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Massaro, Jr. et al.

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[54] **END CLOSURE FOR A HEAT EXCHANGER**

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[73] Assignee: **Westinghouse Electric Corporation,** Pittsburgh, Pa.

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[52] **U.S. Cl.** **165/158,** 122/32
[51] **Int. Cl.** **F28f 9/06**
[58] **Field of Search** 165/143–145, 158–162, 165/173; 122/32

[56] **References Cited**

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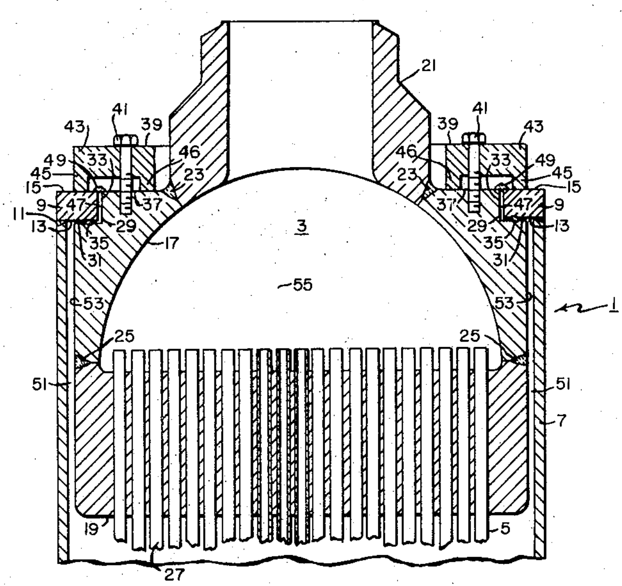
[57] **ABSTRACT**

A shell and tube heat exchanger having a tube bundle, which is removable through the shell, and having a removable channel head, which forms an end closure and a header for the tubes, the channel head having an annular step, which registers with an inwardly directed flange on the shell to form a seal utilizing an O-ring type gasket, the channel head being fastened to the shell by a plurality of clamps, which are bolted to the head in such a manner to provide the proper sealing force on the O-ring gasket, and having a seal weld to insure a leak proof joint.

