Title
Integrated heat pipe and its heat exchange mode and method

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Applicant(s)
Hongwu Yang

Inventor(s)
Yang, Hongwu

Agent / Attorney
Phillips Ormonde Fitzpatrick, 367 Collins Street, Melbourne, VIC, 3000
ABSTRACT

The present invention relates to a kind of integrated heat pipe and a method of heat exchange. The heat pipe includes a tank (1-2) as a heating potion and a lot of heat carriers (1-4) as a radiating portion. The tank (1-2) and the heat carriers (1-4) have same cavity in which a coolant (1-3) is partially filled. The tank (1-2) is held in close contact with a heat source (such as electronic elements). The heat carriers (1-4) are arranged at an interval so that the radiating channels (1-4a) are formed between them. The coolant (1-3) in the tank (1-2) is heated by the heat sources, vaporized coolant moves to the heat carriers (14) and condenses in there. According to the invention, the heat pipe can be increased its radiating surface significantly with the varied arrangement of the heat carriers (1-4).
INTEGRATED HEAT PIPE AND ITS HEAT EXCHANGE MODE AND METHOD

The following statement is a full description of this invention, including the best method of performing it known to applicant(s):

- 1 -
Integrated Heat Pipe and its Heat Exchange Mode and Method

The present application is a divisional application from Australian Patent Application No. 2003211804, the entire disclosure of which is incorporated herein by reference.

FIELD OF THE INVENTION

This invention is related to heat exchange technology and method, specifically, an integrated heat pipe and its heat exchange method.

BACKGROUND OF THE INVENTION

A reference herein to a patent document or other matter which is given as prior art is not to be taken as an admission that that document or matter was, in Australia, known or that the information it contains was part of the common general knowledge as at the priority date of any of the claims.

The development of LSI, mainframe computer and electrical and electronic technologies has imposed higher requirements on the heat elimination of electronic elements and components. For example, the integration level of CPU chips of computers has risen by nearly 20,000 folds just within 30 years with its consumption power rising up to a few dozen watts from its initial a few watts and with the resulting heat flux being up to 100W/cm² in some cases. The working reliability and life of computer is closely related to its working temperature and the required maximum temperature (internal) of chips ≤30°C and the required surface temperature ≤80°C. However, its working reliability will decrease by 3.8% whenever the temperature of chip rises by 1°C, and its life will increase by 50% whenever the temperature of chip decreases by 10%. High speed and high integration level imposes very high requirement on the uniformity of the temperature of chips. Therefore, heat elimination has become a major problem that has to be resolved in the course of research and development of electronic products and it is directly related to the property, reliability and cost of electronic products.

Initially, there were several heat elimination technologies for chips, such as heat elimination fan, heat elimination plate, pre-made heat elimination holes, keyboard
convection heat elimination, water cooling heat elimination, etc. Though their cost was low, their heat eliminating effect was not so good and their reliability was low, therefore, they were not able to meet the requirement of the development of computer.

The State Laboratory of Sandia in the USA first applied heat pipe technology in the heat elimination of computer chips, which produced fairly good heat elimination effect.

Heat pipe technology is a highly effective heat transfer element and highly effective heat transfer technology, which transfers heat by the phase change process, that is, to fill a small amount of liquid medium into the enclosed vacuum chamber of a tubular article, where a liquid medium is used to absorb heat, vaporizes, condenses and eliminates heat. Heat pipe heat exchanger is so constructed that the heat absorption end and heat elimination end of several heat pipe elements are partitioned and the heat absorption end and heat elimination end are surrounded with articles to form two shaped cavities, heat absorption and heat elimination, with hot fluid flowing through the heat absorption chamber and the cold fluid flowing through the heat elimination chamber, thus heat being transferred to the cold fluid via heat pipe and the phase change of the heat pipe medium. The structural characteristic of heat pipe is that the inner chamber of a flexible tubular article is vacuumed and filled with a
small amount of liquid medium and the inner chamber of the pipe is just big enough for a liquid absorption cartridge that ensures liquid reflux. A single heat pipe can be used as heat exchanger, but it is more often that the heat exchangers composed of several heat pipe elements are used at the same time.

However, the current heat pipe technology of the heat elimination of plane heat sources, such as computer chips and other electrical and electronic elements and components is mostly of studded heat pipe type. That is to make notch in the metal plate of fine thermal conductivity, inlay the heat absorption end of heat pipe in the notch, put the heat elimination end at a ventilated place and the metal plate is placed horizontally above the heating element. In order to ensure that the heat source plane is in full contact with the metal plane and electrically insulated, a heat conducting insulation plate coated with heat conducting silicone is placed between them. Heat is transferred via heat conducting silicone, heat conducting insulating plate from the heat source to the metal plate, then to the heat pipe, where as a result of phase change heat is transferred from heat absorption end to the condensation end, and the heat absorbed at the condensation end is transferred through the shell of the heat pipe to another layer of silicone, then to the aluminum fin type radiator. The heat accumulated in the fin radiator is carried away by forced cold wind to accomplish the purpose of reducing the temperature of the heat source ultimately. This inlaying method does not produce very good heat elimination effect as the contact thermal resistance of the element connected with interface in the course of heat transfer is so big that the heat pipe cannot play the role of high efficiency heat transfer and the heat eliminating effect is not so good. In addition, through by welding the heat absorption end of one or several heat pipes on the metal plate and installing a number of fin groups to support heat elimination at the heat elimination end of heat pipe, the contact thermal resistance of the interface can be reduced, the medium of the heat pipe can not be in full contact with the heat source and can not produce very good heat transfer effect.

In the metal foundry Industry, in order to ensure that the alloy melt solidifies immediately in the casting mould and cools down the mould within shortest time to increase the production efficiency of casting moulds, some people insert the heat absorption ends of many heat pipes into the main body of the hard mould to take advantage of the inherent axial heat transfer characteristic of conventional heat pipe in hard mould foundry and in ejection molding and insert the heat elimination end of heat pipe into water cooling pipe so as to level the temperature gradient in the hard mould by heat pipe and to conspicuously improve the heat transfer efficiency of the casting mould without increasing water consumption. What merits attention is the application of heat pipe technology in foundry Industry includes the newest continuous casting and continuous rolling processes, such as wheel rolling and wheel casting and continuous crystallizing that require heat exchanging. Up to now, no structure other than the conventional heat pipe and any new heat transfer mode have been found. However, because of the interface thermal resistance between the casting mould and the wall of heat pipe and the limitations of the structure it is impossible for the original structure to meet the even higher cooling speed requirement of alloy including fast solidifying alloy on the mould and it is more so of certain special and higher requirement.

The fast solidifying metal technology is to fix metal molecules on higher energy level. Since Duwez invented the fast solidifying technology in 1960, the technology has been
improved and systemized continuously and commercialized gradually. Because of its high dynamic property and fine physical and chemical property the fast solidifying metals have attracted the attention of the materials scientific workers throughout the world, who have put much manpower, material and funds in the research. As a result of the development over the last three decades the fast solidification technology and its research on metals have become one of the important branches of materials science and engineering. As the fast solidification technology is to increase the super-cooling extent and speed of solidification mainly by increasing solidification speed, the solidification speed is very important for the formation and property of the fast solidifying material.

At present, there are dozens of fast solidification processes and equipment for production of fast solidifying materials, mainly in three categories of mould cooling technology, atomization technology and surface melting and sedimentation technology. According to the basic principle of fast solidification for melt dispersion and thermal resistance reduction the existing production unit includes rotating or fixed cold mould (or base), mostly made from metals of fine thermal conductivity. Its heat exchange method is to build a cooling liquid passage in fabrication of the equipment base, which is designed to carry away swiftly the heat absorbed by the base to accomplish the fast cooling purpose of fast solidifying material. Because of the limitations of the traditional heat transfer mode and the structure of the base the contact area between base and cooling liquid is small (normally, the area of the heat absorption end is always bigger that that of the heat elimination end) and contact thermal resistance is big, it is difficult for the cooling liquid to carry away the large amount of heat emitted by the melt during the solidification process instantly. Therefore, it is very difficult to improve and balance the distribution of temperature field so as to further increase the heat transfer speed during the solidification process. Moreover, as the temperature at the heat balance spot of the base is fairly high during operation, the capacity of the production unit declines, its life gets shorter, its efficiency gets lower and the quality deteriorates. Up to now there is no report about any application of heat pipe technology in the field of fast solidification technology.

Hot fluid ejecting nozzles are widely applied in engineering technology, particularly, plasma welding cutting torch, plasma spray coating nozzle, nozzle of electron beam welding torch, nozzle of large power arc welding torch, etc. As the high temperature heat flux flows through nozzle for such a long time during operation that the nozzle is easily damaged, people tend to manufacture nozzles with metals of fine thermal conductivity and some even cool nozzles with water. Notwithstanding all this, the effect is not so good and the life does not get any longer and the cooling water leakage may damage the electrical insulation of the equipment greatly reducing the reliability of the equipment. Although some people use heat pipe technology in nozzles, the high efficiency heat transfer characteristic of heat pipe can not be displayed because their technical design fails to greatly improve the heat elimination area of nozzle and the geometric dimensions of nozzle are small. Therefore, the existing technology is still unable to meet the requirement of the engineering technology and should be further improved.

Heat exchanger, including that for heat exchange between fluid media is the most conventional basic equipment used in various Industrial sectors of the state economy. People have never stopped in trying to improve the function of heat exchanger to increase the
heat transfer efficiency of heat exchanger by various technologies, methods and means over hundreds of years. The heat pipe phase change heat transfer technology, including the use of high heat conductivity medium to transfer heat, is an effective try. The high thermal conductivity, big heat elimination area and fairly low production cost of heat pipe heat exchanger is well applied in residual heat recovery in the field of heat exchanger. Nevertheless, the branch like distribution of the heat pipe of the traditional heat pipe heat exchanger and its square box structure is apt to fouling on heat elimination surface and dead corner and whirlpool of fluid flow thus affecting the normal heat exchange and application life of heat exchanger. The single structure and huge volume of the traditional heat exchanger is one of the limiting factors. Up to now there is no report about any application of integrated heat pipe technology in the field of heat exchanger.

Large electric motor, generator and engine are the power source of the modern Industry, the mainstay for the existence of modern technology and the basic equipment of the state economy. Their common structural characteristic is that they all have a turning shaft-rotor that requires heat elimination any time. If the heat including that emitted inside the rotor cannot be eliminated, overheating might happen reducing the power, abating the insulation and damaging electrical and mechanical equipment, or even leading to the loss of working capacity of equipment. Generally speaking, for every degree of temperature rises above the upper limit of the motor, its life span is reduced by half. In order to eliminate heat from rotor the large capacity motor and generator are normally cooled with the gas in enclosed re-circulation, or by pipe ventilation, independent fan type cooling or by having hollow copper winding of rotor for cooling water flowing through the hollow copper winding, shaft and sealed water jacket to carry away the heat. Some people apply the heat pipe phase change heat transfer technology to improve the heat elimination of motor rotor in this manner that they hollow out the shaft of the motor so as to form a somewhat biased empty chamber, which extends through the heat absorption end and heat elimination end of rotor and is vacuumed and filled with a small amount of liquid medium. The medium absorbs heat and vaporizes at the heat absorption end and emits heat and condenses into liquid at the heat elimination end. The reflux liquid flows back to the heat absorption end over the slope under the action of a centrifugal force. The heat carried by the medium at the heat elimination end is carried away by the cold air blowing out of the fan and the internal heat in the rotor is ultimately eliminated thus forming a reciprocating heat recycle. The rotating heat pipe technology can produce fairly good effect in improving the heat elimination of motor rotor. However, the above-mentioned methods have many shortcomings, such as inferior heat elimination and high production cost and still they have a common shortcoming, that is, heat elimination area is small and the heat elimination capacity is intrinsically inadequate. How to improve the heat elimination capacity of motor rotor and to enhance the capacity and reliability of the above-mentioned power machines has been a subject that the scientists and engineers have to confront for a long time.

As described above, the existing heat pipe, heat pipe heat exchanger and heat pipe heat exchange technology, initially applied in home appliances, have found more and more applications in high tech spheres such as aviation and space Industries as a result of their development over last 50 years or so because of simple structure, reliability, high heat thermal conductivity and easy realization and they are being used in more and more areas. Some
new heat pipe structures and new heat transfer mechanisms came into being over recent years, but up to now the method for increasing the heat elimination area of heat pipe of heat exchange technology is mostly to increase the absolute length of the heat elimination end of heat pipe, install auxiliary heat elimination ribbed plates and increase the number of heat pipes; the structure of heat pipe heat exchanger is still single; the structure of the heat absorption end of heat pipe and heat pipe radiator is still short of any variation. All these have greatly limited the application and popularization of heat pipe and heat pipe technology. Particularly, as to how to reduce thermal resistance of contact heat source apart from the heat flux to increase heat transfer efficiency, it is difficult for the existing heat pipe heat exchange technology to display its merit fully because of its unique structure. For the heat elimination for a narrow space, special geometric shape and large heat flux density and the heat elimination for the large heat flux density during intermittent interval and the limited cold course conditions, it is imperative to improve the existing heat pipe technology.

It would be desirable to make up the shortcomings of background technology and increase heat transfer efficiency.

**SUMMARY OF THE INVENTION**

According to the prevent invention there is provided an integrated heat pipe, comprising: a shell body including a first portion to form a plurality of heat carriers and a second portion to form a heat absorption end, the plurality of heat carriers defining a plurality of chambers substantially isolated from each other, the plurality of chambers being connected to each other to form a sealed chamber;

a heat transfer medium deposited inside the sealed chamber, the heat transfer medium being in a liquid form to absorb heat from the heat absorption end, the heat transfer medium releasing heat to the plurality of heat carriers after travelling in the sealed chamber from the heat absorption end to the plurality of chambers defined by the plurality of heat carriers,

wherein the plurality of heat carriers are configured to share the sealed chamber and to share the heat transfer medium.
According to the present invention there is also provided a heat exchange method in an integrated heat pipe, comprising:

(a) absorbing heat through contacting a heat source at a surface of a heat absorption end of a shell body of the heat pipe, wherein the heat is transferred to a same heat transfer medium in a same enclosed chamber through a surface of the heat absorption end of the shell, wherein the heat transfer medium absorbs heat or vaporizes to quickly disperse absorbed heat, wherein a heat carrier outside, inside, or outside and inside of, the enclosed chamber is used as a heat dissipation end, wherein a heat container absorbs or transfers heat absorbed by the heat transfer medium;

(b) transferring heat from the heat transfer medium using a low temperature fluid in a thin-wall passage configured outside, inside, or outside and inside of, the enclosed chamber;

(c) absorbing heat from the heat transfer medium using a heat container configured outside, inside, or outside and inside of, the enclosed chamber;

(d) arranging the heat transfer medium at the heat absorption end of the heat pipe nearest to the heat absorbing surface in the enclosed chamber and using the heat transfer medium to carry heat to a nearest heat dissipating surface of the heat carrier to reduce heat resistance, improve heat conduction and increase heat transfer speed.

According to the present invention there is also provided an integrated heat pipe including an enclosed chamber and a shell whose inside is a vacuum and filled with a heat transfer medium, the heat pipe comprising:

a heat carrier set out of the enclosed vacuum chamber;

wherein the heat carrier is a corrugated radially fin-like thin-wall passage, short fins and long fins radially distributed towards an axis of the heat pipe, the inside of every corrugated long fin or short fin having an internal cavity of the heat carrier, which connects with the enclosed vacuum chamber as an extension of the enclosed vacuum chamber;

wherein the outside of every corrugated long fin or short fin is a passage of the heat carrier, which contacts a cold medium to form a heat dissipating surface of the heat carrier;
wherein every group of heat carriers uses the same enclosed vacuum chamber and the heat transfer medium in the enclosed vacuum chamber, every group of heat carriers being inter-independent and also interconnected;
wherein the shell of the integrated heat pipe is formed by a wall of the enclosed vacuum chamber and a wall of the corrugated thin-wall passage;
wherein to ensure normal heat conduction at a declining position, a liquid absorption cartridge is set in the enclosed vacuum chamber when the phase change heat conduction of the heat pipe uses a liquid heat transfer medium.

