(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 460 343 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
27.03.2019 Bulletin 2019/13

(21) Application number: **16920326.2**

(22) Date of filing: **30.12.2016**

(51) Int Cl.:
F24D 13/04 *(2006.01)* ***F24D 19/10*** *(2006.01)*
F24D 19/08 *(2006.01)*

(86) International application number:
PCT/CN2016/113777

(87) International publication number:
WO 2018/076543 (03.05.2018 Gazette 2018/18)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

(30) Priority: **28.10.2016 CN 201610974401**
28.10.2016 CN 201621193373 U

(71) Applicants:
- **GD Midea Environment Appliances MFG Co., Ltd.**
  Zhongshan, Guangdong 528425 (CN)
- **Midea Group Co., Ltd.**
  Foshan, Guangdong 528311 (CN)

(72) Inventors:
- **YUE, Bao**
  Zhongshan
  Guangdong 528425 (CN)
- **WANG, Wenpeng**
  Zhongshan
  Guangdong 528425 (CN)
- **CHEN, Xiaotan**
  Zhongshan
  Guangdong 528425 (CN)
- **ZHOU, Weiping**
  Zhongshan
  Guangdong 528425 (CN)
- **DU, Wenbo**
  Zhongshan
  Guangdong 528425 (CN)

(74) Representative: **Lam, Alvin et al**
Maucher Jenkins
26 Caxton Street
London SW1H 0RJ (GB)

(54) OIL HEATER

(57) An oil heater (100), comprising: two oil pipes (1) arranged at intervals vertically; and multiple cooling fins (2), both ends of the cooling fins (2) being provided on the two oil pipes (1), separately. An oil way channel in communication with the two oil pipes (1) is provided in each cooling fin (2). An air cavity (21) spaced apart from the oil way channel is provided on at least one side edge of each cooling fin (2). Each air cavity (21) is provided with a top air outlet (210). An air inlet (211) is provided on each side wall of opposite side walls of the air cavity (21) on a length direction parallel to the oil pipes (1). Each air inlet (211) is provided with an air guide plate (212) for introducing the air into the air cavity (21).

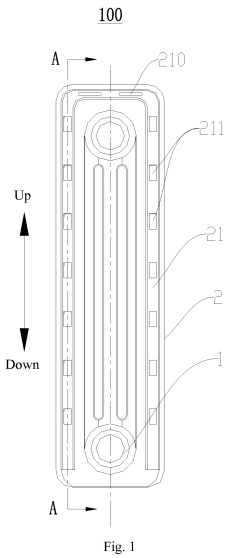

Fig. 1

EP 3 460 343 A1

Description

FIELD

[0001] The present disclosure relates to a technical field of living appliances, in particular to an oil heater.

BACKGROUND

[0002] The current oil heater works by using an electric heating rod to heat the heat-transfer oil in the metal cavity, and then the heat-transfer oil with the high temperature transfers heat to the ambient air through the metal cavity and the fin on the cavity so as to achieve the user's purpose of heating. Generally, the higher the temperatures of the metal cavity and the fin, the better the heat dissipation to the ambient air.

[0003] In the related art, the edge of the fin of the oil heater generally has a very thin air cavity, the air cavity is provided with through holes spaced apart from one another by a certain distance, and the air enters the air cavity through the through holes. Since the thermal conductivity of the air is much lower than that of the metal (usually, the stainless steel), the oil heater in the related art can achieve the purpose of insulating the extreme edge of the fin from a part of the heat. However, the oil heater cannot cool the edge of the fin adequately only by relying on the air insulation design in the air cavity, and thus the user is still in danger of burns while using the oil heater.

SUMMARY

[0004] The present disclosure aims to solve one of the technical problems in the related art at least to some extent. To this end, the present disclosure proposes an oil heater capable of increasing a heat dissipation area of an edge of a fin, increasing a flow intensity of air on an inner surface and an outer surface of the fin, lowering a temperature of the edge of the fin, enhancing a heat dissipation capability of the fin, and avoiding the risk that the user may be burned while using the oil heater.

[0005] The oil heater according to embodiments of the present disclosure includes: two oil pipes arranged in an up and down direction and spaced apart from each other; and a plurality of fins, each fin having two ends disposed to the two oil pipes respectively, defining an oil passage therein communicated with the two oil pipes, and having an air cavity spaced apart from the oil passage in at least one side edge of the fin. The air cavity has a top air outlet. In a direction parallel to a length direction of the oil pipe, each of opposite side walls of the air cavity has an air inlet, and an air guiding plate is provided at the air inlet for guiding air into the air cavity.

[0006] In the oil heater according to embodiments of the present disclosure, by providing the air cavity having the air inlet and the top air outlet in the edge of the fin, and also providing the air guiding plate at the air inlet, the heat dissipation area of the edge of the fin is increased, the flow intensity of the air on the inner surface and the outer surface of the fin is improved, the temperature of the edge of the fin is reduced, the heat dissipation capability of the fin is strengthened, and the risk that the user may be burned while using the oil heater is avoided.

[0007] Preferably, the oil heater further comprises a bimetallic temperature controller configured to detect a temperature of a heat-transfer oil, wherein when the temperature of the heat-transfer oil reaches a temperature set by a user, a power source is turned off.

[0008] According to some embodiments of the present disclosure, each of the opposite side walls of the air cavity has a plurality of air inlets, and the plurality of air inlets are spaced apart from one another in the up and down direction.

[0009] Optionally, each air guiding plate has a free end extending into the air cavity.

[0010] Optionally, each air guiding plate has a free end located outside the air cavity.

[0011] Optionally, each air guiding plate on one side wall of the air cavity has a free end extending into the air cavity, and each air guiding plate on the other side wall of the air cavity has a free end located outside the air cavity.

[0012] Specifically, a part of the air guiding plate outside the air cavity has an extension length less than or equal to half of a distance between two adjacent air cavities.

[0013] Further, the air guiding plates on the same side wall are arranged parallel to one another.

[0014] Further, each air guiding plate has an included angle of 5-15 degrees with respect to a vertical plane.

[0015] Optionally, the plurality of air inlets in one of the opposite side walls of the air cavity are arranged right opposite to the plurality of air inlets in the other one of the opposite side walls of the air cavity in one to one correspondence along the direction parallel to the length direction of the oil pipe.

