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HEAT EXCHANGER

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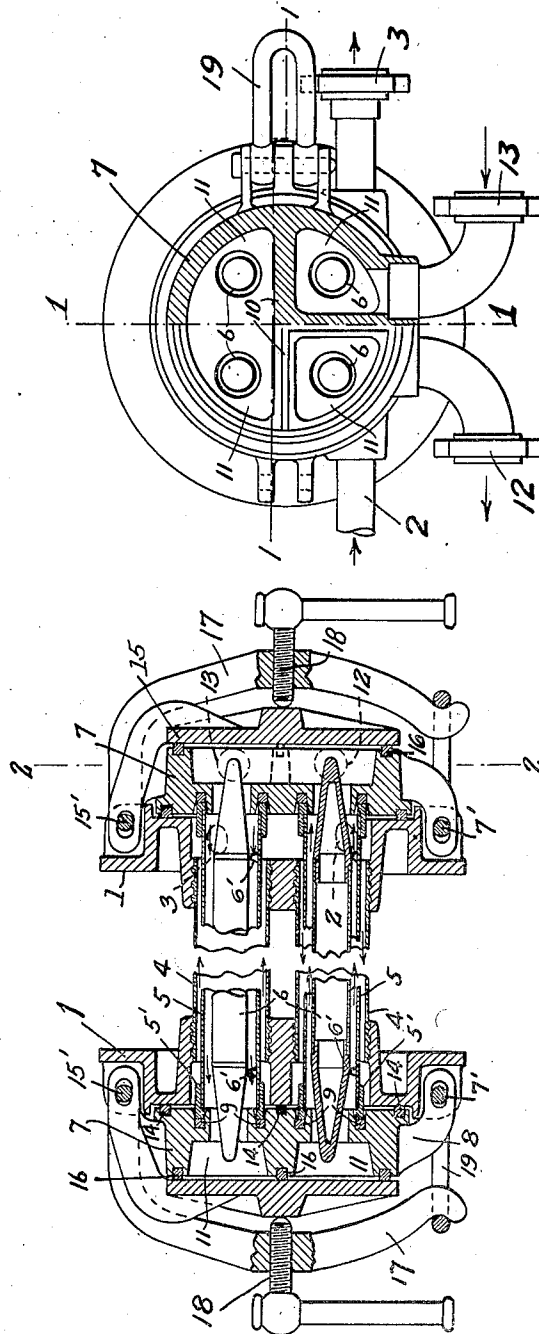


FIG. 2.

FIG. 1.

WITNESS:

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UNITED STATES PATENT OFFICE

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HEAT EXCHANGER

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The invention relates to that type of heat exchanger which comprises tubes arranged in concentric relation through which flow fluids at different temperature to effect heat exchange between the fluids.

The object of the invention is, in general, to provide improved means for holding the tubes in position, insuring against leakage and effecting the desired circulation, while providing for the ready removal of the holding means to make the heat-exchanging surfaces of the tubes readily accessible for cleaning, this being especially necessary when the exchanger is used for the treatment of perishable liquids such as milk and cream.

One preferred embodiment of the invention is shown in the accompanying drawings, in which—

Fig. 1 is a longitudinal section, on the line 1—1 of Fig. 2, through the heat exchanger, broken away to show the two ends.

Fig. 2 is a view looking at right angles to Fig. 1, the right half showing a section on line 2—2 of Fig. 1 and the left half showing an end view with the end cover removed.

The two ends of the heat exchanger shown in Fig. 1 being of substantially the same construction, the same reference letters are applied to corresponding parts.

The heat exchanger belongs to that class wherein two tubes are arranged in concentric relation, one fluid being relatively hot and flowing through either tube and the other fluid being relatively cold and flowing through the other tube. Heat is transferred from one fluid to the other in the course of their flow. The two fluids preferably flow in opposite directions. The purpose may be to heat or to cool one of the fluids. For convenience of description, it will be assumed that the purpose is to heat one of the fluids and that the heating fluid flows through the outer tube and the fluid to be heated flows through the inner tube. There may be as many of these pairs of tubes as desired, and the flow may be through the tubes in multiple or in series, although it will ordinarily be in series. The inlet for either fluid may be at one end of the exchanger and the outlet may be at the same end or at the opposite end. In

the preferred arrangement, the inlets and outlets for both fluids will be at the same end. A tube in which there is no circulation of fluid, and which I call a displacer, may extend concentrically through each inner tube, in order that the liquid flowing therethrough may be in the form of a relatively thin layer, so as to provide the condition best adapted, with high velocity of flow, to effect rapid exchange of heat. The foregoing description applies to the type of heat exchanger to which my invention is applicable.

