This invention has to do with cooling equipment and more particularly to a heat exchanger adapted to receive a coolant medium to the extent that the temperature of the substance being cooled may be quickly, easily and inexpensively lowered and in a more effective manner than has heretofore been made possible through use of conventional systems.

The most important object of the present invention to provide a cooling system incorporating a cooler having a heat exchanger provided with finned tubing for receiving the substance to be cooled, together with means for directing a cooling medium through the substance to be cooled, adapted to be associated with apparatus for lowering the temperature of the cooling medium.

Other objects include the way in which relatively telescoped, tubular elements are provided in a heat exchanger, whereby heat is removed from the substance being cooled not only by radiation convection and/or conduction, but internally through use of pipes for receiving a coolant; the way in which currents of air are used to dissipate the heat of the extended surfaces of the cooler tubes; and the way in which a control is provided to produce automatic operation of the secondary cooling system whenever the heat of the substance being cooled rises to a predetermined temperature.

Other objects include important details of construction, all of which will be made clear as the following specification progresses, reference being had to the accompanying drawings, wherein:

Figure 1 is an elevational view partially schematic and including a flow diagram of water-cooling apparatus made pursuant to one form of my present invention.

Fig. 2 is an enlarged, horizontal, cross-sectional view of the heat exchanger shown in Fig. 1.

Fig. 3 is a view similar to Fig. 2 showing a modified form of heat exchanger; and

Fig. 4 is a transverse, cross-sectional view still further enlarged illustrating the manner of mounting the relatively telescoped, tubular elements of the heat exchangers.

The cooling system embodying the principles of the instant invention includes a cooler broadly designated by the numeral 10, and adapted to be operably interconnected in the manner illustrated by Fig. 1, and as hereinafter fully described, with any suitable means for lowering the temperature of a cooling medium, such as a cooling tower 12.

The cooling tower 12 may be in the nature of that shown in Patent No. 2,650,082, issued to Leon T. Mart, on August 2, 1955, or of any other suitable construction. The cooling tower 12 shown for illustration of the principles of the instant invention, includes a hollow casing 14 containing a fill assembly 16 over which a coolant such as water to be cooled gravitates and through which currents of air are induced, forced by means of a fan 18, or caused to flow by natural draft. The hot coolant is received by a basin 20 which may have a perforated bottom 22 for distribution of the coolant over the fill assembly 16. The cooled coolant is collected by a sump 24 beneath the assembly 16.

Cooler 10 may include a conical plenum 26 provided with fan ring 28 within which a fan 30 operates to direct currents of air upwardly through a heat exchanger 32. The heat exchanger 32 as shown in Fig. 2 of the drawings, includes a pair of opposed headers 34 and 36 provided with partitions 38 and 40 respectively, presenting outer chambers 42 and 44 and inner chambers 46 and 48.

Liquid or other substance to be cooled, is directed into the inner chamber 48 by way of inlet 50, and such substance passes from the heat exchanger 32 by way of an outlet 52 communicating with the inner chamber 46.

The headers 34 and 36 are interconnected by a plurality of tubular elements which include a series of stacks of outermost tubes 54 interconnecting the chambers 46 and 48 and through which the substance being cooled flows in its passage from the inlet 50 to the outlet 52.

Each tube 54 has a pipe 56 telescoped therein and such pipes pass through the partitions 38 and 40 to place the chambers 42 and 44 into intercommunication. The tubes 54 are surrounded by a jacket 58 and are passed as shown in Fig. 4 of the drawings, the pipes 56 are held spaced from the tubes 54 by a number of spaced brackets 60 within the tubes 54 and surrounding the pipes 56. Each of the brackets 60 is provided with a number of radial legs 62 spanning the distance between the pipes 56 and the tubes 54 to hold the same relatively concentric.

The coolant emanating from the sump 24 of cooling tower 12, is directed into an inlet 64 communicating with the outer chamber 42 of header 34 whence such coolant flows through the pipes 56 and into the outer chamber 44 of the header 36. The coolant passes from the chamber 44 by way of an outlet 66 communicating with the chamber 44.

Referencing again to Fig. 1 of the drawings, there is shown a coolant line 68 interconnecting the sump 24 and the inlet 64 within which is disposed a pump 70 energized by an electric motor 72 for circulating the cold coolant from the fill assembly 16 through the heat exchanger 32. A return line 74 coupled with the outlet 66, re-directs the coolant emanating from the outer chamber 44 to the receiving basin 20 of the cooling tower 12.

The substance to be cooled flows from a point of industrial use such as from an engine 76 to the inlet 50 of heat exchanger 32, by way of a line 78 and returns to the point of use 76 by way of a line 80 coupled with the outlet 52. A pump 82 driven in any suitable manner and interposed in the line 80, recirculates such substance through the coils 54 of heat exchanger 32.

