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

(11) EP 2 966 392 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
13.01.2016 Bulletin 2016/02

(21) Application number: **15164437.4**

(22) Date of filing: **21.04.2015**

(51) Int Cl.:
F28F 3/02 (2006.01) ***F28F 21/02*** (2006.01)
F28F 21/06 (2006.01) ***F28F 1/10*** (2006.01)
F28F 1/14 (2006.01)

(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

(30) Priority: **20.06.2014 MY PI2014701699**

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(54) A HEAT EXCHANGER OF AN AIR CONDITIONER

(57) A heat exchanger of an air conditioner comprises a heat dissipating sheet (102) made of polymer such as plastic embedded with nanoparticles such as carbon nanotubes, aurum, argentum or titanium for improving thermal conductivity of the polymer. The heat dissipating sheet is attached to a refrigerant conduit (101) of the air conditioner to allow heat from the refrigerant to be transferred over the sheet be dissipated to the surrounding.

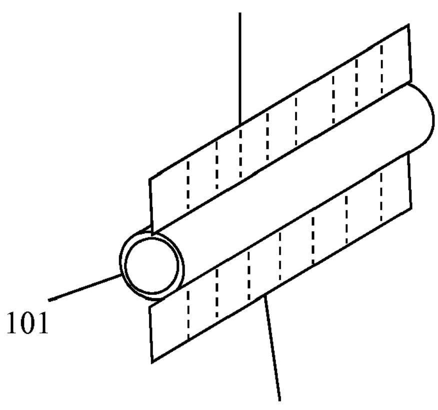

Fig. 1

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Description

Technical Field of Invention

[0001] The present invention relates generally to an air conditioning system. More particularly, it relates to a heat exchanger of an air conditioner made of an enhanced polymer.

Background of the Invention

[0002] Metals such as copper and aluminum are usually used for making heat exchangers of air conditioners as these metallic materials provide high heat transfer efficiency. These metallic materials are becoming expensive and to continuously rely on these materials for making the heat exchangers would not be commercially viable. In view of the rising cost of these materials, alternative materials which are relatively inexpensive and yet able to provide optimal heat transfer for air conditioning process are required for making economical and functional heat exchangers of air conditioners, namely condensers and evaporators.

[0003] In the present invention, an enhanced polymer is used for making heat exchangers of air conditioners. Polymer such as plastic is enhanced with high thermal conductor to improve its thermal conductivity since plastic has low thermal conductivity which is in the range of 0.10 to 0.50 W/m.K. The thermal conductivity value of polymer is low compared to copper which has k = 401 W/m.K. The thermal conductivity of plastic is about eight fold lower than copper. On the other hand, the nanoparticles such as carbon nanotubes have high thermal conductivity, k of around 3000 W/m.K which is about seven fold higher than copper.

[0004] It is an object of the present invention to provide a heat exchanger made from the combination of polymer such as plastic with high thermal conductivity nanoparticles. This will produce an improved material that is suitable for heat exchangers of air conditioners which is relatively inexpensive and able to provide the required heat transfer for air conditioning process.

Summary of the Invention

[0005] Any suitable components of a heat exchanger of an air conditioner or any components which require heat transfer can be made of the enhanced polymer. The nanoparticles that are used to enhance the polymer are in powder form having particles in the size of nanometers. The shape of the nanoparticles can be in the form of tube, rod or sphere. The nanoparticles include but not limited to carbon nanotubes, aurum, argentum and titanium. These nanoparticles will improve the thermal conductivity of the polymer to transfer heat and disperse the same to allow the heat to be dissipated to the surrounding. This will improve the air-side heat transfer performance of the heat exchangers. The heat exchanger as described herein includes a condenser or an evaporator of an air conditioner. Preferably, the nanoparticles are embedded into a polymer sheet to form two patterns namely; (i) aligned pattern; and (ii) dispersion pattern. The nanoparticles are dispersed over a polymer sheet to form stripes of nanoparticles which are aligned to one another. Alternatively, the nanoparticles are scattered over a polymer sheet to form a dispersion pattern.

[0006] The heat exchanger of an air conditioner according to the present invention comprising at least a heat dissipating means which in the form of sheet made of enhanced polymer, namely plastic embedded with nanoparticles such as carbon nanotubes to improve thermal conductivity of the polymer for transferring heat from refrigerant flowing through a refrigerant conduit of the air conditioner. Preferably, the conduit is made of the enhanced polymer. The conduit can be in the form of tubing or blocks with micro channels.

[0007] In an embodiment, the heat exchanger is configured to have a plurality of heat dissipating means or sheet around the conduit which is in the form of a tube wherein the heat dissipating means which is made of the enhanced polymer acts as a fin that is attached to the tube. In an upright arrangement, the heat dissipating means or sheet is protruded to an appropriate height from the top of the tube and extends along the same. The heat dissipating means or sheet is also disposed at bottom of the tube and extends along the same to act as a bottom fin. In an assembly, pluralities of tubes and fins are arranged in the heat exchanger to form a tube bank.