BRIEF DESCRIPTION OF EMBODIMENTS OF THE INVENTION

Fig. 1-1 illustrates a sectional view according to one of the embodiments of the invention;
Fig. 1-2 illustrates a sectional view according to one of the embodiments of this invention;
Fig. 1-3 illustrates a sectional view according to one of the embodiments of this invention;
Fig. 2-1 illustrates a view according to one of the embodiments of this invention;
Fig. 2-2 illustrates a view according to one of the embodiments of this invention;
Fig. 3-1 illustrates a view according to one of the embodiments of this invention;
Fig. 3-2 illustrates a view according to one of the embodiments of this invention;
Fig. 4-1 illustrates a view according to one of the embodiments of this invention;
Fig. 4-2 illustrates a view according to one of the embodiments of this invention;
Fig. 5 illustrates a view according to one of the embodiments of this invention.
Fig. 6-1 illustrates a sectional view according to one of the embodiments of this invention;
Fig. 6-2 illustrates a view according to one of the embodiments of this invention;

Fig. 6-3 illustrates a view according to one of the embodiments of this invention;
Fig. 7-1 illustrates a view according to one of the embodiments of this invention;
Fig. 7-2 illustrates a view according to one of the embodiments of this invention;
Fig. 8-1 illustrates a view according to one of the embodiments of this invention;
Fig. 8-2 illustrates a view according to one of the embodiments of this invention;
Fig. 9-1 illustrates a view according to one of the embodiments of this invention;
Fig. 9-2 illustrates a view according to one of the embodiments of this invention;
Fig. 10-1 illustrates a view according to one of the embodiments of this invention;
Fig. 10-2 illustrates a view according to one of the embodiments of this invention;
Fig. 11-1 illustrates a view according to one of the embodiments of this invention;
and
Fig. 11-2 illustrates a view according to one of the embodiments of this invention.
DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

A kind of integrated heat pipe includes a shell with an enclosed chamber vacuumed and filled with heat transfer medium, which is characterized by the following: there are one or more than one groups of heat carriers outside the enclosed chamber or inside it or outside and inside it, with every group of heat carriers, sharing an enclosed chamber and the heat transfer medium in the same enclosed chamber. The heat transfer medium may be the heat transfer liquid medium of phase change process of high efficiency heat transfer medium for other heat transfer mode, heat carrier is heat elimination end and shell or part of the shell is heat absorption end.

A kind of integrated heat pipe, including a shell with an enclosed chamber vacuumed and filled with heat transfer medium, which is characterized by the following: the integrated heat pipe shell or part of the shell is heat absorption end, which may be one or more than one groups of heat absorbing cavities in the enclosed chamber that runs through the shell; it can be a shell covering the enclosed chamber, including the shell covering the revolving structure of the enclosed chamber or the shell of corrugated and curved surface that packages the enclosed chamber and is distributed along the outline of the revolving structure; it may be an end surface or part of the end surface vertical to the axial line of heat pipe. The outline of the shaped surface of its heat absorption end may correspond, tally or closely match with the shaped surface of heat source and may be the shaped surface composing of the limited group of corrugated and curved surface or the limited group of curved surface of enclosed tubular thin-wall fluid passage or the curved surface of their combination. Its heat transfer medium is distributed at a place at the heat absorption end in the enclosed vacuum chamber closest to the heat absorption surface.

The heat transfer medium mentioned above can be liquid heat transfer medium such as water, or inorganic heat transfer medium or compound powder of ytterbium, barium, copper and oxygen YBCO.

The shell of the said integrated heat pipe and the heat carriers placed outside the enclosed vacuum chamber of inside it or outside and inside it are made from metal of fine thermal conductivity such as copper or aluminum.
The said heat carrier of thin-wall fluid passage structure is designed to eliminate heat with cooling fluid; alternatively, heat containing structure of fine thermal conductivity, large heat volume and big surface area is adopted to hold heat and good heat absorbing material and structure is used as heat container.

5 The shell of the said integrated heat pipe or part of the shell is heat absorption end, and to the contact heat source with heat transfer as main mode of thermal conductivity the formation of its shaped surface corresponds, tallies and closely contact with shape surface of
the heat source. To the heat source of fluid medium with convection as main mode of heat elimination, its shaped surface becomes limited group of corrugated and curved surface or limited group of curved shape of enclosed fluid passage or the form of their combination. Its heat transfer medium is placed at a place at the heat absorption end of the enclosed vacuum chamber closest to the heat-absorbing surface.

When the heat carrier of thin-wall fluid passage structure is placed outside the enclosed vacuum chamber of integrated heat pipe, the structure of the thin-wall fluid passage structure is uneven curved surface with every undulation constituting a group of heat carriers and every group of heat carriers is independent and connected with each other. The inner side of every corrugated curved surface is the inner chamber of a heat carrier, which has access to the enclosed vacuum chamber and is the extension of enclosed vacuum chamber. The outer side of every corrugated curved surface is a fluid passage for a heat carrier in contact with cold liquid as the heat elimination surface of heat carrier. The wall surface of the enclosed vacuum chamber and the wall surface of the corrugated thin-wall fluid passage constitute the shell of this integrated heat pipe together. The curved surface of the thin-wall fluid passage structure may be parallel and upright fins, same radius bended fins, radial and upright fins, radial and bended fins, evenly and unevenly distributed column, the mirrored shape of evenly and unevenly distributed column and base shell, inversed U shape and their combination. They can be any regular or irregular corrugated curved surface. The inner and outer surfaces of the curved surface may have fins for auxiliary heat elimination.

When this heat carrier is of thin-wall fluid passage structure and is placed in the enclosed vacuum chamber of the integrated heat pipe, this thin-wall fluid passage structure is enclosed and tubular and the cold fluid incoming and outgoing ends of the thin-wall fluid passage either run through both ends of enclosed vacuum chamber or run through the neighboring ends of enclosed vacuum chamber, or run through the same end of enclosed vacuum chamber. Every enclosed tubular fluid passage is a group of heat carriers and every group of heat carriers is independent of each other and connected with each other. The inner side of the section of thin-wall fluid passage is cold fluid passage and the heat elimination surface of heat carrier as well. The shape of the section of thin-wall fluid passage may be circular, rectangular, polygon, dentiform or other geometric shape. The inner wall of fluid passage section may have fins.

When a structure of large surface area and easy heat absorption is adopted in this heat carrier and the material of high thermal conductivity and large thermal capacity is placed outside the enclosed vacuum chamber or inside it or outside and inside it as heat container, the structure of this heat container is composed of film-shaped, or flake-shaped or tubular or silk-shaped materials of large surface area or their combination curled or stacked at a space between various layers that ensures heat transfer medium transferring heat fully. The structure of heat container may be bee-hived, floccular, hemp-like or rolled in spirals or stacked, or covered with thin-wall tube or their combination. The openings between layers face the heat absorption end.

The heat absorption end of shell can be made as an end surface or part of the end surface vertical to the axial line of heat pipe, and the shaped surface of its heat absorption end corresponds, tallies and closely matches with the shaped surface of heat source, it can be smooth, flat and straight; smooth and raised; smooth and sunken; it may be fabricated
according to the outline curved shape, and it can be inlaid and covered and closely matched.

The heat absorption end of heat pipe may be one group or more than one groups of heat absorbing cavities running through shell and enclosed chamber, and it may run through both extreme ends of shell, or the neighboring ends of the shell, or the same end of the shell. The cross section of the heat-absorbing chamber may be circular, rectangular, polygon, dentiform, or other geometric shape. The vertical section of its heat-absorbing chamber can be of a slope.

The heat absorption end of heat pipe can be a revolving shell structure that covers the enclosed chamber and is of circular outline surface of the cross section. The vertical section outline surface can be rectangular bucket shaped, drum-shaped, or other revolving shape surface that meets the requirement of heat source.

The heat absorption end of heat pipe can be a corrugated thin-wall curved surface structure that is distributed on the basis of circular outline surface of cross section or other geometric shape covers the enclosed chamber. They can be more than three groups of fin shaped curved surface, evenly distributed or symmetrically distributed, contour or non-contour. They can be radial and upright fin shaped, radial and bended fin shaped or suitable curved shape or their combination. Its vertical section outline is rectangular, drum-shaped or other revolving shape suitable for the heat source.

Between the heat absorption end surface of a heat pipe and another high thermal conductivity metal template there is hollow high thermal conductivity metal template with hot melt pouring channel and gas releasing passage inside it so as to obtain the heat absorption chamber of integrated heat pipe.

Between the heat absorption end surfaces of two heat pipes there is hollow high thermal conductivity metal template with hot melt pouring channel and gas releasing passage inside it so as to obtain the heat absorption chamber of integrated heat pipe, and the heat absorption end surfaces of several heat pipes can also form a heat absorption chamber together.

Heat transfer medium of heat pipe shell or part of the shell as heat absorption end is distributed somewhere in the enclosed chamber closest to the heat absorption surface. Therefore, when liquid medium is used, a liquid absorbing cartridge of heat pipe can be placed somewhere in the enclosed chamber closest to the heat absorption surface. The structure of this liquid absorbing cartridge of heat pipe can be groove, gauze, fiber bundle plus spring, sintered metal powders or their combination or other effective structure.

Auxiliary fluid passage with inlet and outlet can be built in the thin-wall fluid passage for heat carrier of heat pipe or in the heat absorption chamber of heat absorption end or the corrugated curved thin-wall shell or in the thin-wall fluid passage for heat carrier or in the heat absorption chamber of heat absorption end or the corrugated curved thin-wall shell. The fluid passage either covers corrugated fin-shaped curved surface of thin-wall fluid passage or covers the corresponding part of the end cover of enclosed tubular thin-wall fluid passage.

When this heat pipe is used for heat elimination of the plane or curved surface heat sources such as computer CPU, large power electrical and electronic elements and components, the heat absorption end of the above-mentioned heat pipe is vertical to an end surface of the axial line of the heat pipe or some part of the end surface, it can be flat and
straight plane or a curved surface inlaid on the surface of heat source. The shaped surface of its heat absorption end corresponds, tallies and closely matches with the shaped surface of heat source and can be smooth, flat and straight; smooth and raised; smooth and sunken; it can be made according to the outline curved shape of contact heat source and can be inlaid and covered and closely matched. It is placed above the heat source. The heat transfer medium is distributed somewhere in enclosed vacuum chamber closest to the heat absorption surface. When it is placed outside enclosed vacuum chamber as thin-wall fluid passage at the heat elimination end, the structure of thin-wall fluid passage is corrugated curved shape, it can be parallel and upright fin-shaped, same radius bended fin shaped, radial and upright fin shaped, radial and bended fin shaped, evenly and unevenly distributed column, mirrored shape of evenly and unevenly distributed column and base shell, inversed U shaped and their combination, etc. It can be any regular or irregular corrugated curved shape. The inner and outer surface of curved shape can be equipped with fins for auxiliary heat elimination. When placed inside the enclosed vacuum chamber as thin-wall fluid passage at the heat elimination end, the structure of the thin-wall fluid passage is of enclosed and tubular shape, the cold fluid inlet and outlet ends of thin-wall fluid passage either run through both ends of the enclosed vacuum chamber or run through the neighboring ends of the enclosed vacuum chamber. The cross section of thin-wall fluid passage can be circular, rectangular, polygon or other geometric shape. The inner wall of fluid passage section can be fixed with fins. The cooling fluid for heat elimination can be air or other cold fluid such as water.

This heat pipe is used for heat elimination of cooling roll made of thin strap of fast solidifying metal. When used for heat elimination of revolving heat source or turning shaft such as engine rotor and vane rotor of turbine, the cross section outline of the shell covering enclosed chamber is circular and the outline of its vertical section can be rectangular, drum-shaped or other revolving shape that meets the requirement of heat source; one group or more than one groups of enclosed tubular thin-wall fluid passages or one group of enclosed corrugated curved surfaces, which are coaxial with heat pipe and distributed on the basis of circumference and placed in the enclosed chamber and run through shell and the two facing ends that are vertical to the axial line of heat absorption surface. Auxiliary fluid passages connected with the thin-wall fluid passage are placed on the two corresponding ends of shell that are vertical to the axial line of the heat absorption surface, and these auxiliary fluid passages have their own cold fluid inlet and outlet. When liquid medium is used, the inner surface of the heat absorption end of the round shell of the above-mentioned integrated heat pipe can have such effective liquid absorbing cartridge as groove or sintered metal powder. The outer surface of the heat absorption end of the round shell is heat absorption end surface.

When this heat pipe is used to crystallize continuous ingot casting in metallurgical Industry and the heat elimination for fast solidifying metal equipment, the heat absorption chamber of heat absorption end of heat pipe runs through the two corresponding ends of shell and are placed in the middle of heat pipe, and the inner surface of the cross section of its heat absorption chamber can be circular, rectangular, polygon, dentiform or other geometric shape. As cold fluid passage at the heat elimination end of heat pipe, it can be corrugated radial and upright fin shaped curved surface that is distributed parallel or vertical to the axial line of heat absorption chamber, radial and bended fin shaped curved surface or the shaped surface of enclosed tubular thin-wall fluid passage that is distributed parallel to the axial line of heat.
absorption chamber and runs through the corresponding two ends of shell. The cross section of enclosed tubular thin-wall fluid passage can be circular, rectangular, polygon, dentiform or other geometric shape. When liquid medium is used, the cross section of the heat absorption end of above-mentioned integrated heat pipe and the outer surface connected with the vacuum chamber can have groove or liquid absorbing cartridge or sintered metal powder or other effective liquid absorbing structure. A liquid medium accumulation basin is placed at the base of liquid absorbing cartridge. It is vertical to the enclosed chamber of the integrated heat pipe formed by the end cover of heat absorption chamber, heat absorption chamber and thin-wall fluid passage. There is an auxiliary fluid passage with cooling water inlet and outlet, which either covers the thin-wall fluid passage of corrugated fin shaped curved surface or covers the corresponding part of the end cover of enclosed tubular thin-wall fluid passage.

When this heat pipe is used for heat elimination of plasma welding cutting torch, plasma spray coating nozzle, nozzle of electron beam welding torch and nozzle of large power arc welding torch, the heat absorption chamber at the heat elimination end of heat pipe runs through the corresponding two ends of shell and are placed in the middle of heat pipe, and the inner surface of the cross section of heat absorption chamber can be circular or other suitable geometric shape, and the outline surface of its vertical section can be rectangular, inverted cone-shaped or other revolving shape surface that meets the requirement of heat source; as cold fluid passage at the heat elimination end of heat pipe, it can be corrugated, radial and upright fin shaped curved surface, radial and bended fin shaped curved surface, dentiform distributed along inverted cone-shaped revolver, other evenly and unevenly distributed corrugated curved surface thin-wall fluid passage, which are parallel to the axial line of heat absorption chamber, the outline surface of its vertical section is rectangular, inverted cone-shaped or other revolving shape surface. Shell structure covering its outline can be placed outside the corrugated thin-wall fluid passage, constituting the auxiliary fluid passage to quicken the flow of cold fluid. When liquid medium is used in the above-mentioned heat pipe, the surface of its heat absorption chamber that is connected with enclosed vacuum chamber has groove or liquid absorbing cartridge or sintered metal powder or other effective liquid absorbing cartridge structure.

