

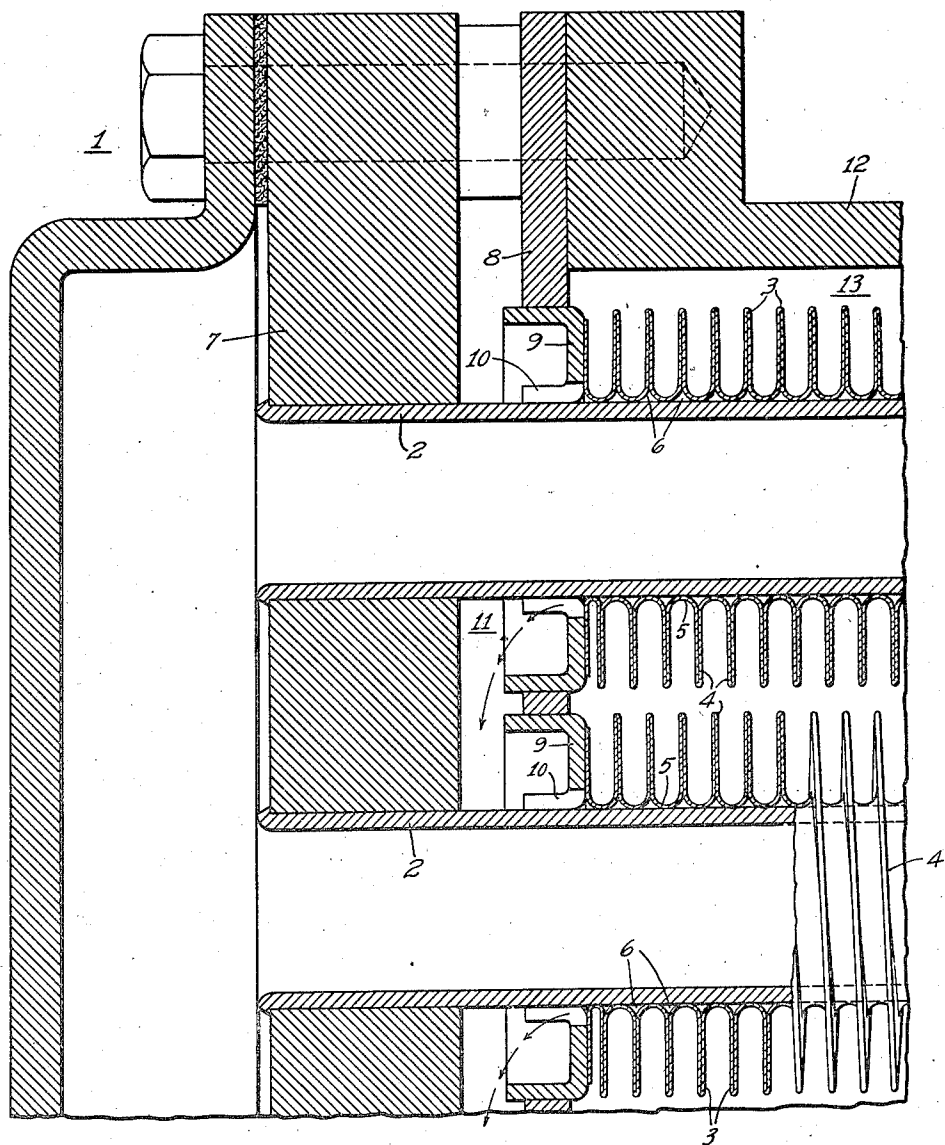
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WATER COOLER

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WITNESSES:

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WATER COOLER

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My invention relates to heat-exchange units, and particularly to water-circulating coolers for cooling the air which cools a large dynamo-electric machine for shipboard-use. In ocean-going vessels it is customary and desirable to use the salt sea-water to circulate in the pipes of the coolers for cooling the ventilating air of large dynamo-electric machines, and it is frequently desirable to place these coolers in such a position that any water-leakage which develops might get down into the vital parts of the machine, or might be carried there by the air-stream. In installations where the utmost reliability is required, it has been customary to provide such a construction that the water from a leaky tube would not come into contact with the air-stream, and it is a particular object of my invention to provide a novel construction for this purpose.

