Oct. 28, 1952 J. DAVIDSON 2,615,686

HEAT TRANSFER DEVICE

Filed May 29, 1948

Fig. 1.

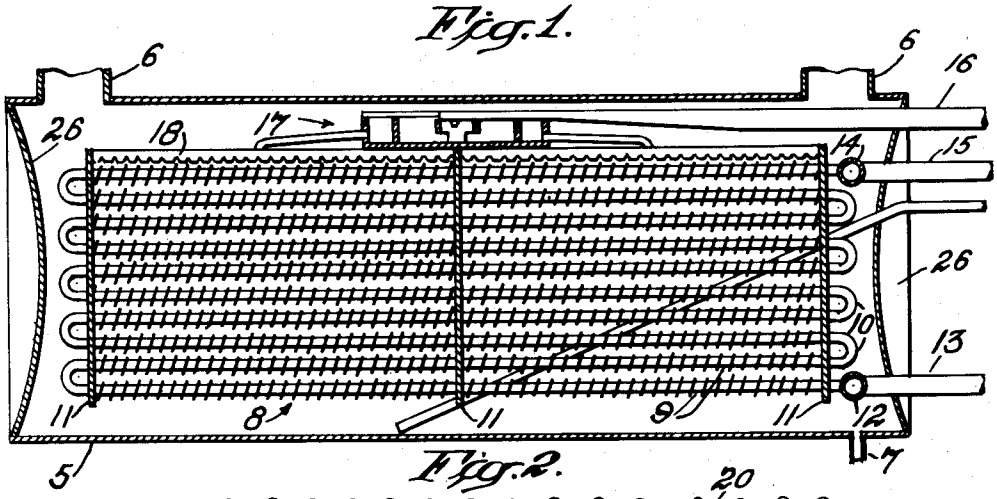


Fig. 2.

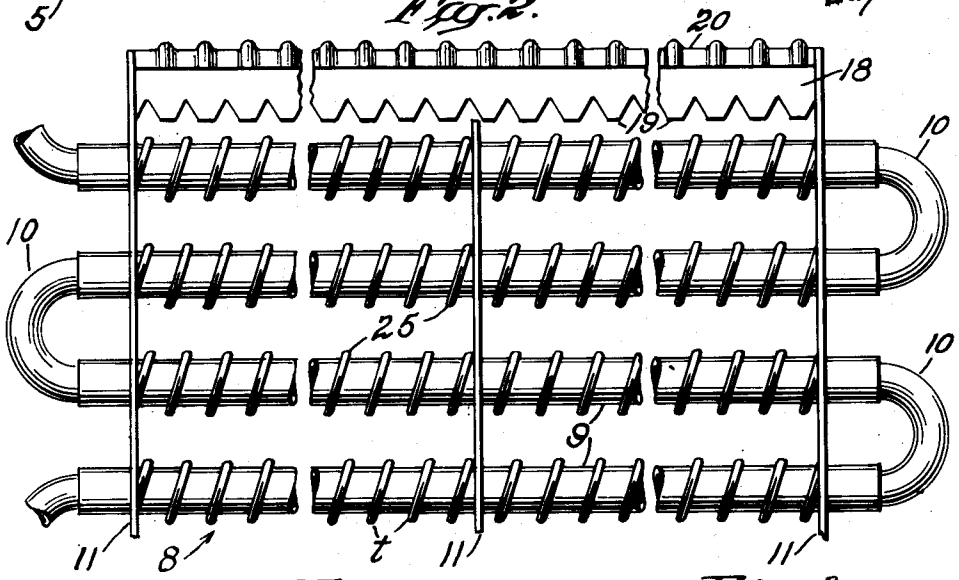


Fig. 3.

