Oct. 5, 1926. 1,602,287

A. C. SPENCER

HEAT EXCHANGER

Filed March 6, 1923

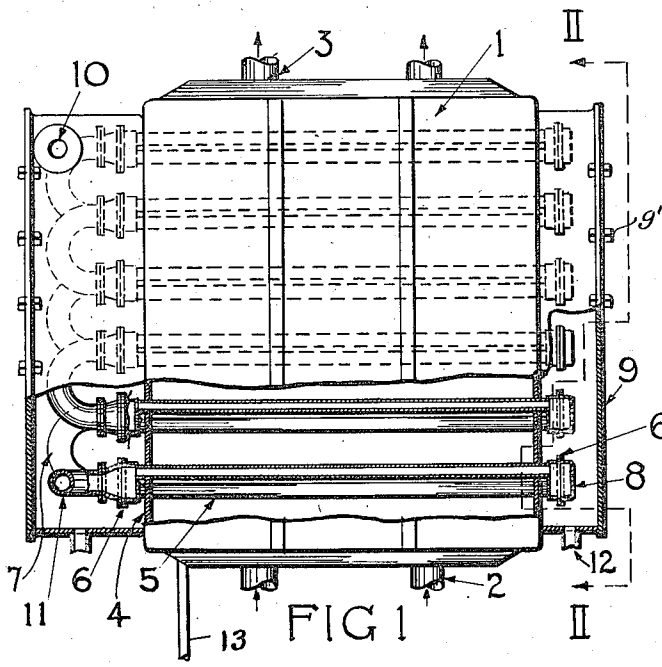


FIG 1

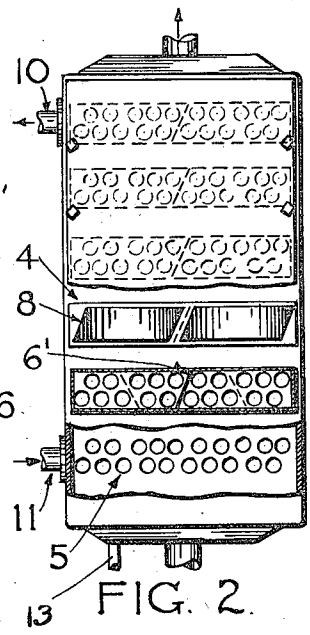


FIG. 2.

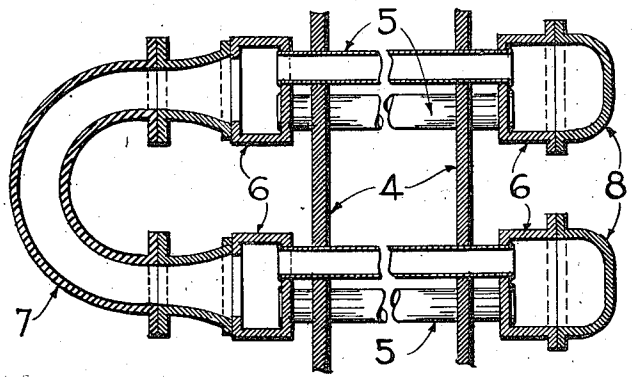


FIG 3

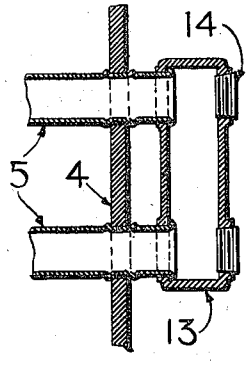


FIG. 4

Inventor

Alexander C. Spencer

By O G Messenger

Attorney

Patented Oct. 5, 1926. 1,602,287

UNITED STATES PATENT OFFICE.

ALEXANDER C. SPENCER, OF SARNIA, ONTARIO, CANADA, ASSIGNOR TO STANDARD DEVELOPMENT COMPANY, A CORPORATION OF DELAWARE.

HEAT EXCHANGER.

Application filed March 6, 1923. Serial No. 623,121.

This invention relates to apparatus for transfer of heat from hot fluids to colder fluids, and will be fully understood from the following description, taken in connection with the accompanying drawing, in which—

Fig. 1 represents a side elevation, (partly broken away), of one embodiment of the invention;

Fig. 2 is an end view, partly in section on the line II—II of Fig. 1;

Fig. 3 is a sectional detail, on a larger scale, of the end connections; and

Fig. 4 is a similar view of a modified form.

In the drawing, the reference character 1 designates an outside shell of suitable material and form, ordinarily for instance made up of boiler-plate or the like. In my preferred construction the make-up is on rectangular lines as shown in Figs. 1 and 2 so as to provide for a standardized type of construction, the top and bottom plates being for example uniform for exchangers of various capacities, differences in capacity being provided by difference in size or number of intermediate plates. It will be understood that in assemblage, the plates are joined by any suitable means, for instance by riveting, as customary in boiler practice. Inlet and outlet pipes 2, 3, one or more of each, provide access to the space within the shell. At each end of the shell is a tube-sheet 4 secured with tight joints; and extending through from tube-sheet to tube-sheet are tubes 5. The tubes are expanded or rolled into the tube-sheets to make tight joints therein, (welding being used also if desired), and the ends project beyond the tube-sheets and are in turn secured, as by being expanded or rolled, into connections 6. These connections serve to join the ends of the tubes so as to secure a consecutive path between tubes. In Figs. 1 and 2, the connections are shown of such proportion as to join the tubes in groups of fives. That is, a group of five tubes is connected for flow with a group of five, and so on back and forth through the series for the same level. From one level or tier of groups to another a similar connection, or preferably an auxiliary modified form as 7 is employed. To facilitate access for making up, cleaning, etc., the connections have removable covers 8. These preferably, like the connections proper, are made in single-piece uniform standardized castings, stampings, or the like, and it is advantageous to have such piece extend clear across each tier or level as shown in Fig. 2. The covers are held to the connections by bolts or the like.

