DESCRIPTION

TITLE OF INVENTION: [A HEATING APPARATUS WITH A SINGLE-COMPARTMENT DESIGN AND A HEATING CONTROL METHOD AND SYSTEM THEREFOR]

TECHNICAL FIELD

[0001] The present disclosure generally relates to the field of liquid heating and, more specifically, to heating apparatuses that utilize computing-generated heat as a heating source.

BACKGROUND

[0002] The following discussion of the background to the invention is intended to facilitate an understanding of the present invention only. It should be appreciated that the discussion is not an acknowledgement or admission that any of the material referred to was published, known or part of the common general knowledge of the person skilled in the art in any jurisdiction as at the priority date of the invention.

[0003] In recent years, the demand for more energy-efficient domestic water heaters has grown due to rising energy costs and heightened environmental concerns. However, conventional water heaters remain largely dependent on traditional heating elements, which operate without considering alternative heat sources like computing waste heat. This singular reliance not only results in higher energy consumption but also fails to address the inefficiencies inherent in the current approach.

[0004] Present solutions often overlook the potential to integrate secondary heat sources, such as the waste heat generated by computing units, leaving this energy resource untapped. Instead, computing waste heat is typically dissipated into the environment, contributing to unnecessary energy loss and thermal pollution. The failure to leverage this readily available heat results in water heaters that are less efficient and more costly to operate, while also exacerbating their environmental impact. As energy demands continue to grow, the limitations of these conventional systems highlight the need for more innovative approaches to domestic water heating.

[0005] There exists a need to develop a more efficient liquid heating apparatus that utilizes computing-generated heat as a heating source, addressing at least one of the problems associated with conventional systems.

SUMMARY

[0006] Specifically, to address the above-mentioned technical problems, the present invention specifically uses the following technical solutions:

[0007] Accordingly, an aspect of the invention refers to a heating apparatus (100), comprising: a first compartment (101) configured to hold liquid to be heated; wherein the first compartment (101) comprises: a first liquid channel (109) configured to direct the liquid from outside the first compartment (101) into the first compartment (101), and; a second liquid channel (111) configured to direct the liquid out of the first compartment (101); wherein the first liquid channel (109) is configured to comprise a first inlet (117) configured to receive the liquid from outside the first compartment (101) and a first outlet (119) configured to release the liquid from the first liquid channel (109) into the first compartment (101); wherein the second liquid channel (111) is configured to comprise a second inlet (123) configured to receive the liquid from the first compartment (101), and a second outlet (121) configured to direct the liquid from the second liquid channel (111) out of the first compartment (101); wherein the first compartment (101) further comprises a computing unit (107) operable to perform a computing task and generate computing waste heat.

[0008] In some embodiments, the first outlet (119) is configured to be positioned in proximity to the computing unit (107); and the second inlet (123) is configured to be positioned distal to the computing unit (107).

[0009] In some embodiments, the heating apparatus (100) further comprises a first heating source (115) configured to be positioned inside the first compartment (101).

[0010] In some embodiments, the first heating source (115) is configured to be positioned in proximity to the second inlet (123).

[0011] In some embodiments, the first heating source (115) is an electrical heating element.

[0012] In some embodiments, the electrical heating element is a heating coil, a heating plate, a heating rod or a heating pad.

[0013] In some embodiments, the liquid is water suitable for domestic use.

[0014] In some embodiments, the first compartment (101) comprises a thermal protection coating (113) on exterior surface of the first compartment (101).

[0015] In some embodiments, the computing unit (107) is positioned at or in proximity to bottom surface of the first compartment (101), and the first inlet (117) and the second inlet (121) are configured to be positioned on top surface of the first compartment (101).

[0016] In some embodiments, the computing unit (107) is positioned at or near an interior sidewall of the first compartment (101).

[0017] In some embodiments, the computing unit (107) comprises one or more of: a bitcoin miner, a cryptocurrency miner, a server-grade central processing unit (CPU), a simulation processor and an artificial intelligence-related computing unit; wherein the artificial intelligence-related computing unit comprises one or more of: a graphics processing unit (GPU), a tensor processing unit (TPU), an AI accelerator and a neural processing unit (NPU).

