



US 20170343272A1

(19) **United States**(12) **Patent Application Publication**
MIAO et al.(10) **Pub. No.: US 2017/0343272 A1**(43) **Pub. Date: Nov. 30, 2017**(54) **BASE OF HEAT PUMP SYSTEM AND HEAT
PUMP SYSTEM FOR DRIER OR
WASHER-DRIER**(52) **U.S. Cl.**CPC *F25D 21/14* (2013.01); *D06F 58/24*
(2013.01); *F25B 30/02* (2013.01)(71) Applicant: **Wuxi Little Swan Co., Ltd.**, Wuxi
(CN)

(57)

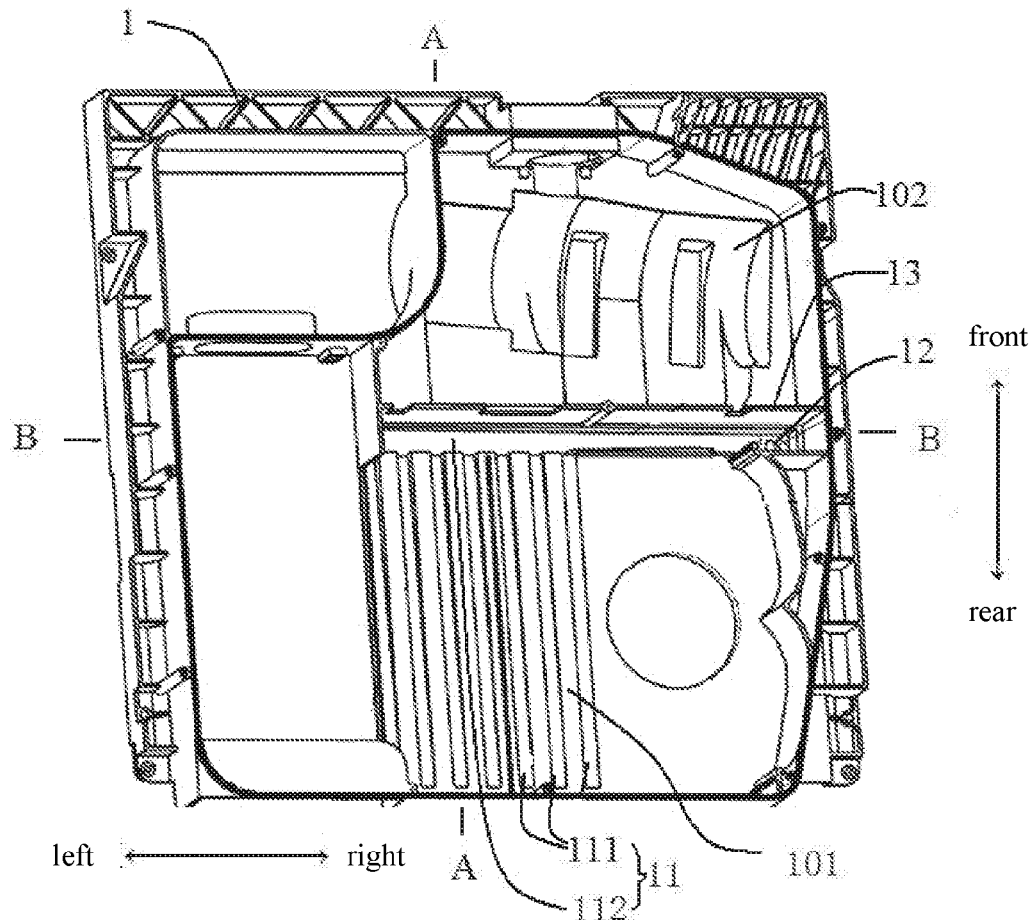
ABSTRACT(72) Inventors: **Yulai MIAO**, Wuxi (CN); **Wei QIAN**,
Wuxi (CN); **Song LU**, Wuxi (CN);
Chunyu ZHU, Wuxi (CN)(21) Appl. No.: **15/350,485**(22) Filed: **Nov. 14, 2016**(30) **Foreign Application Priority Data**

May 31, 2016 (CN) 201610378293.6

May 31, 2016 (CN) 201620518508.5

Publication Classification(51) **Int. Cl.***F25D 21/14* (2006.01)*F25B 30/02* (2006.01)*D06F 58/24* (2006.01)

A base of a heat pump system and a heat pump system for a drier or a washer-drier are provided. The base defines an evaporator storage chamber with a guide groove formed in a bottom surface of the evaporator storage chamber; a drain port is formed in a bottom surface of the guide groove and is in communication with outsider space of the evaporator storage chamber; and the guide groove is configured to guide condensate water to the drain port. For the base according to the present invention, by providing the guide groove in the bottom surface of the evaporator storage chamber, and by guiding the condensate water through the guide groove to the drain port and discharging the condensate water out of the base, it is possible to guarantee heat exchange efficiency of the heat pump system, shorten drying time and improve drying efficiency.