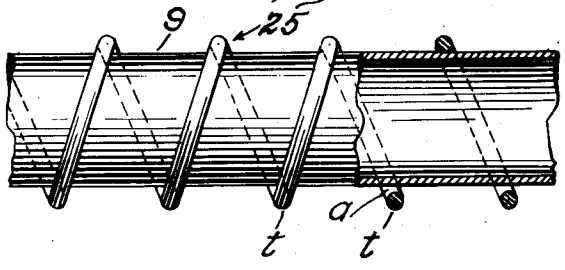
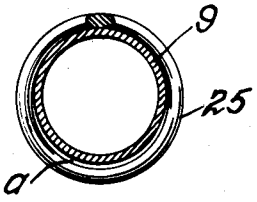


Fig. 4.



INVENTOR.

BY John Davidson

Oliver S. Titcomb

HIS ATTORNEY

Patented Oct. 28, 1952 2,615,686

UNITED STATES PATENT OFFICE

2,615,686

HEAT TRANSFER DEVICE

John Davidson, Evansville, Ind., assignor to Servel, Inc., New York, N. Y., a corporation of Delaware

Application May 29, 1948, Serial No. 30,025

1 Claim. (Cl. 257—35)

1

This invention relates to heat transfer devices such as, for example, an absorber of an absorption refrigeration system and more particularly to improvements in liquid distributing apparatus of the type in which liquid drips successively from one to another of a plurality of generally horizontal elements arranged one over the other in an enclosure.

One form of such a liquid distributing apparatus is illustrated and described in United States Letters Patent to Per Edberg No. 2,399,916 issued May 7, 1946, and entitled Refrigeration. The liquid distributing apparatus illustrated in said patent comprises pipe sections arranged one over the other so that liquid supplied to the top section drips from each section to the next lowermost section. It has also been proposed to provide similar elements with circumferential ridges arranged in spaced relation along their length which are preferably formed by the loops of a wire coiled helically on their periphery. The wire loops on the periphery of the elements break up any rivulets of liquid flowing therealong and provide a series of drop formers at spaced points along the bottom.

It is the object of my invention to improve the liquid distribution and drop forming characteristics of such wires and to facilitate the manufacture and assembly of the liquid distributing apparatus. I accomplish this object by forming the wire loops, preferably in the form of a helical coil, into a cylinder having a greater inside diameter than the outside diameter of the pipe sections so that the wires may be easily and quickly applied by merely sliding them over the ends of the pipe sections. When helical wire coils are so mounted on the pipe sections the loops are spaced from the sides and bottoms of the pipe sections. With such an arrangement the cohesion of the liquid in the space between the wire and pipe section produces a desirable wiping action of the liquid on the pipe section as it tends to follow the helical path of the individual loops of the wire coil. The spacing of the wire coils from the periphery of the pipe sections also produces smaller drops which fall onto and flow over the surface of the next lowermost pipe sections without splashing when they hit the top thereof.

The foregoing and other objects of the invention and details of construction are more fully set forth in the following description and accompanying drawing in which like reference characters denote like parts throughout the several views. The drawing is for the purpose of illustration only and is not a definition of the invention, reference being had for this purpose to the appended claim. In the drawing:

2

Fig. 1 is a sectional view of the absorber of an absorption refrigeration apparatus and showing the liquid distributing means of the present invention applied thereto;

Fig. 2 is an enlarged view of a portion of one of the vertical cooling coils in the absorber showing the helically coiled wires forming spaced ridges on the periphery of the pipe sections;

Fig. 3 is a further enlarged view of a portion of one of the pipe sections and showing the loose arrangement of the helically coiled wire on a pipe section to provide spaces between the bottom of the pipe and the individual turns of the wire coil; and

Fig. 4 is a transverse sectional view taken on line 4—4 of Fig. 3.

In the drawing, the heat transfer device to which the present invention is shown applied is the absorber of an absorption refrigeration system such as illustrated and described in said United States Letters Patent to Per Edberg referred to above. For further description of such a refrigeration system reference is made to the Edberg application which may be considered as incorporated herein. Suffice it to state that the absorber comprises an hermetically sealed casing 5, preferably of cylindrical shape, having spaced ducts 6 at its top for connection to an evaporator and an outlet conduit 7 at its bottom. Mounted in the casing 5 are cooling coils 8. While only one vertically arranged cooling coil 8 is shown in the drawing, it will be understood that a series of such coils are arranged in side by side relationship and extend throughout substantially the entire length and width of the absorber. Each cooling coil 8 comprises a plurality of pipe sections 9 arranged one over the other in a vertical plane with the ends of adjacent pipe sections connected alternately at opposite ends by U-shaped couplings 10 to provide a continuous coil, see Fig. 2. The cooling coils 8 are supported at their center and adjacent each end by stanchions in the form of plates 11.

