Oct. 8, 1957 A. B. NEWTON 2,809,019

COOLING APPARATUS

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Fig. 1

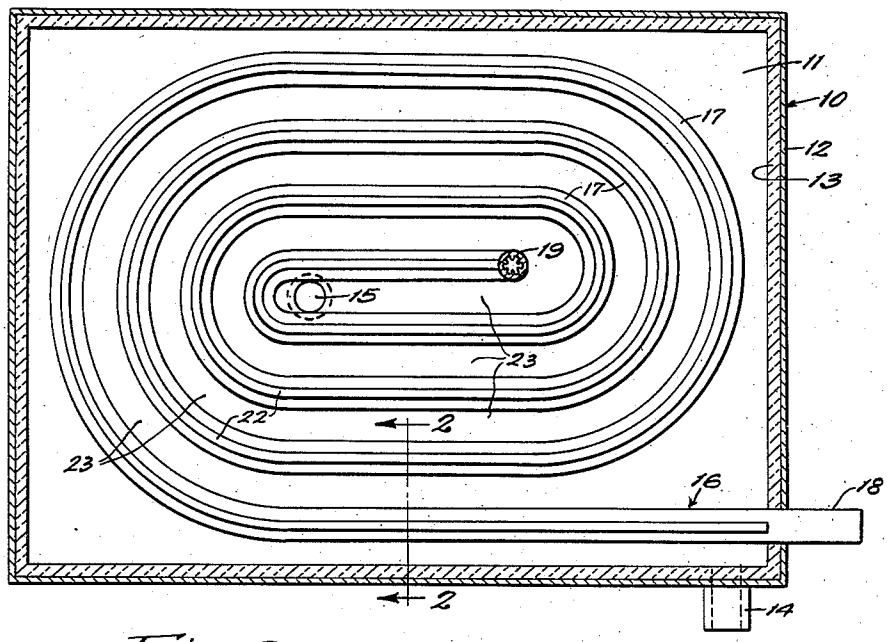


Fig. 2

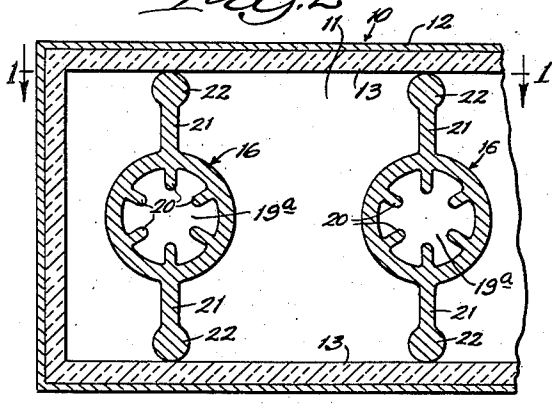
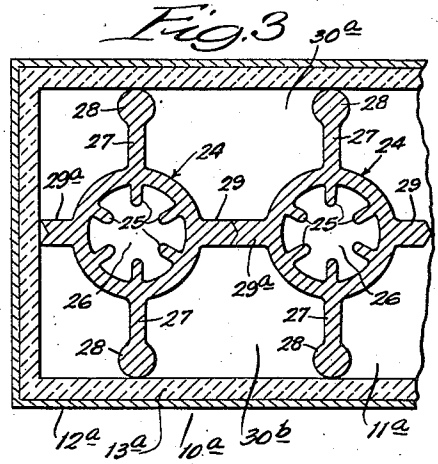


Fig. 3



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COOLING APPARATUS

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5 Claims. (Cl. 257—241)

This invention relates to cooling apparatus, and more particularly to a heat exchanger in which a liquid refrigerant is expanded through an elongated conduit, which throughout its length is in heat exchange relation with a fluid to be cooled. The apparatus is useful especially in the chilling of water and other liquids.