[0018] In some embodiments, the computing unit (107) is arranged to be in data communication with a network.

[0019] In some embodiments, the heating apparatus (100) further comprises a heating control system (500) arranged to control heating process of the heating apparatus (100); wherein the heating control system (500) comprises: a temperature monitoring module (501) operable to detect and measure temperature of the liquid inside the first compartment (101); and an operation control module (502) operable to adjust operation of the computing unit (107) and/or the first heating source (115) according to the temperature of the liquid measured by the temperature monitoring module (501).

[0020] In some embodiments, wherein, when the temperature monitoring module (501) detects that the temperature of the liquid at a first temperature zone within the first compartment (101) drops below a first predetermined temperature threshold, the

operation control module (502) is operable to activate or enhance the heating process of the first heating source (115).

[0021] In some embodiments, wherein the first temperature zone is defined to encompass the second inlet (123).

[0022] In some embodiments, wherein, when the temperature monitoring module (501) detects that the temperature of the liquid at a second temperature zone within the first compartment (101) exceeds a second predetermined temperature threshold, the operation control module (502) is operable to deactivate or reduce the operation of the computing unit (107).

[0023] In some embodiments, wherein the second temperature zone is defined to encompass the computing unit (107).

[0024] In some embodiments, the heating apparatus (100) further comprises a mode switch module arranged to transmit an instruction signal to the operation control module; when the mode switch module is switched to a use mode, the operation control module is operable to activate the first heating source (115); when the mode switch module is switched to a standby mode, the operation control module is operable to deactivate the first heating source (115).

[0025] In some embodiments, wherein, when the mode switch module is switched to the standby mode, operation control module is operable to also regulate the operation of the computing unit (107).

[0026] In some embodiments, wherein the computing unit (107) is removably housed within the first compartment (101).

[0027] Other aspects and features of the present invention will become apparent to those of ordinary skill in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] In the figures, which illustrate, by way of non-limiting examples only, embodiments of the present invention,

[0029] **[Fig. 1]:** illustrates an exterior view of a heating apparatus according to various embodiments of the present invention.

[0030] **[Fig. 2]:** illustrates a front cross-sectional view of a heating apparatus according to various embodiments of the present invention.

[0031] **[Fig. 3]:** illustrates a perspective cross-sectional view of a heating apparatus according to various embodiments of the present invention.

[0032] **[Fig. 4]:** illustrates another perspective cross-sectional view of a heating apparatus according to various embodiments of the present invention.

[0033] **[Fig. 5]:** illustrates, in a block diagram, a heating control system according to various embodiments of the present invention.

[0034] **DETAILED DESCRIPTION**

[0035] Throughout this document, unless otherwise indicated to the contrary, the terms “comprising”, “consisting of”, “having” and the like, are to be construed as non-exhaustive, or in other words, as meaning “including, but not limited to”.

[0036] Furthermore, throughout the document, unless the context requires otherwise, the word “include” or variations such as “includes” or “including” will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

[0037] Unless defined otherwise, all other technical and scientific terms used herein have the same meaning as is commonly understood by a skilled person to which the subject matter herein belongs.

[0038] **Embodiment 1 Heating Apparatus (Integrated Single Compartment Design)**

[0039] Referring to Figures 1 and 2, the invention provides a heating apparatus (100A) configured to heat liquid. This apparatus includes a first compartment (101), which serves as a container for the liquid to be heated. The first compartment (101) is equipped with a first liquid channel (109) that facilitates the inflow of liquid, such as room-temperature water, from outside the compartment into its interior. This first liquid

channel (109) is specifically configured to ensure smooth and efficient transfer of liquid into the first compartment (101). Additionally, the first compartment (101) comprises a second liquid channel (111), which is configured to direct the heated liquid from within the compartment to an external outlet. The integration of these two liquid channels facilitates a continuous and controlled flow of liquid into and out of the first compartment (101), supporting the heating process.