9 Claims, 2 Drawing Figures



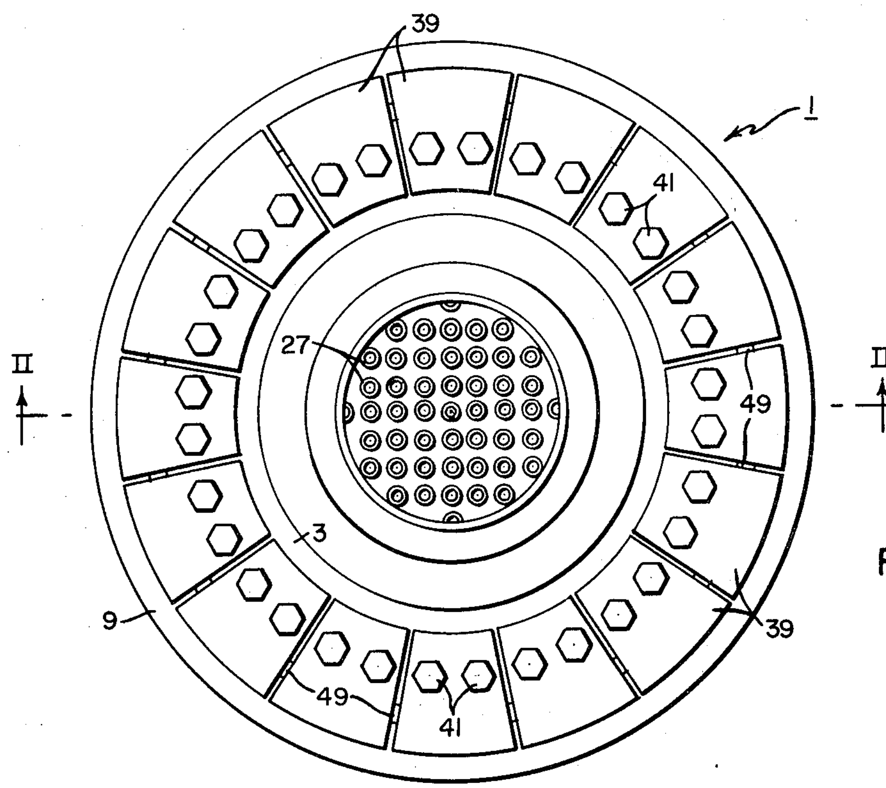

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FIG.1

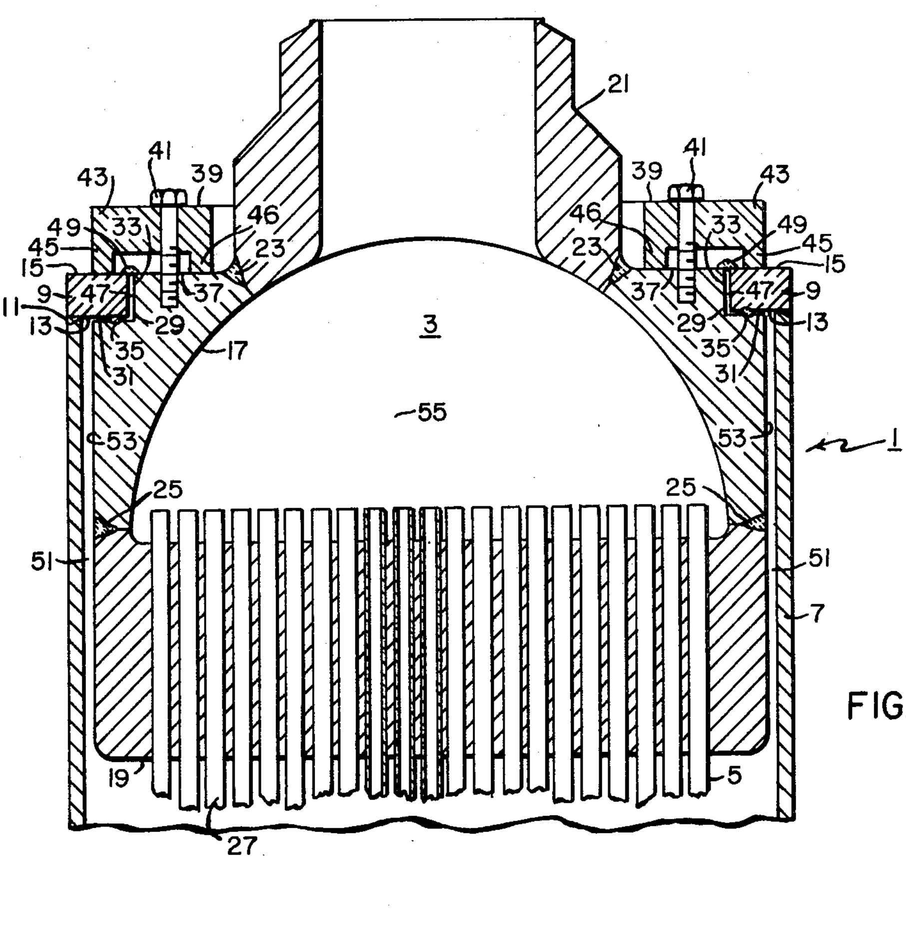
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FIG.2

END CLOSURE FOR A HEAT EXCHANGER

BACKGROUND OF THE INVENTION

This invention relates to shell and tube heat exchangers and more particularly to a sealing arrangement for a channel head which forms an end closure for the shell.

The demand for electrical power in the United States doubles approximately every 10 years. Presently fossil fuels provide the majority of the energy utilized in producing electrical power. In the next 30 years, it is estimated that over 50 percent of our electrical power will be produced by nuclear energy. The supply of fissionable material is limited, so that the future of nuclear power depends on developing a reliable, fast breeder reactor which produces more fissionable material than it consumes. Such a system necessarily requires sound heat exchangers, which can be inspected and serviced with a minimum amount of down time. The present state of the art requires heat exchangers designed to transfer heat from liquid sodium to water, thus such heat exchangers must provide for complete inspection of the tube bundles during periodic overhauls. To allow for direct inspection of the tube bundles, they must be readily removable from the shell to allow for extensive visual inspection with a minimum amount of unit down time.

For more information concerning heat exchangers, in which this invention can be advantageously utilized reference may be made to an application filed Mar. 3, 1971, Ser. No. 120,423, by William G. Harris, Jr. and Anthony A. Massaro, Jr. and assigned to the same assignee.

SUMMARY OF THE INVENTION

In general, a shell and tube heat exchanger, when made in accordance with this invention, has a head portion adapted to receive a plurality of tubes, to serve as an end closure for one end of said shell and to be removable through said shell. The shell has an annular flange extending radially inwardly from one end thereof. The head portion has an annular step, which registers with the flange, the step has an annular tread and riser portion so disposed that the tread portion is generally parallel to a mating surface on the flange. The mating surfaces are adapted to receive a ring-shaped sealing member and the heat exchanger has a plurality of arcuate segments in clamping engagement with the head portion and the flange and are adapted to apply a sealing force generally normal to the mating surfaces.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects and advantages of this invention will become more apparent from reading the following detailed description in connection with the accompanying drawings, in which:

FIG. 1 is a plan view of a portion of a shell and tube heat exchanger having a removable head portion made in accordance with this invention;

FIG. 2 is a partial vertical sectional view taken on line II—II of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings in detail, FIGS. 1 and 2 show a portion of a shell and tube heat exchanger 1 having a channel head 3 for a tube bundle 5, which is removable through a cylindrical shell portion 7 thereof. The shell portion 7 has an annular flange 9 extending radially inwardly from one end 11 thereof, and the flange 9 is welded to the shell 7. The outer diameter of the flange is generally equal to the outer diameter of the shell, while the inner diameter of the flange is considerably less than the inner diameter of the shell. The flange 9 is disposed to have two parallel surfaces 13 and 15 disposed normal to the shell 7.

