Title: TUBE NEST HEAT EXCHANGER WITH CLEANING ACCESS

Abstract: A tube nest heat exchanger with shell under pressure has a lower inlet tube plate (12) separating the interior of the shell from an inlet manifold for arrival of the fluid to be cooled. The tube plate has fluid passages (14) and near the internal surface of the tube plate are side cleaning passages (35) for communication with the exterior of the shell and designed for introduction into the shell of means (45, 46) for cleaning the plate zone at the foot of the nest tubes. There can be inspection passages (38) near the plate surface for visual inspection of the zones to be cleaned.
IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Published:
— With international search report.
TUBE NEST HEAT EXCHANGER WITH CLEANING ACCESS

The present invention relates to a tube nest heat exchanger with inner cleaning access near the lower zone of the tube nest and in particular in the zone of connection of the tubes to the plate.

In the field of thin tube plate exchangers such as those used for outlet from cracking furnaces e.g. for ethylene production it is known that exchanger life is linked mainly to corrosion on the steam side of the hot tube plate.

It has been found that corrosion occurs when the tube plate is fouled because of the deposits of particles from the boiling water container. Indeed, the hot tube plate being the lowermost part of the water circulation system, all the heavy parts tend to fall to the bottom and especially in the presence of obstructions such as heat exchanger tubes. These deposits are entrained by the water running from one side of the plate to the other at considerable speed (approximately 2m per second) and are deposited on the side opposite the water inlet. Furthermore, the parts sheltered from the water flow retain some deposit which in turn acts as a trap for further material deposits.

Deposit of material thus created produces a tube plate temperature rise and thus is a source of corrosion.

Corrosion appears especially on the weld between the tube plate and tubes. This corrosion once started progresses to breakage of the parts attacked.

The general purpose of the present invention is to remedy the above mentioned shortcomings by making available an
exchanger with improved characteristics for removal of slag from critical points.
In view of this purpose it was sought to provide in accordance with the present invention a tube nest heat exchanger with shell under pressure and having a lower inlet tube plate separating the interior of the shell from an inlet manifold for the fluid to be cooled with the tube plate having fluid passages for communication with the interior of the tube nest tubes characterized in that near the internal surface of the tube plate there are side cleaning passages for communication with the exterior of the shell which are designed for introduction into the shell of means for cleaning the plate zone at the foot of the nest tubes.
To clarify the explanation of the innovative principles of the present invention and its advantages compared with the prior art there is described below with the aid of the annexed drawings a possible embodiment thereof by way of non-limiting example applying said principles. In the drawings:
FIG 1 shows a diagrammatic longitudinal cross section view of a heat exchanger in accordance with the present invention,
FIG 2 shows a cross section along plane of cut III-III of FIG 3,
FIG 3 shows a diagrammatic partial view of a base zone of the exchanger, and
FIG 4 shows an internal detail of the exchanger.
With reference to the figures they show diagrammatically a
tube nest heat exchanger designated as a whole by reference number 10. The exchanger 10 has a shell 11 under pressure with the inlet tube plate 12 separating the interior of the shell from an inlet manifold 13 for the fluid to be cooled. The tube plate 12 has passages 14 for communication with the interior of the tubes 15 of which only one is shown making up the tube nest.

A sacrifice plate 16 may be arranged in the manifold facing the tube plate 12 which is pierced opposite the passages in the tube plate to protect it from the impact with the fluid entering the manifold 13.

The exchange fluid enters the shell under pressure through a connector 30 and exits from an upper connector 31 after following a sinuous path designated as a whole by the line 32 defined by a plurality of baffles 33 arranged in the container.

FIG 2 shows a cross section of the exchanger immediately above the tube plate 12. This view is rotated 90° with respect to the view of FIG 1 with the arrow 34 representing the water inlet direction into the exchanger through the inlet 30.

In the raised edge of the plate 12 immediately above the plate plane are cleaning passages 35 aligned with the passages between the tubes of the tube nest. The passages extend across the flow of water in the exchanger.

