as an oven in the manner of a mushroom heater, an assumed power of approx. 10 kW over a duration of 8 hours results in a capacity of 80 kWh. This requires about 280 kg of storage material, which have a volume of about 108 l. Assuming an enclosure of 1 cm and an insulation thickness of 4 cm, this results in a cylinder with, for example, a diameter of 50 cm and a height of 96 cm. The container thus has a total volume of about 189 l. The insulation would have a volume of about 60 l and thus a share of about 32 % of the volume.

In principle, insulation can also be designed to be thinner, since both when used as a cooking plate and as a oven, the radiated heat from the cooking plate is used. The proportion of insulation in the total volume, and also the total volume of the storage tanks, can be reduced accordingly.

Drawing

Further advantages can be seen in the following drawing description. In the drawings, embodiments of the invention are shown. The drawings, description and claims contain numerous features in combination. The skilled person will expediently also consider the features individually and combine them to form useful further combinations.

It is shown exemplary in:

Fig. 1 a sectional view of a cooking plate according to an embodiment of the invention with covered heat transfer surface;

Fig. 2 a sectional view of a cooking plate according to an embodiment of the invention with a heat conducting device in the heating core;

Fig. 3 a sectional view of a cooking plate according to an embodiment of the invention with a carrying frame with handles;

Fig. 4 a sectional view of a cooking plate according to an embodiment of the invention with an adjustment device for changing a distance to a heat transfer surface of a heating core;

Fig. 5 a sectional view of a cooking plate according to an embodiment example of the invention with an adapter for heating a vessel;

Fig. 6 the cooking plate according to Fig. 5 with a higher adapter for heating a vessel;

Fig. 7 a sectional view of a cooking plate according to an embodiment of the invention during thermal charging of a heating core;

Fig. 8 a sectional view of a cooking plate according to an embodiment of the invention;

Fig. 9 a sectional view an oven according to an embodiment example of the invention;

Fig. 10 a sectional view an oven according to an embodiment example of the invention with a warming area;

Fig. 11 the oven according to Fig. 10 schematically in a building or tent.

Embodiments of the invention

In the figures, components of the same kind or having the same effect are numbered with the same reference signs. The figures show examples only and are not to be understood as limiting.

Directional terminology used in the following, with terms such as "left", "right", "above", "below", "before" "behind", "after" and the like, is merely for better understanding of the figures and is in no way intended to represent a limitation of generality. The components and elements shown, their design and use may vary in accordance with the considerations of a person skilled in the art and may be adapted to the particular applications.

Figures 1 to 7 show embodiments of a portable heating source according to the invention in the form of cooking plates 100. The cooking plates 100 are used for preparing food.

Figure 1 shows a sectional view of a cooking plate 100 according to an embodiment of the invention with a covered heat transfer surface 104. The cooking plate 100 has a disc-shaped heating core 10. In this example, the heating core 10 comprises an enclosure 40 containing a metallic phase change material 50. The cross-section of the heating core 10 may be round or square.

The phase change material 50 has a phase change temperature of at least 500 °C. The phase change material 50 may be, for example, a silicide alloy, in particular $AlSi_{12}$. This material has a phase change temperature of about 577 °C, at which the material melts at a constant temperature when energy is added or solidifies when energy is removed.

In one embodiment, the enclosure 40 may be formed from a ceramic material, in particular a fibre-reinforced ceramic material, for example silicon carbide, or aluminium oxide or graphite. However, other suitable materials are also conceivable. The wall thickness can be very thin, for example 1 mm, in particular at least 2 mm, and at least in particular 2.5 mm, and for example is about 3 mm. Preferably, the wall thickness is at most 5 mm.

Preferably, the coefficient of thermal expansion of the metallic phase change material 50 is greater than that of the material of the enclosure 40.

The heating core 10 is arranged in a receptacle 102 of a thermal insulation 70 and is surrounded by the latter, for example, on three sides. The thermal insulation 70 includes an opening 114 through which a heat transfer surface 104 of the heating core 10 is accessible in the intended operating condition. The opening 114 may be covered by a cover 116, such as a cover with a handle. The cover 116 is removed to allow use of the cooking plate 100.