The channel head 3 has a sperical dome portion 17 and a circular tube sheet 19. A nozzle 21 extends axially upward from the sperical dome potion 17. The nozzle 21, dome portion 17, and tube sheet 19 are welded together by circumferential welds 23 and 25 to form a unitized channel head 3. A plurality of tubes 27 depend from the tube sheet 19 and are fastened and sealed thereto by rolling, welding or other means.

The upper portion of the sperical dome portion 17 has an outer annular step 29, which registers with the flange 9. The step 29 has an annular tread portion 31 and a riser portion 33 so disposed that the tread portion 31 is generally parallel with the surface 13 on the flange to provide mating surfaces. These mating surfaces 13 and 31 are adapted to receive a ring-shaped sealing member or gasket 35. Preferrably the gasket 35 is an elastomer O-ring, however, a metal ring or a flat or spirally wound gasket may be utilized. Depending on the type of gasket employed, the mating surfaces may have one or more grooves, the shape of which varies according to the accepted and well known techniques utilized to seal annular mating surfaces.

The riser portion 33 of the step 29 is generally as high as the flange 9 is thick, providing a generally planar annular surface comprising the upper surface 15 of the flange 9 and an annular surface 37 on the upper portion of the sperical dome 17.

A plurality of arcuate segments 39 are disposed in clamping engagement with the surfaces 15 and 37. Cap screws or bolts 41 fasten the arcuate segmented clamps 39 to the dome portion 17 of the channel head 3. The clamps 39 are generally channel shaped with a heavy web 43 and legs 45 and 47. The legs 45 and 47 engage the flange 9 and dome portion 17, respectively, so that by tightening the bolts 41 a sealing force generally normal to the mating surfaces 31 and 13 is applied. The number and size of the bolts 41 can be advantageously predetermined to apply the proper sealing force on the gasket 35 and take into account the weight of the tubes 27, which are supported from the channel head 3.

Besides properly distributing the sealing force to the flange and dome portions, the clamps 39 also bridge a gap 47 between the riser 33 and inside diameter of the flange and provide clearance for a circumferential seal weld 49, which provides a positive seal between the flange 9 and the dome portion 17, if needed.

The tube sheet 19 has a peripheral cylindrical surface 51, which aligns with an outer peripheral surface 53 of the sperical dome 17 providing the channel head with an outer cylindrical surface slightly smaller in diameter than the inner diameter of the shell 7 so that the channel head 3 is freely slidable within the shell 7 to allow the shell to be easily separated from the tube bundle 5, when the seal weld 49 and clamps 39 are removed.

The nozzle 21 and dome portion 17 are so formed that when welded together they provide a hemispherically shaped or dome shaped chamber 55 adjacent the tube sheet 19. The arrangement as hereinbefore described allows shell pressure acting on the bottom of the tube sheet 19 to assist in sealing the gasket 35, this is particularly advantageous to prevent leaks at the seals resulting from pressure surges coincident with a reaction between sodium and water prior to some relief device (not shown) relieving the pressure build up in the shell.

What is claimed is:

1. A shell and tube heat exchanger having a head portion connected to a plurality of tubes, to serve as an enclosure for one end of said shell and to be removable through said shell, said shell having an annular flange extending radially inwardly from said one end thereof, said head portion having an annular step, which registers with said flange, said step having an annular tread and riser portion so disposed that the tread portion is generally parallel to a mating surface on said flange, said mating surfaces having a ring shaped seal member associated therewith and said heat exchanger having a plurality of arcuate segments in clamping engagements with said head portion and said flange, and applying a sealing force generally normal to said mating surfaces.

2. A shell and tube heat exchanger as set forth in claim 1 having an annular seal weld disposed to form a positive seal between the flange and the head portion thereof.

3. A shell and tube heat exchanger as set forth in claim 1, wherein the ring sealing member is an elastomer ring having a round cross section.

4. A shell and tube heat exchanger as set forth in claim 1, wherein the head portion is a sperical head.

5. A shell and tube heat exchanger as set forth in claim 1, wherein the shell is cylindrical and the head has an outer cylindrical surface slightly smaller in diameter than the inner diameter of the shell.

6. A shell and tube heat exchanger as set forth in claim 5, wherein the head portion is generally disposed within the shell and has a centrally disposed nozzle extending axially from the head and beyond the shell.

7. A shell and tube heat exchanger as set forth in claim 1, wherein the arcuate segments are fastened to the head in such a manner that the force normal to the mating surfaces has a predetermined value sufficient to properly seat the seal ring member.

8. A shell and tube heat exchanger as set forth in claim 1, wherein the arcuate segments are bolted to the head in such a manner that the force normal to the mating surface has a predetermined value sufficient to properly seat the seal ring member.

9. A shell and tube heat exchanger as set forth in claim 1, wherein the head portion comprises a generally flat circular tube sheet, a sperical dome portion having a cylindrical outer surface generally equal in diameter to the outer diameter of the tube sheet and slightly smaller than the inner diameter of the shell.

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