Nov. 17, 1931. C. O. SANDSTROM 1,831,971

HEAT EXCHANGE APPARATUS

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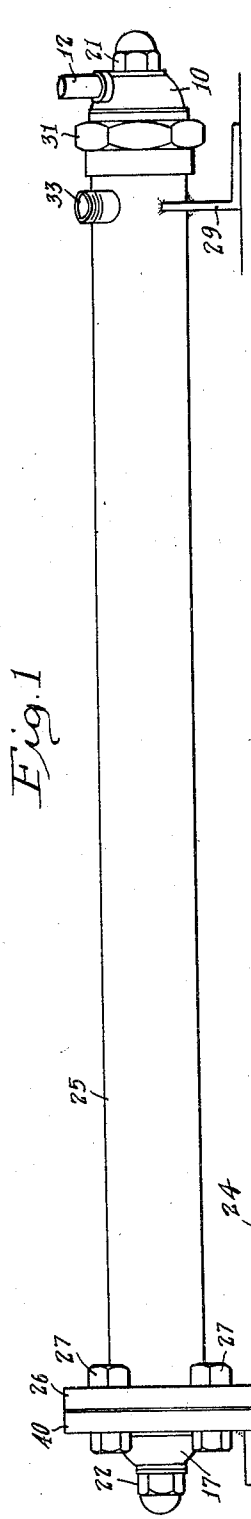


