US 20240200828A1

(19) United States
(12) Patent Application Publication
(10) Pub. No.: US 2024/0200828 A1
(43) Pub. Date: Jun. 20, 2024
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(54) **FAN AND HEAT PUMP TYPE WATER HEATER USING SAME**

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(21) Appl. No.: **18/287,113**

(22) PCT Filed: **Apr. 18, 2022**

(86) PCT No.: **PCT/CN2022/087424**

§ 371 (c)(1),
(2) Date: **Oct. 16, 2023**

(30) **Foreign Application Priority Data**

Apr. 16, 2021 (CN) 202110413790.6

Publication Classification

(51) **Int. Cl.**

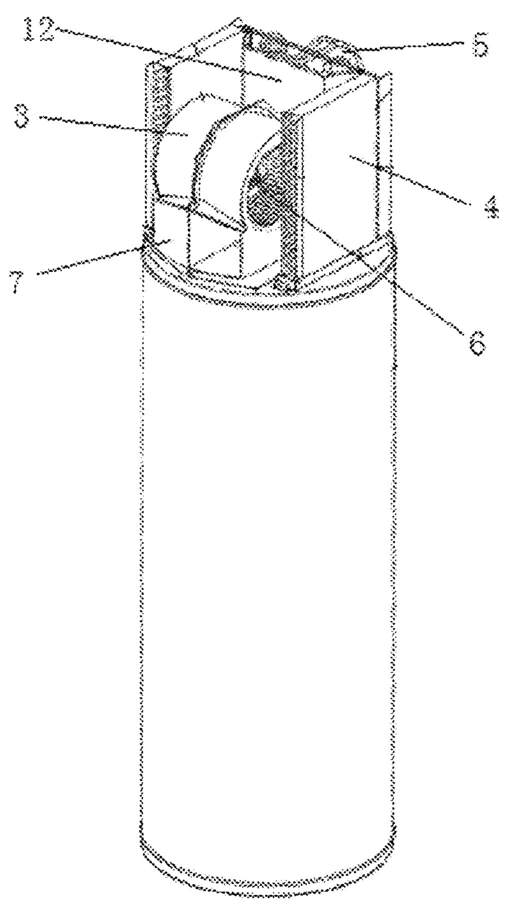
F24H 4/04	(2006.01)
F04D 17/00	(2006.01)
F04D 29/28	(2006.01)
F04D 29/42	(2006.01)

(52) **U.S. Cl.**

CPC ***F24H 4/04*** (2013.01); ***F04D 17/00*** (2013.01); ***F04D 29/283*** (2013.01); ***F04D 29/424*** (2013.01)

(57) **ABSTRACT**

The present invention relates to the field of heat pump water heaters. Disclosed are a fan and a heat pump type water heater using same. The fan of the present invention is mounted upside down in an upper space of a water tank for pumping air refrigerated by an evaporator in the heat pump type water heater; the fan comprises volutes, a partition plate, and an impeller, the impeller is arranged in the volutes, the volutes are designed as an involute structure, and volute tongues of the volutes are in a backscrolling shape; there are two volutes, the partition plate is arranged between the two volutes, spiral shafts of the two volutes are perpendicular to the partition plate, and the two volutes are symmetrically arranged; an air inlet is formed in the side wall of each volute distant from the partition plate, the air inlets are perpendicular to the spiral shafts of the volutes, and air outlet directions of the air outlets of the two volutes are the same. The integrated heat pump water heater of the present invention can achieve effects such as high energy efficiency, large heating capacity, and low noise in a limited space mainly by means of optimization of a wind field of the whole system and reasonable layout of components.



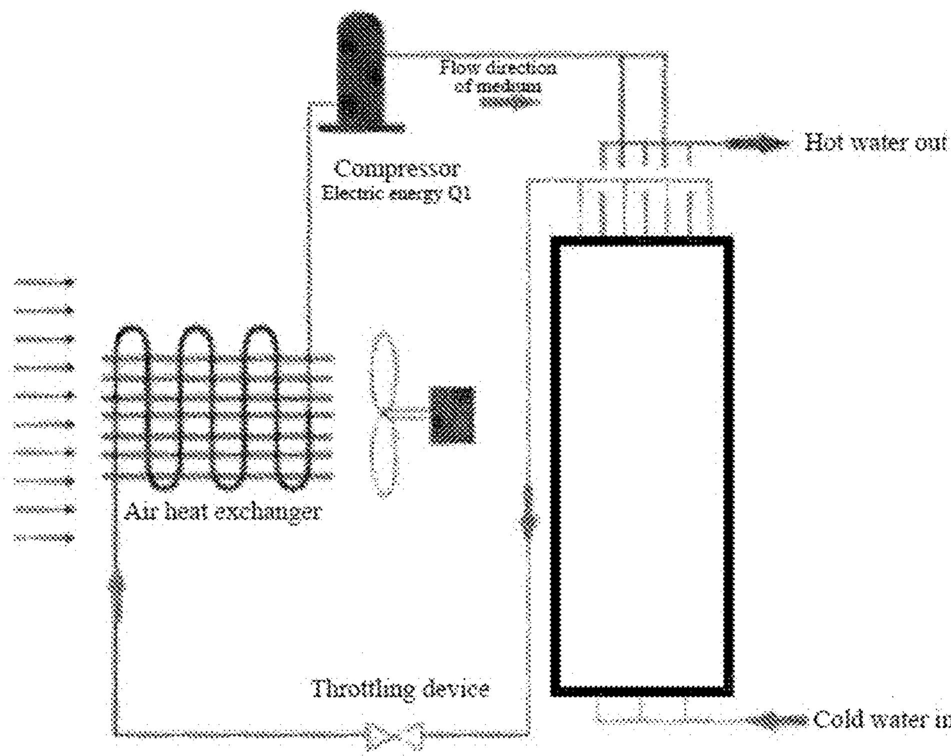

Flow direction
of medium
Hot water out
Compressor
Electric energy Q1
Air heat exchanger
Throttling device
Cold water in