An object of the invention is to provide cooling apparatus in which a circulating coolant is effectively and efficiently utilized to cool a fluid that is circulated in heat exchange relation therewith. Another object of the invention is in providing cooler apparatus wherein a circuitous flow channel for a fluid to tbe cooled is defined in part by a convoluted conduit through which a coolant is expanded, the fluid being maintained in heat exchange relation with the conduit throughout an extensive flow path. Still another object is the provision of a heat exchanger in which a refrigerant is expanded through an elongated conduit coiled to form exteriorly thereof, in conjunction with a closure member, a generally spiral flow passage, provision being made for a liquid to be cooled to enter the flow passage adjacent one end of the conduit and to be discharged therefrom adjacent the other end of the conduit whereby the liquid is maintained in heat exchange relation throughout its extensive length. A still further object is to provide suitable ratios of internal and external area in the heat transfer device for maximum transfer of heat.

A further object is to provide a heat exchanger for cooling liquids in which an elongated externally finned tube is enclosed in a container with the fins thereof in substantially sealing relation with the walls of the container, the tube being spirally coiled about itself whereby a continuous spiral flow passage is formed externally of the tube and extending from one end to the other thereof, provision being made to introduce a liquid to be cooled into the flow passage adjacent one end of the tube and to withdraw it adjacent the other end of the tube, with the result that a refrigerant expanded through the tube is effective to chill a liquid moving through the flow passage. Additional objects and advantages will appear as the specification proceeds.

Embodiments of the invention are illustrated in the accompanying drawing, in which—

Figure 1 is a longitudinal sectional view taken on the line 1—1 of Fig. 2; Fig. 2 is a transverse sectional view taken on the line 2—2 of Fig. 1; and Fig. 3 is a broken transverse sectional view similar to that of Fig. 2 but showing a modified form of the invention.

The heat exchanger or the cooling apparatus comprises a container 10 providing a substantially closed chamber 11 therein. The container is preferably defined by an outer shell 12 which has side walls and a top and bottom wall all secured together in sealing relation to provide a liquid-tight chamber. Preferably the interior of the shell 12 is completely covered with an insulating lining or layer 13 that may be formed from any suitable insulating material that most desirably is relatively rigid but yet is somewhat resilient. The purpose of the resiliency will be brought

out hereinafter. The material used to form the insulation 13 may be foam glass, balsa wood, "Rubatex" or other similar materials.

The container 10 is equipped with an inlet 14 and an outlet 15, both of which communicate with the chamber 11 through the shell 12 and insulation 13. It will be apparent that the inlet and outlet for the chamber 11 may be interchanged and that while in the drawing the port 14 has been designated as the inlet and the port 15 as the outlet, the order may be reversed and the port 15 may serve as the inlet and the port 14 as the outlet in certain instances.

An elongated tube or conduit 16 is mounted within the chamber 11 and is coiled upon itself to form a plurality of generally spiral turns 17. The space between adjacent turns can be varied and is preferably chosen according to the rate of flow and the flow characteristics of the fluid to be cooled. One end of the conduit 16 extends outwardly through a side wall of the container 10 to provide an inlet 18 which may be connected to a suitable source of coolant. The other end of the conduit 16 forms a discharge port 19, which also extends outwardly and through the walls of the container 10. Any suitable coolant may be flowed through the conduit 16 and I desire to evaporate a refrigerant in the internal flow passage 19*a* that is provided by the conduit. In such a case, one end of the conduit will be connected to a source of liquid refrigerant that is under pressure and through customary expansion valves this refrigerant will be expanded into the conduit 16. The evaporated and heated refrigerant will be drawn from the conduit at the opposite end thereof, from where it may be taken to a cooler and compressor, etc., as is customary in refrigerating apparatus.

The conduit 16 is equipped with a plurality of longitudinally extending internal fins 20. The fins 20 are equally spaced apart and extend from one end of the conduit 16 to the other end thereof. If desired, the fins 20 may be straight or they may be formed on a spiral having a relatively long pitch. It will be appreciated that the internal fins 20 are operative to facilitate heat exchange between a liquid or other fluid which will be in contact with the tube 16 about the exterior surface theerof and the refrigerant which is evaporated in the passage 19*a* provided within the conduit.

