PATENT SPECIFICATION

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COMPLETE SPECIFICATION

DRAWINGS ATTACHED

An Installation for Heating a Medium passing through Heater Tubes

We, SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ N.V. a Company organised under the Laws of the Netherlands, of 30, Carel van Bylandtlaan, The Hague, The Netherlands, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to installations for heating media which are passed through heater tubes, being installations of the type in which a heating chamber which is rectangular in horizontal cross-section is subdivided into a plurality of radiant heating sections by a plurality of rows of vertical heater tubes, each section being provided with at least one vertical burner. Such an installation may be, for example, an industrial furnace for heating liquid hydrocarbons.

Installation of this type are known. The side walls of the heating chamber in the known installations, however, are not provided with heater tubes. The sections of these installations are divided by double rows of tubes in which the tubes in one row are staggered with respect to the tubes in the other row. In that case those tubes are loaded on both sides, i.e. heat is transferred both from the section which is laterally bounded by this tube as well as from the adjoining section.

The present invention aims at providing an installation with a number of important advantages over the known installations, viz., firstly, reducing the wall surface required compared to the surface area of tubes housed in the heating chamber, and secondly, increasing the possibility of combining separate tubes into coils of tubing. These factors permit better use to be made of the available heating space and also provide a more uniform heat loading of the tubes in each section.

According to the invention, in an installation of the above type a single row of heater tubes is arranged against each of the side walls of the heating chamber and at least one double row of heater tubes is arranged inside the chamber to form a plurality of sections which are rectangular in horizontal cross-section and laterally bounded by heater tubes, the tubes in the (or in each) double row being arranged in back-to-back pairs, that is in non-staggered relation and spaced so that the distance between the centre line of paired tubes is twice, or almost twice, the distance between the centre line of a tube of a single row and the adjacent side wall.

As the result of such a provision the burners are laterally encompassed by tubes and during operation these tubes are very uniformly loaded in an upward direction which, as is known, is an important advantage of a vertical arrangement. Since the tubes disposed in the interior of the heating chamber are placed back-to-back, the heat loading of these tubes is substantially equal to that of the tubes arranged against the side walls. This arrangement erects a kind of imaginary wall inside the heating chamber, one row of tubes screening the back of the other row and vice versa. Hence this back-to-back arrangement of the double rows of tubes is of direct importance to the distribution of heat among the tubes, as a result of which each section can be substantially equally loaded, which is very favourable from the point of view of heat economy.

The required heating chamber wall surface is considerably smaller than in known installations housing the same quantity of tube surface, and this results in a consider-

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able economy in construction and maintenance costs.

The neat, uniform arrangement of the tubes relative to the heating apparatus opens up a wide range of possible methods of combining the separate tubes into coils of tubing, so that in practice a degree of freedom is, so to speak, added to existing possibilities, owing to the substantially equal load on the separate tubes during operation.

The invention may be performed in various ways and a specific embodiment will now be described by way of example with reference to the accompanying drawing, which is a horizontal cross-section of part of an industrial furnace for heating liquid hydrocarbons.

The furnace comprises a metal side wall 1 which is corrugated in order to increase resistance to buckling and/or bending. A layer of refractory material 2, for instance refractory concrete, is arranged against the side wall 1, for instance, by being poured against the wall. A single row of vertical heater tubes 3 is arranged near to the refractory lining, the centre lines of these tubes being at a distance from the refractory lining which is almost equal to the outside diameter of the tubes. Two rows of heater tubes 4 and 5 are also arranged inside the chamber with the tubes of each row back-to-back in pairs. Two similar rows of heater tubes 4′ and 5′ are also arranged inside the chamber at right angles to the rows 4 and 5. The rows of heater tubes 3, 4, 5, 4′ and 5′ together form four heating sections 6, 7, 8 and 9, each having a rectangular cross-section and being laterally bounded by a row of heater tubes. The bottom of each section is provided with a central opening 10, 11 12, 13 in which is arranged a suitable burner or other combustion apparatus (not shown).

The shortest distance from the centre line of a burner in one section to the centre line of a heater tube of the said section should be at least one and a half times the radius of the largest lateral flame spread during operation of that burner.

