

METHOD FOR HOLDING TOGETHER ADJACENT GRATE BARS AS WELL AS A GRATE BAR ARRANGEMENT

[01] The invention relates to a method for holding together adjacent grate bars, which have an upper side formed as a grate, in which the grate bars are pressed together with a holder. In addition, the invention relates to a grate bar arrangement having a grate bar having an upper side formed as a grate and a holder in order to hold together adjacent grate bars.

[02] Grate bars are used for incinerators such as refuse incinerators in particular, and a large number of grate bars form the grate cover on which the combustible material is burnt. This cover is generally a surface provided with openings. The openings serve to supply the air necessary for combustion ("primary air"). The necessary movements for circulating the fuel ("stoking") take place automatically for larger grate firing systems by moving the grate.

[03] In particular, the invention relates to an inclined grate / moving grate. Such grates look similar to a flat stair with a slope of generally between 0 and 30 °, such as 24 or 26 °, for example. The fuel is moved over the grate by the grate steps moving and thus transporting the fuel. Depending on the direction of the grate bar movement, the inclined grate is also called a pusher grate or reciprocating grate (in both cases, however, the fuel is moved forwards).

[04] Inclined grates are used for coarse and high-ash fuels that require improved stoking, e.g. household and commercial waste, biomass, waste wood, processed waste or lignite (rarer today).

[05] Inclined grates have a plurality of grate bars, which can be firmly connected together or are movable relative to one another in order to move the combustible material on the grate.

[06] Such grate bars generally have openings for air supply. For this, recesses are provided in the side wall of the grate bar or openings are provided on the upper side and/or front side of the grate bar, which enable air conveyed to the lower side of the grate bar to pass between the grate bars or through the grate bars to the combustion bed.

[07] The invention relates in particular to grate bar arrangements, in which several grate bars are arranged side by side. Adjacent grate bars form individual grate steps, which together form the grate cover. One grate step may be slightly offset from another grate step. Grate bars that are adjacent to each other in the transverse direction can be arranged so that they are movable relative to each other or firmly connected.

[08] When moving such grate steps for stoking and transporting the combustible material, relatively large forces are generated, which can also affect the position of the individual grate bars relative to one another. It may be the case here that grate bars are moved sideways, creating slits between adjacent grate bars.

[09] In order to keep the grate bars parallel and adjacent to one another during operation, the grate bars can be connected to one another with holders. These are generally screw connections with which adjacent grate bars are pressed together.

[10] This connection is designed to be detachable so that individual grate bars that have been damaged during the operating period can be replaced without having to replace the entire grate step. For this purpose, on the lower side of the grate bars, i.e. opposite the combustion chamber and combustible material, structures are provided on the grate bars which enable adjacent grate bars to be attached to one another with a holder.

[11] The holders are arranged below the grate bars in order to be protected from harmful temperature and corrosive influences from the combustion of the combustible material on the grate cover.

[12] In particular, the attachment of adjacent grate bars using screw connections is complex as the nut has to be twisted against the screw in confined spaces below the grate and at the same time it must be ensured that the screw does not fall out.

[13] The object of the invention is therefore to further develop a generic method and propose a grate bar arrangement which makes it easier to hold adjacent grate bars together. The grate bar arrangement should preferably also make it easier to replace faulty grate bars.

[14] This object is achieved with a method having the features of Patent Claim 1. Patent Claim 10 describes a grate bar arrangement according to the invention.

[15] Advantageous further developments are the subject of the dependent claims.

[16] According to the invention, it is proposed to operate the holder through a recess on the upper side of the grate bars. This makes it possible to continue to arrange the holder below the upper side of the grate bars. Operation is, however, facilitated by the fact that staff can stand on the upper side of the grate in the combustion chamber whilst operating the holder in order to loosen a screw connection or remove a clamp, for instance.

[17] As grate bars can only be repaired or replaced when the entire incinerator is at a standstill and has cooled down, the holder no longer has to be operated under the grate, where a funnel and other fixtures for moving the grate generally impede operation of the holder.

[18] When operating the holder, positive or non-positive holders can be used. It is advantageous when the grate bars are screwed together from the upper side. In this case, a screw or threaded rod running transverse to adjacent grate bars is screwed together with at least one nut in order to hold together the adjacent grate bars.

[19] In this connection, it is advantageous when recesses are provided on both sides of a grate bar, through which the screw fittings can be inserted and tightened from above. This avoids the need to insert the screw or threaded rod into a hole, which considerably simplifies machining.

[20] For simple operation, it is proposed that the size of the recesses is selected such that a wrench can be applied to the screw head and another one can be applied to the nut and tightened. Accordingly, wrenches are applied to two lock nuts for a threaded rod.

[21] Finally, it is advantageous when the recess is covered with a plate. The plate can be part of the holder or arranged as an individual part above the holder in order to cover the recess such that the upper side of the grate is as flat as possible.

[22] In order to hold the plate securely in the recess even under heavier loads, it is proposed that the plate is positively anchored in the recess. This makes it possible to remove the plate from the anchorage by sliding it in order to enable access to a holder below. In order to prevent the plate from moving during operation of the system, it is proposed that the plate is secured with a wedge. The wedge can, for example, be inserted into a recess with a positive fit, resulting in a flat surface of the grate cover, on the one hand, and preventing the plate from moving, on the other.

[23] Since the wedge falling out could lead to the plate becoming loose, it is proposed in a further development to weld the cover plate or wedge to the grate bar or to weld the plate to the wedge. Since the cover of the recesses and in particular the plate are preferably made of steel, whilst the grate bars are generally made of cast steel, welding the plate to the grate bar is often not possible. The positive connection of the plate with the grate bars combined with the plate and wedge being welded together makes it possible to firmly connect the plate to the grate bars without having to weld the plate to the grate bars.

