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HEAT EXCHANGER

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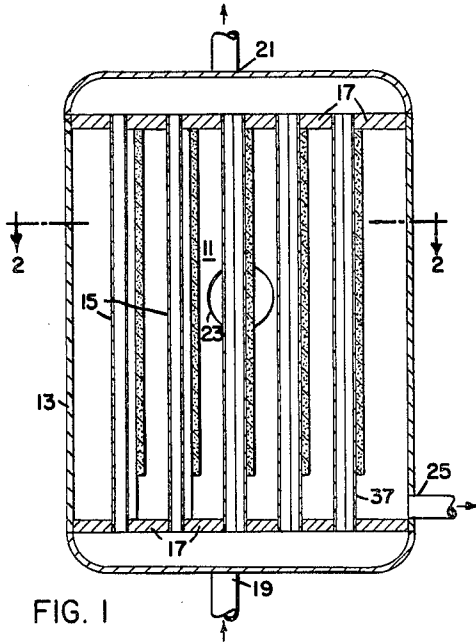


FIG. 1

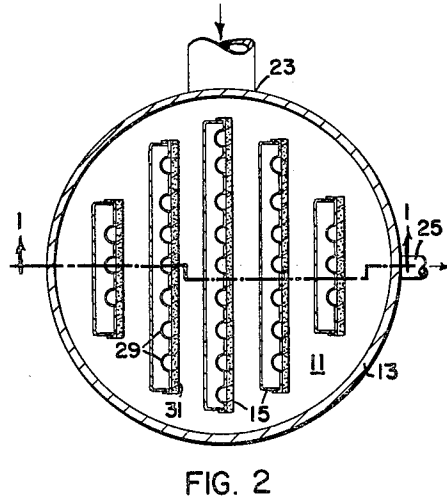


FIG. 2

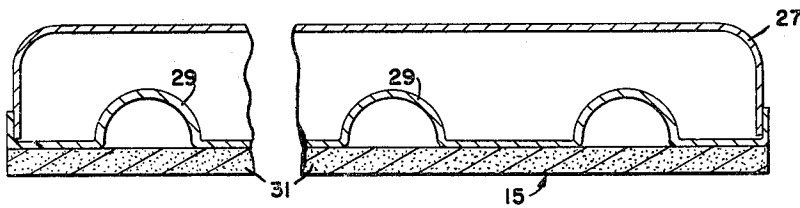


FIG. 3

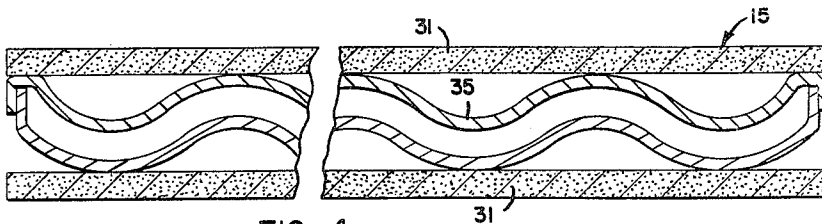


FIG. 4

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HEAT EXCHANGER

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This invention relates generally to heat exchange apparatus. More particularly this invention pertains to an improved heat transfer device for use within condensers.

Typical construction of condensers herein under consideration comprises an enclosed shell generally having a plurality of heat exchange tubes disposed therein forming interior passageways. The shell is provided with suitable connections for passing two fluid mediums in heat exchange relationship with each other such that heat is transferred from one of the mediums to the other. The heat exchange tubes conduct a first fluid medium through their interior and provides a surface over which the second fluid medium in the gaseous state may flow. The temperature difference between these two fluid mediums is such that the second fluid medium will condense by dissipating its heat of condensation to the first fluid medium.

A substantial amount of heat may be removed in this manner; however, the heat transfer capacity of a given size condenser is to a great extent limited by the temperature difference between the two fluid mediums and is also highly dependent upon the contact surface available for heat transfer.

It is an object of this invention to improve the heat transfer performance of condensers for use in refrigeration systems and the like.

Another object of this invention is to provide a heat transfer device having a porous transfer surface and an impervious interior surface forming a confined path for conduction of a cooling medium with an arrangement for drainage of condensate.

These and other objects of this invention are achieved in the illustrated embodiments by providing a condenser having a heat transfer device disposed within its outer shell. The heat transfer device is comprised of an elongated hollow plate of impervious metal having extended longitudinal indentations, a porous metal layer fixed to the plate and combining with the indentations to define a plurality of passageways. A condensable medium in contact with the porous metal layer will be condensed by dissipating heat to a cooling medium flowing through the interior of a plate and the condensate will be removed by flowing through the passageways for improved heat transfer performance.

The porous layer is formed of a compacted metal powder that provides a very large surface area in relation to its volume available for heat transfer and may be any metal showing good thermal conducting characteristics, for example, electrolytically produced dendritic copper powder. The term "porous" as used herein is defined as the characteristic of a body having a large number of minute internal cavities of capillary size which form surface interstices in communication with a number of the internal cavities to provide minute passageways through which a fluid medium may pass through the body.