FIG. 1

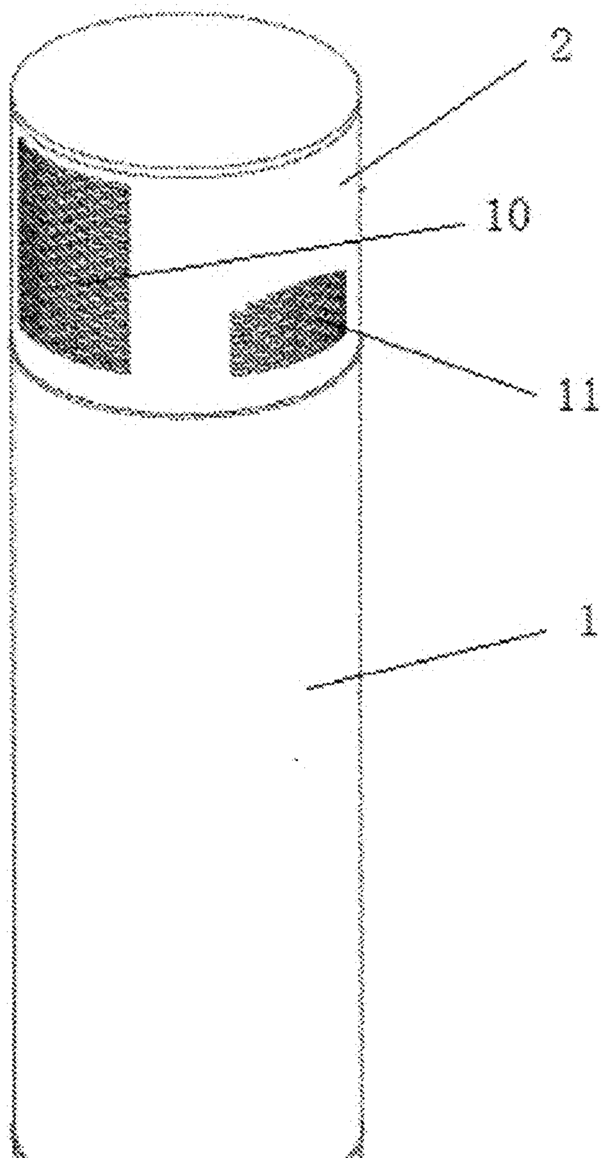


FIG. 2

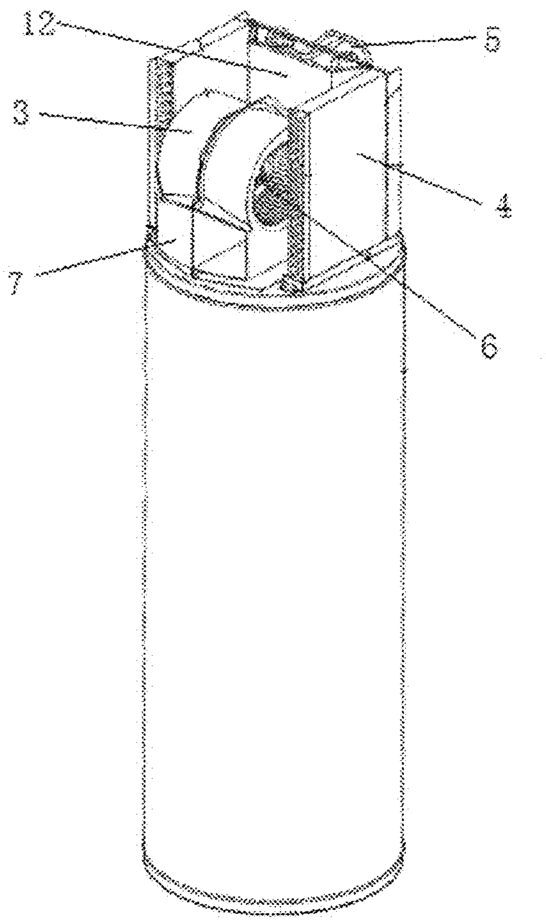


FIG. 3

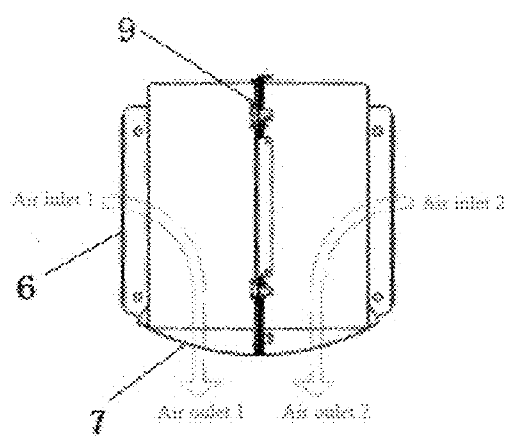


FIG. 4

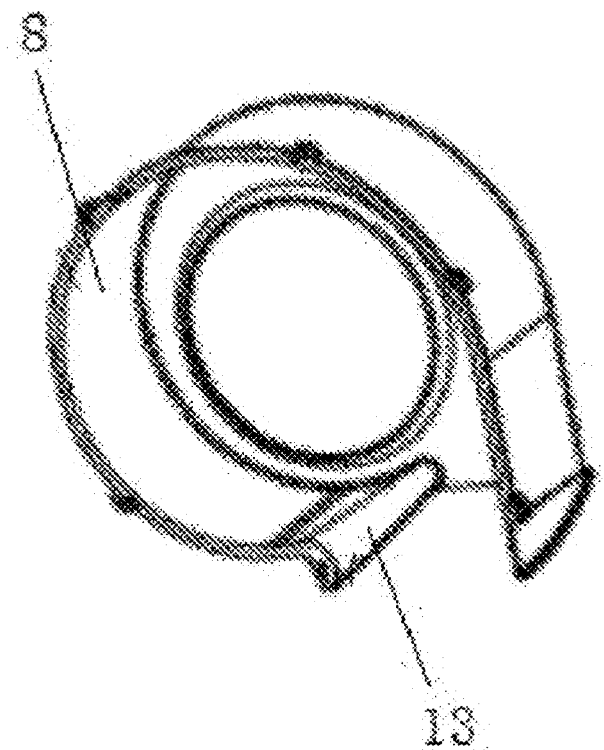


FIG. 5

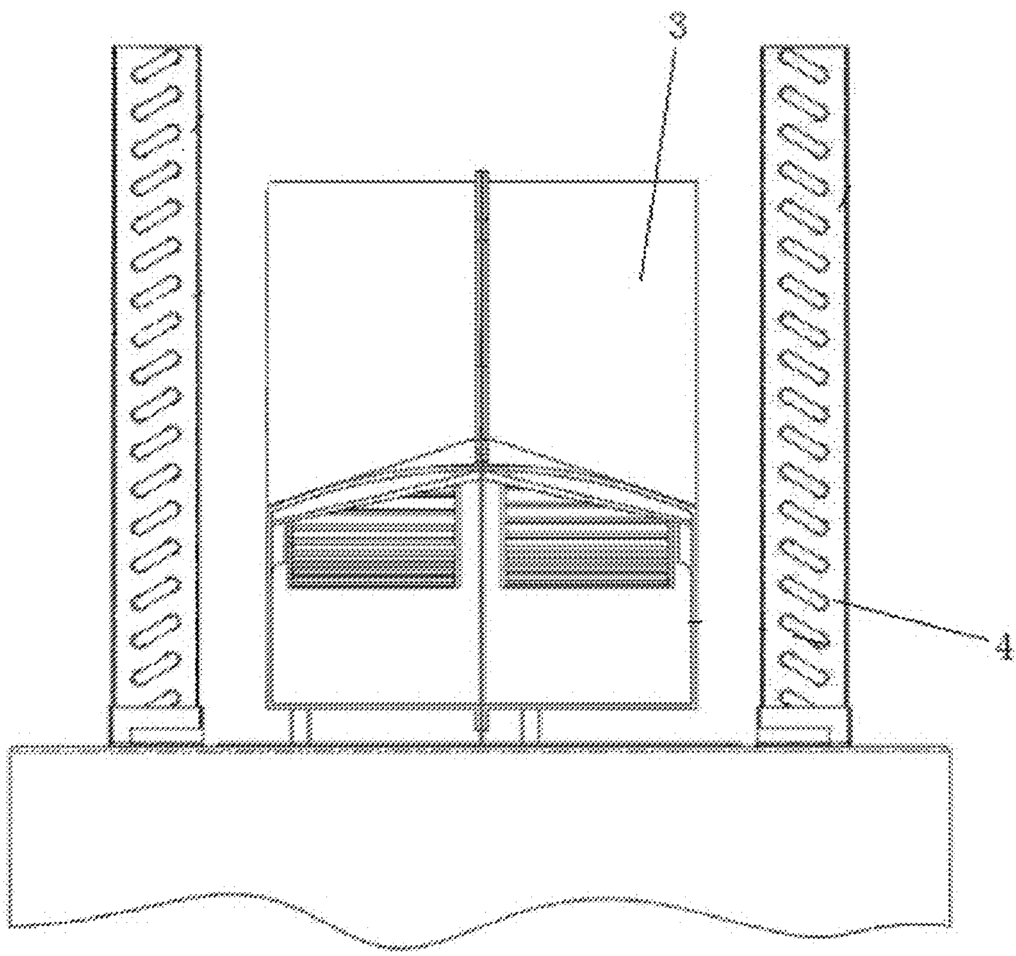


FIG. 6

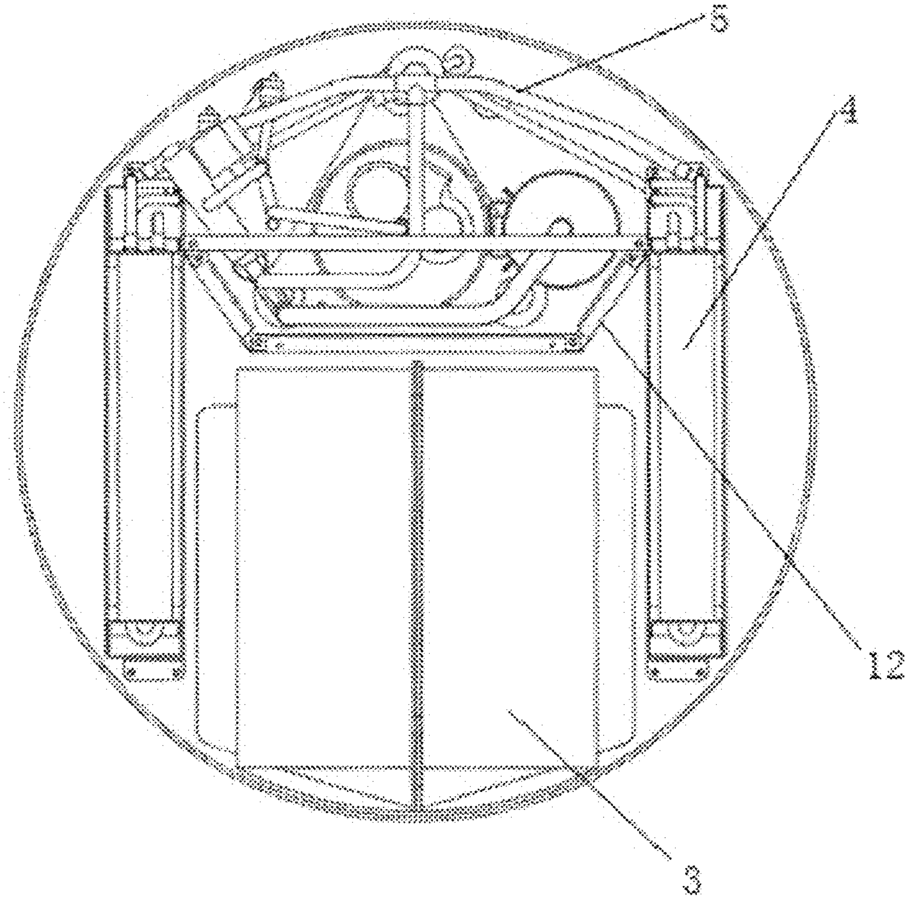


FIG. 7

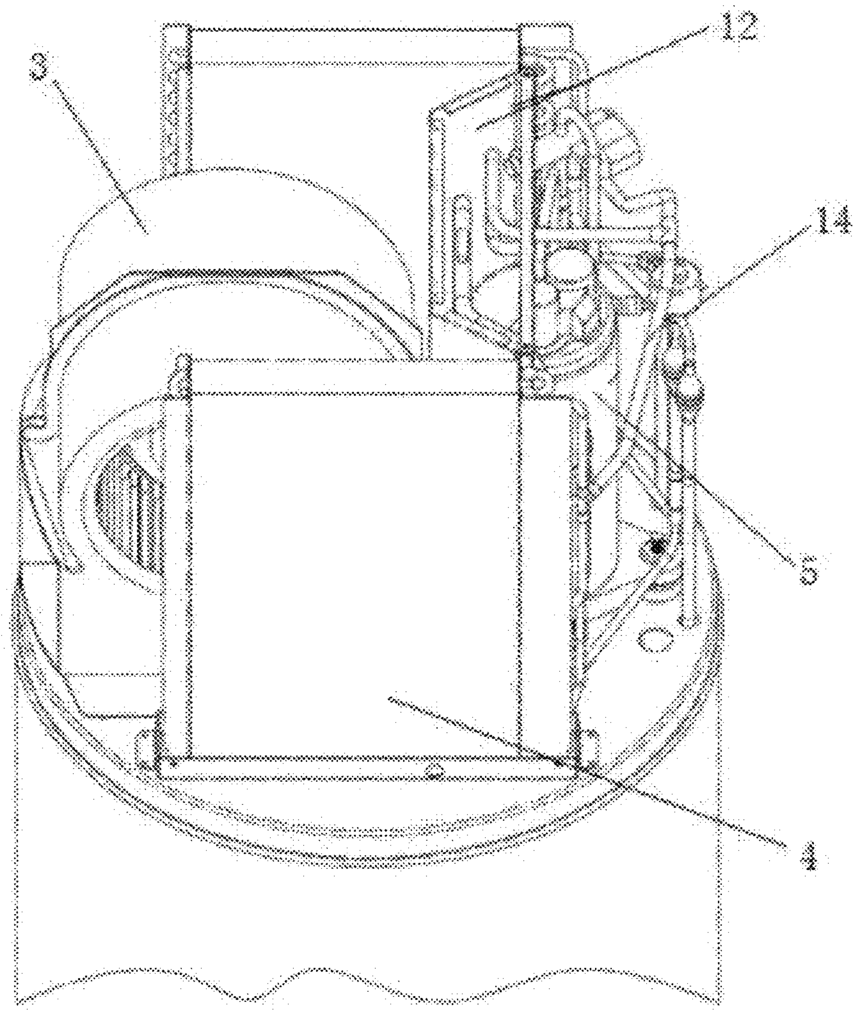


FIG. 8

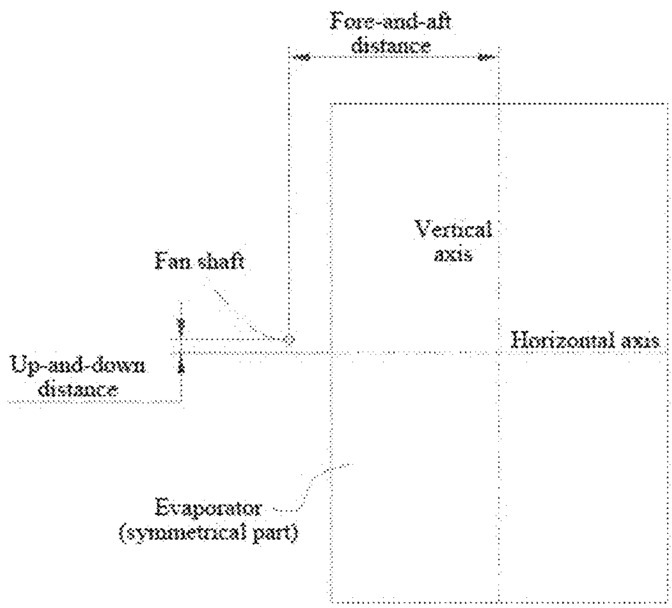


FIG. 9

Prototype scheme	Rotating speed of fan	Electronic expansion valve	Charging volume	Heating capacity	COP	Number of steps of expansion valve at the end of heating
Rotating speed of fan	950→750 r/min	1.3 mm caliber	965g	2910W	4.16	90 steps (14.7~54.2)
	750→650 r/min	1.3 mm caliber	895g	2840W	4.28	92 steps (15.6~54.9)
	750→650 r/min	1.3 mm caliber	850g	2834W	4.34	90 steps (15.2~54.9)
	650→500 r/min	1.3 mm caliber	850g	2670W	4.27	88 steps (15.8~54.7)
	600→550 r/min	1.3mm caliber	850g	2710W	4.30	88 steps (14.4~54.7)

FIG. 10

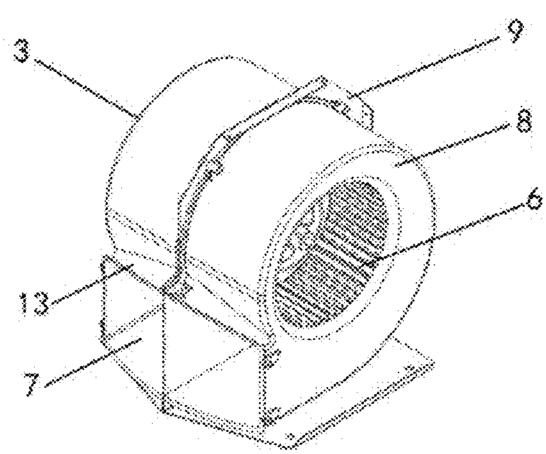


FIG. 11

FAN AND HEAT PUMP TYPE WATER HEATER USING SAME

TECHNICAL FIELD

[0001] The present invention relates to a fan and a heat pump type water heater using same, and relates to the field of heat pump water heaters.

BACKGROUND ART

[0002] With the improvement of living standards, more and more people attach importance to higher quality of life, and pay close attention to how much energy is consumed to obtain the same benefits. Energy utilization has gradually become the pursuit and goal of people's quality of life. As a novel water heater, heat pump type water heaters have higher actual energy efficiency. Compared with electric water heaters, they will generate more than 1 kW of heat by consuming 1 kWof electric energy, which achieves practical application of the heat pump type water heaters as water heaters, and can reflect the