March 17, 1931. O. ENGLER 1,796,707

HEAT EXCHANGER

Filed Aug. 14, 1930

Fig. 1.

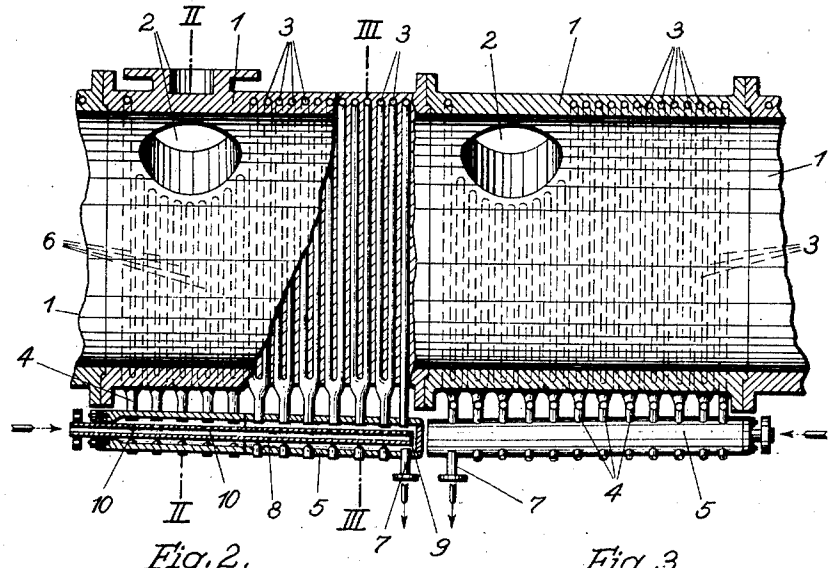


Fig. 2.

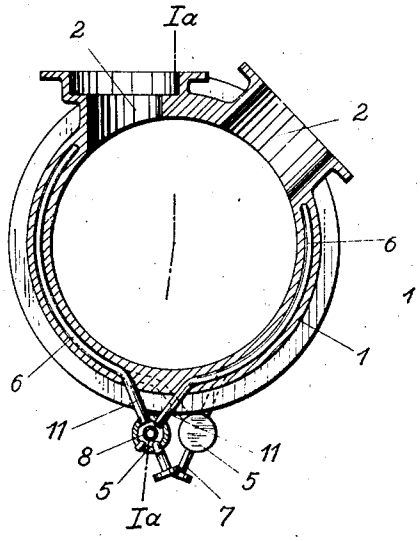
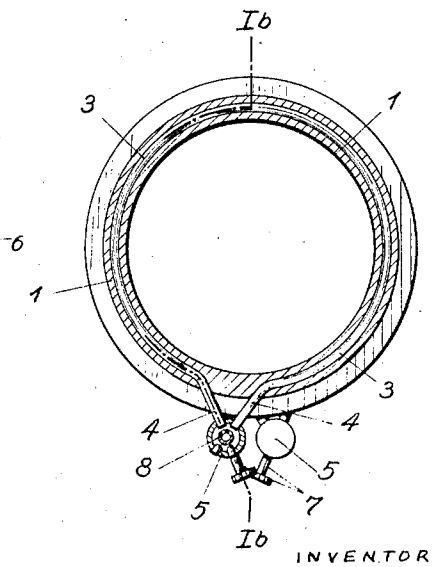


Fig. 3.



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UNITED STATES PATENT OFFICE

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HEAT EXCHANGER

Application filed August 14, 1930, Serial No. 475,296, and in Germany August 23, 1929.