When this heat pipe is used for heat elimination of cold mould made of fast solidifying metal block, there is one group of heat absorbing cavities in the middle of enclosed chamber, which runs through the two opposite ends of shell. The cross section of its heat absorption chamber can be circular, rectangular, polygon, dentiform or other geometric shape with a slope for mould pulling. Heat containing structures of fine thermal conductivity, large thermal capacity and large surface area are used as heat carriers of the heat elimination end of heat pipe and placed outside the enclosed chamber or inside it or outside and inside it, and the structure of thermal container can be film-shaped or flake-shaped or tubular or silk-shaped materials of large surface area or their combination in curled or stacked form, or thin-wall covered or in their combined form. There is a distance between layers enough for full heat transfer by heat transfer medium; the opening between layers faces the heat transfer medium of heat absorption end. When liquid medium is used in the said integrated heat pipe, the cross section of its heat absorption chamber that is connected with vacuum chamber can have groove or liquid absorbing cartridge or sintered metal powder or other effective liquid absorbing cartridge structures.
When this heat pipe is used for heat elimination of cold mould made of fast solidifying metal block, a heat absorption end of heat pipe and another high thermal conductivity metal made template can be made opposite each other with a high thermal conductivity metal template placed between them. The template is hollow and has metal fluid casting channel and gas releasing channel in it. The heat absorption ends of heat pipe and the template surround the hollow part and turn it into a heat absorption chamber. Heat containing structures of fine thermal conductivity, large thermal capacity and large surface area are used as heat carriers of the heat elimination end of heat pipe and placed outside the enclosed chamber or inside it or outside and inside it, the structure of thermal container can be film-shaped or flake-shaped or tubular or silk-shaped materials of large surface area or their combination in curled or stacked form; the structure of its heat container can be bee-hive shaped, floccular, hemp-like, film or sheet formed in spirals or stacked, thin-wall tube covered or their combined form. There is a distance between layers enough for full heat transfer by heat transfer medium; the opening between layers faces the heat transfer medium of heat absorption end. When liquid medium is used in the said integrated heat pipe, the corresponding wall surface of heat absorption end in enclosed vacuum chamber can have liquid absorbing cartridge structures such as groove or sintered metal powder or other effective liquid absorbing cartridge structures.

When this heat pipe is used as heat exchanger between two kinds of fluid media, several groups of heat absorbing cavities as the heat absorption end of heat pipe run through the two opposite ends of shell and are placed in the middle of heat pipe. The cross section of its heat absorption chamber can be circular, rectangular, polygon, dentiform or other geometric shape and their combination. The thin-wall fluid passage structure at the heat elimination end of heat pipe can be corrugated, radial and upright fin shaped or radial and bended fin shaped curved shape, placed outside enclosed chamber and parallel to the axial line of heat absorption chamber. When liquid medium is used in the integrated heat pipe, the surface of the heat absorption chamber connected with vacuum chamber can has such liquid absorbing cartridge structures as groove or sintered metal powder or other effective liquid absorbing cartridge structure. A liquid medium accumulation basin can be placed under the liquid absorbing cartridge. Heat absorption chamber, the corrugated thin-wall fluid passage placed outside enclosed chamber and the end cover of shell vertical to the heat absorption chamber together form the enclosed chamber of heat pipe. The auxiliary hot fluid passage that covers the two ends of the end cover of shell and has hot (and cold) fluid inlet and outlet and the auxiliary cold fluid passage that covers the corrugated thin-wall fluid passage outside enclosed chamber and has cold (and hot) fluid inlet and outlet and the heat pipe together constitute the integrated heat pipe heat exchanger for heat exchange between two fluid media.

A method includes obtaining large heat elimination area in a small volume with an integrated heat pipe of a complicated shape surface and radial structure mainly for contact heat source and fluid medium heat source.

This method is designed to obtain a compact space by taking advantage of the corrugated thin-wall fluid passage placed outside enclosed chamber or inside it or outside and inside it or the enclosed tubular thin-wall fluid passage or thermal container of fine thermal conductivity, large thermal capacity and large surface area or the heat carrier of any of their combination; and to obtain larger heat elimination area by taking advantage of the corrugated
A method for setting the structure of the heat absorption end of integrated heat pipe, including distribution of heat transfer medium somewhere in the enclosed chamber closest to the heat absorption surface. When a liquid medium is used, a liquid absorbing cartridge structure of heat pipe can be placed some where in the enclosed chamber closest to the heat-absorbing surface.

According to this method, when the heat absorption end of heat pipe is an end surface or part of the end surface vertical to the axial line of heat pipe, the shaped surface of its heat absorption end can be so made as to correspond, tally and closely match with the outline surface of heat source. It can be made smooth, flat and straight; smooth and raised; smooth and sunken; it can be made according to the outline curved surface of contact heat source, or inlaid and covered and fully and closely matched.

This method is so designed that when the heat absorption end of heat pipe is one or more than one groups of heat absorption cavities that run through shell and enclosed chamber, the heat absorption chamber structure can be that running through the two opposite ends of shell, or that running through two neighboring ends of shell or that running through the same end of shell. The cross section of its heat absorption chamber can be circular, rectangular, polygon, dentiform or other geometric shape. The vertical section of its heat absorption chamber can be of a slope.

This method includes that the heat absorption end of heat pipe is so made that the outline surface of its cross section is circular and covers the revolving shell of enclosed chamber. The outline surface of its vertical section is rectangular, drum-shaped or other revolving shape that meets the requirement of heat source.

This method includes that the heat absorption end of heat pipe can be so made that the outline surface of its cross section is enclosed corrugated thin-wall curved surface that is based on circular or other geometric shape and covers enclosed chamber, they can be more than three groups of evenly distributed or unevenly distributed, contour or non-contour fin-shaped curved surfaces, which can be radial and upright fin shaped, radial and bended fin-shaped or other suitable curved surface and their combination. The vertical section of its basic outline surface is rectangular, drum-shaped or other revolving shape surface that meets the requirement of heat source.

This method includes that a hollow high thermal conductivity metal template that has hot melt pouring channel and gas releasing channel and is placed between the heat absorption end of heat pipe and another high thermal conductivity metal template, can also obtain the heat absorption chamber of integrated heat pipe and the high thermal conductivity metal template that is made hollow in the center and has hot melt pouring channel and gas releasing channel and placed between the heat absorption end surfaces of two heat pipes, or the heat absorption chamber of integrated heat pipe and the heat absorption end surface of several heat pipes form heat absorption chamber together.

A heat exchange method with integrated heat pipe. This method uses the contact heat source on the surface of the heat absorption end of heat pipe shell to absorb heat and transfer heat to the same heat transfer medium in the same enclosed chamber via the wall surface of the heat absorption end of shell to enable the heat transfer medium to absorb heat or to absorb the heat absorbed in fast dispersion of vaporization, and use the heat carrier
placed outside enclosed chamber or inside it or outside and inside it as heat elimination end, and the heat absorbed by heat transfer medium is contained or transferred; this method uses the low temperature fluid in the thin-wall fluid passage placed outside enclosed chamber or inside it or outside and inside it to transfer the heat absorbed by heat transfer medium. This method uses the thermal container placed outside enclosed chamber or inside it or outside and inside it to hold the heat absorbed by heat transfer medium. This method uses the heat transfer medium of heat pipe placed somewhere in enclosed chamber closest to the heat absorption surface and uses heat transfer medium to carry away heat to the place where heat carrier is closest to the heat elimination surface to reduce thermal resistance, improve heat transfer conditions and increase thermal conductivity.

A liquid medium involving method of heat exchange with rotating integrated heat pipe. When the hot pipe is turning at a high speed, this method uses the shell of circular cross section of heat pipe as heat absorption end surface, which absorbs heat while turning at a high speed, and transfers heat via the wall surface of heat absorption end of shell to the same heat medium in the same enclosed chamber that is swung on the surface of inner wall of heat absorption end. The heat transfer medium absorbs heat and vaporizes quickly, and the enclosed chamber is filled with saturated steam, which is quickly condensed on the surface of thin-wall fluid passage as soon as it meets the low temperature fluid. The hidden vaporization heat carried over is released and the thin-wall fluid passage transfers the hidden vaporization heat to the cold fluid outside the enclosed chamber of thin-wall fluid passage, and the heat absorbed by heat pipe is carried away by cold fluid ultimately. The mass of the liquid medium condensed on the surface of thin-wall fluid passage increases quickly under the centrifugal force and the liquid medium is swung on the surface of the inner wall of heat absorption end again thus starting a new round of heat transfer process, which repeats again and again. This method is of a large heat elimination area, and by taking advantage of phase change an even heat transfer can be carried out at the same temperature throughout the whole heat elimination area. The centrifugal force of the turning heat pipe ensures that the liquid medium flows towards the heat absorption end and the interface thermal resistance in the course of phase change heat transfer can be reduced by a biggest margin so that an optimum heat transfer effect is obtained.

When heat pipe is turning at a lower speed, this method uses the shell of circular cross section of heat pipe as heat absorption end surface, which contacts the heat source at a low turning speed to absorb heat, which is transferred to the same heat transfer medium in the same enclosed chamber that is adhered on the inner wall surface of heat absorption end under the adhesive action of liquid medium and is in the liquid absorbing cartridge. The heat transfer medium absorbs heat and vaporizes quickly, and the saturated steam filling the enclosed chamber condenses quickly on the surface of thin-wall fluid passage as soon as it meets the low temperature fluid in the thin-wall passage, and the hidden vaporization heat carried over is released, and the thin-wall fluid passage transfers the hidden vaporization heat to the cold fluid outside the enclosed chamber of thin-wall fluid passage, and the heat absorbed by heat pipe is ultimately carried away by the cold fluid. The mass of the liquid medium condensed on the surface of thin-wall fluid passage increases quickly under the weight action, and it then returns to the lowest part of the enclosed chamber of heat pipe. The liquid medium enters the liquid absorbing cartridge of heat pipe under the action of
capillary force of liquid absorbing cartridge of heat pipe, and is back again to the position in contact with heat source, thus starting a new round of heat transfer process, which repeats again and again. This method is of large heat elimination area and uses phase change to carry out even heat transfer at the same temperature throughout the heat transfer area, and the capillary force of the liquid absorbing cartridge of heat pipe and the adhesive force of the heat pipe medium ensure that liquid medium flows toward the heat absorption end and ideal heat transfer effect can be obtained similarly.

This invention is further illustrated with the aid of attached figure of instruction manual and Application examples.

**Application Example 1**

As shown in Fig. 1, Application Example 1 is a kind of heat pipe applicable to integrated heat pipe coolers with an in-line finned structure for cooling CPU of computers, express cards, high-power power electronic components.

It is a kind of integrated heat pipe composed of a shell 1-1 with an enclosed chamber 1-2, featuring a heat carrier on the outer side of the enclosed vacuum chamber; the heat carrier 1-4 has a thin-wall fluid passage 1-4a with radial in-line distribution of 12 long fins and 12 fins matching with the axis of the heat pipe, the inner side of each group of long fin and short fin is the internal chamber of the heat carrier 1-4, and is connected with the vacuum chamber 1-2 and the extension to the vacuum chamber 1-2; the outer side of each long fin and short fin is cooling surface of the fluid passage 1-4a of the heat carrier 1-4, which contacts with the cool fluid; each group of the heat carrier shares an enclosed chamber 1-2 and the heat transfer medium 1-3 in the vacuum chamber; each group of heat carrier 1-4 is independent while connected with each other; the wall of the enclosed chamber and the wall of the corrugated thin-wall of the fluid passage combined constitute the shell of the integrated heat pipe; the enclosed vacuum chamber is vacuumed and filled in heat transfer medium 1-3; in order to guarantee normal heat transfer in an inclining state, when applying phase change heat transfer fluids, the interior of the enclosed chamber 1-2 is embedded with the liquid absorption cartridge 1-5.

The corrugate thin-wall fluid passage 1-4a can be of other cambered structures, such as isometric curved finned structure, radial curved finned structure etc. Between two bordering corrugated finned thin-wall fluid passage 1-4a, several fins with their wall closely contacting can be fabricated to increase cooling area of the heat pipe.

One part of the shell 1-1 is made into a plain heat absorption end matching with the plane of the heat source and placed on the top of the heat source to take in heat. The shell transfers the heat to the heat transfer medium 1-3 in the vacuum chamber 1-2, the heat transfer medium absorbs the heat or evaporates to rapidly dispel the heat, and then the heat is transferred to the fluid passage 1-4a through the corrugated wall with long fins and short fins and finally taken away by the cool fluid. Since the cooling area is increased and the heat transfer medium 1-3 is placed in a position that is nearest to the heat source, and by taking the advantages of phase change of fluid and the super heat transfer process of heat efficient heat transfer substances, the whole cooling surface has an even distribution of temperature and every unit cooling area can exert its function to the utmost extent, which is unrivalled by any
other coolers with similar structure.

Application Example 2

As shown in Fig. 2, Application Example 2 is a kind of integrated heat pipe applicable to integrated heat pipe coolers with an in-line finned structure for cooling CPU of computers, or high-power power electronic components.

It is a kind of integrated heat pipe composed of a shell 2-1 with an enclosed chamber 2-2 that is vacuumed to fill in a heat transfer medium 2-3. It features a heat carrier 2-4 on the outer side of the vacuum chamber 2-2; The heat carrier 2-4 has a fluid passage 2-4a structure with parallel array of 13 groups of finned thin-wall fluid passage 2-4a from heat-in of the shell to its opposite end; the internal side of each group of finned thin-wall fluid passage 2-4a is the inner chamber of the heat carrier and is connected with the enclosed vacuum chamber 2-2 and an extension to the enclosed vacuum chamber 2-2; the outer side of each group of finned thin wall fluid passage 2-4a is the cooling surface of the heat carrier 2-4, which contacts with the cool fluid; each group of heat carrier shares the same enclosed vacuum chamber 2-2 and the heat transfer medium 2-3 in the chamber, and each group of heat carrier 2-4 is both independent and connected with each other; the wall surface of the enclosed vacuum chamber 2-2 and wall surface of the finned thin-wall fluid passage 2-4a combined constitute the shell 2-1 of the integrated heat pipe; the enclosed vacuum chamber 2-2 is vacuumed and filled in the heat transfer medium 2-3; in order to guarantee normal heat transfer in an inclining state, when applying phase change heat transfer fluids, the interior of the enclosed chamber 2-2 is embedded with the liquid absorption cartridge 2-5.

The corrugated thin-wall fluid passage 2-4a can be of other cambered structures, such as isometric curved finned structure, radial curved finned structure etc. Between two bordering finned thin-wall fluid passage 2-4a, several fins with their wall closely contacting can be fabricated to increase cooling area of the heat pipe.

One part of the shell 2-1 is made into a plain heat absorption end matching with the plane of the heat source and placed on the top of the heat source to take in heat. The shell transfers the heat to the heat transfer medium 2-3 in the vacuum chamber 2-2, which absorbs the heat or evaporates to rapidly dispel the heat, and then the heat is transferred to the fluid passage 2-4a through the finned thin wall and finally taken away by the cool fluid. Since the cooling area is increased and the heat transfer medium 2-3 is placed in a position that is nearest to the heat source, and by taking the advantages of phase change of fluid and the super heat transfer process of heat efficient heat transfer substances, the whole cooling surface has an even distribution of temperature and every unit cooling area can exert its function to an utmost extent, which is unrivaled by any other coolers with similar structure.

Application Example 3

As shown in Fig. 3, Application Example 3 is a kind of heat pipe applicable to integrated heat pipe coolers with a thin-wall rectangle pipe structure for cooling CPU of computers, or high-power power electronic components.

It is a kind of integrated heat pipe composed of a shell 3-1 with an enclosed chamber

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that is vacuumed to fill in a heat transfer medium 3-3. It features 11 groups of heat carrier 3-4 in the inner side of the enclosed vacuum chamber 3-2 that is enclosed by the rectangle shell, and the left and right end plates 3-6 of the shell; the heat carrier is a fluid passage 3-4a structure composed of thin-wall pipes with a rectangle cross section and runs through both ends of the end plates 3-6 of the shell; the outer wall of each thin-wall pipe with rectangle cross section constitutes the inner chamber of the heat carrier 3-4 and is connected with the enclosed vacuum chamber 3-2 and inside the enclosed vacuum chamber 3-2; the inner wall of each rectangle thin wall pipe is the cooling surface of the fluid passage 3-4a of the heat carrier, which contacts with the cool fluid; each group of heat carrier shares the same enclosed vacuum chamber 3-2 and the heat transfer medium 3-3 in the chamber, and each group of heat carrier 3-4 is both independent and connected with each other; the enclosed vacuum chamber 3-2 is vacuumed and filled in the heat transfer medium 3-3; in order to guarantee normal heat transfer in an inclining state, when applying phase change heat transfer fluids, the interior of the enclosed chamber 3-2 is embedded with the liquid absorption cartridge 3-5.

In the inner wall of thin-wall pipe with rectangle cross-section, several fins with their wall closely contacting can be fabricated to increase the cooling area of the heat pipe.

The cross section of the thin-wall fluid passage can be of other shapes, such as round shape, polygonal shape, dentiform shape or other geometric shapes.