quality of life and a response to the call for low-carbon life. A working principle of the heat pump type water heaters is to use the reverse Carnot cycle to concentrate the heat in the environment and form an effect similar to a heat pump, which extracts the heat from the environment to heat water in a water tank, thereby achieving the purpose of hot water supply.

[0003] The reverse Carnot cycle generally contains four major components. A power core component generally uses a compressor (including a centrifugal rotor compressor, a scroll compressor, etc.), and the compressor is used to compress a medium (including R134a, R404A, R22 and other types of refrigerants) to form a high-temperature high-pressure type gas refrigerant (for example, different refrigerants can form superheated refrigerant media at as high as dozens of degrees Celsius or even nearly a hundred degrees Celsius). The gas refrigerant is transported into a condenser for heat exchange with a water tank or water. Finally, release of the degree of superheat is achieved to have the phase change, the latent heat and sensible heat of the refrigerant medium are used to heat the water, and the refrigerant medium is transformed into a refrigerant liquid medium in a supercooled state. After throttled through a throttling element (which may be a thermostatic expansion valve, a capillary tube or an electronic expansion valve, etc.), the refrigerant liquid medium becomes a low-pressure liquid medium with a higher degree of superheat, which finally evaporates in an evaporator and exchanges heat with the air flowing through the evaporator, thereby absorbing the heat in the air. Due to the function of the throttling element, the evaporation temperature of the low-pressure liquid refrigerant can actually be relatively low at this time, so the refrigerant can adapt to changes in ambient temperature within a certain range, and the effect of absorbing heat in the air to complete the entire cycle can be achieved.

[0004] In order to ensure the comprehensive requirements for heating capacity, energy efficiency, etc. of the water heaters, the heat pump type water heaters are generally of split design. However, this design has shortcomings such as difficulty in installation and higher maintenance costs. In order to ensure the aesthetics of an entire heat pump system, integral design is adopted for more and more heat pump type water heaters. This design has the advantages of easy installation, small space occupation, etc. However, there are very few heat pump type water heaters that can truly achieve high energy efficiency, large heating capacity and integral design, and there is an urgent need of innovative design to resolve the contradiction among aesthetics, space, heating capacity and energy efficiency.

SUMMARY OF THE INVENTION

[0005] In view of the deficiencies in the prior art mentioned above, the present invention provides a fan and a heat pump type water heater using the same to solve the technical problems existing in the prior art that under the requirements for aesthetics, space, convenience of installation, etc., insufficient heating capacity is caused by low efficiency of heat exchange with air resulting from insufficient heating capacity of a system or inappropriate wind field design of the system, the actual energy efficiency is too low under system standard conditions resulting from unreasonable overall layout of the system, etc., which may even lead to a serious deviation of the design of the heat pump system until advantages in energy efficiency brought about by energy efficiency of the heat pump type water heaters cannot be realized.