[0016] Optionally, the plurality of air inlets in one of the opposite side walls of the air cavity are staggered with the plurality of air inlets in the other one of the opposite side walls of the air cavity in the up and direction.

[0017] According to some embodiments of the disclosure, both side edges of each fin define the air cavity therein.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018]

Fig. 1 is a front view of an oil heater according to an embodiment of the present disclosure.

Fig. 2 is a sectional view illustrating a structure of a fin according to an embodiment of the present disclosure.

Fig. 3 is a sectional view illustrating a structure of a fin according to another embodiment of the present

disclosure.

Fig. 4 is a sectional view taken along line A-A, illustrating an embodiment of an air cavity of the oil heater illustrated in Fig. 1.

Fig. 5 is a sectional view taken along line A-A, illustrating another embodiment of an air cavity of the oil heater illustrated in Fig. 1.

Fig. 6 is a partial enlarged view of portion A in Fig. 2.

Fig. 7 is a partial enlarged view of portion B in Fig. 3.

Fig. 8 is a partial enlarged view of portion C in Fig. 4.

Fig. 9 is a partial enlarged view of portion D in Fig. 5.

Fig. 10 is a diagram illustrating a comparison between a temperature distribution curve of an edge of a fin according to an embodiment of the present disclosure and a temperature distribution curve of an edge of a fin in the related art.

[0019] Reference numerals:

oil heater 100;
oil pipe 1; fin 2; air cavity 21; top air outlet 210; air inlet 211;
air guiding plate 212.

DETAILED DESCRIPTION

[0020] Reference will be made in detail to embodiments of the present disclosure, and examples of the embodiments are illustrated in the drawings. The embodiments described herein with reference to drawings are explanatory, and intended to explain the present disclosure. The embodiments shall not be construed to limit the present disclosure.

[0021] In the specification, it should be noted that, relative terms such as "length", "up", "down", "vertical", "horizontal", "top", "inner", "outer" as well as derivative thereof should be construed to refer to the orientation or position as then described or as illustrated in the drawings under discussion. These relative terms are for convenience of description and do not require that the present disclosure be constructed or operated in a particular orientation.

[0022] 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. Thus, the feature defined with "first" and "second" may include at least one this feature explicitly or implicitly. In the description of the present disclosure, "a plurality of' means at least two, such as two or three, unless specified otherwise.

[0023] In the present disclosure, unless specified or limited otherwise, the terms "mounted", "connected", "coupled", "fixed" and variations thereof should be understood broadly, for example, it may be a fixed connection, a detachable connection or an integral formation; it may be a mechanical connection, or it may be an electrical connection or mean communicable with each other; it may be a direct connection or an indirect connection through an intermediate medium, and it may be an internal connection between two elements or an interaction of two elements, unless explicitly defined otherwise. For those skilled in the related art, the specific meanings of the above terms in the present disclosure can be understood on a case-by-case basis.

[0024] An oil heater 100 according to embodiments of the present disclosure will be described below with reference to Figs. 1 to 10. Arrows in Figs. 2 to 5 refer to a flow direction of cold air in an up and down direction.

[0025] As illustrated in Figs. 1-9, the oil heater 100 according to embodiments of the present disclosure includes two oil pipes 1 and a plurality of fins 2.

[0026] The two oil pipes 1 are arranged in the up and down direction and spaced apart from each other. Both ends of each fin 2 are disposed to the two oil pipes 1 respectively, and each fin 2 is provided with an oil passage (not illustrated) communicating with the two oil pipes 1, that is, the two oil pipes 1 communicate with each other through the oil passages 20 of the plurality of fins 2 to form an oil circulation circuit. At least one side edge of each fin 2 is provided with an air cavity 21 spaced apart from the oil passage, and the air cavity 21 has a top air outlet 210. In a direction parallel to a length direction of the oil pipe 1, each of opposite side walls of the air cavity 21 has an air inlet 211, and an air guiding plate 212 is provided at the air inlet 211 for guiding air into the air cavity 21.

[0027] It can be understood that the oil heater 100 further includes a heating rod disposed in the oil pipe 1 located below to heat a heat-transfer oil in the oil pipe 1. Preferably, the oil heater 100 is provided with a bimetallic temperature controller. When a temperature of the heat-transfer oil reaches a temperature set by a user, the bimetallic temperature controller will automatically turn off a power supply, thereby improving the safety and reliability of the oil heater 100.

[0028] When the oil heater 100 is powered on, the heat-transfer oil in the oil pipe 1 located below is heated by the heating rod, and then the heat-transfer oil having a high temperature rises to the oil pipe 1 located above through the oil passages in the plurality of fins 2, so as to produce an oil path circulation. The oil heater 100 radiates the heat of the heat-transfer oil through peripheral wall surfaces of the two oil pipes 1 and fins 2, thereby heating a surrounding space environment, and the air-cooled heat-transfer oil is lowered to the oil pipe 1 located below to be heated by the heating rod again, so as to start a new circulation.

[0029] The cold air outside the oil heater 100 enters the air cavity 21 via the air guiding plate 212 at the air inlet 211 of the air cavity 21, and flows out through the top air outlet 210, that is, an air flow passage is produced in the air cavity 21 in the edge of the fin 2. During the air flow, the heat in the edge of the fin 2 is dissipated, thereby lowering a temperature of the edge of the fin 2.

[0030] It should be noted that since each of the opposite side walls of the air cavity 21 is provided with the air inlet 211, the air cavities 21 of adjacent two fins 2 on the

same side are not in contact with each other, such that an air flow channel is formed between the adjacent two fins 2, thereby facilitating the cold air outside the oil heater 100 in a horizontal direction to enter a high-temperature zone between the adjacent fins 2 of the oil heater 100 corresponding to the oil passages through the air flow channel, and also to circulate and flow between the adjacent fins 2 to exchange heat. Thereby, a contact between the cold air in the horizontal direction and the edge of the fin 2 is increased, and a flow intensity of air on an outer surface of the fin 2 and a heat dissipation effect on the edge of the fin 2 are improved, thus reducing the temperature of the edge of the fin 2 and avoiding the risk that the user may be burned while using the oil heater 100.