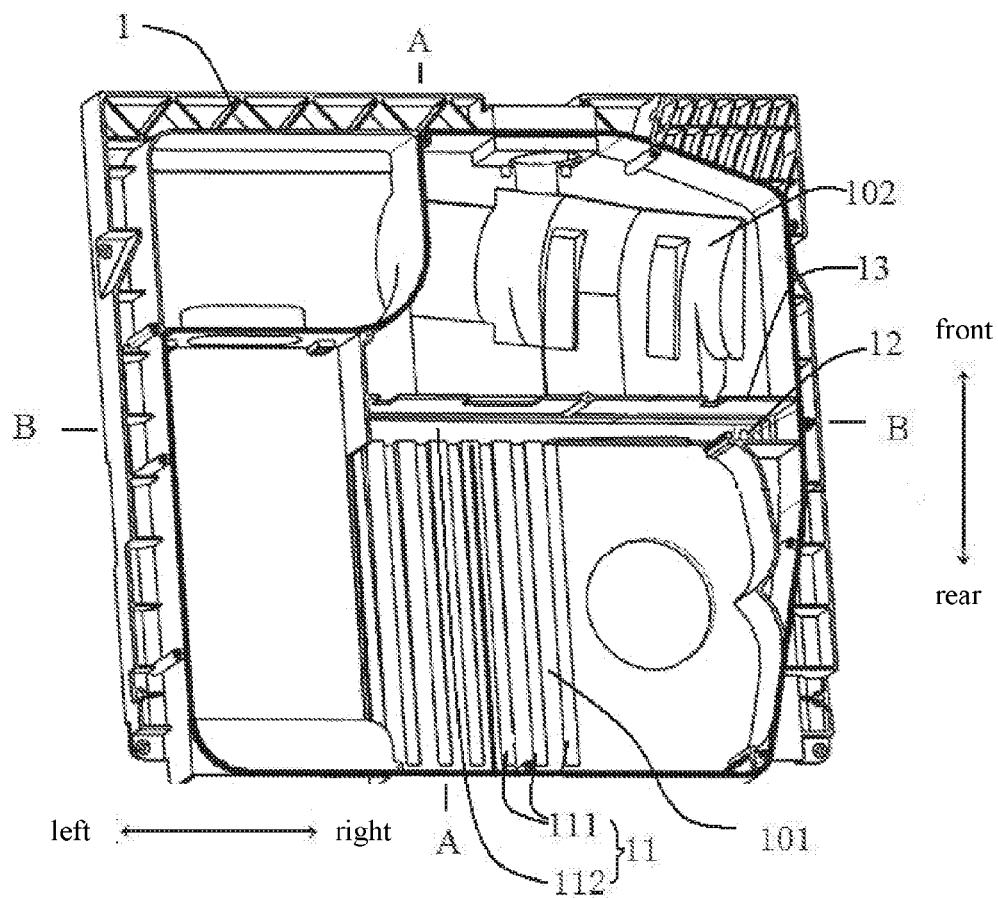


Fig. 1

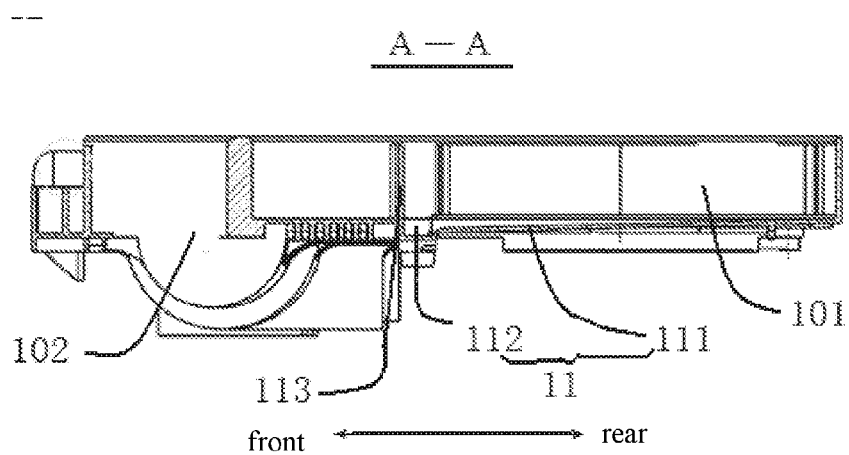


Fig. 2

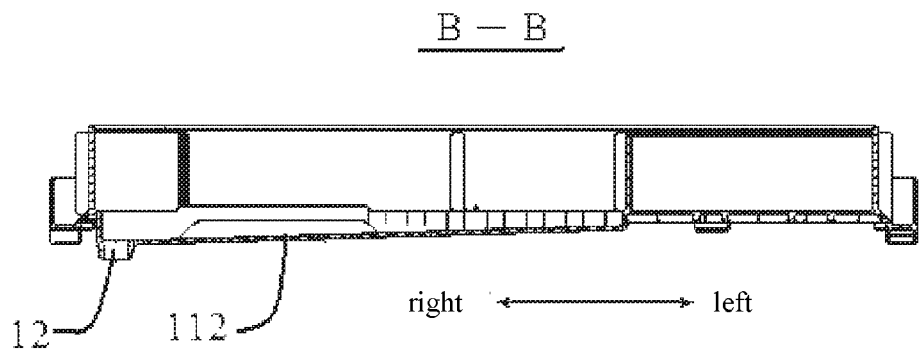


Fig. 3

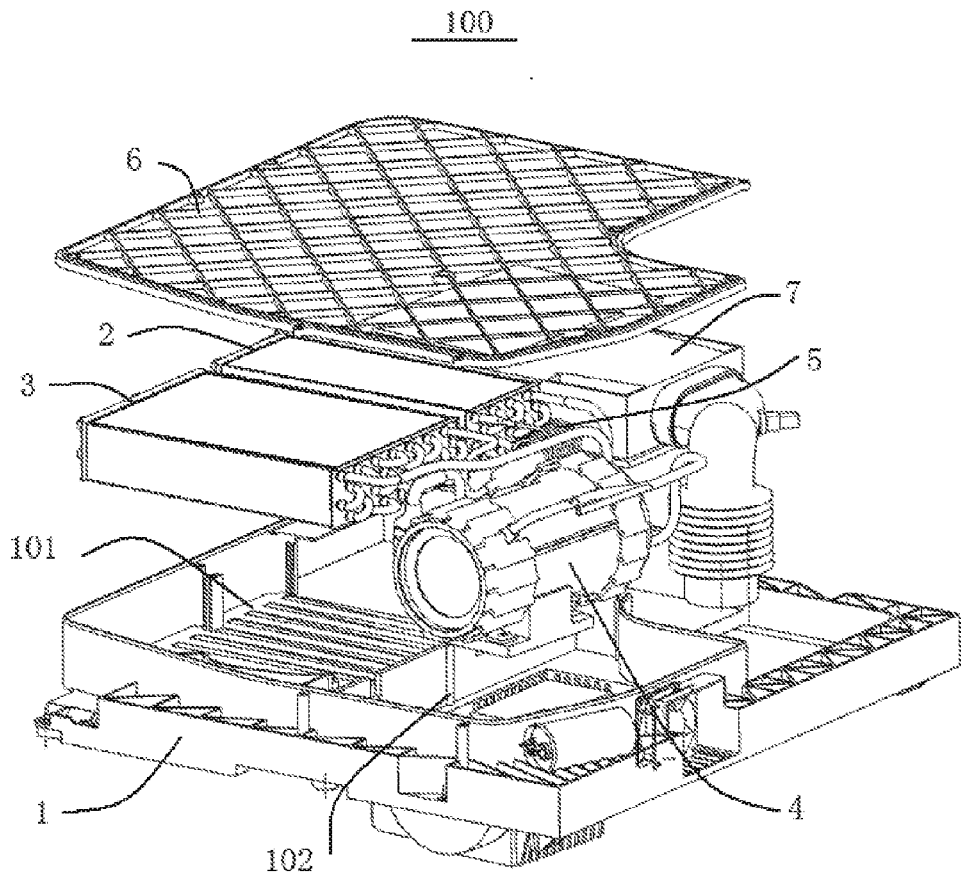


Fig. 4

BASE OF HEAT PUMP SYSTEM AND HEAT PUMP SYSTEM FOR DRIER OR WASHER-DRIER

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to and benefits of Chinese Patent Application Serial No. 201610378293.6 and Chinese Patent Application Serial No. 201620518508.5, each of which was filed with the State Intellectual Property Office of P. R. China on May 31, 2016. The entire contents of each of the above-mentioned applications are incorporated herein by reference.