[0006] To achieve the above purpose, the present invention adopts the following technical solutions:

[0007] A fan for a heat pump type water heater, the fan being a double-air inlet type fan, and most preferably, the double-air inlet type fan being a centrifugal type fan; the fan comprising volutes, a partition plate and impellers; the impellers being arranged in the volutes, rotating shafts of the impellers being located on spiral axes of the volutes and being in shaft connection to transmission shafts in the volutes,

[0008] the volutes being designed as an involute structure, and volute tongues of the volutes being in a backscrolling shape;

[0009] there being two volutes, the partition plate being arranged between the two volutes to form two sets of exhaust channels, spiral shafts of the two volutes being perpendicular to the partition plate, and the two volutes being symmetrically arranged;

[0010] an air inlet being formed in the side wall of each volute distant from the partition plate, the air inlets being perpendicular to the spiral shafts of the volutes, and two air outlets being arranged side by side in the same direction, so that air outlet directions of the air outlets of the two volutes are the same.

[0011] Drive motors are arranged on the partition plate, so that reliable and effective heat dissipation of the motors is ensured; the drive motors are symmetrically arranged with the partition plate as a symmetrical face and are located in a center part of the partition plate, and air on both sides of the partition plate does not interfere with each other. The impellers are arranged on output shafts of the drive motors and located in different volutes. Gaps between the impellers and the volutes meet an involute equation relationship.

[0012] The present invention further provides a heat pump type water heater, comprising a condenser and a water tank; a heat pump system is arranged on the top of the water tank;

[0013] the heat pump system comprises a housing, the above-mentioned fan is arranged inside the housing, and evaporators, a compressor and a throttling device are further arranged;

[0014] an air outlet port of the compressor is connected to an air inlet port of the condenser, a liquid outlet of the condenser is connected to a liquid inlet of the throttling device, a liquid outlet of the throttling device is connected to liquid inlets of the evaporators, and air outlet ports of the evaporators are connected to an air inlet port of the compressor;

[0015] the fan is used for pumping out air refrigerated by the evaporators, the fan is mounted upside down in an upper space of the water tank, and the air outlet and the air inlet of the fan are both upright.

[0016] Further, air outlet directions of the air outlets of the two volutes are horizontal, and the air outlets are located on lower sides of the air inlets.

[0017] Further, axes of the impellers are horizontal, the axes of the impellers preferably coincide with the spiral axes of the volutes, and angles between the axes of the impellers and an axis of the water tank are 90°.

[0018] Further, the evaporators are plate evaporators, the two sets of plate evaporators are symmetrically arranged on both sides of the partition plate, and plate faces of the plate evaporators are opposite to the air inlets of the volutes.

[0019] Further, the two sets of plate evaporators are arranged in parallel. In order to make better use of heat exchange areas, when there are two groups of evaporators, in addition to the evaporators which are vertically symmetrically arranged, other structures, such as a double-L shape, a double-C shape, and a "⊓" shape are included.

[0020] Further, gaps between the air inlets and the evaporators and wall surfaces of the volutes form inlet air uniform distribution chambers, and the distances between the air inlets and the evaporators are 30-90 mm.

[0021] Further, a lattice baffle is connected between the two sets of evaporators. The lattice baffle is arranged vertically, is located on the sides of the volutes, and is distant from the air outlets of the volutes. The compressor is arranged on the face, distant from the air outlets, of the lattice baffle. Both ends of the lattice baffle are connected to the evaporators on both sides of the fan, respectively. A thickness of the lattice baffle is 0.8-1.5 mm. A shape of the lattice baffle may be adaptively adjusted according to a relative position relationship of the compressor and the fan.

[0022] Further, central planes of the evaporators are parallel to the partition plate. Axes of the central planes of the evaporators include vertical axes and horizontal axes. Vertical distances between the vertical axes and the axes of the impellers are 0-125 mm. Vertical distances between the horizontal axes and the axes of the impellers are 0-50 mm. The central planes are vertical planes of the centers of the evaporators, and are parallel to the partition plate. At this time, the axes of the central planes are vertical center lines (vertical axes) and horizontal center lines (horizontal axes) of the rectangular planes. Of course, in other scenarios, they may be just central planes of parts of symmetrically-distributed evaporators (e.g., evaporators in a C shape, an L shape, etc.).

[0023] That is to say, the vertical distances between the vertical center lines of the evaporators and the axes of the impellers are 0-125 mm, and the horizontal distances between the horizontal center lines of the evaporators and the axes of the impellers are 0-50 mm.

[0024] Further, air inlet ports are arranged at positions, corresponding to the evaporators, on the housing, and air outlet ports are arranged at positions, corresponding to the air outlets, on the housing.

[0025] Further, the condenser is arranged inside the water tank or attached to a wall surface of the water tank, and it is included within a range constructed by a peripheral space of the water tank.

[0026] Further, the COP of the heat pump system under standard conditions is not less than 4.0.

Beneficial Effects of the Invention

[0027] 1) The present invention uses an integral water heater as a model to design a heat pump type water heater which has high energy efficiency, large heating capacity, and low noise, and caters for the characteristics such as easy installation, good productive maintainability of the system.

[0028] 2) The arrangement of the fan of the present invention can effectively improve the heat exchange efficiency of the evaporators and reduce noise.

[0029] 3) By using the heat pump type water heater containing the fan in the present invention, under standard conditions, a high energy efficiency index (meeting second-level energy efficiency requirements) that the energy efficiency cannot be less than COP4.0 and a large heating capacity that the heating capacity is not less than 2500 W can be achieved. Moreover, the noise of a whole machine can be maintained at a level close to 40 dB(A).

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] FIG. **1** is a principle diagram of a heat pump type water heater in the prior art;

[0031] FIG. **2** is a schematic diagram of an exterior of a heat pump type water heater provided by an embodiment of the present invention;

[0032] FIG. **3** is a schematic diagram of layout of a part of the heat pump system provided by the embodiment of the present invention;

[0033] FIG. **4** is a top view of a fan provided by the embodiment of the present invention;

[0034] FIG. **5** is a schematic diagram of a volute provided by the embodiment of the present invention;

[0035] FIG. **6** is a front view of the heat pump system shown in FIG. **3**;

[0036] FIG. **7** is a top view of the heat pump system shown in FIG. **3**;

[0037] FIG. **8** is an enlarged view of the heat pump system shown in FIG. **3**;

[0038] FIG. **9** is a schematic diagram of setting of spacing between the fan and axes of evaporators as provided by the embodiment of the present invention;

[0039] FIG. **10** is a schematic diagram of performance test results of the heat pump type water heater provided by the embodiment of the present invention; and

[0040] FIG. **11** is a schematic diagram of an overall structure of the fan of the present invention.

[0041] In the figures: **1**, water tank; **2**, housing; **3**, fan; **4**, evaporator; **5**, compressor; **6**, air inlet; **7**, air outlet; **8**, volute; **9**, partition plate; **10**, air inlet port; **11**, air outlet port; **12**, lattice baffle; **13**, volute tongue; **14**—throttling device.