In the past, various means have been utilized for the purpose in question, the usual means involving a so-called double-tube construction in which each liquid-conducting tube is tightly surrounded by an outer tube or conduit, which is in turn surrounded by a fin-structure, the bore of the outer tube being provided with longitudinally extending slots or ducts which will carry off any water leaking from the inner, or liquid-conducting, tube. This construction, while satisfactory, is nevertheless quite expensive, its rate of heat-transfer is not as high as desirable, and the weight of the tubes is increased approximately 25% by adding the longitudinally slotted outer tubes or conduits, which have to have a considerable wall-thickness in order to accommodate the longitudinal slots.

It is an object of my present invention to provide a type of construction in which each of the liquid-conducting tubes is tightly surrounded by a finned heat-exchange tube in the form of a seamless flexible thin-walled tube having a spiral fin formed integrally thereon, as a part of the wall of the tube, the parts of the heat-exchange tube, between the successive convolutions of its spiral fin, being in good heat-exchanging engagement with respect to the liquid-conducting tube, the spiral fin providing a small spiral duct between the heat-exchange tube and the liquid-conducting tube. I am thus enabled to utilize the small spiral duct as a means for carrying away any leakage-water that may escape from the inner tube.

With the foregoing and other objects in view, my invention consists in the parts, apparatus, structures, combinations and methods hereinafter

described and claimed, and illustrated in the accompanying drawing, the single figure of which is a cross sectional view of a part of one end of a heat-exchange unit constructed in accordance with my invention.

My heat-exchange unit has a header 1 at each end, and a series of liquid-conducting tubes 2 between the headers. Each liquid-conducting tube is tightly surrounded by a finned heat-exchange tube 3, having a spiral fin 4 formed integrally thereon as a part of the wall of the tube, such tubes being readily available on the market. One form of such spiral-finned tube is a seamless flexible thin-walled tube as shown in the drawing. Between successive convolutions of the spiral fin 4, the heat-exchange tube 3 has portions 5 which are pressed or soldered onto the inner water-tube 2, or otherwise disposed in good heat-exchanging engagement therewith. The process of forming the spiral fin 4 on the flexible heat-exchange tube 3 provides a small spiral duct 6 between the heat-exchange tube 3 and the water or other liquid-conducting tube 2, and this small spiral duct is sufficient to carry away any water which may leak out of the inner tube 2.

Each header 1 is provided with a main tube-sheet or plate 7, to which the ends of the liquid-conducting tubes 2 are joined. At least one of the headers 1, and preferably both of them, are provided with a spaced auxiliary sheet-member 8 to which the ends of the heat-exchange tubes 3 are joined, this joint being preferably effected through the means of an annular end-member 9 which is joined to the end of each heat-exchange tube 3, said end-member providing a channel 10 between itself and the inner tube 2, and the auxiliary sheet-member 8 being joined to the several annular end-members 9 of the heat-exchange tubes 3. In this manner, the auxiliary sheet-member 8 and the annular end-members 9 provide communication from the several spiral ducts 6 to the space 11 between the auxiliary sheet-member 8 and the main sheet-member 7 of its header.

In operation, the heat-exchange unit or cooler is provided with a cooler-frame or duct-portion 12 which joins the two headers 1, and which provides an inner air-space 13 in which the air to be cooled is passed, so that the air-stream passes over the outside of the finned heat-exchange tubes 3, said air being confined by the cooler-frame 12 and the auxiliary sheet-members 8 of the headers. It will be noted that the finned tubes 3 serve to keep the cooled air out of contact with any water which may leak out

from the inside of the inner tubes 2, or from the joints between these tubes and the main tube-plate or sheet-member 7 of either header. At the same time, the fact that the fins 4 are integral with the wall-portions 5 of the outer tubes insures a better heat-transfer path, from the water within the inner tubes 2, than was obtained in previous constructions in which the heat had to pass through two joints, first from the inner tube to the outer tube, and then from the outer tube to a separate fin-structure which surrounded the same. At the same time, the fact that my outer tube is thin-walled and flexible, means a very considerable reduction in weight and cost, as compared with the past practice.