[0031] It should be noted that, in the description of the present disclosure, the "high temperature zone" merely indicates a temperature of a region of the fin 2 where the oil passage is provided is higher than that of a region of the fin 2 where the air cavity 21 is provided, and does not refer to a specific temperature value. Since the oil heater 100 according to embodiments of the present disclosure is provided with the air cavity 21 in the edge of the fin 2, an air gap in the edge of the fin 2 of the oil heater 100 according to the embodiments of the present disclosure is expanded, as compared with the oil heater in the related art, such that a heat dissipation area of the edge of the fin 2 is increased, which is beneficial to the heat dissipation of the edge of the fin 2 and hence the temperature of the edge of the fin 2 is reduced.

[0032] The inventors have found through extensive experiments that, as illustrated in Fig. 10, in the oil heater 100 of the present disclosure, the arrangement of the air inlet 211 where the air guiding plate 212 is provided facilitates lowering the temperature of the edge of the fin 2. In comparison with the oil heater in the related art, the temperature of the edge of the fin 2 of the oil heater 100 according to the present disclosure is reduced from an original over-standard temperature to a temperature in a range where safety requirements are met, the temperature drop thereof is up to 20%, and the overall heat dissipation power of the fin 2 is slightly increased by 1%.

[0033] In the oil heater 100 according to embodiments of the present disclosure, since the air cavity 21 having the air inlet 211 and the top air outlet 210 is provided in the edge of the fin 2 and the air guiding plate 212 is provided at the air inlet 211, the heat dissipation area of the edge of the fin 2 is increased, the flow intensity of air on the inner surface and the outer surface of the fin 2 is improved, and the temperature of the edge of the fin 2 is reduced, i.e. strengthening the heat dissipation capability of the fin 2, and avoiding the risk that the user may be burned while using the oil heater 100.

[0034] According to some embodiments of the present disclosure, each of the opposite side walls of the air cavity 21 is provided with a plurality of air inlets 211 spaced apart from one another in the up and down direction. It can be seen that since the plurality of air inlets 211 are spaced apart from one another in the up and down direction, the air guiding plates 212 arranged at the plurality of air inlets 211 also are spaced apart from one another in the up and down direction, so that the air inlets 211 with a louver structure is formed in the same side wall of the air cavity 21. In the up and down direction, the cold air outside the oil heater 100 enters the air cavity 21 through the plurality of air inlet 211 under the guiding of the air guiding plates 212, thereby increasing the flow of the external cold air into the air cavity 21, improving the flow intensity of the air on the inner surface of the fin 2 and also enhancing the cooling rate of the edge of the fin 2. On the other hand, the plurality of air inlets 211 form the louver structure, which has a turbulence effect and allows the air to form turbulence at the air inlet 211, such that an air boundary layer at the air inlet 211 is destroyed, thus improving the air convection heat-exchange efficiency near the air inlet 211, enhancing the heat dissipation capacity of the fin 2, and also facilitating the cooling of the edge of the fin 2. Certainly, it can be understood that since the air guiding plate 212 has a certain inclination in the up and down direction, the air guiding plate 212 also has a certain guiding effect on the cold air in the horizontal direction. Herein, it should be noted that the horizontal direction refers to a direction in Figs. 2 to 5, and such direction is perpendicular to a paper where Figs. 2 to 5 are.

[0035] As illustrated in Figs. 2 and 6, according to some embodiments of the present disclosure, a free end of each air guiding plate 212 extends into the air cavity 21. Thus, the air guiding plate 212 can have a guiding effect on the cold air outside the air cavity 21, and also can ensure that the user will not touch sharp edges and corners, thus avoiding the risk that the user may be scratched, and improving the safety and reliability of the oil heater 100.

[0036] As illustrated in Figs. 3 and 7, according to some other embodiments of the present disclosure, the free end of each air guiding plate 212 is located outside the air cavity 21. Thereby, the guiding effect of the air guiding plate 212 on the external cold air can be further improved, and a flow area of the cold air in the air cavity 21 is ensured, thus avoiding a large resistance to the cold air flowing in the air cavity 21 due to a reduction of the flow area, and also improving the flow intensity of the air on the inner surface of the air cavity 21 so as to enhance the cooling rate of the edge of the fin 2.

[0037] The inventors have found through experiments that the air guiding plate 212 has a most significant turbulence effect on the cold air at the air inlet 211, when a part of the air guiding plate 212 outside the air cavity 21 has an extension length less than or equal to half of a distance between two adjacent air cavities 21. Therefore, in some preferred examples of the disclosure, the extension length of the part of the air guiding plate 212 outside the air cavity 21 does not exceed half of the distance between the two adjacent air cavities 21.

[0038] As illustrated in Figs. 5 and 9, according further

embodiments of the present disclosure, the free end of each air guiding plate 212 on one side wall of the air cavity 21 extends into the air cavity 21, and the free end of each air guiding plate 212 on the other side wall of the air cavity 21 is located outside the air cavity 21. Thereby, the air guiding effect of the air guiding plate 212 on the external air can be further improved, and the turbulence effect of the air guiding plate 212 on the air at the air inlet 211 can be enhanced, thus increasing the air convection heat-exchange efficiency near the air inlet 211, improving the heat dissipation capability of the fin 2, and also facilitating the cooling of the edge of the fin 2.

[0039] Further, the air guiding plates 212 located on the same side wall are arranged parallel to one another. It can be seen that the air guiding plates 212 on the same side wall have the same included angle with respect to a vertical plane. Thus, the oil heater 100 has a simple structure and is easy to manufacture. It is also ensured that the air guiding plates 212 on the same side wall have the same turbulence effect on the air at different air inlets 211, such that the flow of the cold air entering the air cavity 21 through different air inlets 211 is the same, so as to avoid the cold air from being subjected to the large resistance while flowing in the air cavity 21, thereby ensuring the flow intensity of the air on the inner surface of the air cavity 21, and hence facilitating the cooling of the edge of the fin 2. Herein, it should be noted that the vertical direction refers to the up and down direction of the oil heater 100.

[0040] The inventors have found through experiments that the air guiding plate 212 has the most significant guiding effect on the external cold air when the included angle between each air guiding plate 212 and the vertical plane is between 5 degrees and 15 degrees. Therefore, in a preferred example of the present disclosure, the included angle between each air guiding plate 212 and the vertical plane ranges from 5 degrees to 15 degrees.