[0040] The heating apparatus (100A) further incorporates a computing unit (107) inside the first compartment (101) that performs computational tasks while simultaneously generating waste heat. This waste heat is harnessed to heat the liquid within the first compartment (101), thus optimizing energy use by combining computational functionality with heating. The computing unit (107) is positioned within the first compartment (101) to enhance thermal efficiency in certain application scenarios. In some embodiments, the computing unit (107) is located at or in close proximity to the bottom surface of the first compartment (101). Moreover, the computing unit (107) may be installed in a fixed or removable manner, allowing for flexibility in maintenance or replacement.

[0041] Referring to Figures 2 – 4, the first liquid channel (109) includes a first inlet (117) and a first outlet (119). The first inlet (117) is configured to receive liquid from outside the first compartment (101), directing it into the channel, while the first outlet (119) releases the liquid from the first liquid channel (109) into the first compartment (101). The first outlet (119) is positioned within the first compartment (101) in proximity to the computing unit (107) to optimize heat transfer. Specifically, the first inlet (117) is located on the top surface of the first compartment (101) to facilitate liquid entry. In some embodiments, the first inlet (117) is configured to extend beyond the exterior of the first compartment (101), ensuring convenient connectivity with external liquid sources.

[0042] Referring to Figures 2–4, the second liquid channel (111) comprises a second inlet (123) and a second outlet (121). The second inlet (123) is configured to receive liquid from the first compartment (101), channeling it into the second liquid channel (111), while the second outlet (121) directs the liquid from the second liquid channel (111) to the outside of the first compartment (101).

[0043] In some embodiments, the second inlet (123) is positioned within the first compartment (101) near the first heating source (115) to improve thermal efficiency, particularly during rapid heating scenarios, such as when heated water is required for high-demand applications like extensive dishwashing or showering.

[0044] In some embodiments, the second outlet (121) is located on the top surface of the first compartment (101) to facilitate efficient liquid outflow. Additionally, the second outlet (121) may be configured to extend beyond the exterior of the first compartment (101), allowing for transfer of heated liquid to external systems.

[0045] Referring to Figures 2 – 4, in some embodiments, the computing unit (107) and the first heating source (115) are arranged with a physical separation to create distinct heating zones within the first compartment (101). For example, the computing unit (107) may be positioned near or at the bottom of a vertically oriented first compartment (101), while the first heating source (115) is located near the upper region of the compartment (further elaborations below). This arrangement establishes a lower heating zone, primarily heated by the computing unit (107), and an upper heating zone, primarily heated by the first heating source (115), thereby optimizing the distribution and efficiency of heat transfer within the compartment.

[0046] In this embodiment, the computing unit (107) and the first heating source (115) are positioned at different vertical levels within the first compartment (101) to create distinct heating zones. Specifically, the computing unit (107) is located at or near the bottom of the first compartment (101), while the first heating source (115) is positioned in the upper or middle-upper portion of the compartment. This arrangement divides the first compartment (101) into a lower heating zone, where the computing unit (107) gradually and continuously heats the liquid, and an upper heating zone, where the first heating source (115) provides rapid and intensive heating for high-demand applications (e.g., extensive dish washing, showering). In this embodiment, the heating power of the first heating source (115) is significantly greater than that of the computing unit (107).

[0047] For example, the first heating source (115) may be an electrical heating element. Specifically, the electrical heating element can be a heating coil, a heating plate, a heating rod, or a heating pad.

[0048] In some embodiments, to minimize heat loss, the exterior surface of the first compartment (101) is equipped with a thermal protection coating (113), which helps retain heat inside the heating apparatus and improves overall energy efficiency.

[0049] In some embodiments, the computing unit (107) comprises one or more components, such as a bitcoin miner, a cryptocurrency miner, a server-grade central processing unit (CPU), a simulation processor, or an artificial intelligence-related computing unit. Any computing unit (107) capable of generating significant waste heat is well-suited for use in the present invention, as the waste heat can be effectively utilized to contribute to the heating process.

