A spiral heat exchanger includes two assembled covers defining a chamber therebetween for receiving a spiral unit therein. The spiral unit includes a first and a second spiral member separately spirally extending from a central outlet to a peripheral outlet on the two covers to respectively form a first and a second flow passage. A driving unit is assembled to and drives the assembled covers to rotate at the same time, so that cold and hot airflows respectively enter and flow through the first and second spiral members from the central outlet to the peripheral outlet under a centrifugal force to exchange heat at the spiral unit. The spiral unit provides extended flow passages and increased heat exchange area, giving the spiral heat exchanger increased heat transfer capacity and heat exchange efficiency and allowing omission of fans and radiating fin assembly to eliminate operating noise and accumulated dust.
SPIRAL HEAT EXCHANGER

[0001] This application claims the priority benefit of Taiwan patent application number 099101501 filed on Jan. 20, 2010.

FIELD OF THE INVENTION

[0002] The present invention relates to a heat exchanger, and more particularly to a spiral heat exchanger that includes an internal spiral unit to provide effectively extended heat exchange flow passages, and, when being driven to rotate, uses a centrifugal force to establish a flow field of cold and hot fluids in the heat exchanger without the need of using a conventional thermal module with fan and radiating fin assembly, and can accordingly, avoid the problems of noise caused by rotating fan blades and accumulated dust in the radiating fin assembly.

BACKGROUND OF THE INVENTION

[0003] Thanks to the constant progress in the electronic information technologies, various kinds of electronic devices, such as desktop computers, notebook computers, communication chasses, electric home appliances, industrial electronic apparatus, etc., have become highly popularized among consumers in their daily life. However, electronic elements in these electronic devices will produce high amount of waste heat when they operate at high speed. The waste heat, if not timely removed, tends to accumulate in the electronic devices and results in constantly raised temperature in the electronic devices and the electronic element thereof. In worse conditions, the accumulated waste heat will cause overheat of the electronic elements and accordingly, failure, damage, or lowered operating efficiency thereof. Thus, heat sinks and heat exchangers are used to dissipate and remove the heat produced by the electronic elements in the electronic devices to avoid undesirable damaged thereof.

[0004] A heat exchanger is a device capable of transferring heat in a certain space to another space. The processes of heat transfer can be generally divided into three types, namely, heat conduction, convection, and radiation. These three types of heat transfer often coexist in common heat exchangers. However, depending on different applications, one of the three types of heat transfer will dominate over the other two. In the heat exchangers for industrial purpose, the heat transfer thereof is mainly to transfer heat from a zone with heated radiating fins to a zone with cold radiating fins via heat conduction or heat pipes. In the above heat transfer process, there is included heat transfer via both air convection and heat conduction. The above forms the theoretic basis of heat transfer with a heat exchanger.

[0005] Basically, a heat exchanger enables removal of heat from a high-temperature liquid or gas via a medium. Since water and air are the most easily available media for heat exchange, most heat exchangers use water or air as the medium to transfer heat. In the case as used as the medium for heat transfer, the heat exchanger is referred to as an air-cooling type heat exchanger.

[0006] FIG. 1 shows a conventional plate-type heat exchanger 1, which is one of the air-cooling type heat exchangers and includes an inlet 11 and an outlet 12. The plate-type heat exchanger 1 is internally provided with a plurality of partitions 13 to define a flow passage 14 between any two adjacent partitions 14. A fluid, such as a coolant, water, air and the like, enters into the plate-type heat exchanger 1 via the inlet 11 to flow through the flow passages 14, so that the fluid is distributed in the heat exchanger 1 and then flows out of the heat exchanger 1 via the outlet 12. Thus, the heat exchanger 1 provides the functions and effects of heat distribution and heat exchange.

[0007] While the heat exchanger 1 enables the fluid to diffuse in the flow passages 14, the flow passages 14 tends to cause pressure dispersion of the fluid, resulting in unevenly distributed fluid. Further, the plate-type heat exchanger 1 provides only one-way flow passages 14 and limited heat exchange area, and therefore has apparently low heat exchange efficiency and low heat transfer effect. Accordingly, the heat dissipation effect provided by the plate-type heat exchanger 1 is not ideal.

[0008] Another conventional air-cooling type heat exchanger includes a thermal module having a fan and a radiating fin assembly. The radiating fin assembly provides increased heat transfer area. The radiating fin assembly with heat flux conducted thereto exchanges heat with air at a convection field provided by the fan. This type of heat exchanger has the problems of producing noise when the fan blades rotate and having accumulated dust on the radiating fin assembly when the latter has been used over a long period of time.

