

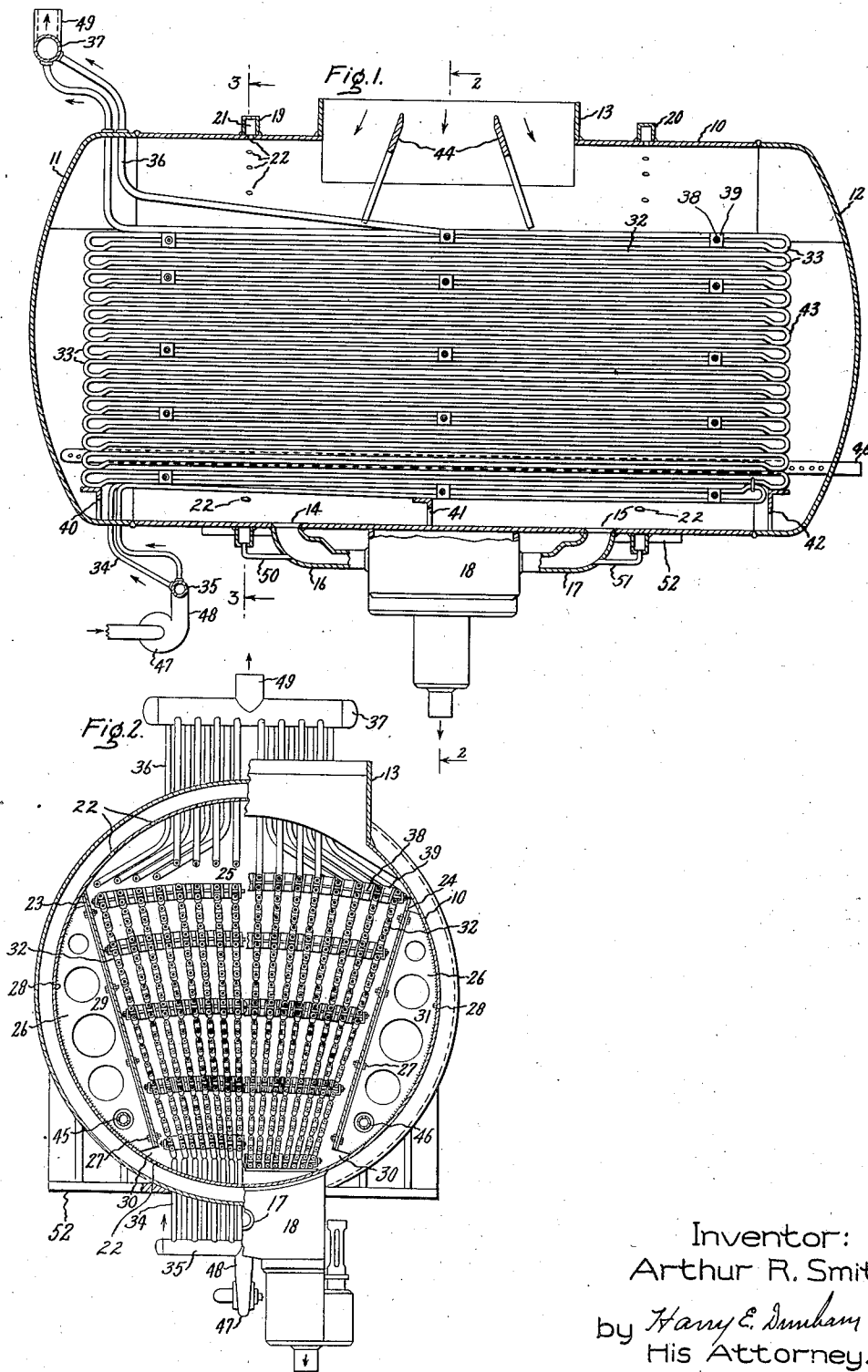
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SURFACE TYPE HEAT EXCHANGER

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## SURFACE TYPE HEAT EXCHANGER

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The present invention relates to surface type heat exchangers such as are used as condenser boilers in mercury power plants although it is not limited thereto necessarily. In condenser boilers mercury vapor exhausted from a turbine is condensed and the heat content of the vapor is transferred to water in order to produce steam.

