April 5, 1932. E. G. SULLIVAN 1,852,490

HEAT EXCHANGER

Filed Feb. 17, 1931 2 Sheets-Sheet 1

Fig. 1.

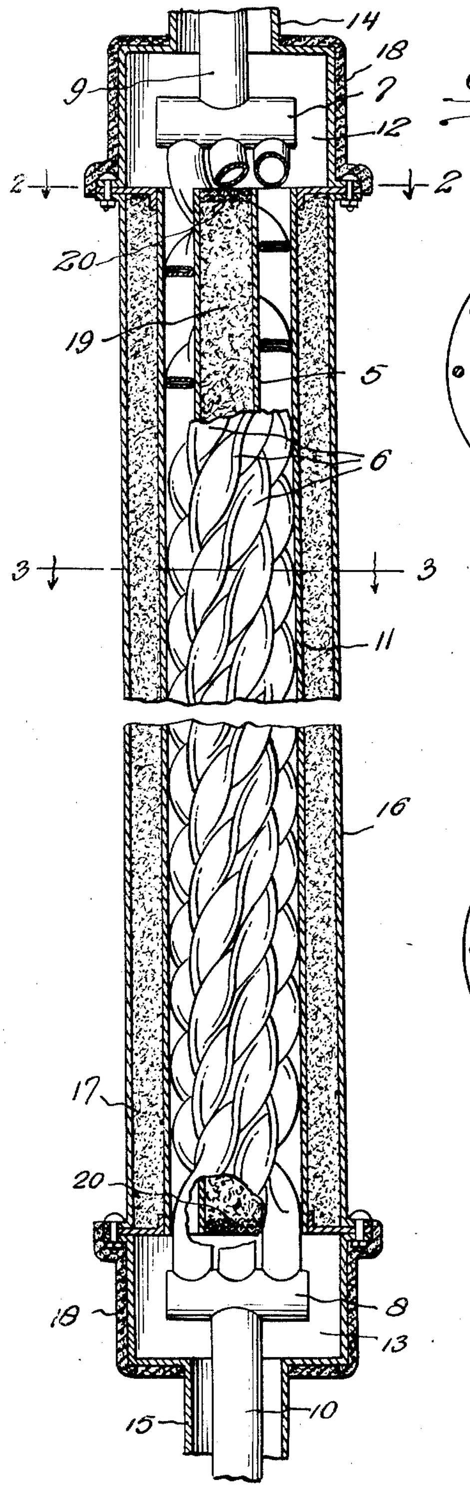

Fig. 2.

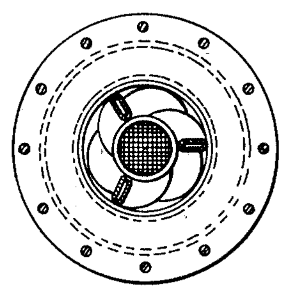

Fig. 3.

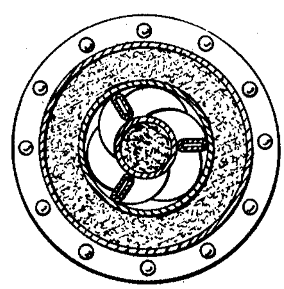

Fig. 4.

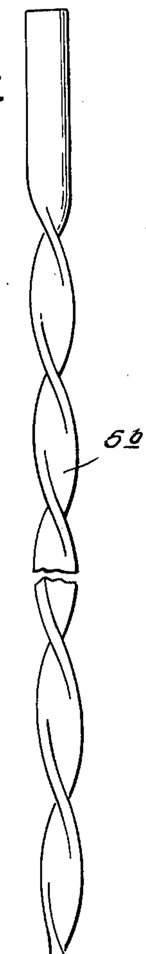

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Fig. 5.