FIELD

[0002] The present invention relates to a field of household appliances, and more particularly to a base of a heat pump system and a heat pump system for a drier or a washer-drier.

BACKGROUND

[0003] A drum-type washer-drier may adopt various drying modes, including heat pump drying. In the related art, a heat pump drying system of a heat pump washer-drier is often installed in a separated manner. That is, a compressor and two other components are disposed at upper and lower parts of the washing machine separately, and connected via pipes, which complicates the structure and is not conducive to production and maintenance.

[0004] In the related art, various components of the heat pump drying system are integrated, in which an evaporator and a condenser are disposed in the base, but high-temperature and high-moisture air tends to produce condensate water when going through the evaporator, and the condensate water tends to be blown away due to a continuous air flow through the base or tends to lag behind, thereby being heated again by the condenser, which will lower heat exchange efficiency and prolong drying time.

SUMMARY

[0005] The present invention aims to solve at least one of the problems existing in the related art. Thus, embodiments of the present invention provide a base of a heat pump system, which discharges condensate water condensed at an evaporator out of the base.

[0006] Embodiments of the present invention further provide a heat pump system having the base and used for a drier or a washer-drier.

[0007] According to a first aspect of the present invention, the base defines an evaporator storage chamber with a guide groove formed in a bottom surface of the evaporator storage chamber; a drain port is formed in a bottom surface of the guide groove and is in communication with outside space of the evaporator storage chamber; and the guide groove is configured to guide condensate water to the drain port.

[0008] For the base according to the present invention, by providing the guide groove in the bottom surface of the evaporator storage chamber, and by guiding the condensate water through the guide groove to the drain port and discharging the condensate water out of the base, it is possible to guarantee heat exchange efficiency of the heat pump system, shorten drying time and improve drying efficiency.

[0009] In some embodiments, the bottom surface of the guide groove inclines downwards towards the drain port in a water flow direction.

[0010] Alternatively, the guide groove includes a first groove configured to correspond with an evaporator in an up-and-down direction, and a second groove having a first end corresponding and communicating with the first groove, and a second end provided with the drain port in a bottom surface thereof.

[0011] Further, a bottom surface of the first groove inclines downwards towards the second groove in a water flow direction, and a bottom surface of the second groove inclines downwards towards the drain port in the water flow direction.

[0012] Preferably, the first groove is substantially perpendicular to the second groove; and one first groove is provided, or a plurality of first grooves are arranged and spaced apart from one another along an extension direction of the second groove.

[0013] In some embodiments of the present invention, the base further defines a compressor storage chamber, partitioned from the evaporator storage chamber by a partition plate; and the second groove is adjacent to the partition plate and extends along the partition plate.

[0014] Preferably, the first groove is located upstream of an air flow direction in the evaporator storage chamber.

[0015] Advantageously, the bottom surface of the second groove is lower than the bottom surface of the first groove.

[0016] In some embodiments of the present invention, the bottom surface of the evaporator storage chamber is configured as a horizontal plane, and at least part of the bottom surface of the evaporator storage chamber is recessed to form the guide groove.

[0017] According to a second aspect of the present invention, the heat pump system includes a base which is the base according to the first aspect of the present invention, and an evaporator disposed within an evaporator storage chamber of the base, wherein condensate water produced at the evaporator is suitable to flow to a drain port through a guide groove.

[0018] For the heat pump system according to the present invention, the overall performance of the heat pump system is improved by providing the drying device according to the first aspect of the present invention.

[0019] Additional aspects and advantages of embodiments of present invention will be given in part in the following descriptions, become apparent in part from the following descriptions, or be learned from the practice of the embodiments of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] FIG. 1 is a schematic view of a heat pump system according to an embodiment of the present invention;

[0021] FIG. 2 is a sectional view taken along line A-A in FIG. 1;

[0022] FIG. 3 is a sectional view taken along line B-B in FIG. 1;

[0023] FIG. 4 is an exploded view of a heat pump system for a drier or a washer-drier according to an embodiment of the present invention.