[0041] Optionally, as illustrated in Fig. 2 and Fig. 3, the plurality of air inlets 211 in one of the opposite side walls of the air cavity 21 are arranged right opposite to the plurality of air inlets 211 in the other one of the opposite side walls of the air cavity 21 in one to one correspondence along the direction parallel to the length direction of the oil pipe 1. Thus, the oil heater 100 has a simple structure and is easy to manufacture.

[0042] Optionally, as illustrated in Fig. 4 and Fig. 5, the plurality of air inlets 211 in one of the opposite side walls of the air cavity 21 are staggered with the plurality of air inlets 211 in the other one of the opposite side walls of the air cavity 21 in the up and direction. It thus can be seen that, the air inlets 211 of the louver structures in the opposite side walls of the air cavity 21 are asymmetrically distributed in the up and down direction, thereby preventing the cold air flowing in the air cavity 21 from being subjected to the large resistance at the air inlet 211 of the louver structure due to the reduction of the flow area of the air, ensuring the flow intensity of the air on the inner surface of the fin 2, and also facilitating the cooling of the edge of the fin 2. It can be understood that extension directions of the free ends of the air guiding plates 212 on the opposite side walls of the air cavity 21 can be set according to actual conditions. For example, the free ends of the air guiding plates 212 on the opposite side walls of the air cavity 21 may extend into the air cavity 21 at the same time, or may be located outside the air cavity 21 at the same time. Or, the free ends of the air guiding plates 212 on one side wall of the air cavity 21 extend into the air cavity 21, and the free ends of the air guiding plates 212 on the other side wall of the air cavity 21 are located outside the air cavity 21.

[0043] According to some embodiments of the present disclosure, both side edges of each fin 2 are provided with the air cavity 21 therein, so that the heat dissipation area of the fin 2 can be further increased, and the heat dissipation capability of the fin 2 can be enhanced.

[0044] The structure of the oil heater 100 according to an embodiment of the present disclosure will be described in detail below with reference to Fig. 1, Fig. 5 and Fig. 9. However, it should be noted that the following description is merely exemplary, and it is obvious for those skilled in the related art to combine, replace or modify the technical solution or some technical features in the following description, after those skilled in the related art have read the following technical solution of the present disclosure, which also falls within the protection scope claimed by the present disclosure.

[0045] As illustrated in Fig. 1, Fig. 5 and Fig. 9, an oil heater 100 according to an embodiment of the present disclosure includes two oil pipes 1 and a plurality of fins 2.

[0046] The two oil pipes 1 are arranged in the up and down direction and spaced apart from each other. Two ends of each fin 2 are disposed to the two oil pipes 1 respectively, and each fin 2 is provided with an oil passage communicating with two oil pipes 1. Both side edges of each fin 2 are provided with an air cavity 21 spaced apart from the oil passage.

[0047] Each air cavity 21 is provided with a top air outlet 210. In a direction parallel to a length direction of the oil pipe 1, each of opposite side walls of each air cavity 21 is provided with seven air inlets 211 spaced apart from one another in the up and down direction. The air inlets 211 in one of the opposite side walls are staggered with the air inlets 211 in the other one of the opposite side walls in the up and down direction.

[0048] An air guiding plate 212 is provided at each air inlet 211, and each air guiding plate 212 has an included angle of 10 degrees with respect to the vertical plane. The free end of each air guiding plate 212 on one side wall of each air cavities 21 extends into the air cavity 21, and the free end of each air guiding plates 212 on the other side wall of each air cavities 21 is located outside the air cavity 21, in which the part of the air guiding plate 212 located outside the air cavity 21 has an extension length less than or equal to half of a distance between the adjacent two air cavities 21.

[0049] Reference throughout this specification to "an

embodiment," "some embodiments," "one embodiment", "another example," "an example," "a specific example," 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 disclosure. Thus, the appearances of the phrases such as "in some embodiments," "in one embodiment", "in an embodiment", "in another example," "in an example," "in a specific example," or "in some examples," in various places throughout this specification are not necessarily referring to the same embodiment or example of the present disclosure. Furthermore, the particular features, structures, materials, or characteristics may be combined in any suitable manner in one or more embodiments or examples. In addition, it is possible for those skilled in the related art that various embodiments or examples described in the specification and features of the various embodiments or examples may be combined without departing from each other.

[0050] Although explanatory embodiments have been illustrated and described, it would be appreciated by those skilled in the art that the above embodiments cannot be construed to limit the present disclosure, and changes, alternatives, and modifications can be made in the embodiments without departing from spirit, principles and scope of the present disclosure.

Claims

1. An oil heater, comprising:

two oil pipes arranged in an up and down direction and spaced apart from each other; and
a plurality of fins, each fin having two ends disposed to the two oil pipes respectively, defining an oil passage therein communicated with the two oil pipes, and having an air cavity spaced apart from the oil passage in at least one side edge of the fin, the air cavity having a top air outlet, in a direction parallel to a length direction of the oil pipe, each of opposite side walls of the air cavity having an air inlet, and an air guiding plate being provided at the air inlet for guiding air into the air cavity.

2. The oil heater according to claim 1, further comprising a bimetallic temperature controller configured to detect a temperature of a heat-transfer oil, wherein when the temperature of the heat-transfer oil reaches a temperature set by a user, a power source is turned off.

3. The oil heater according to any one of claims 1-2, wherein each of the opposite side walls of the air cavity has a plurality of air inlets, and the plurality of air inlets are spaced apart from one another in the up and down direction.

4. The oil heater according to claim 3, wherein each air guiding plate has a free end extending into the air cavity.

5. The oil heater according to claim 3, wherein each air guiding plate has a free end located outside the air cavity.

6. The oil heater according to claim 3, wherein each air guiding plate on one side wall of the air cavity has a free end extending into the air cavity, and each air guiding plate on the other side wall of the air cavity has a free end located outside the air cavity.

7. The oil heater according to any one of claims 4-5, wherein a part of the air guiding plate outside the air cavity has an extension length less than or equal to half of a distance between two adjacent air cavities.

8. The oil heater according to claim 3, wherein the air guiding plates on the same side wall are arranged parallel to one another.

9. The oil heater according to claim 3, wherein each air guiding plate has an included angle of 5-15 degrees with respect to a vertical plane.

10. The oil heater according to any one of claims 3-9, wherein the plurality of air inlets in one of the opposite side walls of the air cavity are arranged right opposite to the plurality of air inlets in the other one of the opposite side walls of the air cavity in one to one correspondence along the direction parallel to the length direction of the oil pipe.