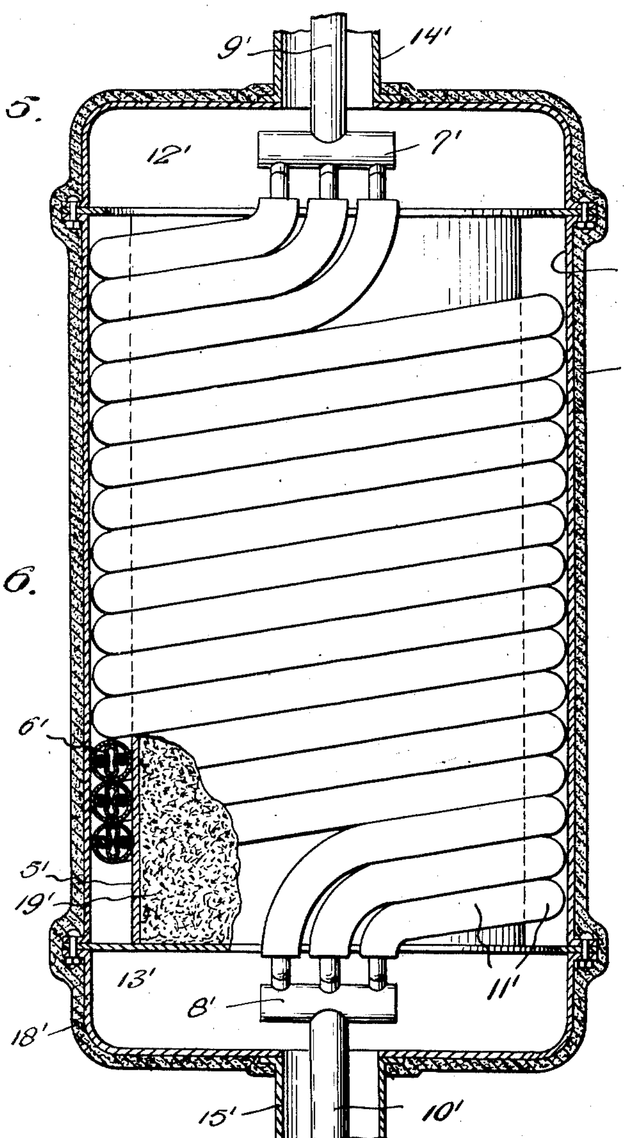
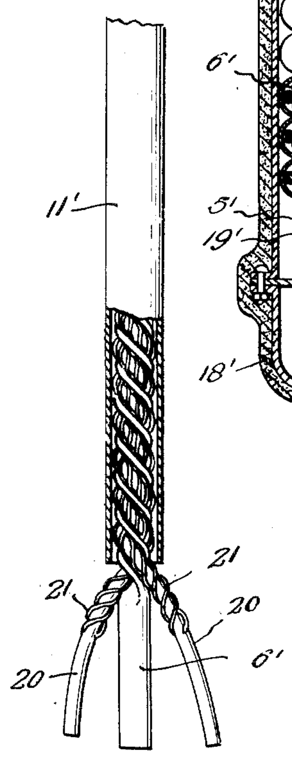


Fig. 6.



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UNITED STATES PATENT OFFICE

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HEAT EXCHANGER

Application filed February 17, 1931. Serial No. 516,488.

This invention relates to heat exchangers, or to an apparatus for use in transferring heat from one fluid to another fluid, through an intervening heat conducting wall.

The primary object of the present invention is to provide improvements in heat exchangers utilizing heat exchange elements and units of the general type disclosed in my co-pending application for U. S. Letters Patent Serial Number 516,487, filed February 17, 1931, whereby an extremely thorough exchange of heat between the fluids is effected as required in certain specific uses of heat exchangers.

In my co-pending application mentioned above, there is shown and described a heat exchange unit including a fluid conduit in the form of a flattened spirally twisted tube. As shown in said application, efficient forms of heat exchangers for many uses may be readily constructed employing a heat exchange unit or units, each of which includes a single flattened spirally twisted conduit of straight form. However, in many uses a higher degree of efficiency is required involving a greater or more complete exchange of heat between the two fluids, and the present invention aims to effect this result by constructing a heat exchanger involving a plurality of the flattened spirally twisted conduits disposed in side by side or parallel relation and coiled about a suitable core within a casing. Means is provided to pass one fluid through these coils and to pass the other fluid about such coils so that the latter fluid is maintained in a highly turbulent state for efficient heat interchanging action. Due to the coiled form of the flattened spirally twisted conduits, the fluid flowing therethrough will be of relatively large volume and will travel in a comparatively long path as compared to the actual length of the heat exchanger, thus insuring a device of maximum capacity and efficiency.

