

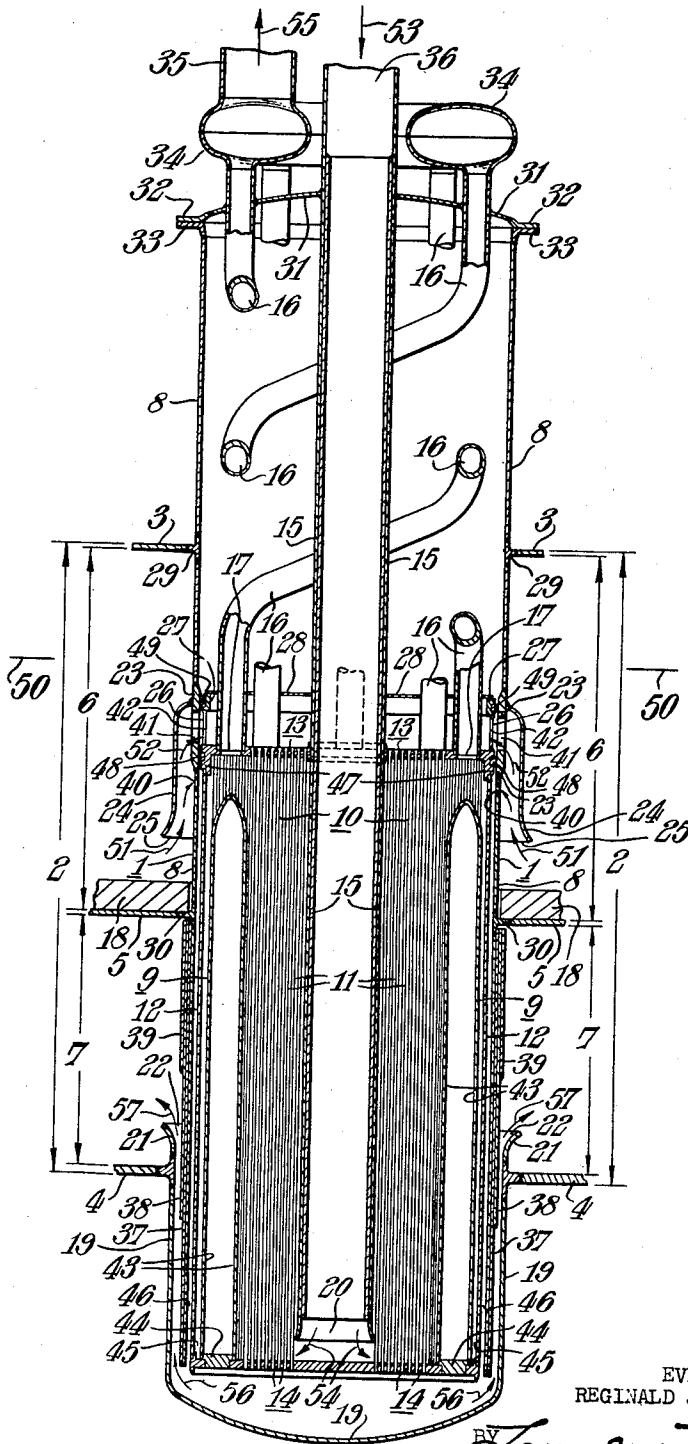
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E. LONG ET AL

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HEAT EXCHANGERS

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INVENTORS
EVERETT LONG
REGINALD JOHN SYMES

BY *Lanyon and Taylor*

ATTORNEYS

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HEAT EXCHANGERS

Everett Long, Culcheth, near Warrington, and Reginald John Symes, Cuddington, England, assignors to United Kingdom Atomic Energy Authority, London, England

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4 Claims. (Cl. 257—199)

This invention relates to heat exchangers.

It is one object of the invention to provide a heat exchanger of the shell and tube type suitable for use in a heat transfer system for heat exchange between primary liquid sodium and secondary liquid sodium, the heat exchanger being readily removable for maintenance purposes.

A heat exchanger according to the invention comprises a tank for containing a first liquid, the tank being divided by a partition into upper and lower tanks, a tube penetrating the partition to permit flow of said first liquid between the upper and lower tanks via the tube, a removable heat exchanger unit in the tube comprising a nest of tubes through which said first liquid passes and a shell between two tube plates and means for feeding a second liquid into and out from said shell through the upper of the two tube plates to flow through said shell counter-currently to said first liquid passing through said nest of tubes.

A heat exchanger according to the invention will now be described with reference to the single figure of the accompanying drawing which is a sectional elevation.

Referring to the drawing, a heat exchanger 1 comprises a tank 2 defined by a top plate 3, a bottom plate 4, and sides plates (not shown). The tank 2 is divided by a partition plate 5 into an upper tank 6 and a lower tank 7. A tube 8 penetrates the partition plate 5 and houses a heat exchanger unit 9 comprising a nest 10 of tubes 11 and a shell 12 between two tube plates 13, 14. A tube 15 of multilayer structure passes through the tube plates 13 and eight equispaced tubes 16 have their open ends 17 located by the tube plate 13.

In greater detail, the plate 5 supports a layer 18 of heat insulating material and the plate 4 supports a cylindrical vessel 19 surrounding and spaced from the lower end of the tube 8.

