

Collecting main for tubular cracking furnaces

[0001] The invention relates to a collecting main for the discharge of hot process gases from tubular cracking furnaces as frequently used in natural gas reforming plants for the production of synthesis gas. Such collecting main is always provided with several nozzles via which the process gas tubes of the tubular cracking furnace can be connected to the collecting main. In the area of the nozzles, the process gas tubes usually run in guide sleeves. The gas outlets of the guide sleeves or process gas tubes end in the collecting main and extend into it. Under proper operating conditions the reaction gas is introduced into the collecting main via these gas outlets, the present invention providing at least part of the outlets in the form of pipe bends. Furthermore, the invention relates to the use of such collecting mains in a tubular cracking furnace.

[0002] A plurality of tubular cracking furnaces is known which are used for the indirect heating of crackable fluids, especially for the cracking of hydrocarbons for the production of synthesis gas and/or hydrogen. In these tubular cracking furnaces a plurality of process gas tubes are arranged in the furnace chamber in the form of registers or bundles, these process gas tubes being connected to collecting mains running underneath the furnace bottom. Patent documents DE 1 542 530 B or DE 10 2006 022898 describe such tubular cracking furnaces.

[0003] As further described in DE 1 542 530 B or DE 10 2006 022898, the collecting mains consist of several layers, i.e. of at least an outer metal jacket tube, the so-called pressure jacket, which is usually made of weldable steel material and an inner insulation tube usually made of refractory brick-lining or refractory concrete. DE 1 667 324 B describes a three-layer tube as used for industrial applications. The innermost layer may consist of a metal inner tube as already suggested in DE 1 542 530 B for the area where the process gas tube penetrates into the collecting main. This inner tube serves to protect the concrete insulation from erosion caused by the process gas flow. The temperature in the collecting main ranges between approx. 800°C and 950°C.

[0004] The thickness or insulation efficiency of the insulating layer is to be selected such that it protects the steel material of the outer or jacket tube by limiting the temperature in the outer or jacket tube to approx. 200°C on the one hand and on the other hand by preventing the concrete from becoming too cold. Usually the stress acting upon the concrete as a result of the thermal expansion increases the porosity of the concrete which leads to an escape of process gas from the metal inner tube which is generally not of gas-proof design. These small gas flows, also called creep flows, may convey considerable amounts of heat to the outer jacket tube and produce local overheating.

[0005] It is therefore the aim of the task of the present invention to prevent such effects in the collecting main and to provide an improved type of collecting main. The present invention achieves this aim by means of a collecting main for the discharge of hot process gases from tubular cracking furnaces conveyed in process gas tubes, the collecting main being provided

- inside with at least one insulation layer of refractory concrete or refractory brick-lining,
- outside with a wall of a metal outer tube,
- with several nozzles via which the process gas tubes of the tubular furnace may be connected to the collecting main,
- the process gas tubes running at least partly in guide sleeves in the area of the nozzles,
- and one gas outlet connected to the related process gas tube each extending into the collecting main via which the process gas is introduced into the collecting main on proper operating conditions,
- and at least one gas outlet being provided as a pipe bend.

[0006] Surprisingly it has been discovered that, by means of the curved outlets and the consequential flow acceleration and homogenisation as well as with the associated decrease of the pressure loss in the collecting main, it was possible to notably reduce the creep flows within the insulation layer. This is due to the fact that the resulting reduced pressure loss, which involves no other advantage to the operation of the tubular cracking furnace, decreases the driving force for the creep flows due to the porosity of the insulation layer and hence also the heat amounts conveyed to the jacket tube.

[0007] Embodiments of the collecting main may either provide that the process gas tube ends in the guide sleeve and the gas outlet constitutes an extension of the guide sleeve or that the gas outlet constitutes an extension of the process gas tube, the guide sleeve being of basically cylindrical shape.

[0008] In further embodiments of the collecting main, it may be provided that

- the cross-sectional area of the gas outlet narrows towards its end. This will lead to higher gas velocities at the gas outlet,
- the bend of the gas outlet ranges between 30° and 90°,
- the extreme end of the gas outlet extends into the collecting main up to a maximum depth of 40 % of the clear diameter of the collecting main,
- a metal inner tube is provided inside the collecting main.

[0009] The collecting main is used in a tubular cracking furnace. Normally a great number of collecting mains are provided which form a collecting system. To account for the different thermal influences in the centre and along the periphery of the collecting system, the various gas outlets in the individual collecting mains may be of different design, i.e. not all shaped as pipe bends or with pipe bends of different shape.

[0010] Fig. 1 gives the details of an advantageous embodiment of the present invention without being limited to this specific embodiment. Fig. 1 shows a segment of collecting main 1 according to the present invention and a nozzle 2, which are represented in a sectional view.

[0011] Nozzle 2 is arranged above collecting main 1. Collecting main 1 consists of three layers. The first layer is made up by metal inner tube 3, the second layer by insulation layer 4 which is made of refractory concrete, and the third outer layer which consists of the outer or jacket tube 5. Nozzles 2 (in this example there is only one nozzle) are arranged above collecting main 1. In the area of nozzle 2, process gas tube 6 from the furnace chamber, which is not shown, runs through a guide sleeve 7. In the example shown process gas tube 6 ends in the area of insulation layer 4 in guide sleeve 7. At its free end, guide sleeve 7 is shaped as a bend 8 the outlet opening of which points into the direction of the main flow of collecting main 1.

[0012] List of references used

1	Collecting main	5	Outer tube
2	Nozzle	6	Process gas tube
3	Inner tube	7	Guide sleeve
4	Insulation layer	8	Pipe bend

Patent claims

1. Collecting main for the discharge of hot process gases from tubular cracking furnaces conveyed in process gas tubes, the collecting main being provided
 - inside with at least one insulation layer of refractory concrete or refractory brick-lining,
 - outside with a wall of a metal outer tube,
 - with several nozzles via which the process gas tubes of the tubular furnace may be connected to the collecting main,
 - the process gas tubes running at least partly in guide sleeves in the area of the nozzles,
 - and one gas outlet connected to the related process gas tube each extending into the collecting main via which the process gas is introduced into the collecting main on proper operating conditions,

characterised in that

at least one gas outlet is provided as a pipe bend.
2. Collecting main according to claim 1, **characterised in that** the process gas tube ends in the guide sleeve and the gas outlet constitutes an extension of the guide sleeve
3. Collecting main according to claim 1, **characterised in that** the gas outlet constitutes an extension of the process gas tube and the guide sleeve is of basically cylindrical shape.
4. Collecting main according to any of the claims 1 to 3, **characterised in that** the cross-sectional area of the gas outlet narrows towards its end.
5. Collecting main according to any of the claims 1 to 4, **characterised in that** the bend of the gas outlet ranges between 30° and 90°.
6. Collecting main according to any of the claims 1 to 5, **characterised in that** the extreme end of the gas outlet extends into the collecting main up to a maximum depth of 40 % of the clear diameter of the collecting main.
7. Collecting main according to any of the claims 1 to 6, **characterised in that** a metal inner tube is provided inside the collecting main.
8. Use of the collecting main according to any of the claims 1 to 7 in a tubular cracking furnace.