At least one plane of the shell 3-1 embedded with the liquid absorption cartridge 3-5 should be made into a plain heat absorption end matching the plane of the heat source and placed on the top of the heat source to take in heat. The shell transfers the heat to the heat transfer medium 3-3 in the enclosed vacuum chamber 3-2, the heat transfer medium takes in the heat or rapid evaporate to dispel the heat, and the heat is transferred to the cool fluid in the fluid passage 3-4a through the thin-wall of the pipes with rectangle cross section and finally taken away by the cool fluid. Since the cooling area is increased and the heat transfer medium 3-3 is placed in a position that is nearest to the heat source, and by taking the advantages of phase change of fluid and the super heat transfer process of heat efficient heat transfer substances, the whole cooling surface has an even distribution of temperature and every unit cooling area can exert its function to an utmost extent, which is unrivalled by any other coolers with similar structure.

Application Example 4

As shown in Fig. 4, Application Example 4 is a kind of integrated heat pipe applicable to integrated heat pipe coolers with a mirror image structure including a cylinder shell with even distribution of 9 pipes and a base for cooling CPU of computers, or high-power power electronic components.

It is a kind of integrated heat pipe composed of a shell 4-1 with an enclosed chamber 4-2 that is vacuumed to fill in a heat transfer medium 4-3. It features 9 groups of cylinder heat carrier 4-4 in the outer side of the enclosed vacuum chamber 4-2. The heat absorption end of the shell 4-1 is a thin-wall structure made of hollow rectangle plate and its opposite end has the mirror image, which enables the connection of inner chamber of the fluid passage 4-4 of the 9 groups of cylinder thin-wall pipes and connection of the enclosed vacuum chamber; the internal surface of each group of heat carrier is the inner chamber of the heat carrier 4-4, and
is connected with the enclosed vacuum chamber 4-2 and is the extension to the enclosed vacuum chamber 4-2; the outer surface of each group of heat carrier is the cooling surface of the fluid passage 4-4a of the heat carrier 4-4, which contacts with the cool fluid. In order to further increase cooling area of the heat carrier 4-4, 12 groups of sinks 4-11 parallel to the hollow thin-wall rectangle plates are fabricated between the hollow thin-wall rectangle plates and they run through the cylinder pipes; each group of heat carrier shares the same enclosed vacuum chamber 4-2 and the heat transfer medium 4-3 in the chamber, and each group of heat carrier 4-4 is both independent and connected with each other; the enclosed vacuum chamber 4-2 is vacuumed and filled in the heat transfer medium 4-3; in order to guarantee normal heat transfer in an inclining state, when applying phase change heat transfer fluids, the interior of the enclosed chamber 4-2 is embedded with the liquid absorption cartridge 4-5.

At least one part of the shell 4-1 should be made into a plain heat absorption end matching the plane of the heat source and placed on the top of the heat source to take in heat. The shell transfers the heat to the heat transfer medium of the 4-3 in the enclosed vacuum chamber 4-2, the heat transfer medium takes in the heat or rapid evaporate to dispel the heat, and the heat is transferred to the cool fluid in the fluid passage 4-4a through the thin-wall of the cylinder pipes and finally taken away by the cool fluid. Since the cooling area is increased and the heat transfer medium 3-3 is placed in a position that is nearest to the heat source, and by taking the advantages of phase change of fluid and the super heat transfer process of heat efficient heat transfer substances, the whole cooling surface has an even distribution of temperature and every unit cooling area can exert its function to an utmost extent.

Application Example 5

As shown in Fig. 5, Application Example 5 is a kind of integrated heat pipe applicable to crystallize for continuous ingot casting systems with continuous casting and rolling process in the metallurgy industry.

It is a kind of integrated heat pipe composed of a shell 5-1 with an enclosed chamber 5-2 that is vacuumed to fill in a heat transfer medium 5-3. It features an heat carrier 5-4 inside the enclosed chamber 5-2 enclosed by the cylinder shell 5-1 (or other geometric shapes), and the end plates 5-3 of the shell; the heat absorption chamber 5-1a in the shell 5-1 is designed to serve as the heat absorption end which is closely incorporated with the graphite sleeve 5-12; the central hole in the graphite sleeve 5-12 is the passage for melting metal with the 5-15 as the inlet of casting liquid and 5-16 as the outlet of casting ingots; the entrance 5-13 for lubricant oil is fabricated between the heat absorption chamber 5-1a and the graphite sleeve; the heat carrier 5-4 is composed of 80 groups of thin-wall pipes with round cross section which run through both ends of the end plates 5-6; the outer wall surface of each pipe is the inner chamber of the heat carrier 5-4 and is connected with the enclosed vacuum chamber and placed inside the enclosed vacuum chamber; the inner wall surface of each pipe is the cooling surface of the fluid passage 5-4a of each heat carrier, which contact with the cool fluid; each group of heat carrier shares the same enclosed vacuum chamber 5-2 and the heat transfer medium 5-3 in the chamber, and each group of heat carrier 5-4 is both independent and connected with each other; the enclosed vacuum chamber 4-2 is vacuumed and filled in the
heat transfer medium 5-3; in order to guarantee normal heat transfer of the heat absorption chamber 5-1a which serves as the heat absorption end, when applying phase change heat transfer fluids, the inner wall of the heat absorption chamber 5-1a in the enclosed vacuum chamber 5-2 is embedded with the liquid absorption cartridge 5-5.

When working, the heat absorption chamber 5-1a which runs through the end plates at both ends of the shell 5-1 serves as the heat absorption end and contacts with the graphite sleeve 5-12 to take in the heat from the heat source, and the heat is transferred to the heat transfer medium 5-3, which absorbs the heat or evaporates to dispel the heat, and the heat is transferred to the cool fluid in fluid passage 5-4a through the thin wall pipes with round cross section and finally taken away by the cool fluid, which enable the hot fluid that contacts with the graphite sleeve to rapidly freeze to molding.

The cross section of the fluid passage 5-4a can also be of other geometric shapes, such as rectangle shape, polygon shape, dentiform shape etc.

An auxiliary fluid passage 5-8 is built between the upper surface and lower surface of the shell 5-1 and is connected with the abovementioned fluid passage 5-4a, and it is equipped with an entrance 5-9;

The heat absorption chamber 5-1a can be of other geometric shapes, such as such as rectangle shape, polygon, dentiform shape etc. 5-14 is the orifice of spraying cool water for cooling casting ingots.

**Application Example 6**

As shown in Fig. 6, Application Example 6 is a kind of heat pipe applicable to integrated heat pipe cold modules for producing bulk metal materials in a rapid solidification process. No other cooling sources or additional assistant cooling device is required for this integrated heat pipe. It can be used singly or by connecting up two pieces together.

It is a kind of integrated heat pipe composed of a shell 6-1 with an enclosed chamber 6-2 in which a heat transfer medium 6-3 is filled. Its features is that the heat absorption end 6-1a of the shell that is vertical to the axis of the heat pipe is built on the outer side of the enclosed chamber 6-2, and is a plane of the heat pipe; the heat carrier 6-4 is built in the enclosed vacuum chamber 6-2 which is enclosed by the shell 6-1 of the heat container integrated heat pipe; the heat carrier 6-4 is a heat container 6-4a made metal materials with high heat conducting coefficient and large heat capacity, and it has large enough surface area to absorb and store heat (the heat container 6-4b is actually the hidden heat elimination end built inside the integrated heat pipe); the heat container 6-4b is made of one group of spiral curled foil of red copper with large surface area; each layer has enough space for the heat transfer medium 6-3 to transfer heat; the aperture between layers is set up to face the heat absorption end; the enclosed vacuum chamber 6-2 is vacuumed and filled with heat transfer medium 6-3. The shell 6-1 and its heat absorption end 6-1a enclose the heat container 6-4b within the enclosed chamber 6-2 which is vacuumed and filled with some heat transfer medium6-3 to form an integrated heat pipe with a heat container.

The structure of the heat container 6-4b can be made metal foil, sheet, filament, wire in honeycomb shape, flocculent, gunny fiber like, film, or spiral curled flake or lapped layers, thin-wall pipe in set or even the combination of these forms.

Part of the shell 6-1 serves as the heat-in plane. In order to ensure that the heat is
transferred normally in the heat-in plane of the heat pipe, the outer rim of the enclosed vacuum chamber 6-2 and the inner wall surface of the heat-in plane should be embedded with the liquid absorption cartridge 6-5 when phase change of the heat transfer medium is used to transfer heat.

Single heat pipe or double heat pipes or even multiple heat pipes integration may be used in this invention.

When the heat pipe is used singly, a template made of materials with high heat conducting coefficient, such as red copper, should be set between the heat absorption end of the heat pipe and another end made of materials with high heat conducting coefficient, such as red copper, and the heat absorption end, the end plate and the template should be pieced together with bolts. On the middle of template, a hole is engraved and a passage for melting metal and an exhaustion passage are set aside, and the heat absorption end, the end plate and the template are engraved to form a heat chamber 6-1a. When melting metal alloy for casting is pouring into the heat chamber 6-1a, heat can be swiftly transferred from the heat absorption end 6-1a of the heat pipe to the heat transfer medium 6-3 in the enclosed vacuum chamber 6-2, where heat can be absorbed by the heat transfer medium or swiftly diffused by the evaporation of the heat transfer medium; and finally the heat transferred by liquid phase change or good heat-transferring material can be diffused and absorbed swiftly through each layer of spiral curled film or foil material with larger surface area. The melting alloy with instant release of solidification potential energy and critical heat energy keeps the metallic structures of liquid alloy molecule of short-range, chaos and disorder, and finally the instant solidification metal material of non-crystal, crystallite or quasi-crystal state, etc. is thus obtained.

Better heat transfer efficiency can be obtained by inserting the material with high heat conductivity coefficient (such as template made of red copper) that has an inlet for casting and an air vent between two heat pipes. Three or more heat pipes can be used as an integrated one.

**Application Example 7**

As shown in Fig. 7, Application Example 7 is a kind of heat pipe applicable to rotating integrated pipe-bundle heat pipe roller for producing metal strips through rapid solidification process.

It is a kind of integrated heat pipe composed of a shell 7-1 with an enclosed vacuum chamber 7-2 where the heat transfer medium 7-3 is filled. Its feature is that the heat absorption end of the shell 7-1 with round cross section and rectangle vertical section is at the outer side of the enclosed chamber; the heat carrier is set in the vacuum chamber 7-2 enclosed by the cylinder shell 7-1 and the end plates 7-6 of the shell; the heat carrier 7-4 is a thin-wall liquid passage 7-4a composed of 110 groups of thin-wall pipe with round section, and it runs through both ends of the end plates 7-6 of the shell; the outer surface of the wall of each thin-wall pipe is the inner chamber of the heat carrier 7-4 and is connected with and in side the enclosed vacuum chamber 7-2; each internal wall surface of the thin-wall pipe with round section is a liquid passage 7-4a of the heat carrier 7-4, and it is the heat dispersed surface of heat carrier 7-4 that contacts with the cold liquid; each group of heat carrier shares an enclosed vacuum chamber 7-2 and the heat transfer medium 7-3 inside the enclosed vacuum.
chamber 7-2; each group of heat carrier 7-4 is not only independent but also connected with each other; the closed chamber 7-2 is vacuumed and filled with heat transfer medium 7-3; in order to guarantee normal transfer of heat when the roller rotates at a low speed, the outer rim of the enclosed vacuum chamber 7-2 and the inner surface of the wall of the shell 7-1 should be embedded with the liquid absorption cartridge 7-5 when phase change of the heat transfer medium is used to transfer heat.

When it works, the outer surface of the rotary cylinder shell 7-1 that serves as the heat absorption end contacts with the heat sources and takes in heat, and then transfers the heat to the heat transfer medium 7-3 in the enclosed vacuum chamber 7-2, where the heat is absorbed by the heat transfer medium or swiftly diffused by the evaporation of the heat transfer medium, and then the heat can be conveyed to the cold liquid in the liquid passage 7-4a by each group of the round section thin-wall pipe, and finally the heat of the heat sources will be taken away by the cold liquid to make the hot metal liquid contacting with the surface of the cylinder shell 7-1 solidify swiftly.

The section of the liquid passage 7-4a may be of other shapes, such as rectangle shape, dentiform shape, etc.

An auxiliary fluid passage 7-8 is built at both ends of the shell and is connected with the abovementioned fluid passage 7-4a, and it is equipped with an entrance 7-9 for in exit and entrance of fluid. The shell 7-1 is mounted on the rotary axis, making this pipe bundle-melting roller a rotator.

The section of the heat absorption chamber 10-1a can be of other geometric shapes, such as round, rectangle, polygonal, dentiform shape, or the combination of these shapes.

The vertical section of the heat absorption end can be of an extended type, or other geometric shapes that suitable for turning.

The shape the thin-wall fluid passage 7-4a can also be of other geometric shapes, such as rectangle shape, polygonal shape, dentiform shape etc.

This invention will have specific heat transfer mechanism when liquid medium is used; their features are as follows:

a) The round section shell 7-1 of the heat pipe will serve as the surface of the heat absorption end to contact heat sources and absorb heat when it rotates at a high speed, it will transfer the heat absorbed through its wall surface of the heat absorption end of its shell to the heat transfer medium 7-3 in the same enclosed vacuum chamber 7-2 which is thrown onto the internal wall surface of the heat absorption end by the centrifugal force, where the heat is absorbed by the heat transfer medium 7-3 and the heat transfer medium 7-3 rapidly evaporates to dispel the heat; saturated water vapor fills the space of the enclosed vacuum chamber 7-2 and pass through the low temperature thin-wall liquid passage 7-4, and it condenses instantly on the surface of the thin-wall liquid passage 7-4, the carrying evaporating heat is released there, and then the heat is conveyed by the thin-wall liquid passage 7-4 to the cold liquid in the outer chamber 7-4a of the thin-wall liquid passage, and finally the heat absorbed by the heat pipe will be taken away by the cold liquid. As the condensed liquid medium on the surface of the thin-wall liquid passage accumulates, it is thrown again on to the internal wall surface of the heat absorption end under the centrifugal force and a new round heat transfer begins, and in this way, it repeats continuously. This method has large heat radiating surface, uses the phase change to realize even heat transfer under the isothermal surface conditions.
The centrifugal force of the heat pipe rotating ensures the liquid medium flow to the heat absorption end and reduce tremendously the heat stagnation at the interface during the heat transfer of the phase change, thus the best heat transfer effectiveness will be acquired.

b) The round section shell 7-1 will be served as the heat absorption end to contact heat sources and absorb heat when it rotates at low speed, it will transfer the heat absorbed through its wall surface of the heat absorption end of its shell to the heat transfer liquid medium 7-3 within the same enclosed vacuum chamber 7-2 which will adhere onto the internal wall surface of the heat pipe liquid absorption cartridge 7-5 by the cohesive force, there heat can be absorbed by the heat transfer medium 7-3 and rapid evaporate to dispel the heat. Saturated water vapor fills the space of the enclosed vacuum chamber 7-2 and pass through the low temperature thin-wall liquid passage 7-4, and it condenses instantly on the surface of the thin-wall liquid passage 7-4, the carrying evaporating heat is released there, and then the heat is conveyed by the thin-wall liquid passage 7-4 to the cold liquid outside the closed chamber 7-4a of the thin-wall liquid passage, and finally the heat of the heat pipe will be taken away by the cold liquid. As the condensed liquid medium on the surface of the thin-wall liquid passage accumulates, it returns again to the lowest position of the enclosed chamber 7-2 of the heat pipe under its own gravity, the liquid medium 7-3 will run into the heat pipe liquid absorption cartridge under the capillary force and it is brought again to the position where it can contact the heat sources, thus a new round heat transfer begins, and in this way, it repeats continuously. This method has large heat radiating surface, uses the phase change to realize even heat transfer under the isothermal surface conditions. The capillary force of the heat pipe liquid absorption cartridge and the adhesive force of the liquid medium of the heat pipe ensures the liquid medium flow to the heat absorption end, thus the best heat transfer effectiveness will be acquired.

Application Example 8

Fig. 8 illustrates an integrated heat pipe of this Application example 8, an internal tooth form chamber (or may be called the enclosed corrugated thin-wall configuration) rotating integrated heat pipe roller used for the preparation of instant metal thin strip and the metal strip of the continuous casting and rolling processes in metallurgical industry.