[0009] In brief, the conventional heat exchangers have the following disadvantages: (1) the flow passages for heat exchange have limited length to result in poor heat transfer effect; (2) the fluid medium does not distribute evenly in the heat exchanger to result in poor heat transfer effect; (3) the heat exchange efficiency is poor; (4) the heat dissipation effect is poor; (5) the fan blades produce noise when rotating; and (6) the radiating fin assembly tends to become dirty after having been used over a long time.

[0010] It is therefore tried by the inventor to develop an improved spiral heat exchanger to eliminate the problems in the conventional heat exchangers.

SUMMARY OF THE INVENTION

[0011] A primary object of the present invention is to provide a spiral heat exchanger that includes a spiral unit to enable increased heat transfer capacity and extended heat exchange flow passages. The spiral heat exchanger, when being driven to rotate, utilizes a centrifugal force to establish a flow field therein for cold and hot fluids flowing therethrough to exchange heat. Due to the extended heat exchange flow passages and accordingly, increased heat exchange area, the spiral heat exchanger does not require any conventional thermal module with fan and radiating fin assembly and can therefore avoid the problems of fan operating noise and accumulated dust in the radiating fins.

[0012] Another object of the present invention is to provide a spiral heat exchanger that is driven by a driving unit to rotate, and includes a spiral unit provided with at least one type of heat transfer enhancing means, such as surface ribs, dimples, pin-fins, helical wires, and twisted tapes. Therefore, when the spiral heat exchanger rotates, the cold and hot airflows under a centrifugal force can flow through the spiral unit and the heat transfer enhancing means thereof from an inner side to an outer side of the spiral unit to effectively utilize the heat exchange between cold and hot air and achieve high heat exchange efficiency.

[0013] A further object of the present invention is to provide a spiral heat exchanger that allows cold and hot airflows to flow through a spiral unit and exchange heat thereof.

[0014] A still further object of the present invention is to provide a spiral heat exchanger that includes a spiral unit and utilizes first and second turbulence generating units to generate eddies in the cold and hot airflows flowing through the
spiral unit, so that the cold and hot airflows can effectively exchange heat at the spiral unit at increased heat exchange efficiency.

A still further object of the present invention is to provide a spiral heat exchanger that includes a spiral unit and utilizes a first and second turbulence generating units to isolate entrained dust from cold and hot airflows flowing through the spiral unit.

To achieve the above and other objects, the spiral heat exchanger according to a preferred embodiment of the present invention includes a first cover, a second cover, a spiral unit, and a driving unit. The first cover has at least one first inlet, at least one first outlet, and at least one first turbulence generating unit. The first inlet is a through hole arranged at a central area of the first cover, and the first outlet is a through hole arranged near an outer peripheral area of the first cover. The second cover is assembled to the first cover to define a chamber in between the first and the second cover. The second cover has at least one second inlet, at least one second outlet, and at least one second turbulence generating unit. The second inlet is a through hole arranged at a central area of the second cover, and the second outlet is a through hole arranged near an outer peripheral area of the second cover. The spiral unit is arranged in the chamber and includes a first and a second spiral member. The first spiral member is spirally extended from the first inlet in a radially outward direction to the first outlet to form a first flow passage communicating with the first inlet and the first outlet, and the second spiral member is spirally extended from the second inlet in a radially outward direction to the second outlet to form a second flow passage communicating with the second inlet and the second outlet. The first flow passage and the second flow passage are adjacent to each other. The driving unit is provided with a shaft and a connecting element connected to a distal end of the shaft. The driving unit is assembled to one of the first cover and the second cover via the connecting element, so as to drive the first and the second cover to rotate at the same time. First airflow and second airflow surrounding the spiral heat exchanger can enter the first and the second spiral member, respectively, when the spiral heat exchanger is driven by the driving unit to rotate, and to exchange heat at the spiral unit. Meanwhile, when the first and the second airflow flow through the first and the second spiral member, respectively, the first and the second turbulence generating unit can generate eddies swirling in directions opposite to the flow directions of the first and the second airflow. With these arrangements, the spiral heat exchanger can have largely increased heat transfer capacity and extended heat exchange flow passages to effectively upgrade the heat exchange efficiency thereof.