[0050] In some embodiments, the artificial intelligence-related computing unit comprises one or more of: a graphics processing unit (GPU), a tensor processing unit (TPU), an AI accelerator and a neural processing unit (NPU).

[0051] Additionally, in some embodiments, the computing unit (107) is configured to enable data communication with a network. In some embodiments, the computing unit (107) is connected to a network using wired cables. In some embodiments, the computing unit (107) is equipped with a wireless communication module, which includes a wireless communication chip and an antenna to facilitate wireless connectivity.

[0052] In some embodiments, the computing unit (107) is configured to perform bitcoin mining and other computational tasks, both of which rely on consistent data transmission to achieve efficient and uninterrupted operation, at least in some application scenarios. Although the volume of data transmitted may not be substantial, maintaining a stable and reliable connection is crucial to ensure uninterrupted performance. To achieve this, the wireless communication module within the computing unit (107) is equipped with both a wireless communication chip and an antenna. These components work together to facilitate communication with external networks. Additionally, to extend the effective communication range, a wireless communication range extension device may be incorporated. Such as wireless communication range extension device can be integrated with the heating apparatus itself, positioned at an existing Internet or Wi-Fi access point (e.g., a router), or placed independently between the access point/router and the heating apparatus. This ensures that the computing unit (107) remains within the extended communication range, allowing for stable connectivity regardless of the placement of the heating apparatus.

[0053] To further enhance the flexibility and usability of the heating apparatus, the computing unit (107) may also be equipped with additional wireless communication technologies, enabling it to operate in environments where traditional Internet access is unavailable. For instance, the computing unit (107) can support communication standards such as EDGE, 2G, 3G, 4G, 5G, or their future iterations. By incorporating such diverse communication options, the dependency of the heating apparatus on Wi-Fi connections is alleviated, at least to some extent, thereby improving convenience and making the device suitable for a wider range of scenarios, including remote locations or areas with limited network infrastructure.

[0054] During operation of the heating apparatus (e.g., a domestic water heater), the user or installer can connect the wireless communication module of the computing unit (107) to an existing Wi-Fi network to activate the heating function. Alternatively, if Wi-Fi is not available or preferred, the user can rely on other communication standards, such as EDGE, 2G, 3G, 4G, or 5G, to establish connectivity. Ensuring the proper connection setup is an essential step before the device begins its heating operations.

[0055] In the event of a data connection disruption, the system is designed to notify the user promptly through various channels. Notifications can be delivered via mobile applications, push alerts, SMS messages, chat applications, device indicators, or standalone notification devices. These alerts inform the user of the connectivity issue, prompting them to take timely action to restore the connection and resume normal operation.

[0056] Moreover, if a data connection issue is detected, the heating control system is programmed to adjust its functionality to mitigate potential inefficiencies. For example, the operation control module (502) may issue a control signal to the computing unit (107), instructing it to suspend its computing tasks temporarily. This ensures that the heating control system prioritizes maintaining efficient operations while reducing the strain on the heating apparatus during periods of network instability.

[0057] To ensure reliable data communication in the heating apparatus that utilizes a computing unit as a heating source, various advanced methods can be implemented to enhance connectivity and maintain efficient operation. These methods are particularly critical in systems where uninterrupted data transfer directly supports both computational tasks and the heat generated by the computing unit.

[0058] One effective approach is adaptive frequency hopping, where the wireless communication module in the computing unit dynamically scans and switches between frequencies to avoid interference. By identifying less congested channels in real time, the system ensures stable data transmission, which is essential for continuous computational operations and efficient heat generation.

[0059] Signal amplification can be employed to adaptively boost signal strength based on the distance between devices and surrounding environmental conditions. This ensures that the computing unit maintains robust connectivity, even when the heating apparatus is located far from the network access point or in challenging environments.

[0060] Using multi-antenna beamforming, the system leverages multiple antennas to focus the wireless signal directly toward the target device, such as a router or range extender. By minimizing signal dispersion and interference, this technique ensures that the computing unit remains reliably connected, enabling uninterrupted computational activity.