Fig. 1

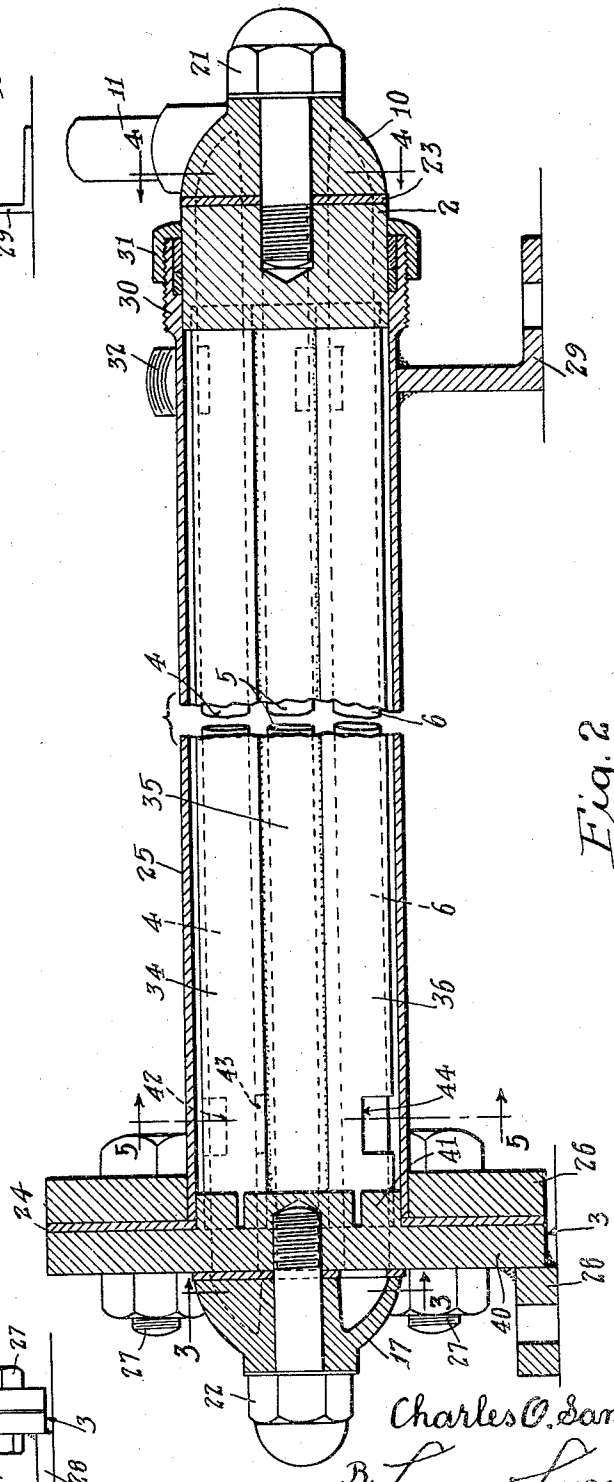


Fig. 2

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Fig. 6

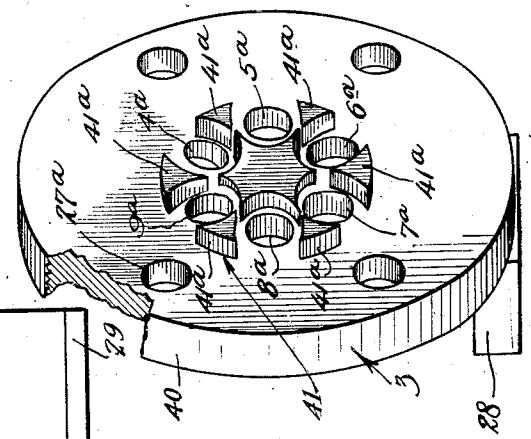


Fig. 4

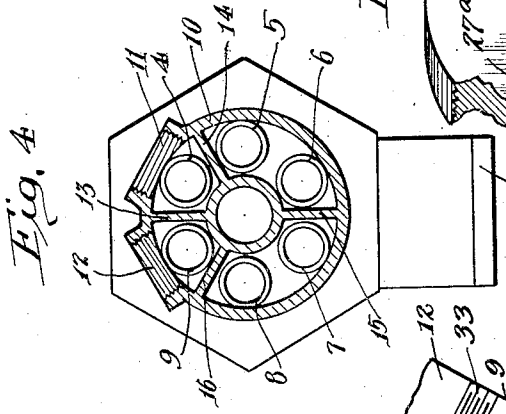


Fig. 5

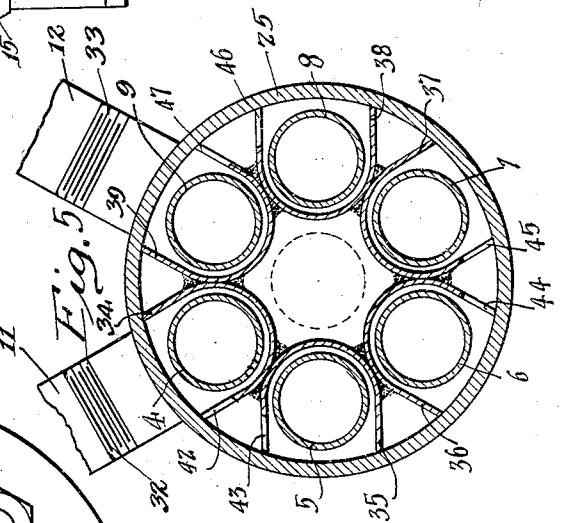
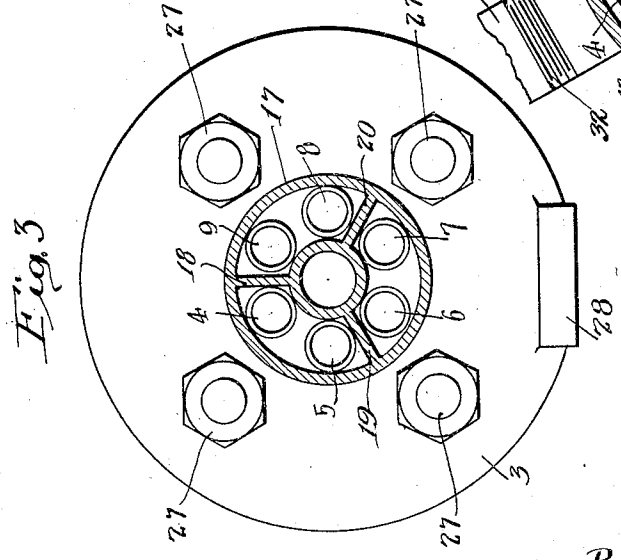


Fig. 3



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UNITED STATES PATENT OFFICE

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HEAT EXCHANGE APPARATUS

Application filed November 8, 1930. Serial No. 494,309.

This invention relates to a heat exchange apparatus or heat exchanger and relates particularly to a heat exchanger which is adapted for use involving small quantities of fluid.

Heat exchangers now on the market are relatively expensive and inefficient when they are built in sizes for handling only a relatively small quantity of fluid.

It is the general object of the present invention to provide a heat exchanger of suitable design for efficiently securing transfer of heat in an exchanger embodying only a small number of tubes.

It is a further object of the present invention to provide a heat exchanger which is compact and inexpensive in construction and which can be readily altered to change the number of passages of fluid through the exchanger so that the fluid may be caused to pass through all of the tubes in series or, when it is desired, through a number of the tubes in parallel.