DETAILED DESCRIPTION OF EMBODIMENTS

[0042] The technical solutions in the embodiments of the present invention will be clearly and completely described below with reference to the accompanying drawings in the embodiments of the present invention. Apparently, the described embodiments are merely parts of the embodiments rather than all of the embodiments of the present invention. All other embodiments obtained by those of ordinary skill in the art based on the embodiments of the present invention without creative efforts shall fall within the scope of protection of the present invention.

[0043] As shown in FIG. **1**, the compressor **5**, on one hand, provides power for circulation of a refrigerant (of course, the type of refrigerant is not limited here, which may be R134a, R404A, R22, even CO_2 working in a supercritical state, etc.) in an entire system, and on the other hand, compresses the gaseous refrigerant to do work to allow the energy of the refrigerant to increase by W working energy, where the dissipation effect in this process is not considered here. After the refrigerant absorbs work done by the compressor **5**, it becomes a high-temperature high-pressure gaseous refrigerant due to its own temperature rise. At the position of a water tank **1**, it can be arranged on an outer wall surface of the water tank **1** through coils or micro-coils. Of course, an auxiliary thermal conductive layer with good thermal conductivity can be applied between the coils or micro-coils and the wall surface. Alternatively, it can be arranged in the water tank **1** in a form of coils. Of course, for special types of water heaters, a plate heat exchanger may be used to realize wall-type heat exchange between water and the refrigerant, which is not limited here. After the refrigerant in a high-temperature high-pressure state in the condenser exchanges heat with low-temperature water, it is condensed into a lower-temperature liquid, in other words, latent heat and sensible heat contained in the refrigerant in the condenser are transferred to the water, and it is assumed here that the total heat absorbed is Qw. Of course, the water that has absorbed the heat can be circulated to be heated multiple times to raise the temperature of the water in the water tank **1** to the set temperature. The condensed refrigerant passes through a throttling device **14** (which may be a thermostatic expansion valve, a capillary tube, an electronic expansion valve, etc. here), and becomes a superheated refrigerant having a certain degree of superheat. After entering evaporators **4**, it is equivalent that it enters a large range of space fully developed, so the refrigerant absorbs heat. At the time, the air exposed to the evaporators **4** is pumped in real time through a fan **3**, thereby achieving the effect of obtaining continuous energy supply from the surrounding air. Of course, in order to meet the requirements for the heating capacity, the rotation speed of the fan **3** can be precisely controlled, thereby achieving the effect of precise temperature rise. At the time, it is assumed that the energy absorbed from the surrounding air is Qa. In the entire cycle process, we can clearly obtain Qw=W+Qa based on the principle of energy conservation, wherein W is the work done by the compressor **5**, and is strongly associated with power consumption, which can even account for more than 80% of the power consumption of the entire system, which is not limited thereto. The energy actually obtained by water includes two parts, namely the part generated by the compressor **5** doing work and the part pumped from the surrounding air, wherein the energy of the part pumped from the surrounding air is often several times the energy of the part generated by the compressor **5** doing work, therefore, it is also the reason why the heat pump type water heater can obtain higher energy efficiency and a higher output ratio, and is also the most fundamental reason why the heat pump system is more energy-saving compared with a traditional electric water heater. For this reason, heat pump type water heaters will become a new trend with high energy efficiency in subsequent production and life. However, in scenarios of large heating capacity and high energy efficiency, traditional types of heat pump water heaters are generally designed as water heaters of a split type, in other words, the condenser and the water tank **1** act as one part, while the compressor **5**, the fan **3**, etc., act as another part, and indoor and outdoor parts are formed, which is similar to an installation scheme of today's air conditioners. However, installation scenarios required by this solution are complex, and the entire system occupies a very large space. For users, the appearance of split heat pump type water heaters cannot be designed to be particularly beautiful. The present invention uses an integral water heater as a model to design a heat pump type water heater which has high energy efficiency, large heating capacity, and low noise, and caters for the characteristics of easy installation, good productive maintainability, etc. of the system.

Embodiment 1

[0044] As shown in FIGS. **3-5** and **11**, a fan for a heat pump type water heater, the fan **3** being a double-air inlet fan, which can ensure that the air inlet quantity satisfies the demand; a partition plate **9** being arranged between the fan **3** to ensure that inlet air on both sides and subsequent outlet air substantially do not interfere with each other; spiral shafts of two volutes **8** being perpendicular to the partition plate **9**, and the two volutes **8** are symmetrically arranged. The design of the double-air inlet fan allows the establishment of negative pressure zones from symmetrical sides to achieve an effect of a greater heating capacity. Of course, air inlets **6** can also be arranged as more than two structures, which is not limited here.

[0045] The air inlets **6** are formed in the side walls of the volutes **8** distant from the partition plate **9**. The air inlets **6** are perpendicular to spiral shafts of the volutes **8**. Air outlet directions of air outlets **7** of the two volutes **8** are the same. The air outlets **7** and the air inlets **6** of the fan **3** are arranged correspondingly, which aims to ensure that the air inlets **6** and the evaporators **4** can form optimal negative-pressure fields here.

[0046] FIG. **4** is a schematic diagram of air flow of the fan **3** in a working state with a double-air inlet and double-air outlet type fan **3** as an example. Most preferably, the double-air inlet and double-air outlet fan is a centrifugal fan, which can ensure a larger negative pressure between the fan **3** and the evaporators **4**, and can also ensure that an entire system still has a sufficient air inlet quantity under the condition of a restricted installation position. The partition plate **9** in the middle optimally contains drive motors of the fan **3**. The drive motors are arranged in passages of air after heat exchange which flows through the evaporators **4**, and can also ensure reliable heat dissipation of the motors. Optimally, the motors are symmetrically installed in the center of the partition plate **9**. The air on both sides of the partition plate **9** does not interfere with each other. Under driving by the drive motors, the two impellers of the centrifugal fan **3** rotate. Due to the action of centrifugal force borne by the air between the impellers and the volutes **8**, the static pressure energy of the air is partially converted into velocity energy. At this time, the air inlets **6** of the fan **3** will form a negative pressure state. In order to ensure the entire balance, the surrounding air flows through the evaporators **4** under the action of the negative pressure to generate continuous heat source supply.

[0047] The volutes **8** of the fan **3** are optimally designed as an involute structure, and volute tongues **13** of the fan **3** are optimally designed as a structure with a gradually-enlarging opening part, that is, a backscrolling shape. In addition, gaps between the impellers of the fan **3** and the volutes **8** of the fan **3** need to satisfy a set involute equation relationship, so that on the premise that the sufficient negative pressure is ensured, the operating noise of the fan **3** is low. The application of the centrifugal fan **3** with the double-air inlet and double-air outlet structure ensures lower noise under the requirements of large heating capacity, high energy efficiency and restricted volume.