[0061] To address potential data errors during transmission, error correction algorithms like forward error correction (FEC) can be integrated into the computing unit's communication protocol. These algorithms detect and rectify errors in real time, preserving the integrity of data essential for computational tasks.

[0062] In addition, proactive buffering is utilized to mitigate the effects of brief connectivity interruptions. By temporarily storing data, the computing unit ensures continuous operation, preventing computational delays or disruptions in heat generation that could impact the performance of the heating apparatus.

[0063] Dynamic power control is another key feature, allowing the computing unit to adjust its wireless transmission power based on the quality of the connection. Lower power is used for nearby connections to conserve energy, while higher power is employed for distant or weaker connections, ensuring that the computing unit remains operational without compromising energy efficiency.

[0064] Dual-band communication enables the computing unit to transmit data simultaneously over two frequency bands, such as 2.4 GHz and 5 GHz. This redundancy ensures that computational tasks continue seamlessly, even if one band experiences interference, thus maintaining consistent heat generation.

[0065] In scenarios where direct communication between the computing unit and the network is obstructed, peer-assisted relaying allows nearby devices to act as relay points, extending the range and reliability of the connection. This ensures that the computing unit remains functional, even in complex or obstructed environments.

[0066] To further enhance bandwidth and redundancy, real-time channel bonding combines multiple communication channels into a single high-capacity data path. This allows for increased data transfer speeds and ensures that computational tasks remain uninterrupted, even if one channel degrades.

[0067] Intelligent packet scheduling prioritizes data packets based on their importance and latency requirements. For example, time-sensitive computations necessary for heating optimization can be prioritized over less critical tasks, ensuring the apparatus operates efficiently.

[0068] Additionally, interference cancellation leverages advanced signal processing to identify and neutralize external interference. This maintains clear and stable communication between the computing unit and the network, supporting uninterrupted computational and heating functions.

[0069] Lastly, self-healing network protocols are implemented to automatically detect and recover from connection failures. These protocols enable the computing unit to re-establish the network connection or reroute data via alternative paths without user intervention, ensuring continuous operation of the heating apparatus.

[0070] Embodiment 2: Heating Control System

[0071] Referring to Figure 5, in addition to the components described in Embodiment 1, the heating apparatus of the present invention includes a heating control system (500) designed to regulate the heating process. Specifically, the heating control system (500) comprises the following components:

[0072] Temperature Monitoring Module (501):

[0073] The temperature monitoring module (501) is configured to detect and measure the temperature of the liquid within the first compartment (101). In some embodiments, the temperature monitoring module (501) comprises temperature sensors for accuracy and reliability. Specifically, at least two temperature sensors may

be installed within the first compartment (101) to monitor the temperature in distinct zones: a first temperature zone (e.g., region close to the second inlet (123)) and a second temperature zone (e.g., region encompassing the computing unit (107)).

[0074] Operation Control Module (502):

[0075] The operation control module (502) is operable to adjust the operation of the computing unit (107) and/or the first heating source (115) based on the temperature data provided by the temperature monitoring module (501). This adjustment may include actions such as turning the computing unit (107) on or off, performing high-volume computational tasks, operating the computing unit (107) periodically, or controlling the activation and deactivation of the first heating source (115).

[0076] In some embodiments, when the temperature monitoring module (501) detects that the liquid temperature in the first temperature zone falls below a predefined threshold (e.g., during extensive use of heated water), The operation control module (502) activates or intensifies the heating process of the first heating source (115) to ensure rapid heating of the liquid before it is directed out of the first compartment (101). Enhancing the heating process may involve increasing the power output of the first heating source (115). The first temperature zone is defined as the area surrounding the second inlet (123).

[0077] In other embodiments, when the temperature monitoring module (501) detects that the liquid temperature in the second temperature zone exceeds a predefined upper threshold (e.g., the temperature in the second zone is rising to a level that is unsuitable for sustaining the continuous operation of the computing unit (107)), the operation control module (502) reduces or halts the operation of the computing unit (107). The second temperature zone is defined as the region near or surrounding the computing unit (107). This ensures that liquid heated by the computing unit (107) can efficiently flow out of the first compartment (101) through the first outlet (119) and first liquid channel (109). Additionally, the computing unit (107) is enclosed in a waterproof casing to prevent damage.