The conduit 16 is equipped with external fins 21 which in the particular illustration given are diametrically opposed and lie within the same vertical plane extending through the longitudinal axis of the conduit. The fins 21 may be equipped at their ends with enlargements or bulb sections 22 which will strengthen the fins. Preferably, the external fins 21 and the enlarged end portions 22 thereof, and also the internal fins 20, are all formed integrally with the conduit 16. The conduit should be formed from a material having good heat-conducting properties, such as aluminum, copper, etc. I desire to form the conduit 16 and its internal and external fins in an extrusion process and desirably the conduit, etc. is extruded aluminum, copper, or the like. It will be apparent that other good heat-conducting materials might be used and the fins could be separate members rigidly secured to the tube in an appropriate manner.

It has been mentioned heretofore that preferably the insulation 13 is slightly resilient though relatively rigid. The reason for this is that the enlarged end portions 22 of the exterior fins 21 engage the insulation 13 and should form a substantially liquid-tight seal therewith. Thus, the fins 21, which extend longitudinally along the top and bottom of the conduit 16, engaging throughout their entire length the insulation 13 and thereby the conduit in conjunction with the container, form an elongated flow passage 23 which winds spirally within the chamber 11 and exteriorly of the conduit 16. One end of the pas-

sage 23 communicates with the inlet 14, while the opposite end of the passage 23 communicates with the outlet 15. Thus the conduit 16 not only provides an internal flow passage therethrough, but at the same time, in combination with the walls of the container 10, forms an external flow passage within the container 11 that extends from one end to the other of the conduit 16.

The insulation is preferably a material which combines its insulating properties with a high strength, will not absorb or be adversely affected by the liquid with which it is in contact and is capable of being strongly and permanently bonded to the external casing 12. Typical materials which have proven suitable are balsa wood, foam glass, or a closed cell form of expanded glass or curved rubber. Foam glass and balsa wood have been particularly effective.

A slightly modified form of the invention is illustrated in Fig. 3. In the form of the invention there illustrated, the container 10 is substantially the same as that heretofore described and will be designated with the numeral 10*a*. Similarly, the chamber provided within the container is designated with the numeral 11*a*, the shell with the numeral 12*a* and the insulating material with the numeral 13*a*. The conduit 24 is quite similar to the conduit 16 heretofore described, and is equipped with a plurality of spaced-apart internal fins 25 which extend inwardly and toward the center of the flow passage 26 provided internally of the conduit 24. The conduit 24 is also equipped with external fins 27 having enlarged end portions 28 and which are substantially identical to the fins 21 with which the conduit 16 is equipped.

As is shown clearly in Fig. 3, the conduit 24 is also equipped with a pair of relatively short horizontal fins 29 and 29*a* that extend laterally from the walls of the conduit 24 and have mating ends. It is seen that the external fins 29 are spaced apart by 180° on the conduit 24 while the fins 27 are spaced apart also by 180° and that the spacing between the fins 27 and fins 29 is substantially 90°.

In this form of the invention, the conduit 24 is coiled about itself to provide spaced-apart turns, just as is shown in Fig. 1. However, the external fins 29 of adjacent turns of the conduit 24 are brought into contiguous relation as shown in Fig. 3. Similarly, the fin 29 adjacent the insulation 13*a* of the container 10*a* is brought into abutting relation therewith. Thus, instead of a single continuous spiral flow passage being provided externally of the conduit 24 and within the chamber 11*a*, in effect, a pair of small passages are formed one above the other. These flow passages are designated in Fig. 3 with the numerals 30*a* and 30*b*. It will be appreciated that both the inlet and the outlet for the container 10*a* must communicate with each of the passages 30*a* and 30*b*. This is readily accomplished, and if the container is generally rectangular as shown in the drawings and if the conduit 24 has arcuate turns as illustrated in Fig. 1, then an inlet for the container 10*a* will readily communicate with each of the upper and lower flow passages for the flange or fin 29 will not engage the insulating layer of the container at the corner portions thereof. Then at these corner portions the upper and lower flow passages will merge into a single passage.

It will be apparent that two or more stacked spiral conduits may be employed within a container and the stacks may or may not be separated by an insulating separator which would be positioned between the adjacent bulbs 22 or 28 of the external fins, depending upon whether the liquid to be cooled is intended to flow in parallel or in series through the flow passages formed by the stacked conduits. I have found that the cooler is particularly useful in chiller apparatus having a capacity of from two to ten tons and where no more than two separate refrigerating circuits are provided.