[0008] In another embodiment, the heat exchanger is configured to have a heat dissipating means or sheet made of the enhanced polymer attached between two conduits wherein the sheet forms a serpentine profile between the conducts. The individual conduit includes micro channels. The serpentine sheet allows heat from the refrigerant flowing inside the conduits to be transferred and dissipated to the surrounding.

[0009] The heat dissipating sheet is preferably attached to the conduits (tube or block) where it forms an extension for a bigger heat transfer surface areas. Furthermore, cooling over the sheet by using air can expedite heat transfer process. For instance, the length of the fins (L) is taken as equal to the hydraulic diameter of the tube (D_h), L/D_h. The use of the heat dissipating means made from the enhanced polymer will improve air-side heat transfer performance of the heat exchanger compared to conventional polymer (i.e. without nanoparticles).

Brief Description of the Drawings

[0010] The present invention will now be described by way of example, with reference to the accompanying drawings, in which:

Fig. 1 shows a tube attached with heat dissipating sheets made of the enhanced polymer;

Fig. 2 shows a plurality of tubes attached with heat dissipating sheets made of the enhanced polymer;

Fig. 3 shows a heat exchanger with a serpentine heat dissipating sheet;

Fig. 4 shows a heat exchanger with more than one serpentine heat dissipating sheet;

Fig. 5 shows a pattern of nanoparticles in a polymer sheet; and

Fig. 6 shows another pattern of nanoparticles in a polymer sheet.

Detailed Description of the Invention

[0011] As shown in Fig. 1 and 2, a heat exchanger of an air conditioner comprises a plurality of tubes (101). The cylindrical tubes can be made of normal plastic or plastic enhanced with nanoparticles to improve the tube's heat transfer capability. The tubes act as the refrigerant conduits of the air conditioner.

[0012] Each tube comprises at least a heat dissipating sheet made of the enhanced polymer. Individual heat dissipating sheets can be disposed side by side over the tube to act as fins. In an upright arrangement, the heat dissipating sheet (102) protrudes to an appropriate height and extends along the top the tube. The heat dissipating sheet (103) protrudes to an appropriate height and extends along the bottom of the tube.

[0013] Referring to Fig. 3, the heat exchanger of an air conditioner comprises refrigerant conduits in the form of blocks with microchannels. The first block (104a) is paired with the corresponding block (104b); and a heat dissipating sheet (305) made of the enhanced polymer arranged in serpentine forming a sinuous profile between the said blocks. The rigid serpentine sheet is connected to the said blocks. The blocks as shown in the Fig. 3 and 4 can be sections of a single conduit or individual conduits that form a refrigerant loop of the air conditioner. The blocks can be made of plastic or the enhanced plastic. The heat from the refrigerant flowing through the conduits will be transferred and dissipated via the serpentine heat dissipating sheet (305) to allow the heat to be dissipated to the surrounding. Fig. 4 shows a heat exchanger with more than one serpentine sheet connecting several blocks.

[0014] The nanoparticles used in making the sheet are in the form of powder having particle size of nanometers. The shape of the nanoparticles can be in the form of tubes, rod or sphere. The nanoparticles are dispersed over a polymer sheet. As shown in Fig. 5, the nanoparticles are embedded in lengthwise or crosswise direction forming stripes on the polymer sheet. Fig. 6 shows the nanoparticles are in dispersed pattern over polymer sheet.

[0015] The enhanced plastic can be produced by combining raw polymer material, e.g. polypropylene, polycarbonate and polyethylene with nanoparticles as filler, e.g. carbon nanotubes, aurum, argentum or titanium. The melting temperature of the nanoparticles should be higher than that of the polymer material, i.e. a typical polycarbonate and nanoparticles of carbon nanotubes melting point is about 200°C and 1000°C, respectively. This is to allow the structure of the nanoparticle remains intact after it undergoes heat treatment to embed the nanoparticles into the polymer. The raw polymer material is commonly in the form of resin, powder or pellets which the nanoparticles are dispersed into the raw polymer material and mixed as two-phase material. The mixed products of polymer and nanoparticles, namely enhanced plastic, is then undergoes process of thermoset, or thermoplastic, e.g. injection molding or extrusion to form the final intended shape such as cylinder or flat sheet. The nanoparticles are very small in the size of the nano-scale, 1×10^{-9} and function as the filler for the polymer material to increase the overall thermal conductivity of the polymer. The final shape of the enhanced plastic is used as the components to produce the heat exchanger, e.g. fin-tube heat exchanger or microchannels heat exchanger. This method is for fully dispersed nanoparticles in polymer material.

[0016] For partial aligned nanoparticles dispersed in polymer, two sheets of polymer are required. The nanoparticles are dispersed and arranged in several strips of narrow bands on a first sheet of polymer as shown in Fig. 5. Then, the second sheet of polymer is placed on top of it. The combination of the polymer and nanoparticles is placed in a humidity-controlled chamber to heat the combined material at about 200°C-240°C for about 30 minutes where it is the melting point for typical polymer. As it melts, the first and second polymer fused together along with the nanoparticles. The heated material, i.e. the polymers with nanoparticles, is withdrawn from the chamber for it to cool down to room temperature. The hardened combination of the polymer and nanoparticles now forms a new material, namely polymer with embedded partial aligned nanoparticles. This sheet of polymer with nanoparticles can be heat treated to mold into different shapes such as cylinders.