[0078] Mode Switching Module (503):

[0079] The heating control system further comprises a mode switching module (503) configured to transmit control signals to the operation control module (502). When the

mode switching module is set to "use mode", the operation control module (502) activates the first heating source (115) to rapidly heat the liquid inside the first compartment (101), as the heated liquid is being extensively directed out of the first compartment (101). Conversely, when the mode switching module (503) is set to "standby mode," the operation control module (502) deactivates the first heating source (115). In some embodiments, in standby mode, the operation control module (502) may also regulate the operation of the computing unit (107).

[0080] In other words, this embodiment introduces dual modes-standby mode and use mode. In standby mode, the user does not require the liquid from the heating apparatus, while in use mode, the liquid is needed for tasks such as washing or bathing.

[0081] In some embodiments, further controls can be incorporated. For example, when the system detects user activity (e.g., opening a valve connected to the second liquid channel (111)), the mode switching module (503) automatically switches to use mode.

[0082] In some embodiments, the operation control module (502) includes a data analysis module configured to analyze usage patterns based on historical temperature data. This enables the system to anticipate periods of high hot water demand. As a result, the operation control module (502) can proactively adjust the heating process to ensure the water is heated to an optimal temperature when extensive use is expected.

[0083] Dual Heating Zones and Modes:

[0084] In this embodiment, the computing unit (107) serves as one heat source, while the first heating source (115) serves as another. The two heat sources are positioned at different heights within the first compartment (101), dividing it into upper and lower heating zones. The computing unit (107) heats liquid in the lower zone, and the first heating source (115) heats liquid in the upper zone. This configuration allows the heating apparatus to operate in a dual heating mode.

[0085] In some embodiments, the first compartment (101) is oriented horizontally, with the computing unit (107) positioned on or near one sidewall of the compartment and the first heating source (115) located on the opposite sidewall. This arrangement could also facilitate in creating two distinct temperature zones within the first compartment (101).

[0086] The computing unit (107), the first liquid channel (109), the second liquid channel (111) and the first heating source (115) can be positioned inside the first compartment (101) in various ways, provided that the computing unit (107) is placed in the low-temperature region where the first liquid channel (109) is configured to direct the liquid (in low temperature); and the first heating source (115) is placed in a high-temperature region where the second liquid channel (111) is configured to draw the liquid (in high temperature) out of the first compartment (101).

[0087] For example, in the case of a horizontally oriented first compartment (101), such as a cylindrical water tank, the first liquid channel (109) can be configured to enter through the bottom surface, where denser cold water naturally accumulates. This configuration ensures that cold water is directed to the bottom region of the first compartment (101), where the computing unit (107) is located or positioned nearby. Similarly, the second liquid channel (111) can be arranged to exit from the top region, allowing the less dense hot water, which naturally rises, to be efficiently discharged. Economic Mode: In standby mode or use mode, when the liquid demand is low (e.g., for washing hands or face), only the computing unit (107) operates to heat the liquid, minimizing energy consumption.

[0088] Enhanced Mode: In use mode, when liquid demand is high (e.g., for showers or dishwashing), the first heating source (115) is activated for rapid heating. This enhanced mode ensures a continuous supply of heated liquid as cooler liquid enters through the first liquid channel (109) and heated liquid exits through the second liquid channel (111). The first heating source (115) may also operate independently or in conjunction with the computing unit (107). The heating power of the computing unit (107) is significantly lower than that of the first heating source (115). For example, the computing unit (107) may have a heating power of 400 W, while the first heating source (115) operates at 2000 W.

[0089] Standby Mode Operation:

[0090] In standby mode, the operation control module (502) sends control signals to activate the computing unit (107) to perform computational tasks. The heat generated by these computing tasks gradually and continuously warms the liquid in the first compartment (101). During this process, the temperature monitoring module (501) continuously or periodically monitors the temperature in the second temperature zone. If

the temperature exceeds the upper threshold, the operation control module (502) reduces or halts the operation of the computing unit (107) to prevent overheating.