The thermal insulation 70 may be, for example, fumed silica. Optionally, conventional insulating materials may also be useful, such as ceramic fibre-based insulating materials, such as mineral wool, calcium magnesium silicate fibre, calcium silicate, microporous insulating material, still air, vacuum insulating panels, and the like

The heating core 10 transfers heat from the phase change material 50 substantially through the heat transfer surface 104.

The heat transfer surface 104 serves as a storage surface for a vessel for heating the vessel. Optionally, an adapter may be placed on the heat transfer surface 104 of the heating core 10 and its top surface may serve as a storage surface and heating surface on which the vessel may be placed on the adapter. In this way, the heat transfer between the heating core 10 and the vessel can be controlled.

Figure 2 shows a sectional view of a cooking plate 100 according to a further embodiment of the invention. The construction of the cooking plate 100 corresponds to that of Figure 1, to which reference is made to avoid unnecessary repetition. In the embodiment of Figure 2, a heat conducting device 20 is additionally arranged in the phase change material 50. The heat conducting device 20 may have a plurality of unspecified lamellae which serve to introduce heat into the heating core 10 or to dissipate heat from the heating core 10 with the phase change material 50 and may contribute to homogeneous temperature distribution. For example, the lamellae extend parallel to the vertical axis of the cooking plate 100. If the cooking plate 100 is formed with a circular cross-section, the lamellae may form concentric rings. Other geometries are also possible.

The heat conducting device 20 may be formed of the same material as the enclosure 40.

Figure 3 shows a sectional view of a cooking plate 100 according to a further embodiment of the invention. The construction of the cooking plate 100 corresponds to that of Figure 2, to which reference is made to avoid unnecessary repetition.

The cooking plate 100 additionally has a support frame 108 with handles 106, in which the thermal insulation 70 with the heating core 10 is held. This allows the cooking plate 100 to be carried comfortably and safely.

Figure 4 shows in a sectional view a cooking plate 100 according to a further embodiment of the invention. The construction of the cooking plate 100 corresponds to that of Figure 3, to which reference is made to avoid unnecessary repetition.

In this embodiment, the cooking plate 100 includes an adjustment device 110 for changing a distance between a storage surface 112 and a heat transfer surface 104 of the heating core 10. The adjustment device 110 is inserted into the opening 114 of the heat insulation 70.

The storage surface 112 can be deposited at different heights of the adjustment device 110. By adjusting the distance, the heat transfer from the heating core 10 to the vessel can be influenced.

Alternatively, the adjustment device 110 can be used as a grill attachment where grilled food can be cooked at different distances from the heating core 10.

Additionally, in this embodiment, the cooking plate 100 includes an electrical heating device 60 below the heating core 10. This may be a resistance heater or an induction heater and may be charged via a charging station.

Figure 5 shows a sectional view of a cooking plate 100 according to a further embodiment of the invention. The construction of the cooking plate 100 corresponds to that of Figure 3 without the adjustment device 110; reference is made to Figure 3 to avoid unnecessary repetition.

In the opening 114 of the thermal insulation 70, an adapter 118 is placed on the heat transfer surface 104, on which a vessel 120 is placed.

Optionally, the heat transfer surface 104 may be vertically adjustable with vertical pins in corresponding hollow cylinder-like recesses in the phase change material 50.

The pins may be part of the enclosure 40, thereby forming an overall sealed enclosure chamber. The pins of the heat transfer surface 104 may be contacted with the hollow cylinders, for example, either by a good fit or by additional heat conductive paste.

Figure 6 shows the cooking plate 100 according to Figure 5 with a higher adapter 118 on the heat transfer surface 104 for heating the vessel 120. By means of different adapters 118, the heat transfer from the heating core 10 to the vessel 120 can be specifically influenced. In this way, for example, different cooking levels can be set even if the heating core 10 has a constant temperature.