To one of the end plates 1 are fixed the inlet tube 2 and the outlet tube 3. Each end plate 1 also has fixed into it the ends of the outer tubes 4. It may be assumed that these tubes carry the heating fluid which is to transfer heat to the outer fluid, which flows through the inner tubes 5. The inner tubes are strengthened at their ends, preferably by reinforcing rings 5', to enable a perfect joint to be obtained. Extending through the inner tubes are displacers 6, which may be held spaced from and in concentric relation with the inner tubes by means of projections 6' on the inner walls of the inner tubes.

The head 7 is hinged at 7' to the end plate 1 and is provided with circular grooves in which rubber washers 9 are inserted. When the head is swung into the closing position shown in Fig. 1, the reinforced ends of the inner tubes 5 extend into these grooves and make leak-proof joints between the liquids which circulate in the inner and outer tubes respectively. The head 7 is provided with a circular flange around its periphery and with partitions forming cells 11 (hereinafter more particularly described), which are closed by an end cover 15. Between the end plate 1 and the head 7 is the rubber washer 14 and between cover 15 and the outer flange and inner partitions of the head 7 are the rubber washers 16. End cover 15 is hinged at 15' to the end plate 1. Also hinged at 15' is the clamping lever 17, which is held in closed position by means of the loop 19. Threaded in the clamping lever is a turnable screw 18, by means of which the cover 15 is forced into tight contact with the head 7 and the head 7

forced into tight contact with the end plate 1.

Secured to the head 7 are the fluid inlet tube 13 and the fluid outlet tube 12. Assuming that the fluid to be heated enters tube 13, it flows thence into one of the quadrant shaped cells 11 at the right-hand end of the exchanger, thence through one of the four inner tubes 5 to a semi-circular cell 11 at the left-hand end of the container, thence to the right through a second inner tube, thence through a semi-circular cell, thence to the left through a third inner tube, thence through a semi-circular cell, thence to the right through a fourth inner tube and thence out the outlet tube 12.

The heating fluid enters inlet tube 2, and flows thence through the four outer tubes 4 in the reverse direction to the flow through the inner tubes of the fluid to be heated.

In order to clean the apparatus, the clamping screw 18 is loosened, and the lever 17, cover 15 and head 7 successively swung out. The inner tubes 5 together with the displacers 6 are then removed and the tubes brushed out. The outer tubes are then readily accessible for cleaning on the inside by means of a special pipe-brush.

Having now fully described my invention, what I claim and desire to protect by Letters Patent is:

1. In a heat exchanger, the combination with an end plate and outer tubes carried thereby, of an end head, means to clamp the end head against the end plate, said head being provided with circular grooves, and inner tubes within the outer tubes and extending into said grooves.

2. In a heat exchanger, the combination with an end plate and outer tubes carried thereby, of an end head, means to clamp the end head against the end plate, said head being provided with circular grooves, inner tubes within the outer tubes and extending into said grooves, the inner tubes being reinforced at their outer ends, and washers in said grooves engaged by the reinforced ends of the inner tubes.

3. In a heat exchanger, the combination with an end plate and outer tubes carried thereby, of inner tubes and an end head carrying the same and applied to the end plate, and provided with cells which communicate with inner tubes and provide for flow of fluid through the inner tubes successively.

4. In a heat exchanger, the combination with an end plate and outer tubes carried thereby, of inner tubes and an end head carrying the same and applied to the end plate, a circular outer flange and inner partitions forming cells which communicate with inner tubes and provide for flow of fluid successively therethrough, and an end cover removably applied to the end head and closing said cells.

5. In a heat exchanger, the combination

with an end plate and outer tubes carried thereby, of an end head and inner tubes carried thereby, the end head being pivotally supported on the end plate, and means to clamp the end head against the end plate.

6. In a heat exchanger, the combination with an end plate and outer tubes carried thereby, of an end head and inner tubes carried thereby, the end head being pivotally supported on the end plate, and movable against and away from the same, a cover plate also pivotally supported on the end plate and movable against and away from the end head, and means to clamp the cover plate against the end head and the end head against the end plate.

7. In a heat exchanger, the combination with an end plate and outer tubes carried thereby, of an end head and inner tubes supported on the end plate, a cover plate pivotally supported on the end plate, a lever pivotally supported on the end plate, and clamping means carried by the lever and adapted to hold the cover plate closed against the end head and the end head closed against the end plate.

8. In a heat exchanger, the combination with end plates at opposite ends of the exchanger, outer tubes carried by and between the end plates, inner tubes within and extending beyond the ends of the outer tubes, movable end heads at opposite ends of the exchanger and provided with circular grooves receiving the ends of the inner tubes, and means to apply pressure to the end heads in the direction of the axis of the exchanger to clamp the ends of the inner tubes between the end heads.

In testimony of which invention, I have hereunto set my hand, at Hamburg on this 18th day of September, 1929.

BERNHARD ADOLF OTTO PROLLIUS.