REFERENCE NUMERALS

- [0024] heat pump system **100**,
- [0025] base **1**,
- [0026] evaporator storage chamber **101**, compressor storage chamber **102**,
- [0027] guide groove **11**, first groove **111**, second groove **112**,
- [0028] drain port **12**, partition plate **13**,
- [0029] evaporator **2**, condenser **3**, horizontal compressor **4**, throttling device **5**, top cover **6**, filtering device **7**.

DETAILED DESCRIPTION

[0030] Embodiments of the present invention will be described in detail and examples of the embodiments will be illustrated in the drawings, where same or similar reference numerals are used to indicate same or similar members or members with same or similar functions. The embodiments described herein with reference to drawings are explanatory, which are used to illustrate the present invention, but shall not be construed to limit the present invention.

[0031] Various embodiments and examples are provided in the following description to implement different structures of the present disclosure. In order to simplify the present disclosure, certain elements and settings will be described. However, these elements and settings are only by way of example and are not intended to limit the present disclosure. In addition, reference numerals may be repeated in different examples in the present disclosure. This repeating is for the purpose of simplification and clarity and does not refer to relations between different embodiments and/or settings. Furthermore, examples of different processes and materials are provided in the present disclosure. However, it would be appreciated by those skilled in the art that other processes and/or materials may be also applied.

[0032] In the following, a base **1** of a heat pump system **100** according to embodiments of a first aspect of the present invention will be described with reference to FIGS. **1** to **3**.

[0033] As shown in FIG. **1**, the base **1** according to embodiments of the first aspect of the present invention defines an evaporator storage chamber **101** with a guide groove **11** formed in a bottom surface of the evaporator storage chamber **101**; a drain port **12** is formed in a bottom surface of the guide groove **11** and is in communication with outside space of the evaporator storage chamber **101**; and the guide groove **11** is configured to guide condensate water to the drain port **12**.

[0034] It shall be noted that after high-temperature and high-moisture air is cooled down through heat absorption of an evaporator **2**, the condensate water produced thereby tends to be blown to a condenser **3** due to a continuous airflow passing through the base **1** and hence is heated again, which degrades heat exchange efficiency of the heat pump system **100** and prolongs drying time. However, in this embodiment of the present invention, by providing the guide groove **11** in the evaporator storage chamber **101**, the condensate water produced at the evaporator **2** is converged to the guide groove **11**, then led to the drain port **12** via the guide groove **11**, and discharged out of the base **1** via the drain port **12**. Thus, the heat exchange efficiency of the heat pump system **100** may be guaranteed, so as to improve the drying efficiency.

[0035] For the base **1** of the heat pump system **100** according to the present invention, by providing the guide groove **11** in the bottom surface of the evaporator storage chamber **101**, and by guiding the condensate water through the guide groove **11** to the drain port **12** and discharging the condensate water out of the base **1**, it is possible to guarantee the heat exchange efficiency of the heat pump system, shorten the drying time and improve the drying efficiency.

[0036] Advantageously, with reference to FIGS. **2** and **3**, the bottom surface of the guide groove **11** may incline downwards towards the drain port **12** in a water flow direction. That is, the condensate water in the guide groove **11** flows from high to low position, which is conducive to making the condensate water in the guide groove **11** automatically flow to the drain port **12** under the action of gravity to be discharged, and hence makes the structure of the guide groove **11** more reasonable.

[0037] In an embodiment of the present invention, as shown in FIG. **1**, the guide groove **11** includes a first groove **111** configured to correspond with the evaporator **2** in an up-and-down direction, and a second groove **112** having a first end (e.g. a left end of the second groove **112** in FIG. **1**) corresponding and communicating with the first groove **111**, and a second end (e.g. a right end of the second groove **112** in FIG. **1**) provided with the drain port **12** in a bottom surface thereof. In such a way, the condensate water condensed at the evaporator **2** may first drop into the first groove **111**, then flow to the left end of the second groove **112** from the first groove **111**, and finally flow to the drain port **12** at the right end of the second groove **112** from the left end thereof, so as to be discharged outside. Thus, the structure of the guide groove **11** may become more reasonable.