Cooling water is supplied to the cooling coils 8 through a header 12 and supply pipe 13 from any suitable source such as a city water main, cooling tower or the like. Cooling water from the bank of cooling coils 8 is delivered through a header 14 and conduit 15 to a waste pipe or preferably to a condenser, not shown.

Liquid absorbent is supplied to the top of the absorber through a conduit 16 and is dispersed

by a liquid divider 17 for gravity flow over the plurality of cooling coils 8. The liquid divider 17 may be of any suitable form for delivering absorbent uniformly throughout the length of the uppermost pipe sections 9 of the cooling coils 8. With such a liquid divider 17, the absorbent liquid is supplied to the uppermost pipe section 9 of each cooling coil 8 by a dripper plate 18 having a depending serrated edge 19 overlying the pipe section. Liquid is supplied to the dripper plate 18 from a longitudinal trough of the liquid divider 17 by a capillary cover plate 20 of the type illustrated and described in detail in said Edberg patent. Absorbent liquid drips from the lower serrated edge 19 of the plate 18 onto the top of the uppermost pipe sections 9 and flows by gravity over the surface of the pipe section and drips onto the next lowermost pipe section and thus flows by gravity from the top to the bottom of each cooling coil 8 to wet its entire surface area with absorbent liquid.

In accordance with the present invention wire loops surround each pipe section loosely at intervals along its length to provide a space between the loops and the sides and bottom of the pipe. The loops are preferably formed by the turns *t* of a helically coiled wire 25 extending between the stanchions 11. The ends of the coiled wires 25 may be formed parallel with the stanchions 11 but preferably they are merely cut to length so that their ends engage the stanchions at a single point, see Fig. 2. As illustrated in detail in Figs. 3 and 4 the cylinder of each helically coiled wire 25 has an inside diameter slightly greater than the outside diameter of the pipe sections 9 to provide a space *a* between each turn *t* of the coil and the sides and bottom of the pipe sections 9. The size of the wire, the pitch between adjacent turns and the spacing *a* depends upon the viscosity of absorbent solution. As one example, No. 14 wire (B. & S. gauge) having a diameter of .064 of an inch and wound in a helical coil 25 on a cylinder having an inside diameter of $2\frac{1}{32}$ of an inch with the individual turns *t* spaced apart ½ inch when mounted on pipe sections ⅝ of an inch in diameter have produced a very good liquid distribution of a 50% lithium bromide solution throughout the surface area of the pipe sections 9. With helically coiled wires 25 and pipe sections 9 of the dimensions indicated, a space *a* of $\frac{1}{32}$ of an inch is provided between the bottom of the pipe sections and the inside of the individual turns *t* of the coils.

The helically coiled wires 25 are relatively inexpensive to manufacture and are adapted to be assembled on the pipe sections 9 of the cooling coils 8 with facility. When assembling the cooling coils 8 into an integral structure one end of the pipe sections 9 is first inserted through holes in one of the supporting plates 11. A helically coiled wire 25 is then slid over the free end of each pipe section 9. The intermediate supporting plate 11 is placed in position on the pipe sections 9 after which another set of the helically coiled wires 25 is slid over the free ends of the pipe sections. The third plate 11 is mounted in position at the opposite ends of the pipe sections 9 and the pipes are connected to the supporting plates or stanchions 11 as by tack welding or the like to provide a rigid structure. The U-shaped connectors 10 then may be welded to the ends of adjacent pipe sections alternately at the opposite sides to form continuous cooling coils 8. To complete the assembly the ends of the individual cooling coils 8 are connected to the headers 12 and 14, respectively, to adapt a cooling medium to be circulated therethrough. The liquid divider 17 is mounted on the top of the stanchions 11 as illustrated in Fig. 2 so that a dripper plate overlies the uppermost pipe section 13 of each individual cooling coil 8. The assembly of cooling coils 8 and liquid divider 17 is then inserted in the absorber shell 5 and end plates 26 applied to hermetically seal the absorber. One form of the invention having now been described in detail the mode of operation is explained as follows.