The object of the present invention is to provide an improved construction of surface type heat exchangers which may be effectively and efficiently operated as condenser boilers.

For a consideration of what I believe to be novel and my invention, attention is directed to the following description and the claims appended thereto in connection with the accompanying drawing.

In the drawing Fig. 1 illustrates a sectional view of a condenser boiler embodying my invention; and Fig. 2 is a section of Fig. 1. The right-hand half of Fig. 2 is taken along line 2-2 of Fig. 1 and the left-hand half of Fig. 2 is taken along line 3-3 of Fig. 1.

The arrangement comprises an outer fabricated cylindrical shell or drum 10 with cup-shaped end portions 11 and 12 fused to opposite ends of the shell 10. The shell in the present example is horizontally disposed and has an upper portion forming an inlet 13 for receiving medium to be cooled such as mercury vapor discharged from a turbine and to be condensed within the shell. A lower portion of the shell has two spaced openings 14, 15 for discharging cooled or condensed medium. In the present instance these openings are connected by conduits 16 and 17 respectively to a mercury sump 18. The shell or container for high temperature fluid is of relatively light weight and for this reason reinforced by a plurality of axially spaced annular channel members or loops 19, 20. Each channel member is sealed, in the present instance fused, to the outer wall of the shell 10 and the annular channels 21 formed between the channel members and the shell communicate with the interior of the shell through a plurality of circumferentially spaced openings 22 in the upper and lower portions of the shell. With this arrangement heated medium is admitted through the upper openings 22 into the channels 21 whereby the channel members 19, 20 are subjected to substantially the same temperature as the shell 10 and the setting up of excessive temperature stresses is thereby avoided.

Two spaced plates 23 and 24 are disposed within the shell 10 on opposite sides of and oppositely inclined towards a vertical plane through

the center of the shell. The plates 23, 24 form between them a condenser space proper 25, that is, the space in which condensation or heat transfer is to take place. The purpose of oppositely inclining the plates is to produce a space 25 which decreases in cross sectional area in the direction of flow of vapor and thereby to assure substantially uniform condensation and constant velocity of the medium to be condensed. Each of the plates 23, 24 extends along the entire length of and is securely supported on the outer shell by means of a plurality of axially spaced perforated plates 26 having inner bent edge portions fastened to the plates by bolts 27 and outer curved edges fused to portions of the shell 10 by welds 28. The plate 23 and an adjacent portion of the shell form a space 29. This portion of the shell is without perforations and the upper edge of the plate 23 has sealing contact with the shell so that no fluid can enter directly from the upper part of the condenser space proper 25 into the upper end of the space 29. The lower end of the plate 23 is spaced from the adjacent portion of the shell forming a clearance 30 therewith, permitting fluid to pass from the lower portion of the space 25 into the lower portion of the space 29. Similarly, the other plate 24 forms a space 31 with the shell and has an upper edge forming sealing contact with the shell and a lower edge spaced from and forming a clearance with the shell.

Condensation of mercury vapor in the present example is effected by a plurality of spaced rows or banks of tubes. In the present instance I have shown eight spaced rows or banks of tubes 32 on each side of the vertical centerline of the drum. Each row of tubes consists of a plurality of series-connected substantially uniformly spaced hairpin-shaped tube portions 33 with an inlet conduit 34 projecting through the bottom of the shell and connected to an inlet header 35, and with an outlet or discharge conduit 36 projecting through the top of the shell and connected to an outlet or steam header 37. The hairpin-shaped tube portions have a diameter increasing from the inlet conduit towards the outlet conduit. In the present example the inlet half of each row of tubes has a uniform diameter smaller than the uniform diameter of the outlet half of such row. Each row of tubes is inclined with respect to the central vertical plane through the drum, with the inclination per row increasing from the row of tubes nearest the central vertical plane towards the plates 23 and 24 respectively. Thus the rows or banks of tubes

form passages between them for the fluid to be cooled or condensed and the cross sectional area of these passages decreases downwardly when viewed in Fig. 2, that is, in the direction of flow of vapor. In other words, as condensation takes place the cross sectional area of the passages for vapor is reduced to assure substantially uniform velocity of the medium to be condensed on its path through the condenser.

