A cooler with an inner core created from a plurality of extruded plates is disclosed. The plates have a first side with rigid fins and an opposite side that is substantially flat. The extruded plates are stacked on top of each other to create cooling channels. The plates are then held within a container which has an input, an output and can be sealed to prevent leaks.
Fig. 2
Fig. 5
COOLING APPARATUS USING STACKABLE EXTRUDED PLATES

BACKGROUND

[0001] Coolers of various types are used to cool a medium, often a liquid, by transferring a medium through pipes or vessels that have fins or extensions. The fins have a larger surface area to transfer the heat away from the pipe or vessel. In addition, the cooler may spread the medium over a larger surface area and the larger surface area is subject to cooling forces such as a cooling airflow.

[0002] However, creating the fins in an economical way out of corrosion resistant materials has proven to be a challenge. In addition, past coolers have had a limited life span and high weight. Further, attempting to fix the coolers was difficult and costly.

SUMMARY

[0003] A cooler with an inner core created from a plurality of extruded aluminum plates is disclosed. The plates have a first side with rigid fins and an opposite side that is substantially flat. The extruded plates are stacked on top of each other to create cooling channels. The plates are then held within a container which has an input, an output and can be sealed to prevent leaks. Further, the container itself may be extruded and have fins to further dissipate heat.

[0004] Advantageously, if the core is damaged or clogged, one or more of the plates that make up the core may be easily removed and replaced. Further, as the plates are aluminum, they will not rust or degrade.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] FIG. 1 is an illustration of the cooler with the side open;

[0006] FIG. 2 is a sectional view of a first extruded plate and an additional extruded plate;

[0007] FIG. 3 is an illustration of a plurality of extruded plates stacked to create an inner core;

[0008] FIG. 4 is an illustration of the openings inside the core created by the stacked extruded plates;

[0009] FIG. 5 is an illustration of the inner core inside the container; and

[0010] FIG. 6 is an illustration of the inner core inside the container.

DESCRIPTION

[0011] FIG. 1 illustrates a cooling apparatus 100. The cooling apparatus 100 may have a container 110 and an inner core 120. The inner core 120 may be a plurality of extruded plates 130 that are stacked on top of each other inside the container 110. The container may have an input 140 and an output 150 and a plurality of cooling fins 160.

[0012] The container 110 may be virtually any shape as long as it can hold the inner core 120 and fit in the desired location. Further, to be effective, the container 110 may have cooling fins 160 which may affect the shape. The shape of the container 110 also may be affected by the use of the cooling apparatus 100. For example, if the cooling apparatus 100 is for a passenger car where airflow is plentiful and heat is not extreme, a smaller cooling apparatus 100 with less cooling fins 160 may be necessary. If the cooling apparatus 100 is for a large earth mover where airflow may be low and temperatures may be high, a larger cooling apparatus 100 with additional cooling fins 160 may be required.

[0013] The shape of the container 110 also may be designed for specific materials to be cooled. For example, cooling a thick fluid may require a larger cooling apparatus 100 with larger openings in the inner core 110. Similarly, cooling a thin liquid that flows easily may require a smaller container 110 and smaller openings in the inner core 120.

[0014] In one embodiment, the container 110 is made from aluminum. Advantageously, aluminum is light weight and is corrosion resistant. In addition, container 100 may be extruded and machined into the desired shape, making manufacturing simple and cost effective. The fins 160 may be aluminum, and as can be seen in FIG. 6, may be extruded and may be part of the container 110 extrusion or may be extruded and attached separately.

[0015] As mentioned previously, the container 110 may have an input 140 and an output 150. In FIGS. 1, 4, 5 and 6, a first side 170 and an opposite side 180 are illustrated as being open, and the first side 170 could be considered an input 140 and the opposite side 180 could be considered an output 150. Of course, the size, location and type of input 140 and output 150 may vary based on the use, the material to be cooled, the placement of the cooling apparatus 100, etc. For example, in an embodiment, the first side 170 and opposite side 180 may be sealed shut using plates or seals, and orifices, such as hose connections, may be used as inputs 170 and outputs 180. In this embodiment, the first side 170 may be opened, the inner core 120 may be placed inside the container 110, and then the container 110 may be sealed shut. In this way, the inner core 120 may be easily serviced. The placement of the input 140 and output 150 may be adjusted based on the orientation of the inner core 120 with the purpose being to spread the material to be cooled over a larger surface area to allow the heat to be extracted from the material.