[0038] Further, as shown in FIGS. **2** and **3**, a bottom surface of the first groove **111** inclines downwards towards the second groove **112** in a water flow direction (e.g. a front-to-rear direction in FIG. **2**), and a bottom surface of the second groove **112** inclines downwards towards the drain port **12** in the water flow direction (e.g. a left-to-right direction in FIG. **3**). Consequently, it may be facilitated that the condensate water in the first groove **111** flows to the second groove **112** under the action of gravity, and the condensate water in the second groove **112** flows to the drain port **12** under the action of gravity, thereby making the structures of the first groove **111** and the second groove **112** more reasonable.

[0039] Preferably, referring to FIG. **1**, the first groove **111** may be substantially perpendicular to the second groove **112**. When the condensate water flows from the first groove **111** to the second groove **112**, the flow direction of the condensate water may be changed to guide the condensate water to the drain port **12**. Moreover, one first groove **111** is provided, or a plurality of first grooves **111** are arranged and spaced apart from one another along an extension direction (e.g. a left-and-right direction in FIG. **1**) of the second groove **112**. Thus, the number of the first groove **111** may be set according to practical requirements to improve flexibility of the setting. In addition, the plurality of first grooves **111** are arranged along the extension direction of the second groove **112**, such that each first groove **111** is jointed with the second groove **112** in a lapped manner to facilitate that the condensate water accumulated in each first groove **111** may flow into the second groove **112**, and such that the structure of the base **1** may become more compact and reasonable.

[0040] In some embodiments of the present invention, as shown in FIG. 1, the base 1 further defines a compressor storage chamber 102, in which a horizontal compressor 4 is disposed, and the evaporator storage chamber 101 and the compressor storage chamber 102 are partitioned from each other by a partition plate 13; the second groove 112 is adjacent to the partition plate 13 and extends along the partition plate 13. Thus, it is possible to partition the horizontal compressor 4 mounted on the base 1 from the evaporator 2 and the condenser 3 effectively, to prevent the compressor from interfering with the evaporator 2 or the condenser 3, reduce leakage of hot air in the condenser 3 and guarantee the heat exchange efficiency of the heat pump system 100.

[0041] Preferably, as shown in FIG. 1, the first groove 111 is located upstream of an air flow direction in the evaporator storage chamber 101. Thus, the condensate water may be accelerated to flow to the drain port 12 under the continuous action of the airflow when flowing in the guide groove 11, so as to improve the flow velocity of the condensate water, further avoid heat exchange loss of the condenser 3 and improve the heat exchange efficiency of the heat pump system 100. It shall be noted herein that the term “upstream” means that the airflow first flows through the first groove 111 and then to the condenser 3.

[0042] Advantageously, referring to FIG. 1, the bottom surface of the second groove 112 is lower than the bottom surface of the first groove 111, so as to guarantee that the condensate water in the first groove 111 may flow into the second groove 112 smoothly, thereby making the structure of the guide groove 11 more reasonable.

[0043] In some embodiments of the present invention, as shown in FIG. 1, the bottom surface of the evaporator storage chamber 101 is configured as a horizontal plane, and at least part of the bottom surface of the evaporator storage chamber 101 is recessed to form the guide groove 11. Thus, the structure of the base 1 may be simplified to facilitate the mounting of the evaporator 2 and the collection of the condensate water condensed at the evaporator 2, and the structure of the base 1 becomes more compact and reasonable.

[0044] According to embodiments of a second aspect of the present invention, the heat pump system 100 for driers or washer-driers includes the base 1 according to the first aspect of the present invention, and the evaporator 2 disposed within the evaporator storage chamber 101 of the base 1, in which the condensate water produced at the evaporator is suitable to flow to the drain port 12 through the guide groove 11.

[0045] For the heat pump system 100 according to the present invention, the condensate water may be discharged conveniently by providing the base 1 according to the first aspect of the present invention, thereby improving the overall performance of the heat pump system 100.

[0046] In the following, the heat pump system 100 according to a specific embodiment of the present invention will be described with reference to FIGS. 1 to 4.

[0047] Referring to FIG. 4, the heat pump system 100 includes the base 1, the evaporator 2, the condenser 3, the horizontal compressor 4, a throttling device 5, a fan, an air passage, a top cover 6 and a filtering device 7, in which the horizontal compressor 4, the condenser 3, the evaporator 2, the throttling device 5, the fan, the air passage and the

filtering device 7 are all disposed on the base 1, while the top cover 6 covers over the base 1.

[0048] Specifically, as shown in FIG. 1, the base 1 defines the evaporator storage chamber 101, the compressor storage chamber 102 and a condenser storage chamber, in which the partition plate 13 is disposed between the evaporator storage chamber 101 and the compressor storage chamber 102 and partitions them from each other; the evaporator 2, the horizontal compressor 4 and the condenser 3 are disposed in respective storage chambers.