11. The oil heater according to any one of claims 3-9, wherein the plurality of air inlets in one of the opposite side walls of the air cavity are staggered with the plurality of air inlets in the other one of the opposite side walls of the air cavity in the up and direction.

12. The oil heater according to any one of claims 1-11, wherein both side edges of each fin define the air cavity therein.

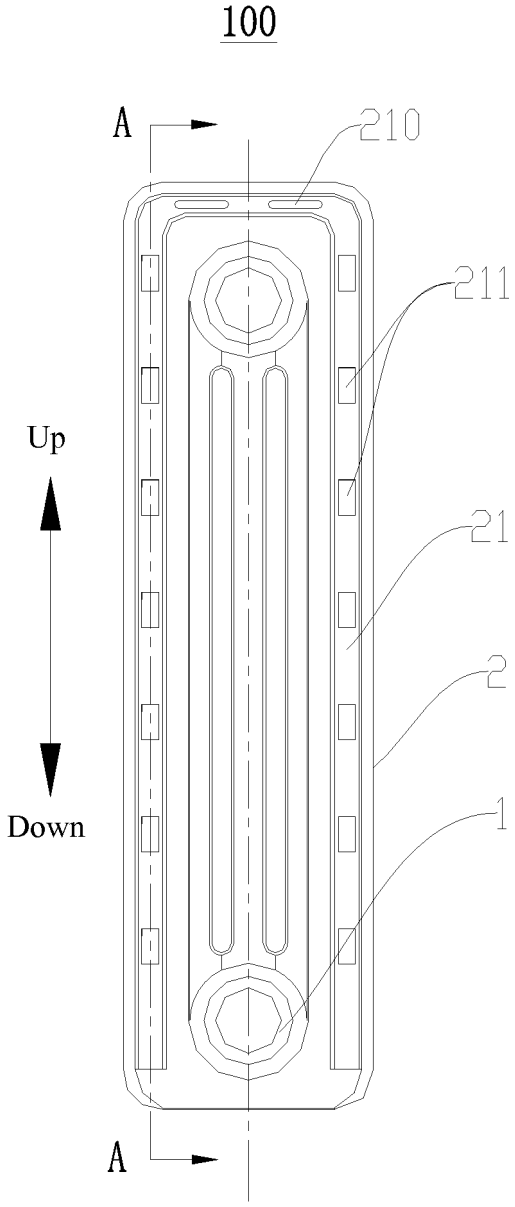

Fig. 1

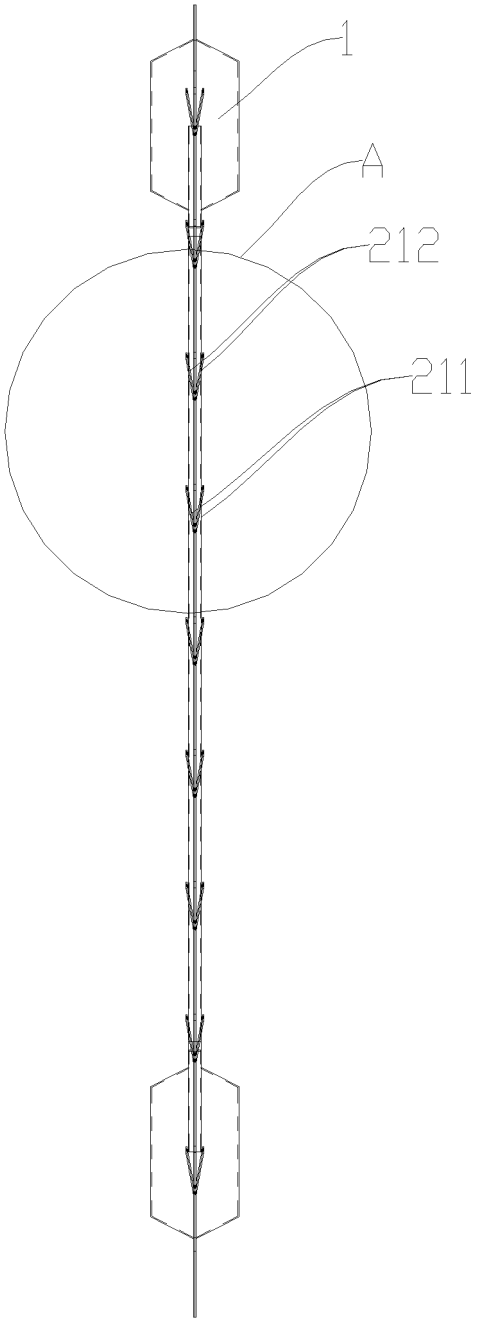

Fig. 2

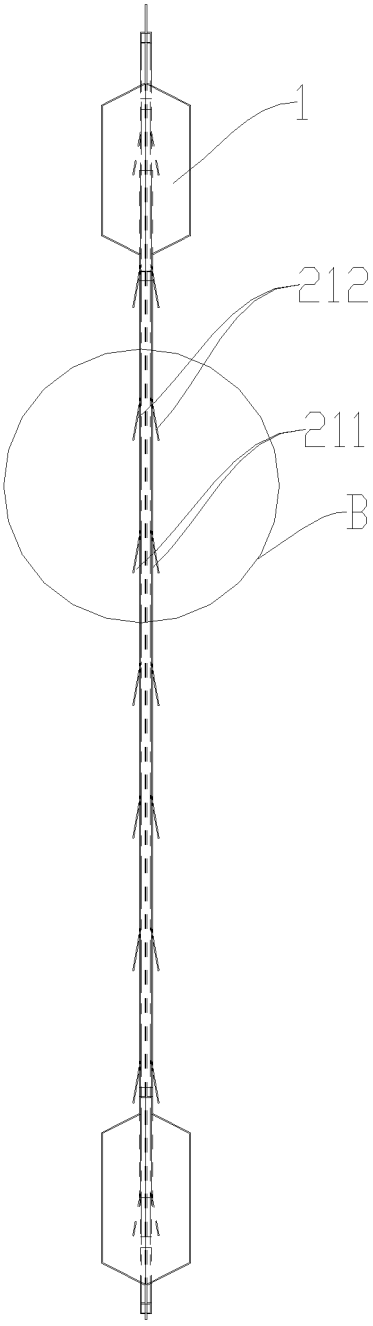

Fig. 3

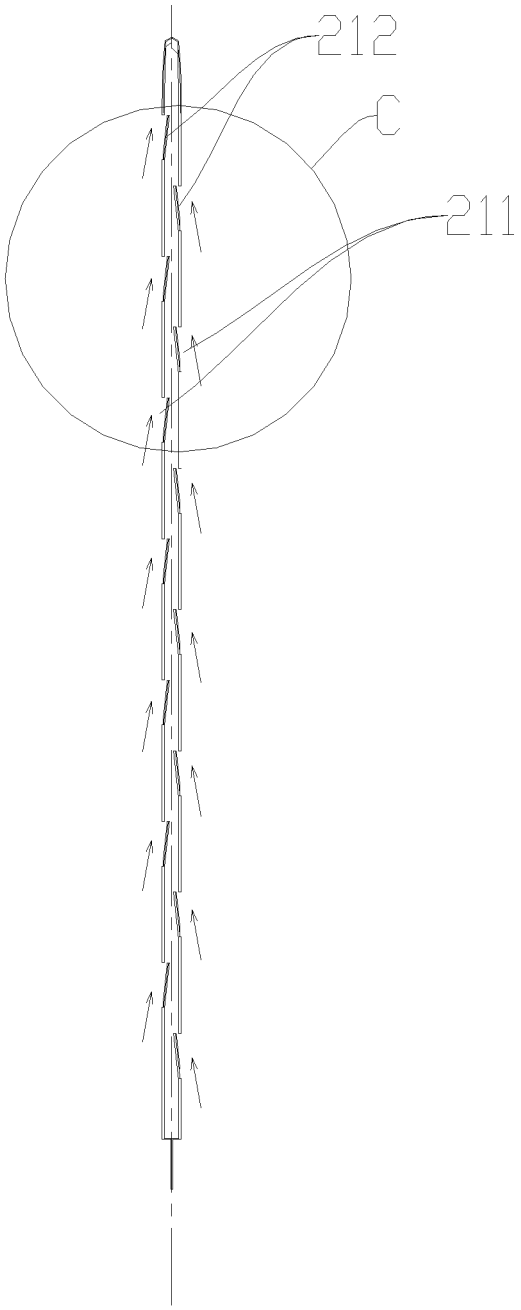

Fig. 4

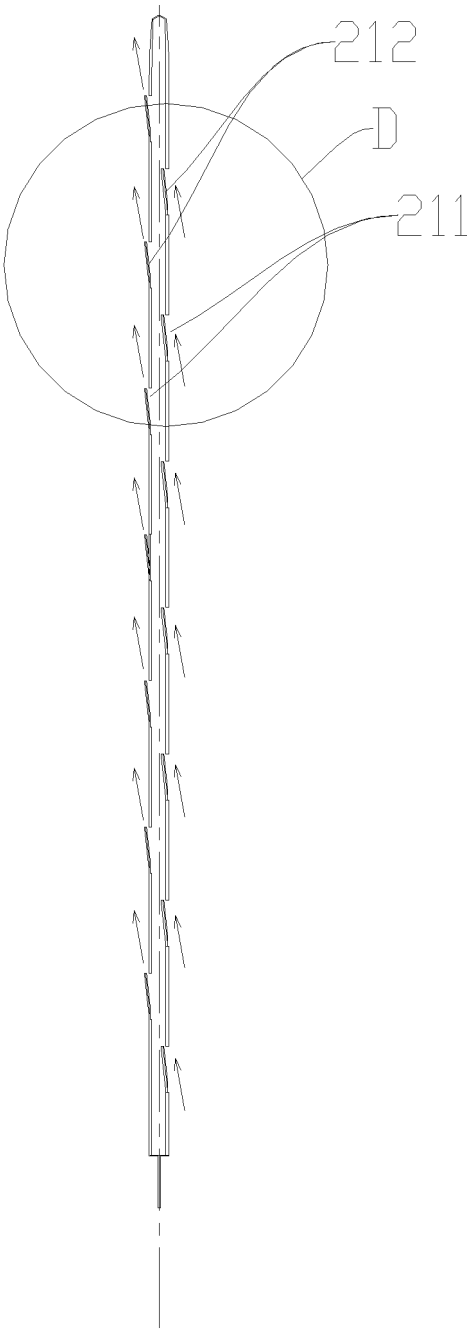

Fig. 5

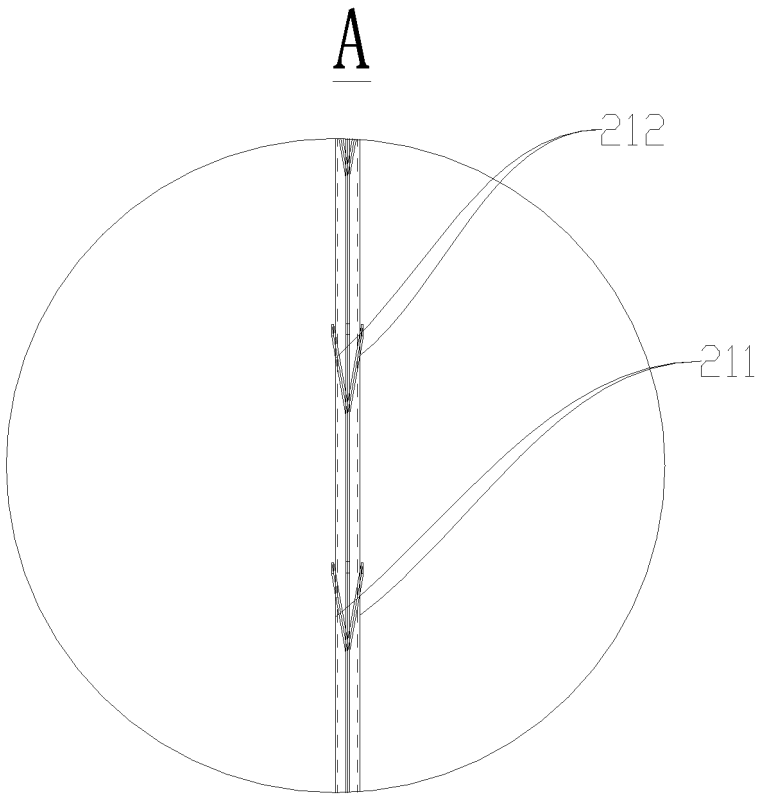

Fig. 6

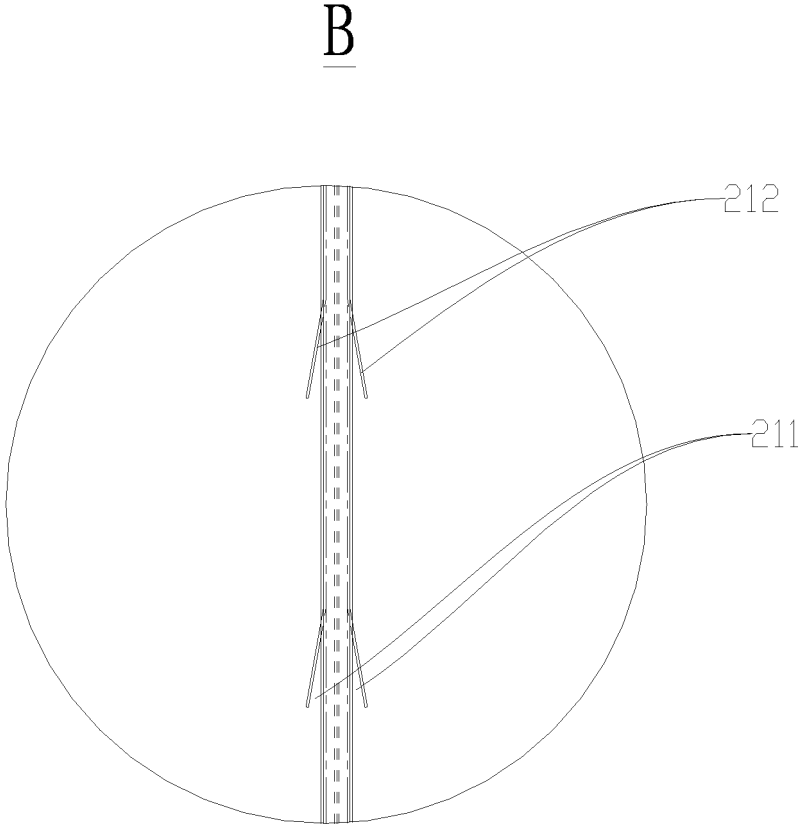

Fig. 7

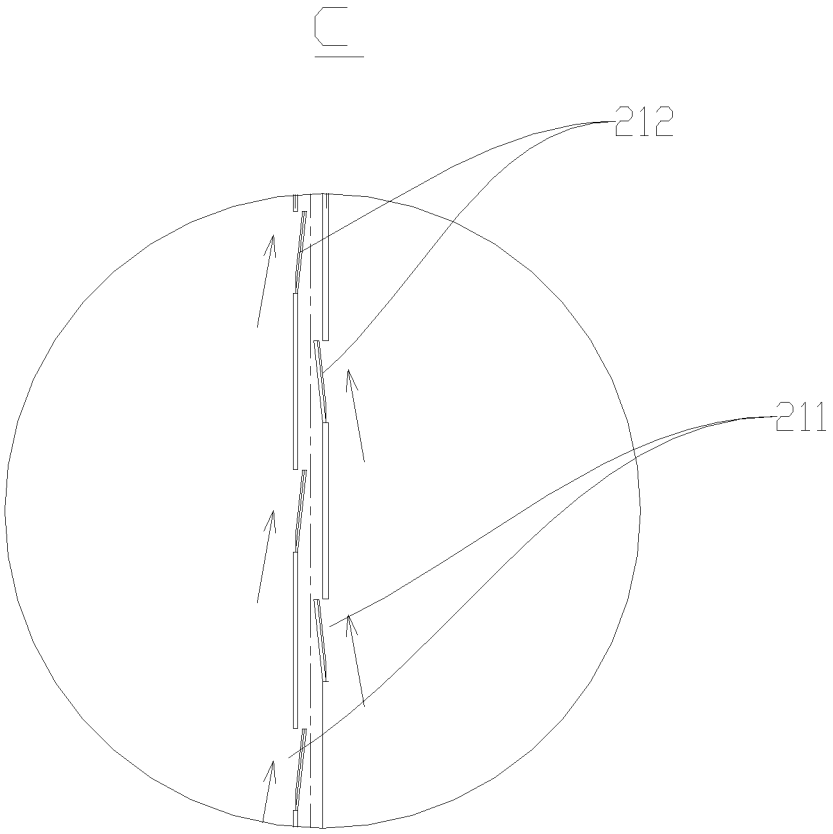

Fig. 8

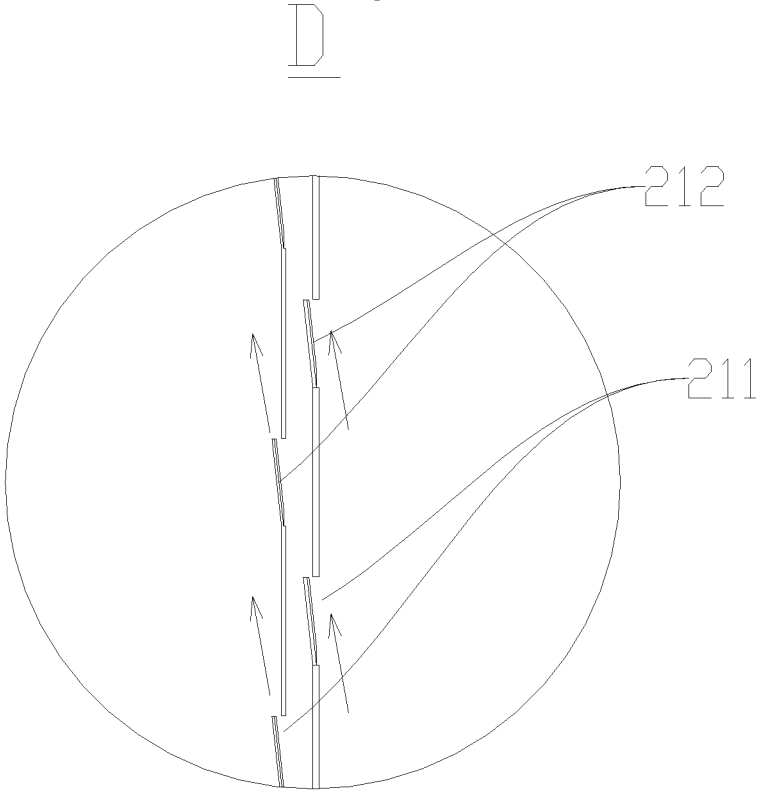

Fig. 9

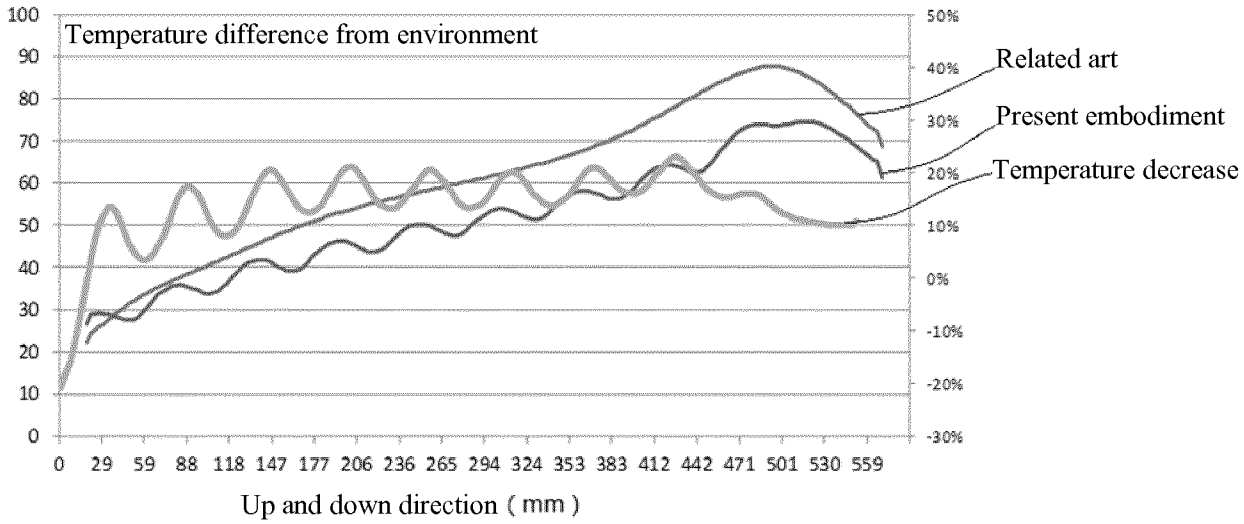
Temperature difference from environment
100
90
80
70
60
50
40
30
20
10
0
50%
40%
30%
20%
10%
0%
-10%
-20%
-30%