In the embodiment described, the burners are arranged in the bottom of each section. It is, however, also possible for the burners to be arranged in the top of each section so that the flame is directed downwardly. It is also possible for several burners to be arranged in one section instead of one burner. If, for instance, the rows of tubes 4′ and 5′ were omitted, two sections would be formed of a more oblong shape in cross-section, each of which would be provided with two burners. The shape of the sections and the number of burners depend on all manner of operating conditions, e.g. the type of medium to be heated, the desired degree of heating, the capacity and the throughput envisaged. It is, however, essential for each section to be laterally encompassed by rows of tubes.

The burners may be of the type usual for such furnaces. They may consist, for example, of a central straight-pressure-type mechanical atomizer using liquid hydrocarbon as fuel, which is surrounded by suitable air supply elements and, if required, by means for mixing and conveying the fuel and air.

The rows of tubes may be connected either in series or in parallel, and combinations of such arrangements are also possible. Depending on the connection selected, the ends of the tubes may be connected to headers or be connected by means of suitable bends to form a number of vertical coils of tubing.

The tubes may be secured in a simple manner by suspending them from the roof or by supporting them on the bottom and providing a suitable guide at the top.

The tube arrangement described is in principle very suitable for use in a furnace composed of a plurality of prefabricated elements closed upon themselves and so superposed that all the elements, the roof and the tubes are supported by the bottom element, as described in British patent specification No. 882,745. With such a construction there is no need for the shaped steel support structure used in many known industrial furnaces, which results in a considerable saving in construction costs.

In the construction described the heat is chiefly transferred by radiation; the still hot combustion gases withdrawn via the top still have a sufficient calorific value to permit their use for further heat transfer, so that they can be transferred direct to a following heating chamber, in which banks of heater tubes are also provided and heat is mainly transferred by convection. For instance, it is possible to connect a steam generator after the furnace described. Such an arrangement may be particularly advantageous in oil refineries. In principle, it is also possible to connect in parallel a plurality of installations of the type described and to transfer the still hot combustion gases to a common chamber adapted for the transfer of heat by convection.

It is also possible to use an installation according to the invention solely for the generation of steam.

The installation described provides very attractive possibilities of flexible control, both as regards throughput and the degree of heating, and also permits a wide choice of media for heating. When a plurality of the installations are connected in parallel a compact unit may be obtained which is suitable for heating various media and can be simultaneously used for generating steam.

EXAMPLE

In an existing installation the heating chamber has the following dimensions:—

length : 6 metres
width : 11 metres
height : 19 metres

This installation is used for heating crude oil from about 230°C to about 350°C at a pressure of 2 atms. The capacity of this installation is 50,000 ton calories.

WHAT WE CLAIM IS:—

1. An installation for heating a medium which is passed through heater tubes and comprising a heating chamber which is rectangular in horizontal cross section subdivided into a plurality of radiant heating sections by a purality of rows of vertical heater tubes, each section being provided with at least one vertical burner, a single row of heater tubes being arranged against each of the side walls of the heating chamber and at least one double row of heater tubes being arranged inside the chamber to form a plurality of sections which are rectangular in horizontal cross-section and laterally bounded by heater tubes, the tubes in the (or each) double row being arranged in back-to-back pairs, that is, in non-staggered relationship, and spaced so that the distance between the centre lines of paired tubes is twice or almost twice the distance between the centre line of a tube of a single row and the adjacent side wall.

2. An installation as claimed in Claim 1, in which the distance from the centre line of a tube in the single row to the adjacent side wall is equal, or substantially equal, to the outside diameter of the tube.

3. An installation as claimed in Claim 1 or Claim 2 in which at least one vertical burner is arranged at the bottom of each section.

4. An installation as claimed in any one of the preceding claims in which the shortest distance from the centre line of a burner in one section to the centre line of a heater tube of that section is at least equal to one and a half times the radius of the largest lateral flame spread during operation of that burner.

5. An installation substantially as described with reference to the accompanying ~~drawings~~ drawing.

KILBURN & STRODE,
Chartered Patent Agents,
Agents for the Applicants.

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