Various further objects and advantages of the present invention will be apparent from the description of a preferred form or example of heat exchanger embodying the invention. For this purpose, I have hereinafter described one form or example of a heat exchanger which embodies this invention, the description being given with reference to the accompanying drawings, in which

Figure 1 is an elevation;

Figure 2 is an enlarged elevation mainly in section and with the center of the exchanger broken away to contract the view;

Figure 3 is a section on the line 3—3 of Figure 2 taken through the return cap at one end of the apparatus;

Figure 4 is a section taken on the line 4—4 of Figure 2 through the return cap at the inlet and discharge end of the apparatus;

Figure 5 is a section on the line 5—5 of Figure 2 taken through ports in the baffles of the exchanger; and

Figure 6 is a perspective of the tube sheet 3.

Referring to the drawings, the heat exchanger comprises a small tube sheet 2 at the inlet and discharge end of the apparatus and a further tube sheet 3 at the other end of the apparatus. A plurality of tubes is rolled into the tube plates or sheets 2 and 3 in the usual manner so as to extend between the tube sheets and provide a plurality of tube passages for the exchanger. Six of the tubes 4, 5, 6, 7, 8 and 9, respectively, are arranged in hexagonal manner.

At one end of the apparatus there is provided a return cap 10 which is provided with an inlet 11 and an outlet 12 which are threaded to receive pipes for introducing and withdrawing fluid which is to flow through the tubes 4 to 9 of the exchanger. The cap 10 (see Fig. 4) has a partition 13 separating the inlet, and outlet ports and additional partitions 14, 15 and 16, the partitions 13 and 14 separating the cap into a chamber which will permit fluid to flow from the inlet 11 into only the tube 4.

The partitions 14 and 15 provide a chamber for interconnecting the tubes 5 and 6. The partitions 15 and 16 provide a chamber for connecting the tubes 7 and 8 and the partitions 16 and 13 provide a chamber for connecting the tube 9 with the outlet 12.

In the opposite end of the exchanger there is provided an additional return cap 17 which is provided with partitions 18, 19 and 20 (see Fig. 3). The partitions 18 and 19 provide a chamber to interconnect tubes 4 and 5. The partitions 19 and 20 provide a chamber for inter-connecting tubes 6 and 7 and partitions 18 and 20 provide a chamber for interconnecting tubes 8 and 9.

The caps are provided with stud bolts 21 and 22 threaded to the tube sheets 2 and 3, respectively, by means of which the caps 10 and 17 are pressed against the tube sheets. If desired, gaskets, such as indicated at 23 and 24, may be provided for forming a more fluid-tight joint.

The exchanger is also provided with a cylindrical shell 25 which at one end is preferably welded to a flange 26 which is bolted in place by bolts 27 passing through openings 27^a in the tube sheet 3. The tube sheet 3 is shown as provided with an extending foot 28 which serves as a support for the exchanger.

At the opposite end of the exchanger the shell 25 is welded to a supporting leg 29 and

is extended over the tube sheet 2 so as to be freely movably thereon in order to take care of expansion and contraction. This end of the shell is made fluid-tight by means of a stuffing box 30 provided with a gland 31.

Near one end of the exchanger are welded pipe nipples 32 and 33 which, respectively, provide for the inlet and outlet of the fluid which is to flow over the outside of the tubes 4 to 9 inclusive. In order to cause the fluid flowing over the tubes to pass along the tubes there is provided within the shell a plurality of U-shape baffle members 34, 35, 36, 37, 38 and 39 (see Fig. 5). These U-shape baffles are free to move with expansion and contraction of the tubes, while their edges bear firmly against the enclosing outer shell 25. Each of the U-shape baffle members houses one of the tubes and provides a compartment by which fluid may flow along and outside of the tube for transferring heat to the fluid within the tube; the baffle 34 enclosing the tube 4; the baffle 35 enclosing the tube 5; the baffle 36 enclosing the tube 6; the baffle 37 enclosing the tube 7; the baffle 38 enclosing the tube 8, and the baffle 39 enclosing the tube 9.

At the ends of the baffles there are provided ports for transferring the fluid from one U-shaped baffle to the succeeding baffle. Thus, the ports 42 and 43, respectively, at the rear end of the baffles, connect the baffles 34 and 35. The ports 44 and 45 connect the baffles 36 and 47 and the ports 46 and 47 connect the baffles 38 and 39.