0 29 59 88 118 147 177 206 236 265 294 324 353 383 412 442 471 501 530 559
Up and down direction (mm)
Related art
Present embodiment
Temperature decrease

Fig. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2016/113777

A. CLASSIFICATION OF SUBJECT MATTER

F24D 13/04 (2006.01) i; F24D 19/10 (2006.01) i; F24D 19/08 (2006.01) i
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F24D 13; F24D 19

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNABS; CPRSABS; CNTXT; CNKI; DWPI; SIPOABS: 油汀, 电, 采暖, 取暖, 散热片, 空气, 腔, 腔室, 孔, 导风, 导流, 导向, oil heater, electric, electrical, heat+, fin, air, cavum, hole? guid+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN 204786732 U (GUANGDONG MIDEA ENVIRONMENT APPLIANCES MFG CO., LTD. et al.) 18 November 2015 (18.11.2015), description, paragraphs [0030]-[0046], and figures 1-6	1-12
Y	CN 201368530 Y (KANG, Juyin) 23 December 2009 (23.12.2009), description, page 2, paragraph 8, and figures 1-3	1-12
A	CN 205261721 U (NINGBO ZHANZHI ELECTRICAL APPLIANCE CO., LTD.) 25 May 2016 (25.05.2016), entire document	1-12