The nature of the present invention as well as the objects and advantages thereof will be more clearly apparent from the following description taken in connection with the accompanying drawings, in which:

Figure 1 is a vertical section of a heat exchanger constructed in accordance with the present invention.

Figure 2 is a transverse section on line 2—2 of Figure 1.

Figure 3 is a transverse section on line 3—3 of Figure 1.

Figure 4 is an elevational view of the flattened spirally twisted tube used to form the respective coils of the heat exchanger shown in Figure 1.

Figure 5 is a view similar to Figure 1 of a modified form of heat exchanger embodying the present invention; and

Figure 6 is a fragmentary elevation, partly broken and in section, of one of the heat exchange elements utilized to form the respective coils of the heat exchanger shown in Figure 5.

Referring to Figures 1 to 4 inclusive, a heat exchanger is shown including a tubular open-ended core 5, about which is helically coiled or wound from end to end a plurality of similar fluid conduits 6 whose adjacent ends at opposite ends of the core are respectively connected with headers 7 and 8 provided respectively with fluid supply and outlet pipes 9 and 10. Encasing the core 5 and coiled conduits 6 so as to snugly contact the latter is a straight tubular conduit 11 which connects at its opposite end respectively with outlet and supply chambers 12 and 13 encasing the headers 7 and 8 and respectively provided with fluid outlet and inlet pipes 14 and 15 surrounding the inlet and outlet pipes 9 and 10. A casing 16 surrounds the conduit 11, and a packing 17 of heat insulating material is placed between the conduit 11 and casing 16. The outlet and inlet chambers 12 and 13 may be suitably heat-insulated as indicated at 18.

Each of the coiled conduits 6 is formed from a length of flattened spirally twisted tubing as shown at 5*b* in Figure 4 and clearly described in connection with Figures 1 to 4 inclusive of my co-pending application mentioned above. As explained in said application, this provides each conduit 6 with wide opposed walls which are subjected throughout their width to the heating or cooling action of the other fluid as it flows in heat interchanging relation with the conduits 6. Such other fluid, as will be readily seen, flows about the conduits 6 between the latter and the conduit 11, passing in helical paths about the core 5 parallel with the coils of these conduits 6 and also following the twists of the latter. In addition, the fluid will pass to some extent in a straight path directly across the coils of the conduits 6, and in this way the fluid in the outer conduit 11 is brought to and maintained in a very highly turbulent state so as to insure most efficient and uniform heat interchanging action. The efficiency of this action is enhanced by permitting some of the fluid to flow through the core 5 in addition to passing about the conduits 6 within the conduit 11. In order to maintain the fluid in a turbulent state as it passes through the inner conduit or core 5, the latter is preferably filled with a finely divided heat conducting powder or material as at 19, such material being maintained within the core 5 by means of foraminous closures or gauze disks 20 secured in the opposite open ends of the core 5. It will be seen that the heat exchanger is preferably of the countercurrent type in which one fluid passes through the conduits 6 in one direction and through the conduit 11 in the opposite direction.

Referring to Figures 5 and 6, a modified form of heat exchanger is shown including a core 5′ of relatively large diameter about which is coiled or helically wound from end to end in side by side or parallel relation a plurality of heat exchange units, each of which includes a fluid conduit 6′ in the form of a flattened spirally twisted tube. The conduits 6′ of these heat exchange units have their adjacent ends connected at the opposite ends of the core 5′ respectively with headers 7′ and 8′ having fluid supply and outlet pipes 9′ and 10′ respectively.