Claims

1. A heat exchanger of an air conditioner comprising a heat dissipating sheet (102,103, 305) made of polymer such as plastic embedded with nanoparticles such as carbon nanotubes having high thermal conductivity than the polymer wherein the heat dissipating sheet is attached to a refrigerant conduit (101,104) of the air conditioner for transferring and dissipating heat from a refrigerant to a surrounding.

2. A heat exchanger as claimed in claim 1 wherein the refrigerant conduit (101,104) is made of polymer

such as plastic embedded with nanoparticles such as carbon nanotubes having high thermal conductivity than the polymer

3. A heat exchanger as claimed in claim 1 wherein the conduit is in the form of a tube (101).

4. A heat exchanger as claimed in claim 1 wherein the conduit is in the form of block (104) having micro channels (105).

5. A heat exchanger as claimed in claim 1 wherein the nanoparticles include aurum, argentum or titanium.

6. A heat exchanger as claimed in claim 3 wherein the heat dissipating sheet (101) is protruded from top of the tube and extend along the same to act as a fin.

7. A heat exchanger as claimed in claim 3 wherein the heat dissipating sheet (102) is protruded from bottom of the tube and extend along the same to act as a fin.

8. A heat exchanger as claimed in claim 1 wherein the nanoparticles are embedded into the polymer by dispersing the nanoparticles over a polymer sheet to form stripes of nanoparticles which are aligned to one another.

9. A heat exchanger as claimed in claim 1 wherein the nanoparticles are embedded into the polymer by dispersing the nanoparticles over a polymer sheet.

10. A heat exchanger as claimed in claim 4 wherein the heat dissipating sheet (305) is in the form of a serpentine shape between the block (104a) and its corresponding block (104b).

11. A heat exchanger as claimed in claim 10 wherein the heat dissipating sheet is attached to the two blocks (104a, 104b).

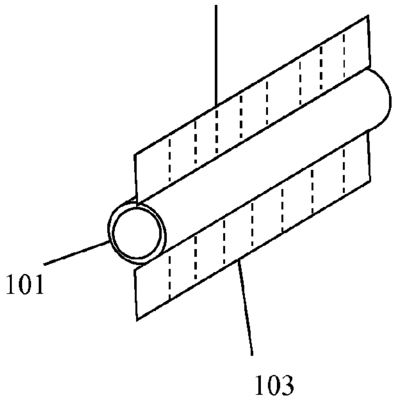

Fig. 1

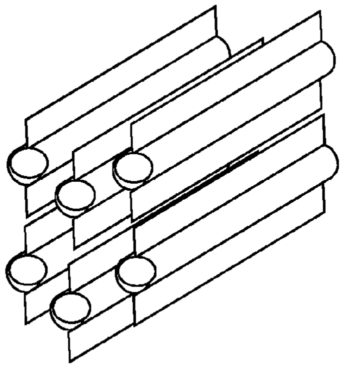

Fig. 2

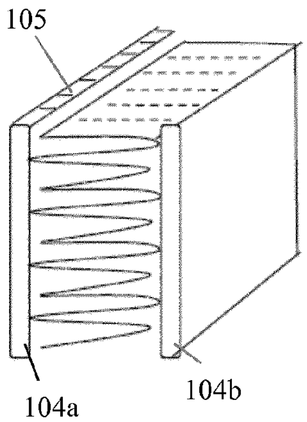

Fig. 3

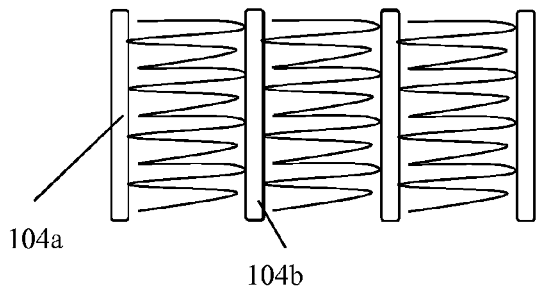

Fig. 4

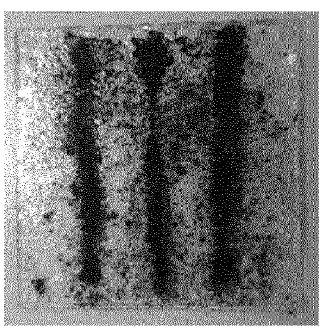

Fig. 5

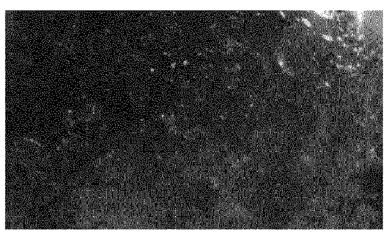

Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 15 16 4437

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
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CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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