A	CN 103822291 A (NINGBO SINGFUN ELECTRIC APPLIANCE MANUFACTURE CO., LTD.) 28 May 2014 (28.05.2014), entire document	1-12
A	EP 0917636 A1 (BASIC PATENTS et al.) 26 May 1999 (26.05.1999), entire document	1-12

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 June 2017	21 July 2017
Name and mailing address of the ISA State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No. (86-10) 62019451	Authorized officer XU, Jingjing Telephone No. (86-10) 62084827

Form PCT/ISA /210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2016/113777

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 204786732 U	18 November 2015	None	
CN 201368530 Y	23 December 2009	None	
CN 205261721 U	25 May 2016	None	
CN 103822291 A	28 May 2014	CN 103822291 B	11 January 2017
EP 0917636 A1	26 May 1999	CZ 9900045 A3	14 July 1999
		NO 990098 D0	11 January 1999
		CN 1225165 A	04 August 1999
		AU 723536 B2	31 August 2000
		ES 2145616 T3	01 July 2000
		CN 1109227 C	21 May 2003
		JP 2000514912 A	07 November 2000
		AU 3549897 A	09 February 1998
		CA 2259576 A1	22 January 1998
		PT 917636 T	31 August 2000
		PL 184379 B1	31 October 2002
		KR 20000023745 A	25 April 2000
		US 6169851 B1	02 January 2001
		BG 63582 B1	31 May 2002
		GB 9703040 D0	02 April 1997
		AT 191970 T	15 May 2000
		JP 2008057970 A	13 March 2008
		PT 917636 E	31 August 2000
		EP 0917636 B1	19 April 2000
		WO 9802696 A1	22 January 1998
		GB 9826543 D0	27 January 1999
		TR 9900057 T2	21 April 1999
		IL 127949 A	31 October 2001
		DE 69701742 D1	25 May 2000

Form PCT/ISA /210 (patent family annex) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2016/113777

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
		GR 3033697 T3	31 October 2000
		BG 103070 A	31 March 2000
		IL 127949 D0	30 November 1999
		HK 1017059 A1	18 August 2000
		GB 2328733 A	03 March 1999
		NO 990098 A	11 March 1999
		PL 331008 A1	21 June 1999
		GB 2328733 B	01 March 2000
		NZ 333641 A	29 June 1999
		DE 69701742 T2	23 November 2000

Form PCT/ISA /210 (patent family annex) (July 2009)