Figure 7 shows a sectional view of a cooking plate 100 according to a further embodiment of the invention. The construction of the cooking plate 100 corresponds to that of Figure 3, to which reference is made to avoid unnecessary repetition.

In this embodiment, the thermal charging of the heating core 10 is not effected via an electrical heating device 60, but via radiant heat, in particular via concentrated solar radiation. This acts on the heat transfer surface 104 and heats the phase change material 50 in the heating core 10.

It is understood that this type of charging can also be combined with an electric heating device 60 as in Figures 4 to 6.

Figure 8 in a sectional view of a warming plate 200 according to an embodiment of the invention.

In this embodiment of the portable heating source, the heating core 10 with the phase change material 50 arranged in an enclosure 40 is arranged in a hollow space 202 of the thermal insulation 70. The thermal insulation 70 is configured to be divisible along a dividing line 210 so that a portion of the thermal insulation 70 can be lifted off.

To heat the heating core 10, an electric heating device 60, such as a resistance heater or induction heater, may be provided. For example, an inductor plate 208, which is heated by electromagnetic radiation, may be disposed on at least one side of the enclosure 40.

The warming plate 200 is surrounded by a handle rim 206, by which the warming plate 200 can be conveniently and securely gripped. The warming plate 200 is used for keeping food warm or for keeping people or objects warm. The hot warming plate 200 may be suitably adapted in shape for various applications.

Figures 9 to 11 show embodiments of a portable heating source according to the invention in the form of ovens 300. The ovens 300 are used for heating persons or rooms.

Figure 9 shows a sectional view of an oven 300 according to an embodiment of the invention. The heating core 10 with the enclosure 40 filled with the phase change material 50 is arranged in a mobile transport cart 308. Conveniently, this transport cart 308 is formed similar to a trolley or shopping cart and can thus be easily moved, for example, by means of a handle 306.

The heating core 10 is arranged in a hollow space 302 of a first thermal insulation 70, which is surrounded by a further thermal insulation 304.

The thermal insulation 70, 304 may be constructed in such a way that, for example, heat radiation can be emitted heating core 10 to the surroundings via openings.

Optionally, the oven 300 may further comprise a recess 310 in which, for example, a warm water tank 311 may be receivable which is fed by the heat of the heating core 10. This is shown in Figure 10.

Not shown in Figures 9 and 10 is any electrical power connection required for electrically charging the heating core 10. This can advantageously be designed in such a way that conventional sockets can be used.

Figure 11 schematically illustrates the oven 300 of Figure 10 in a building or tent 312.

The heat transfer from the oven 300 to the environment can be effected via the thermal insulation 70, 304 or via air ducts in the thermal insulation 70, 304. Natural convection is used here or, with appropriate design, also a so-called chimney effect. The depicted building (hut, tent, etc.) can either be a component separate from the oven 300 or directly integrated with the oven 300.

10 Heating core

20 Heat conducting device

40 Enclosure

50 Phase change material

60 Heating device

70 Thermal insulation

100 Cooking plate

102 Receptacle

104 Heat transfer surface

106 Handle

108 Support frame

110 Adjustment device

112 Storage surface

114 Opening

116 Cover

118 Adapter

120 Vessel

200 Warming plate

202 Hollow space

206 Handle rim

208	Inductor plate
300	Oven
302	Hollow space
304	Thermal insulation
306	Handle
308	Transport cart
310	Recess
311	Warm water tank
312	Building

CLAIMS

1. A portable heating source in the form of a cooking plate (100) and/or a warming plate (200) and/or an oven (300), with a heating core (10) containing at least one phase change material (50) in an enclosure (40), wherein the heating core (10) is surrounded at least in regions by a thermal insulation (70), and wherein the phase change material (50) comprises a metallic or semi-metallic phase change material (50) with a phase change temperature of at least 500 °C.

2. The portable heating source according to claim 1, wherein the phase change material (50) comprises a metallic alloy or semi-metallic alloy with one or more of the constituents aluminium, silicon, copper, magnesium, boron, zinc, in particular an AlSi alloy, preferably $AlSi_{12}$.