A housing is arranged to cover over the connections, at each end, and the closure plate 9 thereof is held by suitable means, as bolts 9′, so as to be removable when desired. The inlet and outlet pipes 10, 11 for the tube system, pass through the housing at the side being suitably guarded by flanges and join into the adjacent connection 6 in each instance. In case of leakage into the housing, drainage may be effected by drains 12, either pipes or simple openings as desired. A drain for the central space within the shell is provided by the pipe 13.

The operation of the exchanger will be clear. A hot fluid, for example in vapor form, is passed into the shell at inlets 2 and circulates about the tubes 5 and finally emerges at outlet pipes 3. At the same time, a cooler fluid is passed into the tubes by inlet pipe 10, and flowing through the first group of five tubes as illustrated is turned back by the connection at the farther end into the next group of five tubes in the same tier or level, the partitions as at 6^1 in the connections being located to permit flow into the desired group only. Returning to the first end the flow is directed into the last group of the tier (the example illustrated showing four groups to a tier or level). On returning to the first end the flow is directed by the auxiliary connection 7 into the tier below, and so the flow proceeds from group to group and tier to tier through the tubes, finally emerging by outlet pipe 11. Heat transfer from the hot to the cooler fluid occurs through the tube-walls. If desired the fluids can be passed in directions other than those stated; or the hot fluid can be the one circulated through the tubes. Such arrangement however would ordinarily be less advantageous.

As already indicated, the construction described contemplates the assemblage of exchangers of any desired capacity by incorporating a smaller or larger number of the tier units of connections and tubes, and the correspondingly necessary uniform top and bottom plates and the intermediate plates.

While in this aspect of the invention, the construction of the shell, etc., on rectangular lines is preferable, in other aspects the invention contemplates the provision of the tubes and connections, etc., and end housing with a shell of any desired shape.

While the grouping of the tubes by fives as mentioned is advantageous as embodying a good balance of surface exposure and throughout for average uses, I contemplate also larger and smaller groupings in the connections. In Fig. 4 there is shown for instance a connection 13 joining the tube ends one to one. Again, instead of having the connection cover as a whole removable, access to the tubes may be had by openings which are normally closed by suitable plugs 14, screwthreadedly or otherwise held as desired.

While I have described my invention by certain specific details, it will be understood that this is for the purpose of illustration and is not limitative, and that changes may be made which are within the spirit and scope of the invention.

I claim:—

1. Apparatus of the character described, which comprises an outside shell having inlet and outlet openings for passage of fluid, tube-sheets at each end of the shell, tubes extending between said tube-sheets and projecting therebeyond, said tubes being expanded into the tube-sheets, a series of connections joining the projecting ends of the tubes by groups of five, said projecting ends being expanded into the connections, detachable cover-plates on said connections, a housing for said connections at each end, a detachable closure plate for each housing, and drains in each housing.

2. Apparatus of the character described, which comprises an outside shell having inlet and outlet openings for passage of fluid, tube-sheets at each end of the shell, tubes extending between said tube-sheets and projecting therebeyond, said tubes being expanded into the tube-sheets, a series of connections joining the projecting ends of the tubes by groups, detachable covers on said connections, a housing for said connections at each end, and a detachable closure for each housing.

3. Apparatus of the character described, which comprises an outside shell having inlet and outlet openings for passage of fluid, tube-sheets at each end of the shell, tubes extending between said tube-sheets and projecting therebeyond, said tubes being expanded into the tube-sheets, a series of connections joining the projecting ends of the tubes by groups, each group having substantially the same number of tubes, and a housing for said connections.

4. Apparatus of the character described, which comprises an outside shell having inlet and outlet openings for passage of fluid, tube-sheets at each end of the shell, tubes extending between said tube-sheets and projecting therebeyond, a series of connections joining the projecting ends of the tubes by groups, detachable cover means opposite the end of each tube, and a housing for said connections.

5. Apparatus of the character described, which comprises an outside shell having inlet and outlet openings for passage of fluid, tube-sheets at each end of the shell, tubes extending between said tube-sheets and projecting therebeyond, a series of closed connections joining the projecting ends of the tubes in groups of more than two tubes, detachable cover means opposite the end of each tube, and a housing for said connections.

6. In apparatus of the character described, the combination of an outside shell having inlet and outlet openings for passage of fluid, tube-sheets in the shell, tubes extending between said tube-sheets and projecting therebeyond, said tubes being in a plurality of tiers, a series of connections joining the ends of the tubes, said connections being formed in a uniform constructional unit extending across each tier, and auxiliary connections joining tier to tier.

7. In apparatus of the character described, the combination of an outside shell having inlet and outlet openings for passage of fluid, tube-sheets in the shell, tubes extending between said tube-sheets and projecting therebeyond, said tubes being in a plurality of tiers, and a series of connections joining the ends of the tubes, said connections being formed as a uniform constructional unit extending across each tier.

8. In apparatus of the character described, the combination with an outside shell having inlet and outlet openings for passage of fluid, of tube-sheets in the shell, tubes extending between said tube-sheets, and projecting therebeyond, and a series of connections joining the ends of the tubes within the shell in groups of substantially equal numbers of tubes.

9. In apparatus of the character described, the combination of a tube-sheet, tubes projecting through said tube-sheet, and closed connections joining said tubes by groups of more than two tubes, said connections comprising uniform units extending across a tier of tubes.

ALEXANDER C. SPENCER.