The present invention relates to heat exchangers of the type used in the drying, cooking, evaporating or melting of various substances and solutions and relates more particularly to heating drums having heating tubes or conduits associated with the shells of the drums and so constructed and arranged as to produce a peculiarly advantageous operation of the heating conduits. In the devices heretofore employed, in which wound screw forming or serpentine forming coils are found, there is much left to be desired insofar as the quick carrying off of the condensate formed by the heating steam, which is necessary to efficient heat exchange, is concerned and previous efforts to provide for quick removal of the condensate have resulted in complicated and entangled systems of tubes and connections. Moreover there have been difficulties in obtaining a sufficient amount of heating surface in the old devices because of difficulty of arranging the heating tubes in view of manholes and other openings in the drum shell. These disadvantages are overcome by means of the present invention according to which the heating tubes or conduits are formed in the shape of bows or arcs lying in substantially vertical planes and are connected to a heating steam inlet and condensate outlet header lying beneath the heating drum. By virtue of this construction and arrangement of the heating conduits, the heating steam streams into the heating conduits from below and the condensate simultaneously flows back down along the inner walls of the bowed heating conduits. In the lower part of the bowed conduits, where an amount of the condensate greater than a negligible one first collects on the conduit walls, the condensate flows off on the outlying wall portion so that the opposite side of the tube which faces and heats the contents of the drum is directly contacted by the entering heating steam. The arrangement of the inlet and outlet conduits is very simple since it is only necessary to connect the arced or bowed conduits with a single inlet and discharge conduit.

At those parts of the drums where its cross-section is continuous and unbroken, the arced heating conduits lying in substantially vertical planes form substantially ring shaped open loops, but at those parts of the drum where its cross-section is broken because of openings in the drum walls, the arced conduits do not form substantially ring shaped loops but comprise oppositely disposed, shorter arced tubes extending from the lower level of the drum to the opening in the drum from either side. In this manner no difficulties are encountered in positioning the heating conduits throughout the entire length of the drum even at points where the drum wall is broken by the openings.

In the drawings, which show a construction illustrating the invention, Fig. 1 is a longitudinal cross-section through the drum which partially follows along the line I^a—I^a of Fig. 2 and partially follows along the line I^b—I^b of Fig. 3;

Fig. 2 is a cross-section along the line II—II of Fig. 1; and

Fig. 3 is a cross-section along the line III—III of Fig. 1.

The shell of the drum is formed of a plurality of substantially tubular sections joined end to end as shown and which may be connected in any convenient manner. In each section there are openings 2 for admission and removal of the material to be treated in the drum or for the entry of workmen for inspection and repair of the drum. The heating conduits which are imbedded in the wall along its unbroken portions are in the form of substantially ring shaped open loops 3 lying in parallel planes substantially at right angles to the longitudinal axis of the drum, the centers of the loops lying along the longitudinal drum axis. Each of the loops fails to completely close at the bottom of the shell and the open ends of each pair of adjacent loops are connected by means of forked conduits 4 as shown in Fig. 1, the outlets of the forked conduits 4 leading to the exterior of the drum and being connected to conduits 5 which are in the nature of headers and which lie on the under side of each of the drum sections as shown in Fig. 3. At those portions of the shell wherein the openings 2 occur

there are pairs of oppositely disposed shorter arced conduits 6 approaching the openings 2 from either side, in place of the ring shaped loops occurring at other points along the drum. The lower ends of adjacent conduits 6 are connected to forked conduits 11 as shown in Fig. 1 and the outlets of the forked conduits connect with header 5 as shown in Fig. 2. The arced or bowed conduits 6 occur in the same drum sections as the loop forming arced conduits 3 whereby the drum shell is provided with heating tubes throughout its entire length.

The headers 5 are closed off at both ends and are provided with outlets 7 which serve to connect them with a condensate discharge conduit. The heating steam inlet tubes 8, which are of smaller diameter than the headers 5, extend into one end of the said headers 5 and run substantially along the entire length of each. Tubes 8 are closed at their ends 9 but their upper surfaces are provided with a number of openings 10 through which heating steam flows to conduits 3 and 6 wherein it streams upwardly. The condensate formed as a result of the heat exchange between the heating steam and the contents of the drum drips down the inner walls of the arced heating conduits to headers 5 from which it flows through outlets 7. The headers 5 associated with the drum sections are not in alignment but are slightly off-set with respect to each other as shown in Figs. 2 and 3 so that all connections are readily accessible.