[0049] As shown in FIG. 1, the guide groove 11 is provided in the evaporator storage chamber 101, and includes the first groove 111 and the second groove 112. Specifically, the bottom surface of the evaporator storage chamber 101 is configured as the horizontal plane, and at least part of the bottom surface of the evaporator storage chamber 101 is recessed to form a plurality of first grooves 111 that incline downwards along a rear-to-front direction. The second groove 112 is substantially perpendicular to the plurality of first grooves 111; the left end of the second groove 112 is connected with a front end of each of the plurality of first grooves 111; and the bottom surface thereof is lower than the bottom surface of each of the plurality of first grooves 111. Further, the second groove 112 inclines downwards along a left-to-right direction. The rightmost end of the second groove 112 is formed with the drain port 12 running through the bottom of the base 1 and communicating with the outside space.

[0050] In the working process of the heat pump system 100, the high-temperature and high-moisture air flowing out from a clothes drying barrel enters the base 1 and passes through the evaporator 2 first for cooling and dehumidification, and the resulting dry hot air of high-temperature returns to the clothes drying barrel for drying clothes.

[0051] In the process of cooling and dehumidifying the high-temperature and high-moisture air by the evaporator 2, the condensate water may be produced at the evaporator 2, and drop into the first groove 111 because the first groove 111 is formed in the bottom wall of the evaporator storage chamber 101. The condensate water flows to the second groove 112 along the rear-to-front direction under the action of gravity; then the condensate water in the second groove 112 flows to the drain port 12 under the double action of the airflow and gravity and is finally discharged via the drain port 12.

[0052] Therefore, for the heat pump system 100 according to the present invention, the guide groove 11 is provided to collect, guide and finally lead the condensate water to the drain port 12 to be discharged out of the base 1, which may prevent the condensate water from being blown to the condenser 3 by the airflow and thus avoid heating the condensate water again, so as to improve the heat exchange efficiency of the heat pump system 100, shorten the drying time, and improve the drying efficiency.

[0053] Additionally, for the heat pump system 100 according to the present invention, by mounting various components of the heat pump system 100 on the base 1, the heat pump system 100 may be componentized, modularized and integrated. Moreover, the integrated heat pump system 100 may be mounted at the top of a drum-type washing machine assembly to realize modularized production and installation.

[0054] In the specification, it is to be understood that terms such as “central,” “longitudinal,” “lateral,” “length,” “width,” “thickness,” “upper,” “lower,” “front,” “rear,”

“left,” “right,” “vertical,” “horizontal,” “top,” “bottom,” “inner,” “outer,” “clockwise,” and “counterclockwise” should be construed to refer to the orientation as then described or as shown in the drawings under discussion. These relative terms are for convenience of description and do not require that the present invention be constructed or operated in a particular orientation.

[0055] In addition, terms such as “first” and “second” are used herein for purposes of description and are not intended to indicate or imply relative importance or significance or to imply the number of indicated technical features. Thus, the feature defined with “first” and “second” may comprise one or more of this feature. In the description of the present invention, “a plurality of” means two or more than two, unless specified otherwise.

[0056] In the present invention, unless specified or limited otherwise, the terms “mounted,” “connected,” “coupled,” “fixed” and the like are used broadly, and may be, for example, fixed connections, detachable connections, or integral connections; may also be mechanical or electrical connections; may also be direct connections or indirect connections via intervening structures; may also be inner communications of two elements, which can be understood by those skilled in the art according to specific situations.

[0057] In the present invention, unless specified or limited otherwise, a structure in which a first feature is “on” or “below” a second feature may include an embodiment in which the first feature is in direct contact with the second feature, and may also include an embodiment in which the first feature and the second feature are not in direct contact with each other, but are contacted via an additional feature formed therebetween. Furthermore, a first feature “on,” “above,” or “on top of” a second feature may include an embodiment in which the first feature is right or obliquely “on,” “above,” or “on top of” the second feature, or just means that the first feature is at a height higher than that of the second feature; while a first feature “below,” “under,” or “on bottom of” a second feature may include an embodiment in which the first feature is right or obliquely “below,” “under,” or “on bottom of” the second feature, or just means that the first feature is at a height lower than that of the second feature.