It is kind of integrated heat pipe which includes enclosed vacuum chamber 8-2 and the shell 7-1 filled with heat transfer medium 8-3 having the following features: the cross section of the heat absorption end 8-1 of the heat pipe shell is round and its vertical section is a rectangle, and the heat absorption end is set on the lateral side of the closed chamber 8-2; the heat carrier 8-4 is set inside the enclosed vacuum chamber 8-2 which is composed by cylindrical section shell 8-1 and the end plate of shell 8-6; heat carrier 8-4 is composed of 12 sets(or one set of 12 tooth-like internal dentiform shape chamber section thin-wall pipes) of the thin-wall liquid passage 8-4a which run through the both ends of the shell end plate 8-6; each tooth internal-wall side of the internal dentiform shape chamber section thin-wall pipe is an internal chamber of heat carrier 8-4 that is set inside the enclosed vacuum chamber 8-2 and communicates with each other; the outer wall surface of each internal dentiform shape chamber section is a liquid passage 8-4a of the heat carrier 8-4, and it is the heat dispersed surface of heat carrier 8-4 that contacts with the cold liquid; each group of heat carrier shares
a enclosed vacuum chamber 8-2 and the heat transfer medium 8-3 inside the enclosed vacuum chamber 8-2; each group of heat carrier 8-4 is not only independent but also communicates with each other; the enclosed vacuum chamber of 8-2 is vacuumed and filled with heat transfer medium 8-3; in order to guarantee heat transfer is normal when the roller rotates at a low speed, the outer rim of the enclosed vacuum chamber 8-2 should be enclosed and the liquid absorption cartridge 8-5 of the heat pipe should be set on the internal-wall of the shell 8-1 when liquid heat transfer medium is used as phase change material for heat transferring.

When it operates, the heat absorption end of lateral side surface of the rotating cylindrical shell 8-1 contacts heat sources and absorbs heat, and then transfers the heat to the heat transfer medium 8-3 within the same enclosed vacuum chamber 8-2 at the same time, and there heat can be absorbed by the heat transfer medium or swiftly diffused by the evaporation of the heat transfer medium, and then the heat can be conveyed to the cold liquid within the liquid passage 8-4a by each set of the round section thin-wall pipe, and finally the heat will be taken away by the cold liquid to make the hot liquid on the surface of the contacted round chamber 8-1 solidified swiftly.

Internal tooth-shape chamber section thin-wall pipe may constitute the section of the liquid passage 8-4a in a ragged way.

An assistant liquid passage 8-8, which has exit-entrance 8-9 for liquid, is set at the right and left end plates of the shell 8-1 that communicates the abovementioned liquid passage.

The chamber 8-1 will be installed on the rotating axis to make the pipe bundle melt rotating roller to be a rotating body.

The vertical section of the heat absorption end 8-1 of the heat pipe shell may have a drum type shape, or other geometric configurations that are suitable for rotating operation.

The section of the thin-wall liquid passage 8-4a may have other geometric configurations, such as rectangle, polygon, tooth form, etc.

This invention includes a specific heat transfer mechanism when liquid medium is used; its features are as follows:

a) The round section shell 8-1 of the heat pipe will be served as the heat absorbing-end to contact heat sources and absorb heat when it operates at a high speed rotating operation, it will transfer the heat absorbed through its wall surface of the heat absorption end of its shell to the heat transfer medium 8-3 within the same enclosed vacuum chamber 8-2 which is thrown onto the internal wall surface of the heat absorption end by the centrifugal force, there heat can be absorbed by the heat transfer medium 8-3 and swiftly diffused by the evaporation of the heat transfer medium 8-3. Saturated water vapor fills the space of the enclosed vacuum chamber 8-2 and pass through the low temperature thin-wall liquid passage 8-4, and it condenses instantly on the surface of the thin-wall liquid passage 8-4, the carrying evaporating heat is released there, and then the heat is conveyed by the thin-wall liquid passage 8-4 to the cold liquid outside the enclosed chamber 8-4a of the thin-wall liquid passage, and finally the heat absorbed by the heat pipe will be taken away by the cold liquid. As the condensed liquid medium on the surface of the thin-wall liquid passage accumulates, it is thrown again on to the internal wall surface of the heat absorption end under the centrifugal force and a new round heat transfer begins, and in this way, it repeats continuously. This method has large heat radiating surface, uses the phase change to realize even heat transfer
under the isothermal surface conditions. The centrifugal force of the heat pipe rotating ensures the liquid medium flow to the heat absorption end and reduce tremendously the heat stagnation at the interface during the heat transfer of the phase change, thus the best heat transfer effectiveness will be acquired.

b) The round section shell 8-1 will be served as the heat absorbing-end to contact heat sources and absorb heat when it operates at a low speed rotating operation, it will transfer the heat absorbed through its wall surface of the heat absorption end of its shell to the heat transfer liquid medium 8-3 within the same enclosed vacuum chamber 8-2 which will adhere onto the internal wall surface of the liquid absorption cartridge of heat pipe 8-5 by the cohesive force, there heat can be absorbed by the heat transfer medium 8-3 and swiftly diffused by the evaporation of the heat transfer medium 8-3; saturated water vapor fills the space of the enclosed vacuum chamber 8-2 and pass through the low temperature thin-wall liquid passage 8-4, and it condenses instantly on the surface of the thin-wall liquid passage 8-4, the carrying evaporating heat is released there, and then the heat is conveyed by the thin-wall liquid passage 8-4 to the cold liquid outside the enclosed chamber 8-4a of the thin-wall liquid passage, and finally the heat of the heat pipe will be taken away by the cold liquid. As the condensed liquid medium on the surface of the thin-wall liquid passage accumulates, it returns again to the lowest position of the enclosed shell 8-2 of the heat pipe under its own gravity, the liquid medium 8-3 will run into the liquid absorption cartridge 8-5 of the heat pipe under the capillary force and it is brought again to the position where it can contact the heat sources, thus a new round heat transfer begins, and in this way, it repeats continuously. This method has large heat radiating surface, uses the phase change to realize even heat transfer under the isothermal surface conditions. The capillary force of the liquid absorption cartridge of the heat pipe and the adhesive force of the liquid medium of the heat pipe ensures the liquid medium flow to the heat-absorbing end, thus the best heat transfer effectiveness will be acquired.

Application Example 9

As shown in Fig. 9, Application Example 9 is a kind of reversed cone nozzle with a radial in-line finned structure applicable to plasma welding and cutting nozzle.

It is a kind of integrated heat pipe composed of shell 9-1 with an closed chamber 9-2 filled in heat transfer medium 9-3, featuring a round heat absorbing chamber 9-1a that runs through the cross section of the shell is set at the heat-absorbing end of the shell 9-1, its vertical section is a reversed trapezoidal shape; the heat carrier 9-4 is set on the lateral side of the enclosed vacuum chamber 9-2; the heat carrier 9-4 has a thin-wall fluid passage 9-4a configuration with radial in-line distribution of 12 long fins and matching with the axis of the heat pipe, the inner side of each group of long fin is the internal chamber of the heat carrier 9-4, and is connected with the closed vacuum chamber 9-2 and the extension to the closed vacuum chamber 9-2; the outer side of each long fin is cooling surface of the fluid passage 9-4a of the heat carrier 9-4, which contacts with the cool fluid; each group of the heat carrier shares an enclosed chamber 9-2 and the heat transfer medium 9-3 in the closed vacuum chamber 9-2; each group of heat carrier 9-4 is both independent and connected with each other; the wall surface of the enclosed vacuum chamber 9-2 and wall surface of the fluid
passage 9-4a with a corrugated radial in-line finned thin-wall structure combined to constitute the shell 9-1 of the integrated heat pipe; the enclosed vacuum chamber 9-2 is vacuumed and filled in the heat transfer medium 9-3; when applying phase change heat transfer fluids, the inner wall of the heat absorption chamber 9-1a in the enclosed vacuum chamber 9-2 is embedded with the liquid absorption cartridge 9-5.

The cross section of the heat-absorbing chamber 9-1a of the shell 9-1 may have other shapes, such as rectangle, polygon, etc.

In order to speed up the cold air convection cooling, an outer shell 9-10 is nestled closely to the outer rim of the corrugated thin-wall liquid passage 9-4a.

The corrugated thin-wall liquid passage 9-4a may have other curved surface, such as radial bent fins, etc. To further expand the cooling surface of the heat pipe, some fins that closely contact with the passage walls are to be mounted between the corrugated fin thin-wall fluid passages 9-4a that are adjacent to each other.

Connecting screw thread that uses to connect with externally mounted equipments will be prepared on the shell 9-1.

The enclosed chamber 9-1a of the shell 9-1 transfers the absorbed heat by its wall surface to the heat transfer medium 9-3 in the closed vacuum chamber 9-2, the heat transfer medium absorbs the heat or evaporates to rapidly dispel the heat, and then the heat is transferred to the lateral side fluid passage 9-4a through the wall surface of the corrugated radial in-line finned thin-wall and finally taken away by the cool fluid. Since the cooling area is increased and the heat transfer medium 9-3 is placed in a position that is nearest to the heat source, and by taking the advantages of phase change of fluid and the super heat transfer process of heat efficient heat transfer substances, the whole cooling surface has an even distribution of temperature and every unit cooling area can exert its function to an utmost extent, which is unrivalled by any other nozzles with similar structure and nozzles with straight heat pipe structure.

Application Example 10

As shown in Fig. 10, Application Example 10 is a kind of complex section integrated heat pipe heat exchanger applicable to the heat exchange between two fluid mediums.

It is a kind of heat pipe composed of a shell 10-1 with an enclosed chamber 10-2 in which a heat transfer medium 10-3 is filled. It features a thin-wall heat absorption chamber 10-1a with heart-shape surface with radial distribution of 12 groups of round pipe along the axis of the heat pipe that is built on the heat absorption end of the shell and runs through the two end covers of the shell 11-1; the heat carrier 10-4 is set on the outer side of the enclosed vacuum chamber; the heat carrier 10-4 has a thin-wall fluid passage 10-4a structure with radial distribution of 48 long fins along the axis of the heat chamber 10-1a; the inner side of each fin is the internal chamber of the heat carrier 10-4, and is connected with the vacuum chamber 10-2 and the extension to the vacuum chamber 10-2; the outer side of each fin is cooling surface of the fluid passage 10-4a of the heat carrier 10-4, which contacts with the cool fluid; each group of the heat carrier shares an enclosed chamber 10-2 and the heat transfer medium 10-3 in the vacuum chamber; each group of heat carrier 10-4 is independent while connected with each other; the heat absorption chamber 10-1a of the shell, the thin-wall fluid passage 10-4a, and the two end covers of the shell 10-1 enclose to form the enclosed
chamber 10-2 and the shell of the heat pipe; the enclosed vacuum chamber 10-2 is vacuumed and filled in the heat transfer medium 10-3; when applying phase change of the heat transfer medium to realize heat transfer, the wall surface of the enclosed chamber corresponding to the heat-in camber 10-1a should be embedded with the liquid absorption cartridge 10-5; the middle part of the auxiliary fluid passage 10-11 which is wrapped in the two ends of the shell 10-1 contains the thin-wall fluid passage 10-4a. These parts and the heat pipe combined form integrated heat pipe heat exchanger with blended-shape plane.

When heat exchange, the hot fluid runs into the heat absorbing chamber 10-1a through the exit-entrance 10-10 and the assistant fluid passage 10-12 and then it is transferred by the wall surface to the heat transfer medium 10-3 in the closed vacuum chamber 10-2, the heat transfer medium absorbs the heat or evaporates to rapidly dispel the heat, and then the heat is transferred to the lateral side fluid passage 10-4a through each group corrugated radial in-line finned thin-wall and finally taken away by the cool fluid. Since the cooling area is increased and the heat transfer medium 10-3 is placed in a position that is nearest to the heat source, and by taking the advantages of phase change of fluid and the super heat transfer process of heat efficient heat transfer substances, the whole cooling surface has an even distribution of temperature and every unit cooling area can exert its function to an utmost extent, the heat exchange among the fluid within the small volume can be realized, and the heat transfer efficiency shall be raised accordingly.

After the impact of gravity is taken into consideration, this heat pipe cooler shall be used vertically or in a certain declining angle when fluid-working medium is employed.

The section of the heat-absorbing chamber 10-1a may have other geometric configurations, such as round, rectangle, polygonal, tooth form, or their combination shape.

The section of the thin-wall fluid passage 10-4a may be processed as other geometric configurations, such as radial bent finned shape or some combinations of round, rectangle, polygonal, tooth form, etc. thin-wall closed pipe fluid passage configurations that run through both end covers 10-1 of the shell correspondingly.

Application Example 11

As shown in Fig. 11, Application Example 1 is a kind of heat pipe applicable to integrated heat pipe rotors with blended shape plane for generators and motors.

It is a kind of integrated heat pipe composed of a shell 11-1 with an enclosed chamber 11-2 in which a heat transfer medium 11-3 is filled. Its feature is the outer round shell is the heat absorption end 11-6, three groups of radial, in-line, finned thin wall cambers 11-6a to take in heat, the heat absorption end is on the outer side of the enclosed vacuum chamber, the heat carrier 11-4 that runs through the two end covers of the shell is the thin-wall fluid passage 11-4a with radial distribution of 16 long fins matching with the axis of the heat pipe; the inner side of each fin is the internal chamber of the heat carrier 11-4, and is connected with the vacuum chamber 11-2 and the extension to the vacuum chamber 11-2; the outer side of each fin is cooling surface of the fluid passage 11-4a of the heat carrier 11-4, which contacts with the cool fluid; each group of the heat carrier shares an enclosed chamber 11-2 and the heat transfer medium 11-3 in the vacuum chamber; each group of heat carrier 11-4 is independent while connected with each other; the heat absorption end 11-6 of the shell, the thin-wall fluid passage 11-4a, and the two end covers of the shell 11-1 enclose to form the
enclosed chamber 11-2 and the shell of the heat pipe; the enclosed vacuum chamber 11-2 is vacuumed and filled in the heat transfer medium 11-3; when applying phase change of the heat transfer medium to realize heat transfer, the wall surface of the enclosed chamber corresponding to the heat-in chamber 11-6a composed of 3 groups of radial, in-line fins of the heat absorption end should be embedded with the liquid absorption cartridge 11-5; the axis of the rotor and the middle part of the auxiliary fluid passage 11-8 which is wrapped in the two ends of the shell 11-1 contains the thin-wall fluid passage 11-4a. These parts and the heat pipe combined form the body of the rotor with blended-shape plane.

The thin-wall heat-in chamber 11-6a with radial and in-line arrangement of fins can be set up according to the heat source of the rotor, the heat generated by the heat source of the rotor is transferred to the heat transfer medium 11-3 in the enclosed chamber 11-2 through the thin-wall heat-in chamber 11-6a with radial and in-line fins, the heat transfer medium 11-3 then take in the heat and evaporates to dispel the heat, and the heat is transferred to the cool fluid in the fluid passage 11-4a through each group of the finned thin-wall and finally taken away by the cool fluid. Since the cooling area is increased and the heat transfer medium 11-3 is placed in a position that is nearest to the heat source, and by taking the advantages of phase change of fluid and the super heat transfer process of heat efficient heat transfer substances, the whole cooling surface has an even distribution of temperature and the heat transfer effect is high, which is contributes to increasing the cooling effect and safety and reliability of the rotor.

The shape of the thin-wall fluid passage 11-4a can also be of other geometric shapes, such as radial curved finned shape etc., or enclosed thin-wall pipe fluid passage structure enclosed by several groups of pipes with round shape, rectangle shape, polygon shape, dentiform shape etc. that run through the two end covers of the shell 11-1.

**INDUSTRIAL APPLICATION**

This invention takes the advantages of diversity of design in heat absorption ends of the shell of heat pipe and placement of heat transfer medium in the enclosed chamber in a position that is nearest to the heat-in surface to reduce contact of heat source and heat resistance; set up of the heat carrier either on the outer side, inner side or outer and inner sides of the enclosed chamber to obtain the largest cooling surface area in the smallest volume; the super heat transfer ability of the heat transfer medium to carry heat to the near place of the heat carrier to the cooling end to increase heat transfer speed and ability. This invention is both applicable to contacting heat sources and fluid medium heat sources and offers such
advantages as low comprehensive heat resistance, large cooling area and high heat transfer speed etc.