What I claim is:

1. A heat exchange device comprising a drum positioned with its longitudinal axis in a substantially horizontal plane, heating conduits arranged along the walls of the drum and having outlets at the under side of the drum, a header positioned on the under side of the drum longitudinally of the drum and connected to the aforesaid outlets, and a heating steam inlet conduit connected to the header, the aforesaid heating conduits lying in substantially vertical planes and shaped in the form of arcs or bows whereby the condensate formed in the bowed heating conduits may readily drip into the header.

2. A heat exchange device comprising a substantially tubular drum, a header mounted longitudinally of the drum adjacent thereto and exterior thereof, arc shaped heating conduits arranged along the walls of the drum along the entire length thereof and in parallel planes substantially at right angles to its longitudinal axis, the centers of said arcs lying along the longitudinal drum axis, said arc shaped heating conduits having outlets extending to the exterior of the drum at points adjacent the aforesaid header, and a heating steam inlet conduit connected to the header, said header being provided with a condensate outlet opening.

3. A heat exchange device comprising a drum for the reception of material to be treated, a heating steam inlet and condensate discharge header mounted on the exterior of the drum at its under side, and heating conduits imbedded in the walls of the drum having ends connected to the aforesaid heating steam inlet and condensate discharge header, each of said heating conduits being arc shaped and lying in a vertical plane substantially at right angles to the longitudinal drum axis.

4. A heat exchange device comprising a drum adapted to be positioned with its longitudinal axis in a horizontal plane and having an opening for the reception of material to be treated, a header mounted on the exterior of the drum at its under side, a heating steam inlet conduit connected to said header, and heating conduits imbedded in the wall of the drum along its entire length, each having leads to the aforesaid header, each of said heating conduits being arc shaped and lying in a plane substantially at right angles to the longitudinal drum axis, the heating conduits lying in the drum wall at points remote from its aforementioned opening being in the form of open loops extending along the major portion of the circumference of the drum, the heating conduits lying in the drum wall adjacent its opening being in the form of relatively shorter arcs extending from points adjacent the said header to either side of the opening.

5. A heat exchange device as claimed in claim 3 wherein the adjacent ends of pairs of adjacent arc shaped heating conduits are connected to forked tubes which serve to connect the heating conduits with the heating steam inlet and condensate discharge header.

6. A heat exchange device comprising a substantially tubular drum having an opening for the reception of material to be treated, a header mounted along the length of the drum exteriorly thereof and adjacent thereto, a heating steam inlet conduit mounted within said header longitudinally thereof and extending into the header for substantially its entire length, said steam inlet conduit being provided with a plurality of openings facing the drum wall, heating conduits imbedded in the drum wall throughout the length of the drum, each of said heating conduits being arc shaped and lying in a plane substantially at right angles to the longitudinal drum axis, the heating conduits lying in the drum wall at points remote from its aforesaid opening being in the form of loops extending along a major portion of the circumference of the drum, the heating conduits lying in the drum wall adjacent its opening being in the form of relatively shorter arcs extending from points adjacent the said header to either side of the opening, and forked tubes connecting adjacent ends of

pairs of adjacent arc shaped heating conduits with the header.

7. A heat exchange device comprising a drum built up of a plurality of substantially tubular sections joined end to end, each of said sections having an individual header mounted longitudinally of its exterior, arc shaped heating conduits imbedded in the wall of each of the sections and lying in planes substantially at right angles to the longitudinal drum axis, the ends of said arc shaped heating conduits of each section being connected to its header, and heating steam inlet conduits connected to the headers, the header of each section being slightly off-set with respect to the headers of its adjacent sections to facilitate the making of connections.

In testimony whereof, I have hereunto set my signature.

OTTO ENGLER.