[0058] Reference throughout this specification to “an embodiment,” “some embodiments,” “an example,” “specific examples” or “some examples” means that a particular feature, structure, material, or characteristic described in connection with the embodiment or example is included in at least one embodiment or example of the present invention. Thus, the appearances of the above phrases throughout this specification are not necessarily referring to the same embodiment or example of the present invention. Furthermore, the particular features, structures, materials, or characteristics may be combined in any suitable manner in one or more embodiments or examples. Those skilled in the art can integrate and combine different embodiments or examples and the features in different embodiments or examples in the specification.

[0059] Although embodiments of the present invention have been shown and illustrated, it shall be understood by those skilled in the art that various changes, modifications, alternatives and variants without departing from the principle and spirit of the present invention are acceptable. The scope of the present invention is defined by the claims or the like.

What is claimed is:

1. A base of a heat pump system, wherein the base defines an evaporator storage chamber with a guide groove formed in a bottom surface of the evaporator storage chamber;
 - a drain port is formed in a bottom surface of the guide groove and is in communication with outside space of the evaporator storage chamber; and
 - the guide groove is configured to guide condensate water to the drain port.
2. The base according to claim 1, wherein the bottom surface of the guide groove inclines downwards towards the drain port in a water flow direction.
3. The base according to claim 1, wherein the guide groove comprises
 - a first groove configured to correspond with an evaporator in an up-and-down direction, and
 - a second groove having a first end corresponding and communicating with the first groove, and a second end provided with the drain port in a bottom surface thereof.
4. The base according to claim 3, wherein a bottom surface of the first groove inclines downwards towards the second groove in a water flow direction, and a bottom surface of the second groove inclines downwards towards the drain port in the water flow direction.
5. The base according to claim 3, wherein the first groove is substantially perpendicular to the second groove; and one first groove is provided, or a plurality of first grooves are arranged and spaced apart from one another along an extension direction of the second groove.
6. The base according to claim 3, wherein the base further defines a compressor storage chamber, partitioned from the evaporator storage chamber by a partition plate; and the second groove is adjacent to the partition plate and extends along the partition plate.
7. The base according to claim 3, wherein the first groove is located upstream of an air flow direction in the evaporator storage chamber.
8. The base according to claim 3, wherein the bottom surface of the second groove is lower than the bottom surface of the first groove.
9. The base according to claim 1, wherein the bottom surface of the evaporator storage chamber is configured as a horizontal plane, and at least part of the bottom surface of the evaporator storage chamber is recessed to form the guide groove.
10. A heat pump system for a drier or a washer-drier, comprising
 - a base defining an evaporator storage chamber, wherein a guide groove is formed in a bottom surface of the evaporator storage chamber, a drain port is formed in a bottom surface of the guide groove and is in communication with outside space of the evaporator storage chamber, and the guide groove is configured to guide condensate water to the drain port; and
 - an evaporator disposed within the evaporator storage chamber of the base, wherein condensate water produced at the evaporator is suitable to flow to the drain port through the guide groove.
11. The heat pump system according to claim 10, wherein the bottom surface of the guide groove inclines downwards towards the drain port in a water flow direction.
12. The heat pump system according to claim 10, wherein the guide groove comprises:

a first groove configured to correspond with an evaporator in an up-and-down direction, and

a second groove having a first end corresponding and communicating with the first groove, and a second end provided with the drain port in a bottom surface thereof.

13. The heat pump system according to claim **12**, wherein a bottom surface of the first groove inclines downwards towards the second groove in a water flow direction, and a bottom surface of the second groove inclines downwards towards the drain port in the water flow direction.

14. The heat pump system according to claim **12**, wherein the first groove is substantially perpendicular to the second groove; and one first groove is provided, or a plurality of first grooves are arranged and spaced apart from one another along an extension direction of the second groove.

15. The heat pump system according to claim **12**, wherein the base further defines a compressor storage chamber, partitioned from the evaporator storage chamber by a partition plate; and the second groove is adjacent to the partition plate and extends along the partition plate.

16. The heat pump system according to claim **12**, wherein the first groove is located upstream of an air flow direction in the evaporator storage chamber.

17. The heat pump system according to claim **12**, wherein the bottom surface of the second groove is lower than the bottom surface of the first groove.

18. The heat pump system according to claim **10**, wherein the bottom surface of the evaporator storage chamber is configured as a horizontal plane, and at least part of the bottom surface of the evaporator storage chamber is recessed to form the guide groove.

* * * * *