This invention also has the advantages of a variety of applications in a number of engineering fields, including cooling for solids that contact with heat sources based on the principle of heat transfer, such as cooling of CPU and cards of computers and high-power power electronic components etc.; rotating heat source of rotating shafts such as cooling rollers for producing metal strips with rapid solidification process, rollers and casting wheels for continuous casting in metallurgy industry, motor rotors and turbine rotors etc.; crystallizing for continuous casting in metallurgy industry and producing metal wires with rapid solidification process; rotors in engines, motors and similar motorized mechanical rotors; producing bulk metal materials of non-crystal, crystallite or quasi-crystal state, etc. with a rapid solidification process in new type metal materials industry; plasma welding and cutting torches, plasma nozzles for spraying paints, nozzles of electron beam welding gun, nozzles of high-power arc welding gun etc.

The foregoing descriptions and Examples are included for illustrative purposes only, and are not intended to limit the scope of the invention. Other features and aspects and objects of the invention can be obtained from a review of the specification. It is to be understood that other embodiments of the invention can be developed and fall within the spirit and scope of the invention.

Each of the references cited above in this application is herein incorporated fully by references.

Throughout the description of this specification the word "comprise" and variations of that word, such as "comprises" and "comprising", are not intended to exclude other additives or components or integers.
THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. An integrated heat pipe, comprising:
   a shell body including a first portion to form a plurality of heat carriers and a
   second portion to form a heat absorption end, the plurality of heat
   carriers defining a plurality of chambers substantially isolated from each
   other, the plurality of chambers being connected to each other to form a
   sealed chamber;
   a heat transfer medium deposited inside the sealed chamber, the heat transfer
   medium being in a liquid form to absorb heat from the heat absorption
   end, the heat transfer medium releasing heat to the plurality of heat
   carriers after traveling in the sealed chamber from the heat absorption
   end to the plurality of chambers defined by the plurality of heat carriers,
   wherein the plurality of heat carriers are configured to share the sealed
   chamber and to share the heat transfer medium.

2. An integrated heat pipe, including a shell body defining an enclosed vacuum
   chamber having a heat transfer medium, characterized by: the shell body or a
   part of the shell body, configured as an heat absorption end, being:
   one or more groups of heat absorbing cavities running through the shell set in
   the enclosed chamber;
   an external shell wrapping the enclosed chamber, comprising a revolved
   structure wrapping the enclosed chamber or a revolved structure
   wrapping the enclosed chamber with a corrugated curving surface
   distributed on the revolved structure;
   an end surface or a portion of the end surface that is perpendicular to an axis
   of the heat pipe;
wherein an outside shape of the heat absorption end is configured to be corresponding and matching to a shape of heat source for tight fit, the outside shape having limited groups of corrugated curving surfaces, limited groups of closed tube shaped thin-wall fluid passage curving surfaces, or their combination;

wherein the heat transfer medium is arranged in the enclosed vacuum chamber at the heat absorbing end nearest to a heat absorbing surface.

3. An integrated heat pipe according to claim 1, further characterized by:

- the heat carriers being of a thin-wall fluid passage structure capable of dissipating heat using a cooling fluid or a heat container structure capable of absorbing heat; wherein when the heat carriers are of the heat container structure with good heat conduction, large heat capacity and big surface and is coupled to outside, inside, or outside and inside of the enclosed chamber, the heat container is made of folded or curled membrane, sheet, tube or thread shaped material with a big surface or their combination.

4. An integrated heat pipe according to claim 1, further characterized by:

- when the heat carriers are of the thin-wall fluid passage structure and is coupled to outside of the enclosed chamber, the thin-wall fluid passage structure being of the corrugated curving surface, the corrugated curving surface being distributed parallel, perpendicular or, parallel and perpendicular to the heat absorption end of the heat pipe;

wherein internal cavities of each group of the heat carriers are extensions of the enclosed chamber and each group of heat carriers is independent, an external shell of the enclosed chamber and an external shell of the thin-wall fluid passage to form the shell body; and

wherein outside of the curving surface is the passage of cooling fluid.
5. An integrated heat pipe according to claim 1, further characterized by:
the curving surface of the thin-wall fluid passage structure is an arbitrary
regular or irregular corrugated curving surfaces, parallel straight finlike,
equidistant curving finlike, radially straight finlike, and radially curving
finlike structure, evenly or not evenly distributed column, mirror image of
evenly or not evenly distributed column and base shell, down-U, or their
combination.

6. An integrated heat pipe according to claim 1, further characterized by:
when the heat carriers are of the thin-wall fluid passage structure and is
coupled to inside of the enclosed chamber, the thin-wall fluid passage
structure being of the closed tube shape;
wherein from a fluid entrance to a fluid exit of the fluid passage runs through
the enclosed chamber between two sides of the enclosed chamber, between adjacent sides of the enclosed chamber, or one side of the
enclosed chamber;
wherein inside of a cross-section of the thin-wall fluid passage is an passage
for a cooling fluid.

7. An integrated heat pipe according to claim 6, further characterized by:
a shape of the cross-section of the thin-wall fluid passage being of a round,
rectangle, polygon, gear, or other geometrical shape, or their
combination.

8. An integrated heat pipe according to claim 1, further characterized by:
when the heat carriers are of the heat container structure made of folded or
curled membrane, sheet, tube or thread shaped material with a big
surface or their combination, a distance between layers being enough to
ensure sufficient heat exchange for the heat transfer medium;
wherein openings between layers are arranged to face the heat transfer medium deposited in the heat absorption end.

9. An integrated heat pipe according to claim 8, further characterized by:
   the heat container structure being coiled or curled or layered from honeycomb, floccules or linen shaped membrane or sheet, or made from fitting thin-wall tubes one inside another, or their combination.

10. An integrated heat pipe according to claim 2, further characterized by:
   one or more groups of heat absorbing cavities running through the shell body between two opposite sides of the shell body, between adjacent sides of the shell body, or one side of the shell body;
   wherein a cross-section of the heat absorption cavities is of a round, rectangle, polygon, gear, or other geometrical shape.

11. An integrated heat pipe according to claim 2, further characterized by:
   a revolved structure wrapping the enclosed chamber at the heat absorption end of the heat pipe having a cross-section of a round outside shape, and a longitudinal section of a rectangle, drum, or other revolved shape to meet a requirement of a heat source.

12. An integrated heat pipe according to claim 2, further characterized by:
   an external shell of the corrugated curving surface distributed on the revolved structure to wrap the enclosed chamber at the heat absorption end having a cross section with more than three groups of evenly or symmetrically distributed finlike curved surfaces with equal or non-equal heights, the finlike curved surfaces being of a radially straight shape, a radially curved finlike shape, an other suitable curving surface shape, or their combination.
13. An integrated heat pipe according to claim 2, the heat absorbing end of the shell body being the end surface or the portion of the end surface that is perpendicular to an axis of the heat pipe, further characterized by:

- the outside shape of the heat absorption end being configured to be corresponding and matching to a shape of heat source for tight fit, the outside shape being smooth and flat, or smooth and raised, or slipper and cupped, or made to fit an external contact surface of a heat source, for clip installation, for sufficient tight fit.

14. An integrated heat pipe according to claim 2, the heat absorbing end of the shell body comprising the limited groups of closed tube shaped thin-wall fluid passage surfaces, further characterized by:

- the limited groups of closed tube shaped thin-wall fluid passages being at inside of the enclosed chamber, from a fluid entrance to a fluid exit of the fluid passages runs through the enclosed chamber between two sides of the enclosed chamber, between adjacent sides of the enclosed chamber, or one side of the enclosed chamber;

- wherein inside of a cross-section of the thin-wall fluid passages is an passage for a cooling fluid.

15. An integrated heat pipe according to claim 14, further characterized by:

- a shape of the cross-section of the thin-wall fluid passage being of a round, rectangle, polygon, gear, or other geometrical shape, or their combination.

16. An integrated heat pipe according to claim 2, further characterized by:

- when the heat absorption end of the shell uses a liquid heat transfer medium, a liquid absorption cartridge structure being coupled to an inside surface of the shell body in the enclosed chamber, the insider surface being
opposite to the heat absorbing surface and open to the enclosed chamber;
wherein the liquid absorption cartridge structure is groove, screen, fiber bundle plus spring, sintered metal powder, their combination, or an other effective structure.

17. An integrated heat pipe according to claim 6 or 14, the heat carrier or the heat absorption end having limited groups of closed tube shaped thin-wall fluid passages, further characterized by:
supplemental fluid passages with passageways for cold, hot, or cold and hot fluids coupled to two sides, the supplemental fluid passages wrapping the corrugated finlike curving surface of the thin-wall fluid passages or corresponding portions of the end cover of the closed tube shaped thin-wall fluid passage.

18. An integrated heat pipe according to claim 1, 2, 4, 5, 13 or 16, further characterized by:
the thin-wall fluid passage heat carrier structure being of a radially straight shape, a radially curved finlike shape, equally spaced straight parallel curved finlike shape, evenly or not evenly distributed cylindrical shape, evenly or not evenly distributed cylindrical shape mirrored with respect to a base shell, a down-U shape, or their combination, or of a closed tube shaped thin-wall fluid passage running through the enclosed chamber from two opposite or adjacent sides of the enclosed chamber;
wherein as the heat absorption end, the shell body or a portion of the shell body is at an opposite side of the corrugated curving surface thin-wall fluid passages or a side parallel to the closed tube shaped thin-wall fluid passages running through two opposite sides of the enclosed chamber;
wherein an outside shape of the heat absorption end is configured to be corresponding and matching to a shape of heat source for tight fit;
wherein the outside shape is smooth and flat, or made to fit an external contact surface of a heat source, for clip installation, for sufficient tight fit;
wherein when the integrated heat pipe uses a liquid heat transfer medium, a liquid absorption cartridge structure is coupled to a heat absorbing bottom open to the enclosed chamber.

19. An integrated heat pipe according to claim 1, 2, 6, 7, 11, 16 or 17, further comprising:

a portion of the shell body wrapping the enclosed chamber at the heat absorption end having a cross-section of a round outside shape, and a longitudinal section of a rectangle, drum, or other revolved shape to meet a requirement of a heat source;

one or more group of closed tube shaped thin-wall fluid passages, a group of closed and corrugated curving surfaces distributed according to a circumference with respect to an axis of the heat pipe, being placed inside the enclosed chamber and running through the enclosed chamber between two opposite sides perpendicular to an axis of the heat absorbing surface, a cross-section section of the closed tube thin-wall fluid passage being of a round, rectangle, polygon, gear, or other geometrical shape;

the group of closed and corrugated curving surfaces distributed according to a circumference with respect to an axis of the heat pipe being of a radially straight shape, a radially curved finlike shape, an other suitable curving surface shape, or their combination;
supplemental fluid passages connected to the thin-wall fluid passages and coupled to two sides of the shell body perpendicular to an axis of the
heat absorbing surface of the shell body, the supplemental fluid passages having entrance and exit openings for cold fluid;

wherein when the integrated heat pipe uses a liquid medium, a liquid absorption cartridge structure of a form of groove or sintered metal powder or other effective liquid absorption structure is coupled to an internal surface of the round heat absorption end of the shell body;

wherein an external surface of the round heat absorption end of the shell body is configured to absorb, during rotation, heat from solidifying and cooling of melted alloy or heat conducted to a surface through contact, absorbed heat being carried away by the heat transfer medium, finally dissipated by the thin-wall fluid passages.

20. An integrated heat pipe according to claim 1, 2, 6, 7, 12, 16 or 17, further characterized by:

the closed and corrugated curving surface shell at the heat absorption end wrapping the enclosed chamber and distributed along contour of the revolved structure having a cross-section with more than three groups of evenly or symmetrically distributed finlike curved surfaces with equal or non-equal heights, the finlike curved surfaces being of a radially straight shape, a radially curved finlike shape, an other suitable curving surface shape, or their combination;

wherein the closed tube shaped thin-wall passages, or the closed and corrugated curved surfaces distributed along a circumferential direction, comprise the heat dissipation end placed in the enclosed chamber and running through the enclosed chamber between two opposite sides of the shell body perpendicular to an axis of the heat absorbing surface;

wherein a cross-section of the closed tube thin-wall fluid passages is of a round, rectangle, polygon, gear, or other geometrical shape;
wherein the closed and corrugated curving surface distributed along a circumferential direction is of a radially straight shape, a radially curved finlike shape, or their combination;
supplemental fluid passages connected to the thin-wall fluid passages and coupled to two sides of the shell body perpendicular to an axis of the heat absorbing surface of the shell body, the supplemental fluid passages having entrance and exit openings for cold fluid;
wherein when the integrated heat pipe uses a liquid medium, a liquid absorption cartridge structure of a form of groove or sintered metal powder or other effective liquid absorption structure is coupled to an internal surface of the round heat absorption end of the shell body;
wherein the closed and corrugated curving surface shell distributed outside the revolved structure is configured as the heat absorbing surface to absorb, during rotation, heat from a shaft and a heat source from inside the shaft or heat released from an external hot fluid, absorbed heat being carried away by the heat transfer medium, finally dissipated by the thin-wall fluid passages.

21. An integrated heat pipe according to claim 1, 2, 3, 4, 6, 7, 10, 16 or 17, further characterized by:

as the heat absorption end of the heat pipe, a heat absorption chamber running through two opposite sides of the shell body and configured in the middle of the heat pipe, a cross-section of the heat absorption chamber having an internal shape of a round, rectangle, polygon, gear, or other geometrical shape;

wherein as the heat dissipation end of the heat pipe, the thin-wall fluid passages are corrugated radially straight finlike curving surface or radially curving finlike curving surface distributed parallel or perpendicular to the axis of the heat absorption chamber, or a closed
tube shaped thin-wall fluid passage shape running through two opposite sides of the shell body and distributed parallel to the axis of the heat absorption chamber;

wherein a cross-section of the closed tube shaped thin-wall fluid passage is of a round, rectangle, polygon, gear, or other geometrical shape;

wherein when the integrated heat pipe uses a liquid medium, groove, a liquid absorption cartridge structure of a form of groove or sintered metal powder or other effective liquid absorption structure is coupled to an external surface at where a cross section of the heat absorbing chamber meets the the vacuum chamber;

wherein a collecting groove for the liquid medium is at a bottom of the liquid absorption cartridge structure;

wherein the enclosed vacuum chamber of the integrated heat pipe is enclosed by end covers perpendicular to the heat absorbing chamber, the heat absorbing chamber, and the thin-wall fluid passages;

wherein a supplemental fluid passage with a passageway for cooling water wraps the thin-wall fluid passage with corrugated finlike curving surface or the corresponding portions of the end covers of the closed tube shaped thin-wall fluid passage;

wherein through heat conduction the heat absorbing chamber absorbs heat released from solidifying and cooling of a passing-by melted alloy, absorbed heat being carried away by the heat transfer medium, finally dissipated by the thin-wall fluid passages.

22. An integrated heat pipe according to claim 1, 2, 8, 9 or 16, further characterized by:

a group of heat absorbing cavities running through opposite two sides of the shell body in the enclosed chamber, a cross-section of the heat
absorbing cavities being of a round, rectangle, polygon, gear or other geometrical shape with a slope;

wherein when the heat carriers are of the heat container structure with good heat conduction, large heat capacity and big surface and is coupled to outside, inside, or outside and inside of the enclosed chamber, the heat container is made of folded or curled membrane, sheet, tube or thread shaped material with a big surface or their combination;

wherein the heat container structure can be curled or folded or layered honeycomb, floccules, linen, membrane, or sheet shape, or made from fitting thin-wall tubes one inside another, or their combination;

wherein layers are spaced enough to ensure sufficient heat exchange for the heat transfer medium;

wherein openings between layers are arranged to face the heat transfer medium deposited in the heat absorption end;

wherein when the integrated heat pipe uses a liquid medium, groove, a liquid absorption cartridge structure of a form of groove or sintered metal powder or other effective liquid absorption structure is coupled to an external surface at where a cross section of the heat absorbing chamber meets the the vacuum chamber;

wherein through heat conduction the heat absorbing chamber absorbs heat released from solidifying and cooling of a passing-by melted alloy, absorbed heat being carried away by the heat transfer medium to the heat container structure and dissipated through the heat container structure.