When the temperature within the line 80 rises to a predetermined point, a thermostat 84 in the line 80, closes a normally open switch 86 which energizes the motor 72 that in turn has a source of power (not shown) coupled with input lines 88 and 90.

During operation of the cooling system thus far described, pump 82 operates continuously to direct the substance being cooled from the point of use 76, through line 78 and into the inlet 50 of header 36. Such substance is collected by the inner chamber 48 and passes through the tubes 54 into the inner chamber 46 whence it returns to the point of use 76 in a cooled condition by way of inlet 52 and line 80.

While the substance passes through the tubes 54, a considerable amount of the heat thereof is given off through the external surfaces of the tubes 54 and the extended surfaces 58 thereon. Such heat is dissipated and removed by continued operation of the fan 30 directing currents of air upwardly through the plenum 26 and across the tubes 54 and their surfaces 58.
In the event however, that the temperature of the substance has not been lowered sufficiently to meet the purposes of its industrial application, prime mover 72 will be automatically energized whenever the temperature of the substance in the line 80 rises to a predetermined point for operating the thermostatic switch 84. Coolant in the sump 24 will thereupon be immediately pumped through the line 68 into the inlet 64 and through the pipes 56 for return to the receiver 20 of the cooling tower 12 by way of line 74. The fan 18 may be permitted to operate continuously or have its prime mover similarly coupled in the circuit shown in Fig. 1 to commence operating when the switch 86 closes. The hot coolant flowing to the receiver 20 by way of line 74 will gravitate through the fill assembly 16 of tower 12 and by evaporative cooling with the aid of the air circulated there-through by fan 18 will be in a condition to still further lower the temperature of the substance in the tubes 54 because of the fact that the pipes 56 are in heat exchange relationship thereto.

A modified form of heat exchanger 132 is shown in Fig. 3 of the drawings and which includes a pair of opposed headers 134 and 136. The header 134 is subdivided into a plurality of superimposed chambers 143, 145 and 147 by partitions 137 and 139. Header 136 has a partition 140 presenting a pair of superimposed chambers 154 and 156.

The system for passage of substance to be cooled and emanating from the source 76, is continuous in the heat exchanger 132 by virtue of the fact that chambers 143 and 149 are connected by a plurality of tubes 154, the chambers 145 and 149 being joined by a number of tubes 155, chambers 145 and 151 being connected by a number of tubes 157 and chamber 151 being placed into communication with chamber 147 by a series of spaced tubes 159. Tubes 154, 155, 157 and 159 are all preferably provided with external surfaces such as fins 158 as in the case of the heat exchanger 32.

It is seen, therefore, that the substance to be cooled flows from line 78, through inlet 150 and into the chamber 143 of header 134. Such substance flows from chamber 143 through tubes 154, chamber 149, tubes 155, chamber 145, tubes 157, tubes 159, and chamber 147 to outlet 152 and into the return line 80.

The tubular elements for circulating the cold coolant emanating from the tower 12 that is included in the heat exchanger 132, is likewise in the form of pipes 156, arranged in continuous coils extending through, or telescoped within corresponding tubes 154, 155, 157 and 159. It is to be noted that all of the coils or pipes 156 traverse the two headers 134 and 136 and communicate with a pair of secondary headers 133 and 135, the former of which is provided with outlet 166 and header 135 being provided with inlet 164 coupled with line 74 and 68 respectively.

When the heat exchanger 132 is utilized in the cooling system, the operation is the same as above described with respect to the form embodying the heat exchanger 32.

It is to be appreciated that cooler 10 may include extended surfaces 58 or 158 of any suitable character and that the heat may be removed therefrom by natural draft, by induced currents of air or by a forced draft as shown. The substance to be cooled may be directed through the heat exchanger by gravity or by any other force and need not be recirculated as shown.

Similarly, the nature of the cooling medium flowing into and out of the heat exchanger is of no significance nor is it important that it be recirculated or cooled in any particular fashion.

Having thus described the invention what is claimed as new and desired to be secured by Letters Patent is:

A cooling unit comprising in combination a cooler including a heat exchanger having a pair of spaced, hollow headers provided with a series of spaced, externally finned tubes interconnecting the same, fan means disposed to force air across the tubes to remove heat from the fins thereof, and a pipe telescoped through each tube respectively; structure including conduit means for circulating a liquid refrigerant into one of said headers, through the tubes, into the other header, and thence into heat exchange relationship to apparatus to be cooled by the refrigerant; a water cooling tower having a fill assembly for gravitational flow of hot water therethrough, means for forcing air through the assembly to cool the circulating water, and a sump below the assembly for collecting the cool water; means including a pump having an electric prime mover for circulating said cool water from the sump through the pipes and thence to the assembly; and control means for said pump including a thermostat in said conduit means responsive to the temperature of the refrigerant therein, and electric switch means operably coupled with said thermostat and with said prime mover.

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