[0091] In addition to the mode-based operation controls described above, the heating control system can incorporate various additional control mechanisms to optimize the efficiency of liquid heating and the operation of the computing unit (107).

[0092] Flow-Dependent Control:

[0093] In some embodiments, flow sensors installed on the second liquid channel (111) or the first liquid channel (109) detect liquid demand. If high demand is detected, the operation control module (502) activates the first heating source (115) to provide rapid heating. For low demand, the computing unit (107) maintains its current heating operation.

[0094] Temperature-Dependent Control:

[0095] In other embodiments, temperature sensors monitor the first temperature zone. If a significant temperature drop is detected, the operation control module (502) activates the first heating source (115) to restore the liquid temperature quickly.

[0096] Adaptive Learning and User Control:

[0097] In some embodiments, the heating control system comprises adaptive learning capabilities, preemptively activating the first heating source (115) during peak demand periods. Additionally, users may manually select heating modes via a control panel or remote interface.

[0098] Additional Features:

[0099] Other embodiments may involve modulating the computing unit's duty cycle for improved efficiency or activating the first heating source (115) in short pulses during peak demand. The operation control module (502) can also be configured to activate the first heating source (115) based on a predefined schedule, allowing for timed heating operations.

[0100] As described above, in recent years, the demand for energy-efficient solutions has become increasingly important across various industries, including

computing and household utilities. As computational tasks become more intensive, the heat generated by computing units has become a significant concern, often requiring additional cooling mechanisms to prevent overheating and ensure optimal performance. This waste heat, if not managed properly, can lead to increased energy consumption and higher operational costs.

[0101] Simultaneously, the need for efficient water heating systems in residential and commercial settings has been a persistent challenge. Traditional water heating methods often rely on significant energy input to maintain or achieve desired temperatures, leading to increased energy usage and costs. The integration of computing systems with household utilities presents an opportunity to address these challenges by repurposing waste heat for practical applications, such as heating water, thereby enhancing energy efficiency and reducing overall energy consumption.

[0102] Accordingly, the present invention provides a technical solution for using the waste heat generated by the computing unit (107) during the execution of intensive computational tasks to heat the liquid within the first compartment (101). This configuration enables the heat generated by the computing unit (107) to maintain the liquid in the first compartment (101) at a constant temperature or bring it closer to a constant temperature over an extended period. As a result, when only a small amount of liquid is needed (e.g., hand washing during winter time; or washing a small coffee cup), the liquid at or near the constant temperature can be used directly, eliminating the need to activate the first heating source (115) within the first compartment (101) for additional heating. Alternatively, when a large amount of liquid is required (e.g., extensive dish washing, showering), the first heating source (115) can be utilized directly to heat the liquid, significantly conserving energy.

[0103] It should be further appreciated by the person skilled in the art that variations and combinations of features described above, not being alternatives or substitutes, may be combined to form yet further embodiments falling within the intended scope of the invention.

[0104] As would be understood by a person skilled in the art, each embodiment, may be used in combination with other embodiment or several embodiments.

Claims

Claim 1. A heating apparatus (100), comprising:

a first compartment (101) configured to hold liquid to be heated; wherein the first compartment (101) comprises: a first liquid channel (109) configured to direct the liquid from outside the first compartment (101) into the first compartment (101), and; a second liquid channel (111) configured to direct the liquid out of the first compartment (101);

wherein the first liquid channel (109) is configured to comprise a first inlet (117) configured to receive the liquid from outside the first compartment (101) and a first outlet (119) configured to release the liquid from the first liquid channel (109) into the first compartment (101);

wherein the second liquid channel (111) is configured to comprise a second inlet (123) configured to receive the liquid from the first compartment (101), and a second outlet (121) configured to direct the liquid from the second liquid channel (111) out of the first compartment (101);

wherein the first compartment (101) further comprises a computing unit (107) operable to perform a computing task and generate computing waste heat.