23. An integrated heat pipe according to claim 1, 2, 8, 9, 10 or 16, characterized by:

as the heat absorption end the shell body or a part of the shell body being smooth and flat, or matching to a heat absorption end of another heat
pipe, the two heat pipes coupled to a highly thermally conductive metal 
molded plate which contains a cavity, the molded plated having 
passages for hot melted substance and passages for expelling air;
wherein heat absorption ends of the heat pipes and the highly thermally 
conductive metal molded plate enclose the cavity in the mold plate to to 
form a heat absorption chamber;
wherein when the heat carriers are of the heat container structure with good 
heat conduction, large heat capacity and big surface and is coupled to 
outside, inside, or outside and inside of the enclosed chamber, the heat 
container is made of folded or curled membrane, sheet, tube or thread 
shaped material with a big surface or their combination;
wherein the heat container structure can be curled or folded or layered 
honeycomb, floccules, linen, membrane, or sheet shape, or made from 
fitting thin-wall tubes one inside another, or their combination;
wherein layers are spaced enough to ensure sufficient heat exchange for the 
heat transfer medium;
wherein openings between layers are arranged to face the heat transfer 
medium deposited in the heat absorption end;
wherein when the integrated heat pipe uses a liquid medium, groove, a liquid 
absorption cartridge structure of a form of groove or sintered metal 
powder or other effective liquid absorption structure is coupled to an 
external surface at where a cross section of the heat absorbing chamber 
meets the the vacuum chamber;
wherein through heat conduction the heat absorbing chamber absorbs heat 
released from solidifying and cooling of a passing-by melted alloy, 
absorbed heat being carried away by the heat transfer medium to the 
heat container structure and dissipated through the heat container 
structure.
24. An integrated heat pipe according to claim 1, 2, 8, 9, 10, 17 or 23, further characterized by:

as the heat absorption end the shell body or a part of the shell body being smooth and flat, or matching to a highly thermally conductive metal end plate, the heat pipe and the end plate coupled to a highly thermally conductive metal molded plate which contains a cavity, the molded plated having passages for hot melted substance and passages for expelling air;

wherein the heat absorption end of the heat pipe, the highly thermally conductive metal end plate and the highly thermally conductive metal molded plate enclose the cavity in the mold plate to to form a heat absorption chamber;

wherein when the heat carriers are of the heat container structure with good heat conduction, large heat capacity and big surface and is coupled to outside, inside, or outside and inside of the enclosed chamber, the heat container is made of folded or curled membrane, sheet, tube or thread shaped material with a big surface or their combination;

wherein the heat container structure can be curled or folded or layered honeycomb, floccules, linen, membrane, or sheet shape, or made from fitting thin-wall tubes one inside another, or their combination;

wherein layers are spaced enough to ensure sufficient heat exchange for the heat transfer medium;

wherein openings between layers are arranged to face the heat transfer medium deposited in the heat absorption end;

wherein when the integrated heat pipe uses a liquid medium, groove, a liquid absorption cartridge structure of a form of groove or sintered metal powder or other effective liquid absorption structure is coupled to an external surface at where a cross section of the heat absorbing chamber meets the vacuum chamber;
wherein through heat conduction the heat absorbing chamber absorbs heat released from solidifying and cooling of a passing-by melted alloy, absorbed heat being carried away by the heat transfer medium to the heat container structure and dissipated through the heat container structure.

25. An integrated heat pipe according to claim 1, 2, 4, 5 10, 16 or 17, further characterized by:

as the heat absorption end of the heat pipe, the heat absorption chamber running through two opposite sides of the shell body and configured to be in the middle of the heat pipe, a cross-section of the heat absorbing cavities having an internal shape of a round or other suitable geometrical shape, a longitudinal section of the heat absorbing cavities having an external shape of a rectangle, down-taper, or other revolved shape that meets a requirement of a heat source;

wherein as the heat dissipation end of the heat pipe a cold fluid passage is parallel to an axis of the heat absorption chamber with a longitudinal section having an external shape of a rectangle shape, a down-taper shape, or an shape suitable for operation with corrugated radially straight finlike curving surface or radially curving finlike curving surface distributed on a revolved surface, or a gear surface distributed on a down-taper revolved surface, or a corrugated curving surface for a thin-wall fluid passage evenly or unevenly distributed on a down-taper revolved surface;

wherein outside of the corrugated thin-wall fluid passage wraps the shell body to form a supplemental fluid passage to accelerate flow of cold fluid;

wherein when the integrated heat pipe uses a liquid medium, groove, a liquid absorption cartridge structure of a form of groove or sintered metal powder or other effective liquid absorption structure is coupled to an
external surface at where a cross section of the heat absorbing chamber meets the the vacuum chamber;
wherein through heat conduction the heat absorbing chamber absorbs heat released from a high temperature fluid, absorbed heat being carried away by the heat transfer medium to the thin-wall fluid passage and finally dissipated through the cold fluid flowing passing-by the outside of the corrugated thin-wall fluid passage.

26. An integrated heat pipe according to claim 1, 2, 4, 5, 6, 7, 10, 14, 15, 16 or 17, further characterized by:

as the heat absorption end of the heat pipe, a number of groups of heat absorption chambers running through two opposite sides of the shell body and configured to be in the middle of the heat pipe, a cross-section of the heat absorbing cavities having a round, rectangle, polygon, gear or other geometrical shapes, or their combination;

wherein as the heat dissipation end of the heat pipe the thin-wall fluid passage structure is parallel to an axis of the heat absorption chamber and of a corrugated radially straight finlike curving surface or a radially curving finlike curving surface at outside of the enclosed chamber;

wherein when the integrated heat pipe uses a liquid medium, groove, a liquid absorption cartridge structure of a form of groove or sintered metal powder or other effective liquid absorption structure is coupled to an external surface at where a cross section of the heat absorbing chamber meets the the vacuum chamber;

wherein a collecting groove for the liquid medium is at a bottom of the liquid absorption cartridge structure;

wherein the heat absorbing chamber, the corrugated thin-wall fluid passage at outside of the enclosed chamber and the shell end covers perpendicular
to the heat absorption chamber enclose the enclosed chamber of the heat pipe;

wherein a supplemental hot fluid passage with an entrance and an exit for hot or cold fluid wrapping two sides of the end covers of the shell body, a supplemental cold fluid passage with an entrance and an exit for cold or hot fluid wrapping the corrugated thin-wall fluid passage at outside of the enclosed chamber, and the heat pipe form a integrated heat pipe heat exchanger for exchanging heat between two fluid mediums.

27. A method of an integrated heat pipe gaining a big heat dissipation surface in a small volume, characterized by comprising:

a) utilizing a corrugated thin-wall fluid passage, or a closed tube shaped thin-wall fluid passage, or a heat container with good heat conductivity, large heat capacity and big surface, or any combination of them at outside, inside, or outside and side of an enclosed chamber to gain compact space;

b) utilizing a curving surface for the corrugated thin-wall fluid passage, or a curving surface for the closed tube shaped thin-wall fluid passage, or a curving and folded surface for the heat container, or any combination of them at outside, inside, or outside and inside of the enclosed chamber to increase a heat dissipation surface;

c) configuring one or more groups of closed tube shaped thin-wall fluid passages inside the enclosed chamber in a revolved structure to increase a heat dissipation surface of a spiral heat pipe.

28. A method of configuring a heat absorption end structure of an integrated heat pipe, characterized by comprising:

a) when the heat absorption end of the heat pipe is a or a part of side surface vertical to axis of the heat pipe, making the shape of the heat absorption
end corresponding and matching to a shape of heat source for tight fit, smooth and flat, smooth and raised, smooth and cupped, or according to an external contact surface of a heat source for clip installation and for sufficient tight fit;

b) when the heat absorption end of the heat pipe is one or more groups of heat absorbing cavities that run through the shell and enclosed chamber, running the cavities through opposite sides, adjacent sides, or the same side of a shell body;

wherein a cross-section of the heat absorbing cavities is of a round, rectangle, polygon, gear or other geometrical shapes and a longitudinal section has a slope;

c) making the heat absorption end of the heat pipe in a revolved shell structure wrapping the enclosed chamber with an outside round cross-section shape and a longitudinal section of a rectangle, drum, or other revolved shape that satisfies a requirement of a heat source;

d) making the heat absorption end of the heat pipe a closed corrugated thin-wall curving surface structure wrapping the enclosed chamber with a round or other geometrical cross section shape, which are over three groups of evenly or symmetrically distributed finlike curving surfaces of equal or non-equal heights, which are radially straight or curving finlike shape or other proper curving surfaces and their combination;

wherein a longitudinal section of a base shape is of a rectangle, drum, or other revolved shape that meets a requirement of a heat source;

e) between a heat absorption end surface of the heat pipe and a highly thermally conductive metal mold plate, fixing a highly thermally conductive metal mold plate with a cavity and a passage for hot melted substance and a passage for letting off air to obtain a heat absorption chamber of the heat pipe; and
between heat absorbing end of two heat pipes, fixing a highly thermally conductive metal mold plate with a cavity and a passage for hot melted substance and a passage for letting off air to obtain a heat absorption chamber of the integrated heat pipe and a number of heat absorbing cavities formed by the heat absorbing end surfaces of the heat pipes;

f) configuring a heat transfer medium in the enclosed chamber at the shell body or a part of the shell body of the heat pipe as the heat absorption end nearest to a heat absorbing surface;

wherein when a liquid medium is used, a liquid absorption cartridge structure is placed at where is nearest to heat absorbing surface in the enclosed chamber.

29. A heat exchange method in an integrated heat pipe, comprising:

a) absorbing heat through contacting a heat source at a surface of a heat absorption end of a shell body of the heat pipe, wherein the heat is transferred to a same heat transfer medium in a same enclosed chamber through a surface of the heat absorption end of the shell, wherein the heat transfer medium absorbs heat or vaporizes to quickly disperse absorbed heat, wherein a heat carrier outside, inside, or outside and inside of, the enclosed chamber is used as a heat dissipation end, wherein a heat container absorbs or transfers heat absorbed by the heat transfer medium;

b) transferring heat from the heat transfer medium using a low temperature fluid in a thin-wall passage configured outside, inside, or outside and inside of, the enclosed chamber;

c) absorbing heat from the heat transfer medium using a heat container configured at outside, inside, or outside and inside of, the enclosed chamber;
d) arranging the heat transfer medium at the heat absorption end of the heat pipe nearest to the heat absorbing surface in the enclosed chamber and using the heat transfer medium to carry heat to a nearest heat dissipating surface of the heat carrier to reduce heat resistance, improve heat conduction and increase heat transfer speed.

30. A heat exchanging method in a rotation based integrated heat pipe using a liquid medium, characterized by:

a) when the heat pipe rotates at a high speed, utilizing a round cross section shell body of the heat pipe as a heat absorption end to absorb heat through contacting a heat source during high speed rotation, wherein heat is transferred to the same heat transfer medium in the same enclosed chamber that is thrown to internal wall surface of the heat absorption end by centrifugal force, wherein the heat transfer medium absorbs heat and quickly vaporizes, wherein saturated vapor filling in the enclosed chamber is condensed to a liquid from at a surface of the thin-wall fluid passage when in contact with a low temperature thin-wall fluid passage to release vaporization, wherein the thin-wall fluid passage transfers the vaporized potential heat to cold fluid that is outside the enclosed chamber of the thin-wall fluid passage and the cold liquid finally carries away heat absorbed by the heat pipe, wherein the liquid medium condensed at the surface of the thin-wall fluid passage accumulates quickly and is again thrown on internal wall surface of the heat absorption end by the centrifugal force to start a new cycle of heat transfer process which repeats cycle after cycle, wherein the method has a big heat dissipation area and uses phase change to transfer heat evenly under an equal temperature over the entire heat dissipation area, wherein the centrifugal force of the rotating heat pipe causes the liquid medium to flow towards the heat absorption end and reduces interface
heat resistance in the process of phase change heat conduction to a full extent;

wherein the method can obtain best heat exchange result;

b) when the heat pipe rotates at a low speed, utilizing a round cross section shell body of the heat pipe as a heat absorption end to absorb heat through contacting a heat source during low speed rotation, wherein heat is transferred to the same heat transfer medium in the same enclosed chamber that is accreted to a liquid absorption cartridge structure on the internal wall surface of the heat absorption end by adhesive force of the liquid medium, wherein the heat transfer medium absorbs heat and quickly vaporizes, wherein saturated vapor filling in the enclosed chamber is condensed to a liquid from at a surface of the thin-wall fluid passage when in contact with a low temperature thin-wall fluid passage to release vaporization, wherein the thin-wall fluid passage transfers the vaporized potential heat to cold fluid that is outside the enclosed chamber of the thin-wall fluid passage and the cold liquid finally carries away heat absorbed by the heat pipe, wherein the liquid medium condensed at the surface of the thin-wall fluid passage accumulates quickly and is pulled back to the lowest position in the enclosed chamber of the heat pipe under weight;

wherein the liquid medium is absorbed into into the liquid absorption cartridge structure of the heat pipe and brought to a position to contact the heat source due to a capillary force to start a new cycle of heat transfer process which repeats cycle after cycle, wherein the method has a big heat dissipation area and uses phase change to transfer heat evenly under an equal temperature over the entire heat dissipation area, wherein the capillary force of the liquid absorption cartridge structure of the heat pipe and the adhesive force of the liquid medium of the heat pipe causes the liquid medium to flow towards the heat absorption end;
wherein the method can obtain ideal heat exchange result.

31. An integrated heat pipe including enclosed chamber (1-2) and shell (1-1) whose inside is vacuum and filled with heat transfer medium (1-3), characterized by:
   a heat carrier (1-4) set out of the enclosed vacuum chamber (1-2);
   wherein the heat carrier (1-4) is corrugated radially straight finlike thin-wall fluid passage (1-4a), twelve short fins and twelve long fins radially distributed towards an axis of the heat pipe, the inside of every corrugated long fin or short fin having an internal cavity of the heat carrier (1-4), which connects with the enclosed vacuum chamber (1-2) as extension of the enclosed vacuum chamber (1-2);
   wherein the outside of every corrugated long fin or short fin is a fluid passage (1-4a) of the heat carrier (1-4), which contacts cold liquid to form the heat dissipating surface of the heat carrier;
   wherein every group of heat carriers uses the same enclosed vacuum chamber (1-2) and the heat transfer medium (1-3) in it (1-2), every group of heat carriers (1-4) being inter-independent and also interconnected;
   wherein the shell (1-1) of the integrated heat pipe is formed by a wall of the enclosed vacuum chamber (1-2) and a wall of the corrugated thin-wall liquid passage (1-4a);
   wherein to ensure normal heat conduction at a declining position, a liquid absorption cartridge (1-5) is set in the enclosed vacuum chamber (1-2) when the phase change heat conduction uses a liquid heat transfer medium.

32. An integrated heat pipe including enclosed chamber (2-2) and shell (2-1) whose inside is vacuum and filled with heat transfer medium (2-3), characterized by:
heat carriers (2-4) set out of the enclosed vacuum chamber (2-2);
wherein Heat carriers (2-4) are corrugated parallel straight finlike thin-wall fluid passages (2-4a);
wherein thirteen groups of finlike thin-wall fluid passages are parallel with equal distance from one side of the body shell to opposite side of the heat absorption end of the shell;
wherein the inside of every corrugated finlike thin-wall fluid passage (2-4a) is an internal cavity of the heat carrier (2-4), which connects with the enclosed vacuum chamber (2-2) and also is extension of the enclosed vacuum chamber (2-2);
wherein the outside of every group of corrugated finlike thin-wall fluid passages (2-4a) is the fluid passage of a heat carrier (2-4a), which touches with cold liquid and also is heat dissipation surface of the heat carrier (2-4);
wherein every group of heat carriers uses the same enclosed vacuum chamber (2-2) and the heat transfer medium (2-3) in it (2-2), every group of heat carriers (2-4) being interindependent and also interconnected;
wherein the shell (2-1) of the integrated heat pipe is formed by a wall of the enclosed vacuum chamber (2-2) and a wall of corrugated thin-wall fluid passage (2-4a);
wherein to ensure normal heat conduction at declining position, the liquid absorption cartridge (2-5) is set in the enclosed vacuum chamber (2-2) when the phase change heat conduction uses a liquid heat transfer medium.