[0016] Inside the container 110, an inner core 120 may be used to assist in cooling the material. The inner core 120 may be made up of a series of plates 130. Two sample plates 130 135 are illustrated in FIG. 2. The plates 130 135 may be made from any appropriate material that can withstand the heat and stress of the intended use of the cooling apparatus 100. In one embodiment, the plates 130 135 are made of extruded aluminum such as 6061 T6 aluminum.

[0017] In shape, the plates 130 135 may have a first side 220 that has a plurality of plate cooling fins 200. The plate cooling fins 200 may be perpendicular to the surface of the plate. Of course, the fins 200 may have a variety of orientations, including a variety of orientations on the same plate 130 135, as long as the fins provide the desired cooling and strength.

[0018] The length of the plate cooling fins 200 may be appropriate to create a desired cavity 210 size. For example, a material to be cooled that is thick or especially viscous may require a cavity 210 that is larger than a material that is thin or less viscous. Thus, the plate cooling fins 200 may be longer and the width between the plate cooling fins 200 may be more spread out.

[0019] The thickness of the plate cooling fins 200 may be such that the fins may support a plurality of plates 130 being stacked on top of the fins 200. Further, the plate cooling fins 200 may be sized such that the force of the material being forced through the cavities 210 and plate cooling fins 200 will not distort the fins.

[0020] The shape of the fins 200 also may vary. In some embodiments, the fins 200 may be substantially rectangular.
In other embodiments, the fins 200 the fins may have a “T” shape such that additional support may be provided to additional plates 135 stacked on top of the plate 130. In addition, the “T” shape may provide additional surface area to cool the material. Of course additional shapes are possible and are contemplated, including non-linear and rounded shapes.

On the opposite side 230 of the first side 220 of the cooling plates 130 135, the surface may be flat. The flat surface of the opposite side 230 may be adapted to allow the plates to be stacked stack and rest on a first side 220 of an additional extruded plate 135. In some embodiments, the opposite side 230 may have notches, ridges or fingers (not shown) that assist in aligning the stacked plates 130 135 and ensure the plates 130 135 stay as desired. In some embodiments, there may be pin holes or screw holes in the plates 130 135 to assist in arranging the plates and holding the plates in the position. In yet another embodiment, there may be interlocking projections on the first side 220 and the fins 200 such that the plate cooling fins 200 and plates 130 135 interlock to hold themselves together.

Of course, in some embodiments, the plates 130 135 may have some fins 200 on the first side 220 and some fins 200 on the opposite side 230 and the fins 200 from the first side 220 of a first plate 130 may be oriented to not interfere with the fins 200 on the opposite side 230 of the addition plate 135. As an example, every other fin 200 may be on different sides of the first plate 130 and the fins 200 from the addition plate 135 may interface with the fins 200 from the first plate 130 to create a desired core 120 with desired openings 210.

In yet another embodiment as illustrated in FIG. 5, the interior of the container 110 may have holders 500 which may be feet or wedges to lock the cooling plates 130 into position. The holders 500 may be integral to the container 110 or may be attached to the container 110 using fasteners such as screws. In addition, the seals of the sides 170 180 may assist in holding the cooling plates 130 135 in the desired position. Of course, other methods of holding the plates 130 together are possible and are contemplated.

As mentioned previously and as illustrated in FIG. 3, if the first extruded plate 130 is stacked on the plate cooling fins 200 of an addition extruded plate 135, cooling openings 210 may be created under the first extruded plate 130 and above the additional extruded plate 135. The cooling openings 210 may be of a desired height, length and width by varying the height, length and separation of the plate cooling fins 200. The inner cooling core 120 may be made as large as desired by simply adding more cooling plates 130 135. As can be seen in FIG. 4, any damage or clogging of the core 110 or cooling plates 130 135 may be corrected by removing one plate 130 135 and replacing it with another cooling plate 130 135.

As illustrated in FIG. 6, the first extruded plate 130 and the additional cooling plates 135 may be the same width, height and depth. In other embodiments, the plates 130 135 may have different widths, heights and depths depending on the desired flow within the core 120. For example, the cooling openings 210 may be larger in the center of the core 120 and smaller on the perimeter of the core 120.