[0048] Further, when used in a heat pump type water heater, the fan **3** is optimally mounted upside down in an upper space of the water tank **1** in order to obtain high heating capacity and energy efficiency, which means that average positions of the air outlets **7** of the fan **3** are required to be lower than average positions of the air inlets **6** of the fan **3**. The two air outlets **7** are arranged side by side in the same direction, so that the air outlet directions are parallel to each other. The height of the air outlets **7** is lower than the height of the air inlets **6**. Air inlet ports **10** are arranged at positions, corresponding to the evaporators **4**, on the housing **2**, and air outlet ports **11** are arranged at positions, corresponding to the air outlets **7**, on the housing **2**. An angle between the axis of the fan **3** and the axis of the water tank **1** (namely, the vertical center line) is 90°.

Embodiment 2

[0049] Based on Embodiment 1, the present invention also provides a heat pump type water heater, comprising a condenser and a water tank **1**; a heat pump system is arranged on the top of the water tank **1**;

[0050] the heat pump system comprises a housing **2**, and a fan **3** (namely, the fan **3** described in Embodiment 1), an evaporator **4**, a compressor **5** and a throttling device **14** which are arranged inside the housing **2**;

[0051] an air outlet port of the compressor **5** is connected to an air inlet port of the condenser, a liquid outlet of the condenser is connected to a liquid inlet of the throttling device **14**, a liquid outlet of the throttling device **14** is connected to liquid inlets of the evaporators **4**, and air outlet ports of the evaporators **4** are connected to an air inlet port of the compressor **5**;

[0052] the fan **3** is arranged beside the evaporators **4** and is used for pumping out the air refrigerated by the evaporators **4**, the air outlets **7** and the air inlets **6** of the fan **3** are both upright.

[0053] The condenser which is arranged inside the water tank or attached to a wall surface of the water tank **1** is not shown, and is included in a range constructed by a peripheral space of the water tank **1**.

[0054] Preferably, the compressor **5** is a power component of the system, which can be selected as a scroll compressor **5**, a centrifugal compressor **5** and other forms. In the heat pump water heater system, due to a special requirement of the system for the degree of superheat, the compressor **5** is designed to be different from a common compressor **5** for an air conditioner, which is not limited here.

[0055] As shown in FIG. **2**, under a frame of an integral water heater, the heat pump type water heater of the present invention designs an outer cylinder of the water tank **1** and a heat pump assembly according to the same range so as to achieve an integration effect of the system. The whole does not contain extra parts located outside the preset range, so that aesthetics and the integral effect of the entire system are ensured, optimized space utilization is realized, and there is no mutant transition site. The preset range shown in the figures is a circle with a certain diameter. Of course, the preset range can be made into other irregular shapes to satisfy the requirements for aesthetics, which is not limited here. However, the design of the preset range here has to balance the needs of two aspects, one is the need of the heat pump assembly for space, and the other one is the need of the water tank **1** for volume (the water tank **1** should be neither too large nor too small, the too large capacity may bring about energy waste, while the too small capacity may make it impractical).

Embodiment 3

[0056] Based on Embodiment 1, the evaporators **4** are two sets of plate evaporators arranged in parallel. The evaporators are symmetrically arranged on both sides of the partition plate (**9**) and opposite to the air inlets (**6**) of the volutes (**8**).

[0057] Preferably, the gaps are provided between the air inlets **6** of the fan **3** and the evaporators **4**. The gaps and the wall surfaces of the volutes **8** form inlet air uniform distribution chambers.

[0058] As shown in FIG. **6**, in order to ensure that uniform negative pressure fields with less disturbance are constructed between the fan **3** and the evaporators **4**, the gaps for equalizing pressure are included between the air inlets **6** of the fan **3** and the evaporators **4**. Here, the double-air inlet fan is still taken as an example of the fan **3**. The evaporators **4** comprise parts symmetrically distributed on both sides of the fan **3**. Of course, in order to make better use of heat exchange areas, other structures such as a double-L shape, a double-C shape, a "⊓" shape, etc. are also included. Gaps for equalizing pressure are included between the symmetrically-arranged parts of the evaporators **4** and the air inlets of the fan **3**. The spacing width range of the gaps is 30-90 mm. Because parameters such as the size of the air inlets of the fan **3** and the porosity and air resistance of the evaporators **4** may have a comprehensive influence on the gap range, in order to ensure that the negative pressure fields constructed by the air inlets are more uniform and have less disturbance characteristics, the spacing width of the gaps is optimally selected to be within the above range. The air outlets **7** of the fan **3** are still located at positions closer to the water tank **1**, which is not limited here.

Embodiment 4

[0059] Based on Embodiment 1, the lattice baffle **12** is arranged between the fan **3** and the compressor **5**. Both ends of the lattice baffle **12** are connected to the evaporators **4** on both sides of the fan **3**, respectively. The lattice baffle **12** is located on the sides of the volutes **8** and is distant from the air outlets of the volutes. The compressor **5** is arranged on the face, distant from the air outlets **7**, of the lattice baffle **12**. The thickness of the lattice baffle **12** is 0.8-1.5 mm.

[0060] As shown in FIG. **7**, the evaporators **4** and the fan **3** form a first part of the heat pump assembly. The lattice baffle **12** is arranged between the compressor **5** and the first part of the heat pump assembly. The lattice baffle **12** is a sheet metal part having a certain thickness range, and is connected to a water tank **1** assembly to form a strong-damping structure for shock absorption. For example, the required thickness range is 0.8-1.5 mm, on one hand, the strength requirement can be met, and on the other hand, the rigidity and vibration damping effect of the entire system can also be ensured. Of course, the lattice baffle **12** is optimally arranged to be a sheet part structure made of a metal material such as steel. In order to further ensure that the two moving components, i.e., the fan **3** and the compressor **5**, do not interfere with each other, a noise reducing material, etc. may be arranged on the lattice baffle. In order to further utilize the heat generated by the compressor **5**, the lattice baffle **12** may be provided with a ventilation opening to utilize the waste heat generated by the compressor **5** more effectively, which is not limited here.

[0061] As shown in FIG. **8**, the compressor **5** may be installed in a separate space range, and is connected to the water tank **1** through components such as a buffer pad. The lattice baffle **12** is also connected to both the water tank **1** and is connected with the evaporators **4**. The evaporators **4** comprise evaporators **4** at least partially symmetrically distributed on both sides of the air inlets **6** of the fans **3**. The evaporators **4** are connected in parallel, that is, the refrigerant is substantially and evenly distributed in the two symmetrically-distributed evaporators **4**. This allows the two symmetrically-distributed evaporators **4** to generate substantially same heat exchange capacity, so that the entire system has a higher utilization of ambient heat in the constructed wind field. Of course, it is not excluded that the two evaporators **4** are partially connected in series, that is, the refrigerant flows through parts of the evaporators **4** first and then the other parts of the evaporators **4**. However, the total heating capacity is slightly smaller.