FIG. 3 is a third exploded perspective view of the spiral heat exchanger according to the first preferred embodiment of the present invention; FIG. 4 is a fully assembled perspective view of the spiral heat exchanger according to the first preferred embodiment of the present invention; FIG. 5 is a sectioned bottom perspective view of the spiral heat exchanger according to the first preferred embodiment of the present invention with a driving unit removed therefrom; FIG. 6A shows the flow direction of a first airflow in the spiral heat exchanger according to the first preferred embodiment of the present invention; FIG. 6B shows the flow direction of a second airflow in the spiral heat exchanger according to the first preferred embodiment of the present invention; FIG. 7 is an exploded perspective view of a spiral heat exchanger according to a second preferred embodiment of the present invention with two spiral members thereof in an assembled state; FIG. 8 is a sectioned bottom perspective view of the spiral heat exchanger according to the second preferred embodiment of the present invention with a driving unit removed therefrom; FIG. 9 is a sectioned bottom perspective view showing the flow directions of airflows in the spiral heat exchanger according to the second preferred embodiment of the present invention; and FIG. 10 is a sectioned bottom perspective view showing the assembling of two covers of the heat exchanger of the present invention to each other.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention will now be described with some preferred embodiments thereof. For the purpose of easy to understand, elements that are the same in the preferred embodiments are denoted by the same reference numerals.

Please refer to FIGS. 2A, 2B to 5. A spiral heat exchanger 2 according to a first preferred embodiment of the present invention includes a first cover 3, a second cover 4, a spiral unit 5, and a driving unit 6. The first cover 3 is provided with at least one first inlet 31, at least one first outlet 32, and a first inner face 33. The first inlet 31 is a through hole arranged at a central area of the first cover 3, and the first outlet 32 is also a through hole arranged near an outer peripheral area of the first cover 3. The second cover 4 is assembled to the first cover 3 to define a chamber 34 in between the first and the second cover 3, 4. The second cover 4 is provided with at least one second inlet 41, at least one second outlet 42, and a second inner face 43. The second inlet 41 is a through hole arranged at a central area of the second cover 4, and the second outlet 42 is also a through hole arranged near an outer peripheral area of the second cover 4. The first inner face 33 of the first cover 3 faces toward the second cover 4, and the second inner face 43 of the second cover 4 faces toward the first cover 3.

The spiral unit 5 is arranged in the chamber 34, and can be a separate unit from the first and the second cover 3, 4 or a unit integrally extended from the first cover 3 or the second cover 4. In the illustrated first preferred embodiment, the spiral unit 5 is a separate unit from the first and second covers 3, 4. The spiral unit 5 includes a first and a second spiral member 51, 52. More specifically, the first spiral member 51 is spirally extended from the first inlet 31 in a radially outward direction to the first outlet 32 to form a first flow passage 511 communicating with the first inlet 31 and the first...
outlet 32, and the second spiral member 52 is spirally extended from the second inlet 41 in a radially outward direction to the second outlet 42 to form a second flow passage 521 communicating with the second inlet 41 and the second outlet 42. The first flow passage 511 and the second flow passage 521 are radially adjacent to each other with the second spiral member 52 located at a radially inner side and the first spiral member 51 located at a radially outer side of the first flow passage 511. In other operable embodiments, one of various types of means for enhancing heat transfer, such as surface ribs, dimples, pin-fins, helical wires, and twisted tapes, can be provided on the first spiral member 51 and the second spiral member 52. In the illustrated first preferred embodiment, the first and second spiral members 51, 52 have smooth surfaces without any of the above-mentioned heat transfer enhancing means.

The driving unit 6 includes a shaft 61 and a connecting element 62 connected to a distal end of the shaft 61. The driving unit 6 is assembled to either the first cover 3 or the second cover 4 via the connecting element 62. The connecting element 62 has at least one opening 621 communicating with the first inlet 31, in the case of being connected to the first cover 3, or with the second inlet 41, in the case of being connected to the second cover 4.

As mentioned above, the spiral unit 5 includes the first and second spiral member 51, 52. The first spiral member 51 is extended from one side of the first cover 3 facing toward the second cover 4, and the second spiral member 52 is extended from one side of the second cover 4 facing toward the first cover 3, as shown in FIG. 23. It is noted that the first cover 3 is shown in FIG. 23 by phantom lines. In the illustrated embodiment, the first spiral member 51 and the first cover 3 are separated from the second spiral member 52 and the second cover 4.