33. An integrated heat pipe including enclosed chamber (3-2) and shell (3-1) whose inside is vacuum and filled with heat transfer medium (3-3), characterized by:
eleven groups of heat carriers (3-4) set inside of the enclosed vacuum chamber (3-2) enclosed by rectangle shell (3-1), left and right end plates (3-6) of the shell;

wherein the heat carrier (3-4) is thin-wall fluid passage (3-4a) formed by rectangle section thin-wall tube and runs through two sides of end plates (3-6) of the shell;

wherein the external wall of every rectangle section thin-wall tube is an internal cavity of the heat carrier (3-4), which connects with the enclosed vacuum chamber (3-2) and also is placed in it (3-2);

wherein the internal wall of every rectangle section thin-wall tube is the fluid passage (3-4a) of a heat carrier (3-4), which touches with cold liquid and also is a heat dissipation surface of the heat carrier (3-4);

wherein every group of heat carriers uses the same enclosed vacuum chamber (3-2) and the heat transfer medium (3-3) in it (3-2), every group of heat carriers (3-4) being interindependent and also interconnected;

wherein to ensure normal heat conduction at declining position, the liquid absorption cartridge (3-5) is set in the enclosed vacuum chamber (3-2) when the phase change heat conduction uses a liquid heat transfer medium.

34. An integrated heat pipe including enclosed chamber (4-2) and shell (4-1) whose inside is vacuum and filled with heat transfer medium (4-3), characterized by:

nine groups of columned heat carriers set out of the enclosed vacuum chamber (4-2);

wherein the shell of bottom heat absorption end (4-1) is the structure of thin-wall and empty rectangle plate, upper thin-wall empty rectangle plate opposite to the shell of bottom heat absorption end (4-1) being mirror image of the bottom to make internal cavities of fluid passage (4-4) of
nine groups of columned thin-wall tube connect together and connect them with the enclosed vacuum chamber (4-2);

wherein the internal section of every thin-wall tube heat carrier (4-4) is an internal cavity of the heat carrier (4-4), which connects with the enclosed vacuum chamber (4-2) and also is its (4-2) extension;

wherein the external surface of every thin-wall tube heat carrier (4-4) is the liquid passage of a heat carrier (4-4a), which touches with cold liquid and also is a heat dissipation surface of the heat carrier (4-4); and
to enlarge the heat dissipation area of thin-wall tube heat carrier (4-4), twelve groups of radiators (4-11) that run through, tightly match the thin-wall tube and are parallel to thin-wall empty rectangle plate are set in the thin-wall empty rectangle plate;

wherein every group of heat carriers uses the same enclosed vacuum chamber (4-2) and the heat transfer medium (4-3) in it (4-2), every group of heat carriers (4-4) being interindependent and also interconnected;

wherein to ensure normal heat conduction at declining position, the liquid absorption cartridge (4-5) is set in the enclosed vacuum chamber (4-2) when the phase change heat conduction uses a liquid heat transfer medium.

20 35. An integrated heat pipe including enclosed chamber (5-2) and shell (5-1) whose inside is vacuum and filled with heat transfer medium (5-3), characterized by:
heat carriers (5-4) set in the enclosed vacuum chamber (5-2) enclosed by columned or other shape shell (5-1) and end plates (5-6) of the shell;
wherein the heat absorbing cavities (5-1a) are set on the shell (5-1) and runs through it (5-1) as the heat absorption end, which tightly matches graphite sheath (5-12), the central hole of the graphite sheath (5-12) being passage for melting metal, in which (5-15) is entrance of cast
liquid and (5-16) is exit of cast ingot, passageway (5-13) for lubricate oil
being set between the heat absorption chamber (5-1a) and the graphite
sheath (5-12);

wherein Heat carriers (5-4) consist of thin-wall fluid passage (5-4a) formed by
80 groups of round section thin-wall tube and run through end plates (5-
6) that are at opposite sides of the shell; and

the external wall of every round section thin-wall tube is an internal cavity of
the heat carrier (5-4), which connects with the enclosed vacuum
chamber (5-2) and also is set in it (5-2);

wherein the internal wall of every round section thin-wall tube is the fluid
passage (5-4a) of a heat carrier (5-4), which touches with cold liquid and
also is a heat dissipation surface of the heat carrier (5-4);

wherein every group of heat carriers (5-4) uses the same enclosed vacuum
chamber (5-2) and the heat transfer medium (5-3) in it (5-2), every
group of heat carriers (5-4) being interindependent and also
interconnected;

wherein to ensure normal heat conduction of the heat absorption chamber (5-
1a) as heat absorption end, the liquid absorption cartridge (5-5) is set on
the internal wall of heat absorption chamber (5-1a) in the enclosed
vacuum chamber (5-2) when the phase change heat conduction uses a
liquid heat transfer medium.

36. An integrated heat pipe including enclosed chamber (6-2) and shell (6-1)
whose inside is vacuum and filled with heat transfer medium (6-3),
characterized by:

the heat absorption end of the shell that is vertical to axis of the heat pipe and
also is a surface of the heat pipe set at outside of the enclosed vacuum
chamber (6-2);
wherein heat carriers (6-4) are set inside of the enclosed vacuum chamber (6-2) enclosed by the shell (6-1) of heat container type integrated heat pipe;

wherein the heat carrier (6-4) is the structure of heat container (6-4b) made of metal that has fine thermal conductivity coefficient, big heat content, large area and easily absorbs and stores heat, so that the heat container (6-4b) structure is covert heat absorption end set in the integrated heat pipe;

wherein the heat container (6-4b) is made of one group of foil sheet large area copper that is coiled and curved. Distance between layers is long enough to ensure fully heat conduction of heat transfer medium;

wherein opening between layers faces to the heat absorption end;

wherein the heat container (6-4b) is enclosed in the enclosed chamber (6-2) by shell (6-1) and heat absorption end (6-1a) of shell, the cavity being vacuum and injected with little heat transfer medium (6-3) to form a heat container type integrated heat pipe.

37. An integrated heat pipe including enclosed chamber (7-2) and shell (7-1) whose inside is vacuum and filled with heat transfer medium (7-3), characterized by:

with round bench section and rectangle lengthwise section, the heat absorption end of the shell (7-1) set at outside of the enclosed chamber (7-2);

wherein heat carriers (7-4) are set at inside of the enclosed vacuum chamber (7-2) enclosed by columned shell (7-1) and its end plates;

wherein heat carriers (7-4) consist of thin-wall fluid passage (7-4a) formed by 110 groups of round section thin-wall tube and run through end plates (7-6) that are at opposite sides of the shell, the external wall of every round section thin-wall tube being an internal cavity of the heat carrier
(7-4), which connects with enclosed vacuum chamber (7-2) and also is in it (7-2);

wherein the internal wall of every round section thin-wall tube is the fluid passage (7-4a) of a heat carrier (7-4), which touches with cold liquid and also is a heat dissipating surface of the heat carrier (7-4);

wherein every group of heat carriers (7-4) uses the same enclosed vacuum chamber (7-2) and the heat transfer medium (7-3) in it (7-2);

wherein every group of heat carriers (7-4) is interindependent and also interconnected;

wherein to ensure normal heat conduction when the roll wheel rotates slowly, the liquid absorption cartridge (7-5) is set on the external wall of the enclosed vacuum chamber (7-2) and internal wall of the shell (7-1) when the phase change heat conduction uses a liquid heat transfer medium.

An integrated heat pipe including enclosed chamber (8-2) and shell (8-1) whose inside is vacuum and filled with heat transfer medium (8-3), characterized by:

with round bench section and rectangle lengthwise section, heat absorption end of the shell (8-1) set at outside of the enclosed chamber (8-2);

wherein heat carriers (8-4) are set at inside of the enclosed vacuum chamber (8-2) enclosed by columned shell (8-1) and its end plates (8-6);

wherein heat carriers (8-4) consist of the thin-wall fluid passage (8-4a) formed by 12 groups (or 12 gears in a group) of internal gear form section thin-wall tube and run through two sides of the shell;

wherein the internal wall of every gear of internal gear form section thin-wall tube is an internal cavity of the heat carrier (8-4), which connects with enclosed vacuum chamber (8-2) and also is in it (8-2);
wherein the external wall of every internal gear form section thin-wall tube is the fluid passage (8-4a) of a heat carrier (8-4), which touches with cold liquid and also is a heat dissipating surface of the heat carrier (8-4);

wherein every group of heat carriers (8-4) uses the same enclosed vacuum chamber (8-2) and the heat transfer medium (8-3) in it (8-2);

wherein every group of heat carriers (8-4) is inter-independent and also interconnected;

wherein to ensure normal heat conduction when the roll wheel rotates slowly, the liquid absorption cartridge (8-5) is set on the external wall of the enclosed vacuum chamber (8-2) and internal wall of the shell (8-1) when the phase change heat conduction uses a liquid heat transfer medium.

39. An integrated heat pipe including enclosed chamber (9-2) and shell (9-1) whose inside is vacuum and filled with heat transfer medium (9-3), characterized by:

with round bench section, the heat absorption chamber (9-1a) set at the heat absorption end of the shell (9-1) and runs through it, its lengthwise section being inverted trapezoid;

wherein heat carriers are set out of the enclosed vacuum chamber (9-2);

wherein heat carriers (9-4) are corrugated radially straight finlike thin-wall fluid passage (9-4a), twelve long fins radially distributed from an axis of the heat absorption chamber;

wherein the inside of every corrugated long fin is an internal cavity of the heat carrier (9-4), which connects with the enclosed vacuum chamber (9-2) and also is its (9-2) extension;

wherein the outside of every corrugated long fin is a fluid passage (9-4a) of a heat carrier (9-4), which touches with cold liquid and also is a heat dissipating surface of the heat carrier;
wherein every group of heat carriers uses the same enclosed vacuum chamber (9-2) and the heat transfer medium (9-3) in it (9-2);

wherein every group of heat carriers (1-4) is inter-independent and also interconnected;

wherein shell (9-1) is formed by wall of the enclosed vacuum chamber (9-2) and wall of the corrugated straight finlike thin-wall fluid passage (9-4a);

wherein the heat pipe core (9-5) is set on the opposite wall of the heat absorption chamber (9-1a) in the enclosed vacuum chamber (9-2) when the phase change heat conduction uses a liquid heat transfer medium.

40. An integrated heat pipe including enclosed chamber (10-2) and shell (10-1) whose inside is vacuum and filled with heat transfer medium (10-3), characterized by:

thin-wall tube running through two opposite end covers of the shell and crossing axis of the heat pipe (10-1) and twelve groups of heart-shaped heat absorbing cavities (10-1a) evenly radially distributed along tube set on the heat absorption end of the body shell;

wherein Heat carriers (10-4) are set out of the enclosed vacuum chamber (10-2);

wherein Heat carriers (10-4) are the corrugated radially straight finlike thin-wall fluid passage (10-4a), forty-eight long fins radially distributed from an axis of the heat absorption chamber;

where the inside of every corrugated long fin is an internal cavity of a heat carrier (10-4), which connects with the enclosed vacuum chamber (10-2) and also is its (10-2) extension;

wherein the outside of every corrugated long fin is a liquid passage (10-4a) of a heat carrier (10-4), which touches with cold liquid and also is a heat dissipating surface of the heat carrier (10-4);
wherein every group of heat carriers uses the same enclosed vacuum chamber (10-2) and the heat transfer medium (10-3) in it (10-2);

wherein every group of heat carriers (10-4) is inter-independent and also interconnected;

wherein the heat absorption chamber (10-1a), thin-wall fluid passage (10-4a) and opposite two end covers of the shell (10-1) enclose the enclosed chamber (10-2) and form the shell of the integrated heat pipe;

wherein the heat pipe core (10-5) is set on the opposite wall of the heat absorption chamber (10-1a) in the enclosed vacuum chamber (10-2) when the phase change heat conduction uses liquid heat transfer medium;

wherein the heat absorption chamber (10-1a), thin-wall fluid passage (10-4a) and opposite two end covers of the shell (10-1) form the shell of the integrated heat pipe;

wherein supplemental hot fluid passage with hot fluid passageway is wrapped in the middle position of opposite two sides (10-1) and fully contains the heat absorption chamber (10-1a);

wherein supplemental cold fluid passage (10-11) with cold fluid passageway (10-9) is wrapped outside of wall of radially straight finlike thin-wall fluid passage (10-4a);

wherein together with the integrated heat pipe, they form compound shape integrated heat pipe exchanger.

41. An integrated heat pipe including enclosed chamber (11-2) and shell (11-1) whose inside is vacuum and filled with heat transfer medium (11-3), characterized by:

the external round surface of the shell as the heat absorption end and three groups of radially straight finlike thin-wall heat absorbing curving surfaces set on it, the heat absorption end being at outside of the...
enclosed vacuum chamber (11-2), heat carriers (11-4) being set out of the enclosed vacuum chamber (11-2), heat carriers (11-4) running through opposite two end covers of the shell (11-1) being the corrugated radially straight finlike thin-wall fluid passage (11-4a), sixteen long fins being radially distributed from an axis of the heat pipe;

wherein the inside of every corrugated long fin is an internal cavity of a heat carrier (11-4), which connects with the enclosed vacuum chamber (11-2) and also is its (11-2) extension;

wherein the outside of every corrugated long fin is a fluid passage (11-4a) of a heat carrier (11-4), which touches with cold liquid and also is a heat dissipation surface of the heat carrier (11-4);

wherein every group of heat carriers uses the same enclosed vacuum chamber (11-2) and the heat transfer medium (11-3) in it (11-2);

wherein every group of heat carriers (11-4) is inter-independent and also interconnected;

wherein the heat absorption chamber (11-1a) of round shell, thin-wall fluid passage (11-4a) and opposite two end covers of the shell (11-1) enclose the enclosed chamber (11-2) and form the integrated heat pipe rotor;

wherein heat pipe core (11-5) is set on the opposite wall of heat absorption chamber (11-1a) of shell and three groups of radially straight finlike thin-wall heat absorbing curving surfaces (11-6a) in the enclosed vacuum chamber (11-2) when the phase change heat conduction uses liquid heat transfer medium;

wherein the heat absorption chamber (11-1a), thin-wall fluid passage (11-4a) and opposite two end covers of the shell (11-1) form the shell of the integrated heat pipe;

wherein rotor shaft and supplemental hot fluid passage (11-8) with hot fluid passageway (11-9) are wrapped in the middle position of opposite two
sides (11-1) of the shell and fully contains the thin-wall fluid passage (11-4a);

wherein together with integrated heat pipe, they form compound shape integrated heat pipe rotor.

42. An integrated heat pipe according to claim 21, wherein said thin-wall fluid passage may be other curving surface such as equidistant fin shape or radially curving fin shape.

43. An integrated heat pipe according to claim 21, wherein several fins can be set among adjacent groups of corrugated finlike thin-wall fluid passages and the fins touch them tightly to enlarge a heat dissipation area of the heat pipe.

44. An integrated heat pipe according to claim 18, 31, 32, 33, or 3, wherein said it can be used for radiation of such solid touch heat source that heat conduction is major radiation form as computer CPU, computer display card, big power electric and electronic part.

45. An integrated heat pipe according to claim 19, 37 or 38, wherein it can be used for radiation of cooling roller for quick solidifying metal thin belt, roller and casting wheel of continuous casting and rolling in metallurgy industry, rotor of engine, rotor of turbine lamina, and other rotating heat source and draft.

46. An integrated heat pipe according to claim 20 or 41, wherein it can be used for radiation of rotors of generator, motor or similar structure machinery.

47. An integrated heat pipe according to claim 21, 35 or 36, wherein it can be used for continuous casting ingot crystal machine and quick solidifying metal wire machine in metallurgy.
48. An integrated heat pipe according to claim 22, 23 or 24, wherein it can be used for radiation of preparing block non-crystal, mini-crystal and sub-crystal quick solidifying metal.

49. An integrated heat pipe according to claim 25 or 39, wherein it can be used for plasma welding-cutting machine, nozzle of plasma coating, nozzle of electron beam welding gun, and nozzle of large power are welding gun.