In use of the cooler, a refrigerant is expanded through the conduit 16 with either the end portion 18 or 19 thereof serving as the inlet for the expanding refrigerant and the remaining end portion will serve as the outlet for the evaporated refrigerant. Similarly, the fluid to be cooled, which may be a liquid such as water, will enter the casing through one of the ports 14 or 15 and will be withdrawn from the other. The liquid to be cooled will flow continuously through the elongated flow passage 23 which spirals about the coiled conduit 16. The external fins 21 and the enlarged portions 22 thereof sealingly engage the insulating cover on the walls of the container and between adjacent turns of the conduit a definite sealed flow passage is formed. Thus, liquid will flow without escape from the inlet to the outlet of the container and completely through the spiral flow passage provided therefor. In the structure shown in Fig. 3, the use is substantially the same except that fluid entering the container 10*a* will be divided and will flow through the separated sections 30*a* and 30*b* of the spiral flow passage.

While in the foregoing specification embodiments of the invention have been illustrated and described in considerable detail for purposes of providing an adequate disclosure of the invention, it will be apparent to those skilled in the art that numerous changes may be made in these details without departing from the spirit and principles of the invention.

I claim:

1. In a heat exchanger, an elongated and coiled conduit being provided with an internal flow passage therethrough and having a plurality of spaced-apart internal fins extending inwardly and longitudinally throughout said passage, said conduit also being provided with two pair of diametrically opposing external fins extending laterally and longitudinally along said condit, a container providing a chamber for receiving said conduit therein and being provided with an inner wall covered with a resilient lining, one of said pairs of external fins extending vertically to sealingly engage the resilient lining of said container and the other of said pairs of external fins extending horizontally for sealing engagement with the horizontal external fins of the adjacent portions of said coiled conduit for providing a pair of circuitous external flow passages between said conduit and the inner wall of said container, said container being provided with an inlet and an outlet for each of said internal and external flow passages.

2. The structure of claim 1 in which said horizontally extending external fins abut the horizontally extending external fins of adjacent portions of said conduit, said horizontal fins having mating ends for providing a fluid-tight seal therebetween.

3. In a heat exchanger, an elongated and coiled conduit being provided with an internal flow passage therethrough, having at least an internal fin extending inwardly and longitudinally throughout said pasage, said conduit also being provided with two pairs of diametrically opposing external fins extending laterally and longitudinally along said conduit, a container providing a chamber for receiving said conduit therein and being provided with an inner wall covered with an insulation lining, one of said pairs of external fins extending vertically to sealingly engage the lining of said container and the other of said pairs of external fins extending horizontally for sealing engagement with the horizontal external fins of the adjacent portions of said coiled conduit for providing a pair of circuitous external flow pasages between said conduit and the inner wall of said container, said container being provided with an inlet and an outlet for each of said internal and external flow passages.

4. The structure of claim 3, in which the horizontal fins in sealing engagement with each other have contacting portions forming a V-interlock.

5. In a heat exchanger, an elongated and coiled conduit being provided with an internal flow passage therethrough, said conduit being provided with two pairs of angularly-related external fins extending laterally and

longitudinally along said conduit, a container providing a chamber for receiving said conduit therein and being provided with an inner wall covered with an insulation lining, one of said pairs of external fins extending outwardly into sealing engagement with the resilient lining of said container to provide a flow passage therewith, and the other of said pairs of external fins extending horizontally for sealing engagement with the horizontal external fins of the adjacent portions of said coiled conduit for providing a pair of circuitous external flow passages between said conduit and the inner wall of said container, said horizontal external fins having their mating ends

interlocked to provide a V-joint, said container being projided with an inlet and outlet for each of said internal and external flow passages.

References Cited in the file of this patent

UNITED STATES PATENTS

2,129,300	Bichowsky	Sept. 6, 1938
2,286,271	Higham	June 16, 1942
2,436,389	Kleist	Feb. 24, 1948
2,467,668	Hallberg	Apr. 19, 1949
2,488,615	Arnold	Nov. 22, 1949