Each heat exchange unit also includes a tubular conduit 11′ snugly encasing the conduit 6′ of that unit and coiled about the core 5′. The adjacent ends of the conduits 11′ of the several heat exchange units open at opposite ends of the core 5′ respectively into fluid outlet and inlet chambers 12′ and 13′ having outlet and inlet pipes 14′ and 15′ surrounding the inlet and outlet pipes 9′ and 10′. A suitable casing 16′ surrounds the core 5′ and the coiled heat exchange units wound about the same, and this casing may be suitably heat-insulated as indicated at 17′. Also, the chambers 12′ and 13′ are preferably heat insulated as indicated at 18′, while the core 5′ may preferably be filled with suitable heat insulating material 19′ so as to minimize absorption of heat through the core 5′. While in some uses, the heat exchange units may consist only of the inner conduits 6′ and outer conduits 11′, there are some uses in which more efficient heat interchange is necessary. In that event, I preferably arrange rods 20 at opposite sides of the flattened spirally twisted conduit 6′ of each heat exchange unit, such rods being loosely coiled about the twisted conduits 6′ and then twisted tightly with the latter so as to bring these elements into intimate contact as shown in Figure 6 of my co-pending application mentioned above. Also, still further efficiency may be had by providing each rod 20 with a helical external winding of wire as indicated at 21. In that event, the unit will correspond either to the one illustrated in Figure 12 or to the one illustrated in Figure 15 of my co-pending application referred to above, depending upon whether or not the rods 20 are solid or tubular. They have been illustrated as solid simply for example.

In operation of the heat exchanger shown in Figure 5, one fluid enters the conduits 6′ of the several helically wound heat exchange units from header 7′ and passes therethrough to the header 8′. The other fluid passes through the conduits 11′ of the heat exchange units from chamber 13′ to chamber 12′, being in this way caused to flow in an exceedingly long path in heat interchanging relation with the other fluid passing through the conduits 6′. In all cases, the two fluids are brought to a highly turbulent state and in most thorough heat interchanging relation.

From the foregoing description, it is believed that the construction and operation, as well as the advantages of the present invention will be readily understood and appreciated by those skilled in the art. Minor changes are contemplated within the spirit and scope of the invention as claimed.

What I claim as new is:

1. In a heat exchanger, a core, a plurality of fluid conduits helically wound about said core in side by side or parallel relation, each of said conduits being in the form of a flattened spirally twisted tube, means to pass a fluid through said conduits, and means to conduct another fluid in heat interchanging relation to said conduits.

2. In a heat exchanger, a core, a plurality of fluid conduits helically wound about said core in side by side or parallel relation, each of said conduits being in the form of a flattened spirally twisted tube, means to pass a fluid through said conduits, and means to conduct another fluid in heat interchanging relation to said conduits, in a reverse direction to the direction of flow of the first fluid through said conduits.

3. In a heat exchanger, a core, a flattened spirally twisted conduit helically wound about said core, and means to conduct a fluid in heat interchanging relation with said conduit.

4. A heat interchanger having a fluid conduit in the form of a helically wound flattened spirally twisted tube.

5. In a heat exchanger, a core, a fluid conduit in the form of a flattened spirally twisted tube helically wound about said core, and a further fluid conduit snugly encasing the first-named conduit.

6. In a heat exchanger, a core, a fluid conduit in the form of a flattened spirally twisted tube helically wound about said core, and a further fluid conduit snugly encasing the first-named conduit, said core being of hollow open-ended form, and means to pass a fluid through the core and the second-named conduit in heat interchanging relation with a fluid passing through the first-named conduit.

7. In a heat exchanger, a core, a fluid conduit in the form of a flattened spirally twisted tube helically wound about said core, and a further fluid conduit snugly encasing the first-named conduit, said core being of hollow open-ended form, means to pass a fluid through the core and the second named conduit in heat interchanging relation with a fluid passing through the first-named conduit, and means within said core for causing the fluid to be brought to and maintained in a turbulent state when passing through said core.

In testimony whereof I affix my signature.

EDWARD G. SULLIVAN.