At the opposite end of the baffles there are provided additional ports for connecting in a similar manner the baffles 35 and 36 and the baffles 37 and 38 one with the other.

By using the arrangement thus described the two fluids will flow through the apparatus in the parallel direction. By using the inlet and outlet ports of the shell for the outlet and inlet, respectively, the fluids may be caused to flow counter-currently.

As shown most clearly in Fig. 6, the tube sheet 3 has an enlarged disc portion 40 and a cylindrical hub portion 41, the outer cylindrical wall of which has a loose fit with the inner cylindrical wall of the shell 25. U-shaped recesses are cut in cylindrical hub 41 of the tube sheet 3 radially inwardly of such size as to fit the outer side walls of the U-shaped baffles 34, 35, 36, 37, 38 and 39, which are shown in Fig. 5. Since the aforementioned baffles touch together, as shown in Fig. 5, the U-shaped groove cut in the tube sheet 3 intersects, leaving the substantially triangular portions 41^a. The tube sheet 2 is of similar construction to the tube sheet 3, except that the body or disc part of the tube sheet is cut off at the diameter of the shell 25. The tube sheet 3 has the openings 4^a, 5^a, 6^a, 7^a, 8^a and 9^a to receive the tubes 4, 5, 6, 7, 8 and 9, respectively.

While I have described the arrangement of the caps and partitions in the caps connecting the tubes in such a manner that the fluid flowing through the tubes will be caused to flow through all of the tubes in series, it will be readily apparent that by substituting caps having different arrangements of partitions, a one-tube, two-tube or three-tube pass may be obtained, and also by eliminating entirely the partitions from the caps 10 and 17 a six-tube pass will be provided.

It will also be apparent that the exchanger may be used as an open or atmospheric type in a cooling tower by removing the enclosing shell 25 and the U-shape baffles 34 to 39, inclusive.

While the particular form of exchanger herein described is well adapted to carry out the objects of the present invention, it will be understood that various changes and modifications may be made without departing from the spirit of the invention, and the invention is of the scope set forth in the appended claims.

I claim:

1. A heat exchanger comprising tube sheets, tubes extending between said tube sheets, caps at the ends of said tubes, a shell enclosing said tubes, and a plurality of U-shape baffle members within said shell for housing said tubes for providing fluid passages around said tubes.

2. A heat exchanger comprising a plurality of tubes arranged in a circular series, tube sheets at the end of said tubes, partitioned caps bolted to said tube sheets providing return chambers for interconnecting the tubes, a shell surrounding said tubes and U-shaped baffle members surrounding the individual tubes providing longitudinal passages for fluid around the tubes, said baffles having ports for interconnecting the passages of the different baffles.

3. A heat exchanger comprising a plurality of tubes, tube sheets at the ends of said tubes, caps providing return passages for the tubes, a shell enclosing said tubes, and U-shape baffle members surrounding said tubes and engaging said shell to provide fluid passages around said tubes, said tube sheets having grooves slidably receiving the ends of said baffles.

4. A heat exchanger comprising a single circular series of tubes, tube sheets at the ends of said tubes, a cylindrical shell rigid with a flange connected to the tube sheet at one end and having a slidable connection with the tube sheet at the other end, and baffle means within said shell and surrounding said tubes for forming fluid passages around said tubes.

5. A heat exchanger comprising a single circular series of tubes, a tube sheet at each end of said tubes, a cap member at each end of the tubes bolted to said tube sheets, said cap members being provided with partitions

forming interconnecting return passages for said tubes, a surrounding shell for said tubes, and baffle members forming longitudinal passages around the tubes, said baffle members having means for inter-connecting said longitudinal passages.

6. A heat exchanger comprising a circular series of tubes, tube sheets at the end of said tubes, caps secured to said tube sheets and having partitions forming return passages for said tubes, a shell surrounding said tubes, and baffles within said shell providing longitudinal fluid passages along said tubes, said baffles having ports for interconnecting the baffle passages in such manner that the fluid flowing around the tubes may pass counter-currently to the fluid within the tubes.

7. A heat exchanger comprising a plurality of tubes, tube sheets receiving the ends of said tubes, caps pressed against said tube sheets and having partitions forming return passages for said tubes, a shell surrounding said tubes, and U-shape baffle members extending longitudinal of the tubes and providing individual longitudinal passages for fluid outside of the tubes.

Signed at Los Angeles, California this 24th day of October, 1930.

CHARLES O. SANDSTROM.