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Description

The present invention relates to a fluidized bed combustion chamber according to the prior art portion of claim 1. The combustion chamber is preferably intended to operate under pressure. Combustion chambers of this kind are of a particular interest for generating gas for large gas turbines or for plants with a combination of a gas turbine and a steam turbine. They permit free choice of fuel and are advantageous from the point of view of environment.

Combustion chambers of this kind suffer from a tendency to accumulation of coarser bed particles in the lower part of a bed after some time in operation. This is particularly the case with combustion chambers having a large bed height. Bed heights of from 3 to 4.5 metres may occur since it is desired to increase the time during which the fuel particles are in the bed in order to increase the combustion efficiency and reduce the exhaust of environmentally detrimental components in the fuel. Large bed heights are therefore of a particular interest for combustion chambers for solid fuels.

From the US—A—3 908 284 a fluidized bed combustion chamber is known showing the features of the prior art portion of claim 1. In this combustion chamber, however, the bottom consists of a variety of V-shaped grooves which are arranged in immediate contact with each other. The openings for the supply of combustion air are located in the inclined grids forming the V-shaped grooves. A first portion of the fluidizable bed material is located in said grooves, while a second portion of fluidizable bed material is located above the horizontal plane up to which the upper ends of the grooves extend. This arrangement allows to vary the amount of the bed material which is fluidized in accordance with the rate of the flow of combustion air.

The DE—A—2 934 787 describes a fluidized bed combustion chamber which is housed in a spherical pressure-proof shell. The fluidized bed has a circular form and is located closely to the inner side of the spherical shell. Due to this location near a portion of the spherical shell which shows an increasing inclination to the vertical in the downward direction, the outer ring-shaped wall portion of the fluidized bed shows a similar inclination in the downward direction. The other (inner) side wall of the fluidized bed is vertically arranged.

The purpose of the invention is to reduce the tendency to segregation of particles of different sizes to different layers of the bed, to provide a smoother surface for the bed, and generally to achieve improved fluidizing conditions in the bed.

These aims are achieved with a fluidized bed combustion chamber of the above-mentioned kind which is characterized by the features stated in the characterizing portion of claim 1.

Particular embodiments of the invention are

characterized by the features stated in the further claims.

While, according to the invention, the lower part of the combustion chamber is formed with two or more parallel ditches having sloping side walls, the upper part of the combustion chamber opens out into a common combustion chamber space. By this construction it will be possible to give the fluidized bed a suitable geometrical shape with a suitable ratio between the area at the top and bottom parts of the fluidized bed. The top area and the bottom area are chosen so that the ratio between said areas is between 1.3 and 3.0. Preferably, a ratio between the areas is chosen which is between 1.5 and 2.0. The inclination of the side walls of the ditches should be between 3° and 15°, preferably between 5° and 10°.

With the above-mentioned shape of the fluidized bed, favourable fluidizing conditions are obtained during operation. With an area ratio between 1.5 and 2.0 and with an inclination of the side walls of between 5° and 10°, a good mixture of bed particles and fuel and an even temperature distribution are obtained. The shape of the bed is favourable from the point of view of regulation and operates in a favourable manner also in the case of partial load. No segregation, or only insignificant segregation, of the bed material is obtained, and thus there is no unfavourable accumulation of coarse bed material at the bottom of the bed. The embodiment permits greater variation of the sizes of the grains of the bed material included.

The invention results in an improved circulation pattern, a long dwell time of the fuel in the bed, good combustion efficiency, and good sulphur absorption. These favourable properties are particularly prominent in the case of beds of large heights. Further, there is obtained a low gas speed at the bed surface and therefore a calm bed surface and a low content of particles in the gas which leaves the bed. A low content of particles is of particular importance when the gas is utilized directly for driving a gas turbine connected to the combustion chamber. The embodiment of the combustion chamber gives a good controllability when used in conjunction with a gas turbine. In case of partial load, the pressure and the temperature are varied. The combustion chamber is then driven with a lower bed level while maintaining the good fluidizing and combustion conditions. The embodiment of the bed gives a very even bed temperature, which is especially desirable when the combustion chamber serves as a source of heat for a gas turbine. The embodiment of the bed also makes possible a very good utilization of the space in a spherical pressure vessel. A bed with a very large area may be located in the pressure vessel in different ways and the surrounding spaces may be efficiently utilized for cleaning equipment, for example cyclones.

The invention will be described in greater detail with reference to the accompanying

drawings in which:

Figure 1 shows schematically a section through a first embodiment of a combustion chamber according to the invention which, together with gas cleaners, is positioned inside a cylindrical pressure vessel,

Figures 2 and 3 show a horizontal and vertical section, respectively, of a second embodiment of a combustion chamber according to the invention,

Figures 4 and 5 show a third embodiment according to the invention in the same way of representation as in the Figures 2 and 3 with a spherical pressure vessel,

Figures 6 and 7 show a fourth embodiment according to the invention similar to that of the Figures 4 and 5, but with a different arrangement of the cleaners.