To create a core 120, a first plate 130 may be stacked on top of an additional cooling plate 135. Additional cooling plates 135 may be stacked or added until the core 120 is of a desired size based on the use of the cooling apparatus 100, the material to be cooled, the conditions in which the cooling apparatus 100 will operate, etc. The cooling plates 130 135 may be extruded and cut to a desired size, making them easy to make and easy to replace if they are damaged, worn, clogged, dirty, etc. Further, the plates 130 135 may be very cost effective to make. The plates 130 135, which are now a formed core 120, may then be fastened in place inside the container 110 using holders 500. In some embodiments, the plates 130 135 may be also be held together using fastener such as bolts or screws. The cooling apparatus 100 may then be brought into communication with an input source 140 and an output source 150. At a desired rate, the material to be cooled may be introduced into the cooling apparatus 100 through an input 140 and may leave through an output 150 once the material has been cooled as desired.

In operation, a material may be communicated to the cooling apparatus 100 through the input 140. The material, such as a fluid like oil, transmission fluid or heated exhaust air, may be introduced to the cooling core 120 through the input 140. The material may expand to fill the space in the core 120. By covering additional surface area with the material, the material is easier to cool. Thus, the material will flow through the cooling openings 210 which will assist in removing the heat from the material as the material will have extensive surface area to flow through and transfer heat. The heat inside the core may flow to the container 110 where the fins 160 may assist in further dissipating the heat from the material. At a desired time, the material will flow out of the core 120, out the output 150 and return to its source.

By using extruded plates that are cut and stacked, a heat exchanger core 120 may be produced quickly and cost effectively out of aluminum that could not otherwise be extruded or machined. It is not possible to extrude the core 120 created by the stacked the plates 130 135 as the detail is not possible in a single extrusion. The cooler 100 may be used in anything that is transferring heat from one fluid to another. The design is unique in the fact that it is so easy to achieve the common core 120 design and optimize it for thermal transfer in any length. In addition, if sufficient cooling is not present, a core 120 with different openings 210 may easily be tested and used. The practice will lend itself to filling any cooler 100 cavity.

In accordance with the provisions of the patent statutes and jurisprudence, exemplary configurations described above are considered to represent a preferred embodiment of many different embodiments. However, it should be noted that the invention can be practiced otherwise than as specifically illustrated and described without departing from its spirit or scope.

1. A cooling apparatus comprising:
   A container that comprises an input, an output and a plurality of cooling fins wherein the container encloses a cooling core;
   A cooling core inside the container wherein the cooling core comprises:
   A first extruded plate comprising:
     a first side comprising a plurality of cooling fins; and
     an opposite side of the first side comprising a flat surface;
   wherein the opposite side of the first extruded plate is adapted to stack and rest on a first side of a second extruded plate;
   The second extruded plate comprising:
     A first side comprising a plurality of cooling fins; and
     An opposite side comprising a flat surface;
wherein the first side of the second extruder plate is adapted to receive and support the opposite side of the first extruded plate in a stacking manner.

2. The cooling apparatus of claim 1, wherein if the first extruded plate is stacked on the second extruded plate, cooling openings are created under the first extruded plate and above the second extruded plate.

3. The cooling apparatus of claim 1, wherein the first extruded plate and the second extruded plate comprise the same width, height and depth.

4. The cooling apparatus of claim 1, wherein the container is adapted to be sealed to prevent leaks.

5. The cooling apparatus of claim 1, wherein the first extruded plate and second extruded plate are made from aluminum.

6. The cooling apparatus of claim 1, wherein the container is made of extruded aluminum.

7. A cooling core for use inside a container comprising:
   A first extruded plate comprising:
   a first side comprising a plurality of cooling fins; and
   an opposite side of the first side comprising a flat surface;
   wherein the opposite side of the first extruded plate is adapted to stack and rest on a first side of a second extruded plate;

The second extruded plate comprising:
   A first side comprising a plurality of cooling fins; and
   An opposite side comprising a flat surface
   wherein the first side of the second extruder plate is adapted to receive and support the opposite side of the first extruded plate in a stacking manner to create cooling openings between the cooling fins.

8. A cooling core for use inside a container comprising:
   A first extruded plate comprising:
   a plurality of cooling fins which interface with cooling fins on an additional extruded plate;
   The additional extruded plate comprising:
   a plurality of cooling fins which interface with the cooling fins on the first extruded plate;
   wherein the first extruded plate is adapted to stack and rest on the additional extruded plate to create cooling openings between the cooling fins.

9. A cooling core for use inside a container comprising:
   A first extruded plate comprising:
   a plurality of cooling fins which interface with an additional extruded plate;
   wherein the first extruded plate is adapted to stack and rest on the additional extruded plate to create cooling openings between the cooling fins.

* * * * *