Please further refer to FIGS. 2A, 2B, 6A and 6B. In the illustrated first preferred embodiment, the driving unit 6 is assembled to the first cover 3 via the connecting element 62, and the connecting element 62 is provided with a plurality of openings 621, so that the openings 621 are communicable with the first inlet 31. When the driving unit 6 operates, it drives the shaft 61 and the connecting element 62 to rotate. At this point, the first cover 3 connected to the connecting element 62 and the second cover 4 assembled to the first cover 3 are brought to rotate at the same time. Under a centrifugal force produced by the rotating spiral heat exchanger 2, a first airflow 71 surrounding a first environment of the spiral heat exchanger 2 enters the first spiral member 51 via the openings 621 on the connecting element 62 and the first inlet 31 on the first cover 3 to flow through the first flow passage 511, and a second airflow 72 surrounding a second environment of the spiral heat exchanger 2 enters the second spiral member 52 via the second inlet 41 on the second cover 4 to flow through the second flow passage 521. In the illustrated first embodiment, the first and the second environment are a cold and a hot environment, respectively. Accordingly, the first airflow 71 and the second airflow 72 are cold airflow and hot airflow, respectively.

When the driving unit 6 operates continuously, under the centrifugal force, the first airflow 71 continuously enters the first spiral member 51 and the first flow passage 511, and the second airflow 72 continuously enters the second spiral member 52 and the second flow passage 521. Meanwhile, the first airflow 71 and the second airflow 72 respectively flow from a central area along the first spiral member 51/the first flow passage 511 and the second spiral member 52/the second flow passage 521 toward radially outer areas. In the course of flowing, the first airflow 71 and the second airflow 72 in the spiral unit 5 flowing from the central area along the spiral unit 5 are centrifugally thrown outward to thereby establish a flow field in the first spiral member 51 and the second spiral member 52 each. Meanwhile, the cold first airflow 71 and the hot second airflow 72 exchange heat at the first and second spiral members 51, 52 as well as the adjacent first and second flow passages 511, 521. Then, the first and the second airflow 71, 72 after heat exchange flow out of the chamber 34 via the first outlet 32 of the first cover 3 and the second outlet 42 of the second cover 4, respectively. By providing the first and the second spiral member 51, 52 in between the first and the second cover 3, 4, length-increased spiral flow passages are formed in the chamber 34 for heat exchange. With the lengthened heat-exchange flow passages, heat exchange between cold and hot fluids can be achieved without the need of using the conventional thermal module with fan and radiating fin assembly. Further, the first and second spiral members 51, 52 also provide effectively increased heat exchange area and enable upgraded heat transfer capacity.

Please refer to FIGS. 7, 8 and 9, in which a spiral heat exchanger according to a second preferred embodiment of the present invention is shown. The second preferred embodiment is generally structurally similar to the first preferred embodiment, except that the first inner face 33 of the first cover 3 facing toward the second cover 4 and the spiral unit 5 is provided with a plurality of first turbulence generating units 331 at positions corresponding to the first spiral member 51/the first flow passage 511 and the second spiral member 52/the second flow passage 521; and the second inner face 43 of the second cover 4 facing toward the first cover 3 and the spiral unit 5 is provided with a plurality of second turbulence generating units 431 at positions corresponding to the first spiral member 51/the first flow passage 511 and the second spiral member 52/the second flow passage 521. When the first airflow 71 and the second airflow 72 enter into the first spiral chamber 51/the first flow passage 511 and the second spiral member 52/the second flow passage 521 via the first inlet 31 and the second inlet 41 at the central area of the first and second cover 3, 4 and flow along the first and the second spiral member 51, 52 toward the first and the second outlet 32, 42, respectively, the first and the second airflow 71, 72 will also pass the first and the second turbulence generating units 331, 431. As a result, eddies whirling in a direction opposite to the flow directions of the first and second airflows 71, 72 are produced in the spiral unit 5. These eddies are helpful in more effective mixing of airflows in the spiral unit 5 to enable increased efficiency of heat exchange between the first and the second airflow 71, 72 in the first and the second spiral member 51, 52, and accordingly upgraded heat transfer capacity. Meanwhile, the first and the second turbulence generating units 331, 431 also provide the function of isolating entrained dust from the airflows 71, 72 when they flow through the first and second spiral members 51, 52.

Please refer to FIG. 10. The first cover 3 and the second cover 4 are correspondingly provided with a plurality of fixing holes 35, 44. By extending a fastening element 8 through each pair of aligned fixing holes 35, 44, the first and the second cover 3, 4 can be securely connected to each other. In this manner, the first cover 3, the second cover 4, and the spiral unit 5 can be held in place relative to one another when the spiral heat exchanger 2 (see FIGS. 2 and 4) is driven to rotate.