Liquid absorbent supplied through the conduit 16 is dispersed by the liquid divider 17 and delivered through the cover plates 20 onto the sides of the dripper plates 18. Liquid absorbent drips from the lower serrated edge 19 of the dripper plate 18 to uniformly supply absorbent liquid throughout the length of the uppermost pipe section 9 of each cooling coil 8. The absorbent liquid flows by gravity over the surface of each pipe section 9 toward the bottom and drips onto the top of the next lowermost pipe section. Thus the liquid absorbent continuously drips from pipe section to pipe section 9 from the top to the bottom of each cooling coil 8.

An absorbent liquid supplied to a particular portion of any pipe section 9 is retained between the turns *t* of the helically coiled wire 25 which limits the flow longitudinally of the pipe sections. Due to surface tension, the absorbent liquid tends to cling in the space *a* between the individual turns *t* of the helically coiled wires 25 and the periphery of the pipe sections 9 which produces a wiping action of the liquid over the surface of the pipe section as it flows in a helical path along the individual turns *t* toward the bottom of the pipe. Also the surface tension of the liquid absorbent tends to restrain its flow from the space *a* at the bottom of the pipe sections 9 so that smaller drops are formed as the absorbent liquid drips from the bottom of the individual turns of the wire. Due to their small size, the drops merely spread out into a film and flow downwardly over the sides of the next lowermost pipe section onto which they fall without splashing or bouncing away from the surface of the pipe section and falling to the bottom of the absorber.

Thus, the helically coiled wires 25 prevent the flow of liquid longitudinally in the pipe sections 9 and also act as drop formers to uniformly distribute the liquid over the entire area of the cooling coils 8 as it flows from the top to the bottom of the absorber. The uniform distribution of absorbent liquid over the entire periphery of the pipe sections 9 provides a large surface area of absorbent for absorbing refrigerant vapor and also for transferring heat to the cooling medium circulating through the cooling coils 8. Absorption solution flows by gravity from the bottom of the absorber casing 5 through the conduit 7.

It will now be observed that the present invention provides helically coiled wires loosely fitted on the pipe sections of the cooling coils in the absorber of an absorption refrigeration system. It will also be observed that the present invention utilizes the surface tension of the liquid absorbent for producing a desirable wiping action of liquid over the surface of the pipe sections as it flows in a helical path following the contour of the turns of the helically coiled wire. It will still further be observed that the loosely fitted coiled wires also produce smaller drops which avoid splashing of liquid away from the surface of pipe sections.

While a single embodiment of the invention is herein illustrated and described, it will be under-

stood that modifications may be made in the construction and arrangement of elements without departing from the spirit or scope of the invention. Therefore, without limitation in this respect, the invention is defined by the following claim.

I claim:

A heat transfer device having a plurality of pipe sections arranged one over the other in a vertical plane, means for flowing a fluid through the interior of the pipe sections, means for directing droplets of a liquid onto the exterior of the uppermost pipe section at spaced points along the top thereof which drips from the bottom of each pipe section onto the top of the next lowermost pipe section from the top to the bottom of the device, a helically wound wire surrounding each pipe section and resting on the top thereof with a space between the loops of the wire helix and the sides and bottom of the pipe section, each loop of the wire helix constituting a drip former from which liquid drips at spaced points from the bottom of the pipe section, and the space between the loops of the wire helix and the pipe section being so related to the surface tension of the liquid as to cause the liquid to cling in the space and thereby interrupt the flow of liquid longitudinally of the pipe section and form small drops as liquid drips from each loop.

JOHN DAVIDSON.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
847,552	Carlson	Mar. 19, 1907

FOREIGN PATENTS

Number	Country	Date
19,566	Switzerland	June 21, 1899
414,720	France	June 25, 1910