Claim 2. The heating apparatus (100) according to Claim 1, wherein the first outlet (119) is configured to be positioned in proximity to the computing unit (107); and the second inlet (123) is configured to be positioned distal to the computing unit (107).

Claim 3. The heating apparatus (100) according to Claim 1 or 2, wherein further comprising a first heating source (115) configured to be positioned inside the first compartment (101).

Claim 4. The heating apparatus (100) according to Claim 3, wherein the first heating source (115) is configured to be positioned in proximity to the second inlet (123).

Claim 5. The heating apparatus (100) according to Claim 3 or 4, wherein the first heating source (115) is an electrical heating element.

Claim 6. The heating apparatus (100) according to Claim 5, wherein the electrical heating element is a heating coil, a heating plate, a heating rod or a heating pad.

Claim 7. The heating apparatus (100) according to any one of the preceding claims, wherein the liquid is water suitable for domestic use.

Claim 8. The heating apparatus (100) according to any one of the preceding claims, wherein the first compartment (101) comprises a thermal protection coating (113) on exterior surface of the first compartment (101).

Claim 9. The heating apparatus (100) according to any one of the preceding claims, wherein the computing unit (107) is positioned at or in proximity to bottom surface of the first compartment (101), and the first inlet (117) and the second inlet (121) are configured to be positioned on top surface of the first compartment (101).

Claim 10. The heating apparatus (100) according any one of Claims 1 - 8, wherein the computing unit (107) is positioned at or near an interior sidewall of the first compartment (101).

Claim 11. The heating apparatus (100) according to any one of the preceding claims, wherein the computing unit (107) comprises one or more of: a bitcoin miner, a cryptocurrency miner, a server-grade central processing unit (CPU), a simulation processor and an artificial intelligence-related computing unit; wherein the artificial intelligence-related computing unit comprises one or more of: a graphics processing unit (GPU), a tensor processing unit (TPU), an AI accelerator and a neural processing unit (NPU).

Claim 12. The heating apparatus (100) according to any one of the preceding claims, wherein the computing unit (107) is arranged to be in data communication with a network.

Claim 13. The heating apparatus (100) according to any one of the preceding claims, wherein further comprising a heating control system (500) arranged to control heating process of the heating apparatus (100); wherein the heating control system (500) comprises:

a temperature monitoring module (501) operable to detect and measure temperature of the liquid inside the first compartment (101); and

an operation control module (502) operable to adjust operation of the computing unit (107) and/or the first heating source (115) according to the temperature of the liquid measured by the temperature monitoring module (501).

Claim 14. The heating apparatus (100) according to Claim 13, wherein, when the temperature monitoring module (501) detects that the temperature of the liquid at a first temperature zone within the first compartment (101) drops below a first predetermined temperature threshold, the operation control module (502) is operable to activate or enhance the heating process of the first heating source (115).

Claim 15. The heating apparatus (100) according to Claim 14, wherein the first temperature zone is defined to encompass the second inlet (123).

Claim 16. The heating apparatus (100) according to any one of Claims 13 – 15, wherein, when the temperature monitoring module (501) detects that the temperature of the liquid at a second temperature zone within the first compartment (101) exceeds a second predetermined temperature threshold, the operation control module (502) is operable to deactivate or reduce the operation of the computing unit (107).

Claim 17. The heating apparatus (100) according to Claim 16, wherein the second temperature zone is defined to encompass the computing unit (107).

Claim 18. The heating apparatus (100) according to any one of Claims 13 – 17, wherein further comprising a mode switch module arranged to transmit an instruction signal to the operation control module;

when the mode switch module is switched to a use mode, the operation control module is operable to activate the first heating source (115); when the mode switch module is switched to a standby mode, the operation control module is operable to deactivate the first heating source (115).

Claim 19. The heating apparatus (100) according to Claim 28, wherein, when the mode switch module is switched to the standby mode, operation control module is operable to also regulate the operation of the computing unit (107).

Claim 20. The heating apparatus (100) according to any one of the preceding claims, wherein the computing unit (107) is removably housed within the first compartment (101).