The various features and advantages of this invention will become apparent from the following description when considered in connection with the drawings, wherein:

FIGURE 1 is a diagrammatic section of a condenser employing heat transfer device in accordance with this invention, the view taken along lines 1-1 of FIGURE 2;

FIGURE 2 is another section of the condenser taken along lines 2-2 of FIGURE 1;

FIGURE 3 is a sectional view of the heat transfer device as contemplated by this invention; and

FIGURE 4 is a sectional view of the heat transfer device in modified form according to this invention.

Referring more particularly to FIGURES 1 and 2, there is shown a condenser 11 having an outer shell 13 with a plurality of heat transfer devices 15 vertically disposed therein between support sheets 17. The shell 13 is shown in FIGURE 2 as cylindrical, however, it may also be of rectangular configuration. The condenser 11 is provided with connections 19 and 21 for conduction of a cooling medium which passes through the interior of the heat transfer devices 15. A condensable medium enters the condenser shell 13 through connection 23 for contact with the exterior surfaces of the heat transfer devices 15. The condensate forming on the exterior surfaces of the heat transfer devices 15 collects at the bottom of the condenser 11 and drains out through connection 25.

The construction of the heat transfer device 15 in accordance with this invention, is shown by FIGURE 3. An elongated hollow plate 27 of impervious metal is provided and generally is formed of two sheets suitably joined together. On at least one side of the plate 27 a plurality of indentations 29 are providing extending along the longitudinal axis and are generally arcuate in shape and equally spaced in parallel relationship. A porous metal layer 31 is fixed to the plate overlaying the indentations 29. The indentations 29 together with the adjoining portions of porous layer 31 form a plurality of passageways defined between the hollow plate 27 and the porous layer 31. The hollow plate 27 and porous layer 31 may be mechanically bonded together by any suitable means such as brazing, which will form a good thermal bond therebetween.

The porous metal layer employed by this invention is generally a preformed body of a compacted powdered metal, for example electrolytically produced dendritic copper powder. The process used to compact the metal powder may be any known technique in the powdered metallurgical art provided the resulting compact remains porous as heretofore defined. It is desirable that the compact be sintered to provide rigidity, however, the operation must be such that the internal cavities are not sealed off from communication with each other, the surfaces, are entirely eliminated.

FIGURE 4 shows a modification of the heat transfer device 15 as contemplated by this invention. An elongated hollow corrugated plate 35 is provided and generally formed by two sheets suitably joined together. A porous metal layer 31 is fixed to each side of the plate and combine with the furrows in the plate to define a plurality of passageways therebetween. The plate 35 and porous layers 31 may be mechanically bonded together by any suitable method such as brazing.

The operation is such that a cooling medium enters the condenser 11 from connection 19 and passes through the interior of the heat transfer devices 15. The medium then leaves condenser 11 from connection 21. A second condensable medium enters condenser 11 through connection 23 and passes over the exterior surfaces of the heat transfer devices 15 and condenses by dissipating its heat of condensation to the cooling medium flowing through the interior of heat transfer devices 15. The condensing operation is improved by the provision of a porous layer 31 which furnishes a very large area in contact with the condensable medium. Condensing will occur primarily within the porous layer 31 and the condensate continues through the layer into the plurality of passageways 33 and drains to the bottom of the condenser 11. A portion 37 of the hollow plate at the bottom of condenser 11 is exposed to assist in the drainage of condensate from passageways 33. Other exposed

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portions of hollow plate 27 will perform the condensing operation in the usual manner.

In addition to the high heat transfer performance attained by this invention, other advantages are provided over prior art condensers. For example, it is possible to reduce the size and obtain the same capacity due to the increased heat transfer area provided by the porous metal jacket without a proportionate increase in volume. Various other advantages and applications will become apparent to those skilled in the art and it is understood that this invention is not limited to the described embodiments but may be otherwise practiced within the scope of the following appended claims.

I claim:

1. A condenser adapted for condensing a refrigerant vapor in a refrigeration system, said condenser comprising:

(a) a hollow, generally plate-like member constructed of impervious heat conducting metal, said plate-like member having:

(1) a plurality of spaced vertically extending indentations in one of the surfaces of said plate-like member, said indentation lying in substantially a single plane and extending to a lower edge of said member,

(2) a substantially flat, heat conducting porous metal sheet overlying said surface of said plate-like member having said indentations, said porous metal sheet being secured to said plate-like member in heat transfer relation therewith and forming with said indentations a plurality of generally vertically extending passages for drainage of condensate from said member,

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(3) a passage for introducing a cooling medium into the hollow interior of said hollow plate-like member, and

(4) a passage for withdrawing cooling medium from the hollow interior of said hollow plate-like member; and

(b) a shell surrounding said hollow, generally, plate-like member, for confining a refrigerant vapor, said shell having:

(1) a passage for admitting refrigerant vapor into said shell, and

(2) a passage for withdrawing condensed refrigerant from said shell.

2. A condenser as defined in claim 1 wherein the indentations in said hollow plate-like member comprise corrugations in at least one of the surfaces of said plate-like member.

3. A condenser as defined in claim 1 wherein said plate-like member has indentations on two opposing sides thereof and includes a porous heat conducting metal sheet secured to both of said opposed sides in heat transfer relation with said hollow plate-like member to form generally vertically extending passages on both sides of said plate-like member for draining condensate therefrom.

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