Advantageously the passages are made alternately on one side and the other of the exchanger so that the even rows between the tubes are aligned with the passages on one side and the odd rows with the passages on the other side. This
way the holes made in the plate to provide the passages 35 are spaced by a pitch double that of the tubes. The passages extend into sleeves 36 protruding laterally from the plate. When the exchanger is operating the passages 35 are closed by welded plates 37 which are removed during cleaning operations.

At a right angle to the passages 35 is a pair of facing inspection passages 38 arranged on a diameter of the container. Each of these passages has a duct 39 ending in a flange 40 for fastening a closing plate 41.

As shown in FIG 4 the tube nest tubes are fastened to the plate 12 opposite necks 42. The necks are at least 20mm high and advantageously between 30mm and 40mm high so that the weld 43 for fastening the tubes to the necks is far from the plate plane. In this manner the weld is outside the zone considered critical for corrosion.

At each plant shutdown the plates 41 are removed and endoscopes 44 are inserted through the inspection passages 38 for visual inspection of the internal part of the plate 12 around the tube nest tubes.

If deposits are found the plugs 37 closing the cleaning passages 35 are removed and cleaning rods 45 with point and surface designed for mechanical cleaning of the zone between the necks 42 are introduced through the holes as shown diagrammatically in FIG 4 also. The mechanical cleaning action will be produced exactly in the zone normally sheltered from water flow in the exchanger. Once the dirt is removed the rods 45 are withdrawn and replaced with suction tubes 46 which suck the previously
removed deposits.
After another visual inspection to ensure the good outcome of the cleaning it is possible to close the passages 35 and 38 and return the exchanger to operation.

Advantageously there is also another passage 47 arranged in the wall of the exchanger near the plate 12 in a position diametrically opposite the cooling water flow inlet 30 as shown in FIG 1. This passage has a welded plug 48 which can be removed during cleaning operations to allow reaching the underlying zone 49 of the plate by hand or with cleaning tools. Dirt accumulates in this zone which is near the zone where the water flow returns upward and the dirt can thus be removed.

It is now clear that the predetermined purposes have been achieved by making available a tube nest exchanger in which it is possible to perform mechanical cleaning of the internal part of the lower tube plate to prevent accumulation of particles which have been found responsible for the internal corrosion of the plate.

Naturally the above description of an embodiment applying the innovative principles of the present invention is given by way of non-limiting example of said principles within the scope of the exclusive right claimed here. For example the shape and proportions of the exchanger can vary depending on specific practical exigencies. In addition the cleaning means can be different from those described and shown. For example, brushes, rods with abrasive walls, water streams et cetera could be used.
CLAIMS

1. Tube nest heat exchanger with shell under pressure and having a lower inlet tube plate separating the interior of the shell from an inlet manifold for the fluid to be cooled with the tube plate having fluid passages for communication with the interior of the tube nest tubes characterized in that near the internal surface of the tube plate are side cleaning passages for communication with the exterior of the shell which are designed for introduction into the shell of means for cleaning the plate zone at the foot of the nest tubes.

2. Exchanger in accordance with claim 1 characterized in that the cleaning passages extend across the flow of the cooling fluid which laps the plate.

3. Exchanger in accordance with claim 1 characterized in that the cleaning passages are arranged alternately on the two opposite sides of the exchanger to be aligned each with the space between a row of tubes of the nest.

4. Exchanger in accordance with claim 1 characterized in that the cleaning means are cleaning rods and suction tubes.

5. Exchanger in accordance with claim 1 characterized in that near the inner surface of the tube plate are side inspection passages in communication with the interior of the container and designed for the insertion of endoscopes for visual inspection of the plate zone at the foot of the tubes.

6. Exchanger in accordance with claim 5 characterized in
that the inspection passages are arranged at a right angle to the cleaning passages.

7. Exchanger in accordance with claim 5 characterized in that in the container wall in a position opposite the cooling fluid inlet zone is another access passage for cleaning of the underlying zone of the plate.

8. Exchanger in accordance with claim 1 characterized in that the tubes are fastened to the plate opposite necks protruding above from the plate surface and surrounding the fluid passages therein.

9. Exchanger in accordance with claim 8 characterized in that the necks are at least 20mm high and advantageously between 30mm and 40mm high.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F28G1/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F28G F22B F28F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Date of the actual completion of the international search

4 April 2001

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Name and mailing address of the ISA

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