The spacing between the several rows of tubes is maintained by a plurality of spacer means. In the present example this spacer means is in the form of vertically spaced substantially horizontally disposed rods 38 with spacers 39 held on the rod between adjacent rows of tubes. The upper rod 38 has end portions engaging and supported on the upper ends of the plates 23, 24. Lower hairpin-shaped portions of the tubes are held on supports 40, 41 and 42 secured to the shell 10. The hairpin-shaped tube portions of each row have looped or widened ends 43 engaging and supporting each other with the ends of the lower tube portions resting on the supports 40 and 42.

Baffles 44 are provided within the inlet 13 and arranged uniformly to distribute vapor to be condensed over the entire length of the tubes. Non-condensables such as air in the case of a condenser boiler may be removed from the condenser through perforated tubes 45 and 46 located respectively in lower parts of the spaces 29 and 31 formed between the plates 23 and 24 respectively and adjacent portions of the shell 10.

During operation mercury vapor is supplied to the condenser through the inlet 13 and this vapor is condensed as it is passed over the banks of tubes, the condensate being discharged through the conduit 16, 17 into the mercury sump 18. Non-condensables accumulating in the lower portion of the condenser space proper 25 pass through the clearances 30 near the lower ends of the plates 23 and 24 respectively and are withdrawn through the perforated tubes 45 and 46. Cooling medium, in the present instance water, is forced by a pump 47 into an inlet 48 of the lower header 35, whence it is passed through the several banks or rows of tubes and evaporated, the vapor being discharged from the outlet conduits 36 of the rows of tubes into the upper header 37 which latter has a steam discharge conduit 49. Some of the mercury vapor passes through the openings 22 in the shell into the channels 21 and is condensed therein, the condensate being discharged from lower portions of the channels 21 through pipes 50, 51 connecting the lower portions of the channels 21 with the aforementioned conduits 16, 17 respectively. The perforations or holes 22 connecting the lower portion of the shell with the channels 21 normally assure a continuous flow of vapor through the channels 21. In case the drain pipes 50, 51 become clogged, condensate is discharged from the lower portions of the channel

21 through the holes 22 into the shell. A supporting structure 52 is secured to the reinforcing hoops 19, 20.

Having described the method of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, I desire to have it understood that the apparatus shown is only illustrative and that the invention may be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. Surface type heat exchanger comprising a cylindrical shell having inlet and outlet openings, and means for reinforcing the shell including an annular channel member surrounding and fused to the shell and forming a channel communicating with the interior of the shell through a plurality of circumferentially spaced openings in the shell.

2. Condenser boiler comprising a cylindrical shell having a top portion forming an inlet for mercury vapor and a bottom portion forming an outlet for mercury liquid, means for reinforcing the shell comprising a plurality of spaced annular channel members surrounding and sealed to the shell, the shell having circumferentially spaced openings to establish communication between the interior of the shell and the channels formed by said channel members, two plates located within the shell on opposite sides of and oppositely inclined towards a central plane through the shell to define a condenser space proper between them decreasing in cross sectional area in the direction of flow of mercury vapor, spaced banks of tubes located within said space, and means for removing non-condensables from the spaces defined between each of said plates and the adjacent portions of the shell, the shell portion adjacent the plates being free from said circumferentially-spaced openings to preclude non-condensables in the last named spaces from flowing into the channels.

3. A container for fluid at high temperature comprising a fabricated cylindrical shell and a reinforcing channel member surrounding and sealed to the shell, the shell having a plurality of circumferentially spaced openings to effect communication between the interior of the shell and the channel formed by the channel member in order to minimize relative expansion between the shell and the channel member.

4. Condenser boiler comprising a shell having an inlet opening for receiving fluid to be condensed and an outlet conduit for discharging condensate, a channel member surrounding the shell and fused thereto and perforations in the shell to establish communication between the interior of the channel member and the interior of the shell, a pipe for conducting condensate from the channel member into said outlet conduit, and banks of spaced tubes disposed within the shell and having inlets for receiving a cooling medium and outlets for discharging heated medium.

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