Embodiment 5

[0062] Based on Embodiment 1, the central planes of the evaporators **4** are parallel to the partition plate **9**. The axes of the central planes of the evaporators **4** include vertical axes and horizontal axes. The vertical distances between the vertical axes and the axis of the fan **3** are 0-125 mm. The vertical distances between the horizontal axes and the axis of the fan **3** are 0-50 mm. The central planes are the vertical planes of the centers of the evaporators **4**, and are parallel to the partition plate **9**. In this case, the axes of the central planes are the vertical center lines (vertical axes) and horizontal center lines (horizontal axes) of the rectangular planes. Of course, in other scenarios, they may be just the central planes of parts of the symmetrically-distributed evaporators **4** (e.g., evaporators **4** in a C shape, an L shape, etc.).

[0063] Preferably, the COP of the heat pump system under standard conditions is not less than 4.0.

[0064] As shown in FIG. **9**, for the symmetrically-arranged part of the evaporators **4**, the axes of their central planes and the axis of the fan **3** need to be within a preset range. For example, in a special scenario where the symmetrically-arranged evaporators **4** comprise parts of at least two planes (as shown in FIG. **9**), the central planes are the vertical planes of the centers of the evaporators **4**. At the time, the axes of the central planes are the center lines of the rectangular planes. Of course, in other scenarios, they may be just the central planes of parts of the symmetrically-distributed evaporators **4** (e.g., evaporators **4** in a C shape, an L shape, etc.). The optimal vertical distances between the vertical axes and the axis of the fan **3** is 0 mm, and the optimal vertical distances between the horizontal axes and the axis of the fan **3** is 0 mm. In this way, the wind fields can be more evenly distributed over the entire evaporators **4**, and the average velocity of the constructed wind fields is more reasonable, ensuring that the evaporators **4** can utilize ambient energy more efficiently. Finally, using the heat pump type water heater of the present invention can achieve a high energy efficiency index (meeting the second-level energy efficiency requirements) that the energy efficiency is not less than COP4.0 and a large heating capacity that the heating capacity is not less than 2500 W under standard conditions. Moreover, the noise of the whole machine can be maintained at a level close to 40 dB(A). A schematic diagram of the performance of the heat pump achieved by using the solution of the present application under different test conditions is shown as FIG. **10**, that is to say, the design structure proposed in the present application can solve the problem of contradiction among space, energy efficiency, heating capacity, etc. It is of extremely great significance in subsequent promotion and use of heat pumps.

[0065] It should be noted that the terms "include", "comprise", or any other variant thereof are intended to cover a non-exclusive inclusion, so that a process, a method, an article, or an apparatus that includes a series of elements not only includes those elements but also includes other elements which are not expressly listed, or further includes elements inherent to such process, method, article, or apparatus. In the absence of further restrictions, an element qualified by the sentence "comprising a . . . " does not preclude the existence of additional identical elements in the process, method, article, or apparatus that includes the element. The basic principles, main features and advantages of the present invention are shown and described above. Those skilled in the art should understand that the present invention is not limited to the above embodiments. The above embodiments and descriptions in the Specification are merely illustrative of the principle of the present invention. Various changes and modifications may be made to the present invention without departing from the spirit and scope of the present invention. These changes and modifications all fall within the scope of protection of the present invention. The scope of protection of the present invention is defined by the appended claims and their equivalents.

1. A fan for a heat pump type water heater, comprising:

two volutes (**8**);

a partition plate (**9**) arranged between the two volutes; and

impellers, wherein the impellers are arranged in the volutes (**8**), rotating shafts of the impellers are located on spiral axes of the volutes (**8**) and are in shaft connection to transmission shafts in the volutes (**8**);

wherein the volutes (**8**) are designed as an involute structure, and volute tongues (**13**) of the volutes are in a backscrolling shape;

wherein spiral shafts of the two volutes (**8**) are perpendicular to the partition plate (**9**), and the two volutes (**8**) take the partition plate (**9**) as a symmetrical face and are symmetrically arranged; and

wherein an air inlet (**6**) is formed in a side wall of each volute (**8**) distant from the partition plate (**9**), the air inlets (**6**) are perpendicular to the spiral shafts of the volutes (**8**), and air outlet directions of air outlets (**7**) of the two volutes (**8**) are the same:

2. A heat pump type water heater, comprising:
a condenser;
and a water tank (**1**); and
a heat pump system arranged on top of the water tank (**1**);
wherein the heat pump system comprises a housing (**2**), in which the fan (**3**) according to claim **1** is arranged along with evaporators (**4**), a compressor (**5**) and a throttling device (**14**);
wherein an air outlet port of the compressor (**5**) is connected to an air inlet port of the condenser, a liquid outlet of the condenser is connected to a liquid inlet of the throttling device (**14**), a liquid outlet of the throttling device (**14**) is connected to liquid inlets of the evaporators (**4**), and air outlet ports of the evaporators (**4**) are connected to an air inlet port of the compressor (**5**); and
wherein the fan (**3**) is arranged beside the evaporators (**4**) and is used for pumping out air cooled by the evaporators (**4**).

3. The heat pump type water heater according to claim **2**, wherein the air outlet directions of the air outlets (**7**) of the two volutes (**8**) are horizontal, and the air outlets (**7**) are located on lower sides of the air inlets (**6**).

4. The heat pump type water heater according to claim **2**, wherein axes of the impellers are horizontal.

5. The heat pump type water heater according to claim **2**, wherein the evaporators (**4**) are plate evaporators, the two sets of evaporators (**4**) are symmetrically arranged on both sides of the partition plate (**9**), and plate faces of the evaporators (**4**) are opposite to the air inlets (**6**) of the volutes (**8**), respectively.

6. The heat pump type water heater according to claim **5**, wherein distances between the air inlets (**6**) and the evaporators (**4**) are 30-90 mm.

7. The heat pump type water heater according to claim **5**, wherein a lattice baffle (**12**) is connected between the two sets of evaporators (**4**), the lattice baffle (**12**) is arranged vertically, the lattice baffle (**12**) is located on the sides of the volutes (**8**) and is distant from the air outlets of the volutes, and the compressor (**5**) is arranged on the face, distant from the air outlets (**7**), of the lattice baffle (**12**).

8. The heat pump type water heater according to, claim **5**, wherein vertical distances between vertical center lines of the evaporators (**4**) and an axis of the fan (**3**) are 0-125 mm, and horizontal distances between horizontal center lines of the evaporators (**4**) and the axis of the fan (**3**) are 0-50 mm.

9. The heat pump type water heater according to claim **5**, wherein air inlet ports (**10**) are arranged at positions, corresponding to the evaporators (**4**), on the housing (**2**), and air outlet ports (**11**) are arranged at positions, corresponding to the air outlets (**7**), on the housing (**2**).

10. The heat pump type water heater according to claim **5**, wherein the two sets of plate evaporators are arranged in parallel.

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