In brief, the spiral heat exchanger according to the present invention has the following advantages: (1) increasing the length of the heat-exchange flow passages to effectively increase the heat exchange area; (2) enabling the air-
flows to evenly distribute in the spiral flow passages to upgrade the heat exchange performance; (3) generating eddies to upgrade the heat exchange efficiency; (4) effectively isolating dust from the airflows; (5) eliminating the use of fans and according any noise caused by fan blades during rotating thereof; (6) eliminating the use of radiating fin assembly and accordingly the problem of accumulated dust in the radiating fin assembly; and (7) providing self-cleaning ability through the eddy field formed in the rotating spiral unit.

[0040] The present invention has been described with some preferred embodiments thereof and it is understood that many changes and modifications in the described embodiments can be carried out without departing from the scope and the spirit of the invention that is intended to be limited only by the appended claims.

What is claimed is:
1. A spiral heat exchanger, comprising:
a first cover having at least one first inlet and at least one first outlet, the first inlet being a through hole arranged at a central area of the first cover, and the first outlet being a through hole arranged near an outer peripheral area of the first cover;
a second cover being assembled to the first cover to define a chamber in between the first and the second cover; the second cover having at least one second inlet and at least one second outlet, the second inlet being a through hole arranged at a central area of the second cover, and the second outlet also being a through hole arranged near an outer peripheral area of the second cover;
a spiral unit being arranged in the chamber and including a first and a second spiral member, the first spiral member being spirally extended from the first inlet in a radially outward direction to the first outlet to form a first flow passage, and the second spiral member being spirally extended from the second inlet in a radially outward direction to the second outlet to form a second flow passage; and the first and the second flow passage being adjacent to each other; and
a driving unit being provided with a shaft and a connecting element connected to a distal end of the shaft, the driving unit being assembled to one of the first cover and the second cover via the connecting element, so as to drive the first and the second cover to rotate at the same time.
2. The spiral heat exchanger as claimed in claim 1, wherein the first cover has a first inner face facing toward the second cover.
3. The spiral heat exchanger as claimed in claim 2, wherein the first cover is provided on the first inner wall with a plurality of first turbulence generating units at positions corresponding to the first and the second spiral member.
4. The spiral heat exchanger as claimed in claim 1, wherein the second cover has a second inner face facing toward the first cover.
5. The spiral heat exchanger as claimed in claim 3, wherein the second cover has a second inner face facing toward the first cover.
6. The spiral heat exchanger as claimed in claim 4, wherein the second cover is provided on the second inner face with a plurality of second turbulence generating units at positions corresponding to the first and the second spiral member.
7. The spiral heat exchanger as claimed in claim 5, wherein the second cover is provided on the second inner face with a plurality of second turbulence generating units at positions corresponding to the first and the second spiral member.
8. The spiral heat exchanger as claimed in claim 1, wherein the connecting element is provided with at least one opening communicating with the first inlet, in the case the connecting element is connected to the first cover, or with the second inlet, in the case the connecting element is connected to the second cover.
9. The spiral heat exchanger as claimed in claim 1, wherein the spiral unit is integrally extended from the first cover.
10. The spiral heat exchanger as claimed in claim 1, wherein the spiral unit is integrally extended from the second cover.
11. The spiral heat exchanger as claimed in claim 1, wherein the first cover and the second cover are correspondingly provided with a plurality of fixing holes.
12. The spiral heat exchanger as claimed in claim 11, wherein each pair of two aligned fixing holes on the first and the second cover has a fastening element extended therethrough, so as to assemble the first cover to the second cover.
13. The spiral heat exchanger as claimed in claim 1, wherein the first spiral member allows a first airflow to flow therethrough, and the second spiral member allows a second airflow to flow therethrough.
14. The spiral heat exchanger as claimed in claim 13, wherein the first airflow is one of a cold and a hot airflow, and the second airflow is another one of the cold and the hot airflow.
15. The spiral heat exchanger as claimed in claim 6, wherein the first spiral member and the second spiral member are provided with any one of various types of heat transfer enhancing means selected from the group consisting of surface ribs, dimples, pin-fins, helical wires and twisted tapes.
16. The spiral heat exchanger as claimed in claim 7, wherein the first spiral member and the second spiral member are provided with any one of various types of heat transfer enhancing means selected from the group consisting of surface ribs, dimples, pin-fins, helical wires and twisted tapes.
17. The spiral heat exchanger as claimed in claim 1, wherein the first spiral member is extended from one side of the first cover facing toward the second cover.
18. The spiral heat exchanger as claimed in claim 17, wherein the second spiral member is extended from one side of the second cover facing toward the first cover.
19. The spiral heat exchanger as claimed in claim 1, wherein the first flow passage and the second flow passage are radially adjacent to each other with the second spiral member located at a radially inner side and the first spiral member located at a radially outer side of the first flow passage.

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