3. The portable heating source according to any of the preceding claims, wherein in the enclosure (40), in particular within an area with phase change material (50), a heat conducting device (20) is arranged.

4. The portable heating source according to any one of the preceding claims, wherein the phase change material (50) has a larger thermal expansion coefficient than a material of the enclosure (40) and/or

wherein the phase change material (50) is at least regionally in thermal contact with the heat conducting device (20), in particular wherein the phase change material (50) has a greater thermal expansion coefficient than a material of the heat conducting device (20) at least in the region of contact with the heat conducting device (20).

5. The portable heating source according to any one of the preceding claims, characterized in that the enclosure (40) and/or the heat conducting device (20) is formed of fibre-reinforced ceramic material, in particular is formed of fibre-reinforced non-oxide ceramic material, in particular of carbon fibre-reinforced carbon and/or carbon fibre-reinforced silicon carbide and/or silicon carbide fibre-reinforced carbon and/or silicon carbide fibre-reinforced silicon carbide and/or ceramic, in particular alumina, zirconia, boron nitride, silicon oxide, aluminium nitride, silicon carbide, boron carbide, and/or graphite.

6. The portable heating source according to any one of the preceding claims, characterized in that energy can be supplied to the phase change material (50) by electrical energy and/or solar radiation.

7. The portable heating source according to any one of the preceding claims, characterized in that the heat conducting device (20) is coupled or couplable to a heating device (60) or comprises a heating device (60), in particular wherein the heating device (60) is an electric heating device.

8. The portable heating source according to any one of the preceding claims, wherein the thermal insulation (70) comprises fumed silica and/or mineral wool and/or calcium silicate and/or ceramic fibre and/or mica and/or a vacuum insulation.

9. The portable heating source according to any one of the preceding claims, wherein, in a cooking plate (100) embodiment, the thermal insulation (70) has an opening (114) which can be closed, in particular by a thermally insulating cover (116), and through which a heat transfer surface (104) of the heating core (10) is accessible.

10. The portable heating source according to claim 10, wherein an adjustment device (110) is provided, by means of which a variable distance between the heat transfer surface (104) and a storage surface (112) is adjustable.

11. The portable heat source according to claim 9 or 10, wherein the opening (114) accommodates interchangeable adapters (118) in the intended state of use, in particular wherein different adapters (118) have different heights and/or different distances from the heating core (10) and/or different thermal conductivities and/or different diameters.

12. The portable heating source according to any one of the preceding claims, wherein, in a design as a warming plate (200), the heating core (10) is arranged in a hollow space (202) of the thermal insulation (70), wherein the thermal insulation (70) is designed to be divisible.

13. The portable heat source according to any one of claims 9 to 12, wherein the cooking plate (100) or warming plate (200) comprises one or more handle arrangements (106, 206).

14. The portable heat source according to any one of claims 9 to 13, wherein the heating core (10) is formed as a substantially flat disc having a diameter greater than its height.

15. The portable heating source according to any one of claims 1 to 8, wherein, in an oven (300) embodiment, the enclosure (40) is arranged in a mobile transport cart (308).

16. The portable heat source according to claim 15, wherein the thermal insulation (70) comprises a hollow space (302) in which the heating core (10) is arranged and the first thermal insulation (70) is surrounded by a second thermal insulation (304).

17. The portable heating source according to claim 15 or 16, wherein a recess (310) is arranged as a heat-retaining area in the first and/or second thermal insulation (70, 304), in particular wherein the recess (310) is provided for receiving a warm water tank (311).

18. The portable heat source according to any one of claims 15 to 17, wherein the heating core (10) is formed as a cylinder whose diameter is smaller than its height.

ABSTRACT

The invention relates to a portable heating source in the form of a cooking plate (100) and/or a warming plate (200) and/or an oven (300), with a heating core (10) containing at least one phase change material (50) in an enclosure (40), wherein the heating core (10) is surrounded at least in regions by a thermal insulation (70), and wherein the phase change material (50) comprises a metallic or semi-metallic phase change material (50).