In the Figures, 1 designates a pressure vessel which encloses a combustion chamber 2 and cleaners 3 connected thereto. The lower portion of the combustion chamber 2 is formed with two parallel ditches or grooves 4, the walls 5 of which incline at an angle α of between 3° and 15° . The height of these grooves 5 is approximately equal to the height of the fluidized bed 6. At the bottom of the grooves 4 there is a bottom 7 with openings or nozzles for blowing combustion air into the bed 6. Fuel is introduced into the bed 6 through nozzles, not shown. Below the bottom 7 there is an air distribution chamber 8 which communicates, through a throttle valve 9, with a space 10 between the pressure vessel 1 and the combustion chamber 2. The area of the grooves 4, at the transition to the common space 11 in the combustion chamber 2, is 1.3—3 times greater than the area at the bottom 7. Compressed combustion air is supplied to the pressure vessel space 10 through the annular space 12 between the conduits 13 and 14. The combustion gases from the combustion chamber 2 are passed to a gas turbine (not shown) via the cleaners 3, the conduits 15, the collecting pipe 16 and the conduit 13. The fluidized bed 6 contains cooling coils 17 in which steam is generated. This steam is utilized in a steam turbine operating in parallel with a gas turbine. Between the two grooves 4 there are a number of smaller connecting channels 18, through which hydrostatic communication between the grooves 4 is obtained. These channels 18 may be formed with a perforated bottom 19 and with a distributing chamber 20 which, through a throttle valve 21 in its bottom wall, communicates with the space 10. The channels 18 permit transportation of bed material between the bottom portions of the grooves 4. This transport of bed material is favourable from the point of view of regulation.

Figures 2 and 3 show a horizontal and vertical section, respectively, of an alternative arrangement of a combustion chamber 2 and cleaners 3 in a cylindrical vessel 1. Groups of cleaners 3 are positioned at the ends of the

pressure vessel 1.

Figures 4, 5, 6 and 7 show horizontal and vertical sections, respectively, of alternative arrangements with the combustion chamber 2 in a spherical pressure vessel 1. The groups of cleaners 3 are positioned at the long sides of the combustion chamber 2 in the arrangement according to Figures 4 and 5. Groups of cleaners 3 are positioned at all the sides of the combustion chamber 2 in the arrangement according to Figures 6 and 7.

Claims

1. Fluidized bed combustion chamber (2) having a preferably plane bottom (7) with a plurality of openings or nozzles for the supply of combustion air to the substantially rectangular combustion chamber (2) formed at its lower portion with two or more parallel grooves (4) with downwardly converging side walls (5) and with a common gas collecting space above the grooves (4), characterized in that the depth of the grooves is substantially equal to the height of the bed during normal operation, the ratio between the top and bottom areas of the grooves (4) being between 1.3 and 3 and the side walls (5) of the grooves (4) inclining at an angle of between 3° and 15° to the vertical.

2. Fluidized bed combustion chamber according to claim 1, characterized in that the ratio between the top and bottom areas of the grooves (4) is between 1.5 and 2.

3. Fluidized bed combustion chamber according to claim 1 or 2, characterized in that the side walls (5) of the grooves (4) incline at an angle of between 5° and 10° to the vertical.

4. Fluidized bed combustion chamber according to any of the preceding claims, characterized in that the combustion chamber (2) is enclosed within a pressure vessel (1) and designed to operate under overpressure.

Patentansprüche

1. Wirbelbettbrennkammer (2) mit einem vorzugsweise ebenen Boden (7), der eine Vielzahl von Öffnungen oder Düsen für die Zufuhr von Verbrennungsluft zu einer im wesentlichen rechteckförmigen Verbrennungskammer (2) hat, welche Verbrennungskammer an ihrem unteren Ende mit zwei oder mehreren Rinnen (4) mit nach unter konvergierenden Seitenwänden (5) versehen ist und einen gemeinsamen Gassammelraum über den Rinnen (4) hat, dadurch gekennzeichnet, daß die Tiefe der Rinnen im wesentlichen gleich der Höhe des Bettes unter normalen Betriebsbedingungen ist, daß das Verhältnis zwischen dem oberen und unteren Querschnitt der Rinnen (4) zwischen 1,3 und 3 liegt und daß die Seitenwände (5) der Rinnen (4) um einen Winkel zwischen 3° und 15° Grad gegenüber der Vertikalen geneigt sind.

2. Wirbelbettbrennkammer nach Anspruch 1, dadurch gekennzeichnet, daß das Verhältnis

zwischen dem oberen und unteren Querschnitt der Rinnen (4) zwischen 1,5 und 2 liegt.

3. Wirbelbettbrennkammer nach einem der Ansprüche 1 oder 2, dadurch gekennzeichnet, daß die Seitenwände (5) der Rinnen (4) um einen Winkel zwischen 5 und 10 Grad gegenüber der Vertikalen geneigt sind.

4. Wirbelbettbrennkammer nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Verbrennungskammer (2) in einem Druckgefäß (1) eingeschlossen ist und zum Arbeiten unter Überdruck konstruiert ist.

Revendications

1. Chambre de combustion (2) à lit fluidisé ayant de préférence un fond plan (7), et comprenant plusieurs ouvertures ou buses pour l'alimentation en air de combustion d'une chambre de combustion (2) sensiblement rectangulaire et formée à sa partie inférieure de deux ou de plusieurs gorges (4) ayant des parois latérales (5) convergentes vers le bas, et un espace collecteur commun pour le gaz au-dessus des

gorges (4), caractérisée en ce que la profondeur des gorges est sensiblement égale à la hauteur du lit en fonctionnement normal, le rapport entre les surfaces du sommet et du fond des gorges (4) est compris entre 1,3 et 3 et les parois latérales (5) des gorges (4) sont inclinées sous un angle compris entre 3° et 15°, par rapport à la verticale.

2. Chambre de combustion à lit fluidisé selon la revendication 1, caractérisée en ce que le rapport entre les surfaces du sommet et du fond des gorges (4) est compris entre 1,5 et 2.

3. Chambre de combustion à lit fluidisé selon la revendication 1 ou 2, caractérisée en ce que les parois latérales (5) des gorges (4) sont inclinées d'un angle compris entre 5° et 10° par rapport à la verticale.

4. Chambre de combustion à lit fluidisé selon l'une quelconque des revendications précédentes, caractérisée en ce que la chambre de combustion (2) est enfermée dans une enveloppe tenant la pression (1) et est conçue pour fonctionner en surpression.

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