The ends of the tubes 11 and the shell 12 are welded to the plates 13, 14, the ends 17 of the tubes 16 are welded to the plate 13 and the tube 15 is welded to the plate 13 where it passes through it. The tube 15 has a flared open end 20 and the vessel 19 has a flared end 21 forming an outlet 22. The tube 8 has an integral flange-tube 23 to which is welded a bell-shaped flange 24 forming an inlet 25. Welded to the plate 13 is a cylinder 26, having a flanged end 27 to which is welded a circular plate 28, the pipes 15, 16, passing freely through the plate 28. The tube 8 is welded to the plates 3, 5, at flanges 29, 30, respectively and the upper end of the tube 8 has an end cap 31, the end cap 31 having a flange 32 secured to a flange 33 on the tube 8. The pipes 15, 16, are supported by the end cap 31, being welded to the end cap 31 where they pass through it. The pipes 16 are coiled between the plate 28 and the end cap 31 and connect to a common annular header 34 having an outlet 35. The pipe 15 has a top inlet 36. Outer tubes 37, 38, 39, are welded to the tube 8 which has a set of ports 40 adjacent to the flange tube 23. The flange tube 23 has ports 41, and the cylinder 26 has ports 42.

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Eight snout-ended closed tubes 43 sealed to plugs 44 in the plate 14 are provided, one of the plugs 44 being arranged vertically below each of the open ends 17 of the pipes 16. The shell 12 defines an annular cavity 45 between the outer boundary of the tubes 11, 43 and the shell 12. The shell 12 also defines an annular cavity 46 between the tube 8 and the shell 12. A flange 47 on the plate 13 locates a ring 48, and the flange end 27 on the cylinder 26 locates a ring 49, the rings 48, 49, bearing on the inner surface of the flange-tube 23. The tank 7 contains circulating pumps (not shown).

In operation, the tank 6 contains hot primary liquid sodium as indicated at liquid level 50 and the tank 7 contains cooled primary liquid sodium, the primary liquid sodium being circulated by the pumps in the tank 7. The hot primary liquid sodium enters the inlet 25 as shown by arrows 51, passes through the ports 41, 42, as shown by arrows 52 and flows down through the tubes 11. At the same time secondary liquid sodium is flowing counter-currently through the spaces between the tubes 11, having entered the pipe 15 at the inlet 36 as shown by arrow 53, flowed down the pipe 15 and into the shell 12 at the open end 20 of the tube 15 as shown by arrow 54. Heat is transferred from the primary liquid sodium to the secondary liquid sodium which then flows upwardly through the pipes 16 and out of the outlet 35 of the header 34 as shown by arrow 55 to be cooled before recirculation. The primary liquid sodium, having been cooled in passage through tubes 11, enters the vessel 19 to rise upwardly as shown by arrow 56 to leave the vessel 19 at the outlet 22 as shown by arrow 57 to be recirculated by the pumps in the tank 7.

The use of the multi-layer tube 15 helps to minimise the stresses due to the temperature gradient in the central region of the heat exchanger unit 9.

The tubes 43 minimize streaming of the secondary liquid sodium, thereby increasing the heat transfer between the primary and the secondary liquid sodiums. The snout shaped ends of the tubes 43 promote smooth entry of the secondary liquid sodium into the open ends 17 of the tubes 16.

Some of the hot primary liquid sodium entering at the inlet 25 flows through the ports 40 and downwardly through the cavity 46. This arrangement in conjunction with the cavity 45 and the provision of the tubes 37, 38, 39, minimise the stresses due to the temperature gradient at the outer region of the heat exchanger unit 9.

The arrangement of the plate 28, the flange-tube 23 and the bell-shaped flange 24 provides an under-flow character to the inlet 25, in contrast to an alternative arrangement whereby the hot primary liquid sodium flows through ports in the tube 8 and straight into the tops of the tubes 11. This underflow arrangement has merit in that it draws its flow from a level low enough to prevent gas entrainment. It also enables the heat exchanger unit 9 to be submerged with the primary liquid sodium at the level 50 i.e., similar to the level of the plate 28, thus reducing the overall height of the heat exchanger.

The coiling of the pipes 16 allows for heat expansion and the support of the pipes 15, 16, from the end cap 31 of the tube 8 also allows for heat expansion, the rings 48, 49 locating freely in the flange-tube 23 which is an integral part of the tube 8. The heat exchanger hangs from the pipes 15, 16, and is free to move axially.

We claim:

1. A heat exchanger comprising a tank for containing a first liquid, the tank being divided by a partition into upper and lower tanks, a tube penetrating the partition and having defined therein an inlet and an outlet to permit flow of said first liquid between the upper and lower tanks via the tube, a removable heat exchanger unit in the tube comprising a nest of tubes through which said

first liquid passes and a shell between two tubes plates, and means for feeding a second liquid into and out from said shell through the upper of the two tube plates to flow through said shell countercurrently to said first liquid passing through said nest of tubes.

2. A heat exchanger as claimed in claim 1 wherein the heat exchanger unit is free to move axially in said tube to accommodate thermal expansion of said heat exchanger unit.

3. A heat exchanger as claimed in claim 1 wherein said shell has a flow path guide member to reduce streaming of the second liquid flowing through the shell and thereby

enhance heat exchange between the first and second liquids.

4. A heat exchanger as claimed in claim 1 wherein the first liquid enters the nest of tubes at a level below that of the first liquid in the upper tank thereby enabling the heat exchanger unit to be submerged with consequent reduction in the overall height of the heat exchanger.

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