I claim as my invention:

1. A heat-exchange unit having a header at each end, a series of liquid-conducting tubes between the headers, a finned heat-exchange tube on each liquid-conducting tube, each heat-exchange tube having a spiral fin formed integrally thereon as a part of the wall of the tube, the parts of the heat-exchange tube between the successive convolutions of its spiral fin being in good heat-exchange engagement with respect to the liquid-conducting tube, the spiral fin providing a small spiral duct between the heat-exchange tube and the liquid-conducting tube, each header having a main sheet-member to which the ends of the liquid-conducting tubes are joined, and at least one of the headers having a spaced auxiliary sheet-member to which the ends of the heat-exchange tubes are joined, said auxiliary sheet-member providing communication from the several spiral ducts to the space between said auxiliary sheet-member and the main sheet-member of its header.

2. A heat-exchange unit having a header at each end, a series of liquid-conducting tubes between the headers, a finned heat-exchange tube on each liquid-conducting tube, each heat-exchange tube having a spiral fin formed integrally thereon as a part of the wall of the tube, the parts of the heat-exchange tube between the successive convolutions of its spiral fin being in good heat-exchanging engagement with respect to the liquid-conducting tube, the spiral fin providing a small spiral duct between the heat-exchange tube and the liquid-conducting tube, an annular end-member joined to at least one end of each heat-exchange tube, said annular end-member providing a channel between itself and the associated liquid-conducting tube, each header having a main sheet-member to which the ends of the liquid-conducting tubes are joined, and at least one of the headers having a spaced auxiliary sheet-

member to which the annular end-members are joined, said auxiliary sheet-member and the annular end-members providing communication from the several spiral ducts to the space between said auxiliary sheet-member and the main sheet-member of its header.

3. A heat-exchange unit having a header at each end, a series of liquid-conducting tubes between the headers, a finned heat-exchange tube on each liquid-conducting tube, each heat-exchange tube being a flexible thin-walled tube having a spiral fin formed integrally thereon as a part of the wall of the tube, the parts of the heat-exchange tube between the successive convolutions of its spiral fin being in good heat-exchanging engagement with respect to the liquid-conducting tube, the spiral fin providing a small spiral duct between the heat-exchange tube and the liquid-conducting tube, each header having a main sheet-member to which the ends of the liquid-conducting tubes are joined, and at least one of the headers having a spaced auxiliary sheet-member to which the ends of the heat-exchange tubes are joined, said auxiliary sheet-member providing communication from the several spiral ducts to the space between said auxiliary sheet-member and the main sheet-member of its header.

4. A heat-exchange unit having a header at each end, a series of liquid-conducting tubes between the headers, a finned heat-exchange tube on each liquid-conducting tube, each heat-exchange tube being a flexible thin-walled tube having a spiral fin formed integrally thereon as a part of the wall of the tube, the parts of the heat-exchange tube between the successive convolutions of its spiral fin being in good heat-exchanging engagement with respect to the liquid-conducting tube, the spiral fin providing a small spiral duct between the heat-exchange tube and the liquid-conducting tube, an annular end-member joined to at least one end of each heat-exchange tube, said annular end-member providing a channel between itself and the associated liquid-conducting tube, each header having a main sheet-member to which the ends of the liquid-conducting tubes are joined, and at least one of the headers having a spaced auxiliary sheet-member to which the annular end-members are joined, said auxiliary sheet-member and the annular end-members providing communication from the several spiral ducts to the space between said auxiliary sheet-member and the main sheet-member of its header.

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