[24] In terms of the device, the object of the invention is achieved by virtue of the fact that the upper side of the grate bar has a recess and the grate bar arrangement has a

cover. This enables the holder to be easily operated, whilst the cover enables the grate to have a flat upper side.

[25] A first embodiment envisages that the holder has a screw connection. Cumulatively or alternatively, the holder can have a clamp.

[26] If the holder is made of a different material than the grate bars, there is the risk of the holder and grate bars expanding differently when the furnace is heated up and of the holder either breaking or coming loose. It is therefore proposed that the holder or an element of the holder has a smaller thermal expansion coefficient than the grate bars. The thermal expansion of metals and alloys is expressed as linear expansion, which is proportional to a linear expansion coefficient indicating the lengthening of the unit of length at 1 ° increase in temperature between 0 to 100 °C. The linear expansion coefficient is, for example, 1.0 for an Ni steel, 36Ni, Invar and 30 for cadmium. For cast iron, a linear expansion coefficient of 10.5 is given in the literature; the linear expansion coefficient for low-alloy steels is 11.5 and 12 for Ni steel, 30Ni. However, for Ni steel, 20Ni, the linear expansion coefficient is as high as 19.5. This means that a screw connection or a clamp can expand more when heated up to 500 ° C, for example, in the grate area than the grate bar made of cast steel. This can in turn mean that tightly screwed grate bars are no longer tightly screwed during operation of the furnace as the screw has expanded too much.

[27] If the material of the holder or of an element of the holder is selected such that they have a smaller thermal expansion coefficient than the grate bars, the holder can still be relatively loose when cold as the greater expansion of the grate bars means the holder becomes tight in operation and holds the grate bars together more as the temperature increases. For example, the grate bars can then be connected with a positively attached holder that exerts a strong holding force on the grate bars when the grate bars expand in order to hold together the grate bars.

[28] It is correspondingly proposed that the holder has a connecting element and a clamping element, wherein the connecting element and clamping element have different thermal expansion coefficients. This makes it possible, through a clever choice of material, to connect the grate bars together simply and, possibly, also loosely when cold, as the holder then exerts a specific force on the grate bars when the grate bar and holder are heated up in order to hold them together.

[29] Elements having a thermal expansion coefficient larger than that of the holder can also be arranged between the holder and the grate bars. For example, a washer fitted onto the screw shank with a high thermal expansion coefficient can be used for a normal screw connection made of steel. Since the steel of the screw connection expands more than the cast steel of the grate bars, the washer can compensate for this expansion again.

[30] In order to hold the cover securely in the recess, it is proposed that it has an undercut in order to engage laterally under an upper side of a grate bar. This enables a simple positive connection. In addition, the cover can also have a wedge in order to secure a plate-like cover in the inserted position.

[31] The cover can be arranged as an individual part above the holder. A special embodiment envisages that the cover is connected to the holder or to part of the holder. The holder or part of the holder thus form the cover at the same time.

[32] Several holders can be provided between two grate bars in order to ensure that the grate bars are held closely together over their entire length. However, it is advantageous if only one holder is arranged in order to hold together adjacent grate bars.

[33] Advantageous embodiments are illustrated in the drawing and described in more detail below. In the figures

Figure 1 shows the head of a grate bar,

Figure 2 shows a section through two adjacent grate bars,

Figure 3 shows a plan view of two adjacent grate bars,

Figure 4 schematically shows the connection of grate bars by means of a U-shaped clamp,

Figure 5 schematically shows the connection of two grate bars by means of a C-shaped clamp and

Figure 6 schematically shows the connection of two grate bars by means of a pin.

[34] The head 1 of a grate bar 2 shown in Figure 1 has an upper side 3, which is substantially flat and has an elevation 5 towards the front end 4. A recess 7, 8 into which a holder 9 can be inserted is respectively provided between this elevation 5 and the flat region 6 of the surface on both sides of the grate bar 2.

[35] Figure 2 now shows two adjacent grate bars 2 and 12 with an interposed holder 9, which holds together the grate bars 2 and 12 by means of a screw connection 10. Above the screw connection 10 serving as a holder 9, the recesses 8 and 13 are covered with a cover 15, which has a plate 16 and a wedge 17, with which the plate 16 is secured.

[36] In order to produce a grate cover 18 with several grate bars 2, 12, the grate bars 2, 12 respectively have recesses 7, 8 and 13, 14 on both longitudinal sides 19, 20.

[37] The screw connection 10 shown in Figure 2 consists of a screw 21 with a screw head 22 and nut 23.

[38] The plate 16 of the cover 15 has undercuts 27 and 25, which enable the plate 16 to be inserted into the recess 7, 8 and held by the undercuts 24 and 25. An inserted wedge 17, which has been welded to the plate 16 after being inserted, prevents the plate 16 from falling out of the recess 7, 8.

[39] As a simple alternative to the screw connection, Figure 4 shows a clamp 30 to hold together two grate bars 2 and 12. This clamp 30 is made of a material with a smaller thermal expansion coefficient than the grate bars 2, 12, which are made of cast steel. The clamp 30 can therefore simply be put over laterally adjacent webs 31, 32. When using the grate bar arrangement, the grate bars expand as a result of the high heat and the clamp, which only expands to a lesser extent, thus holds the grate bars in place.

[40] In the case of the C-shaped clamp 40 shown in Figure 5, which also holds together two side parts 31 and 32 of grate bars 2 and 12, the clamp is made of steel, which expands more than the grate bars. However, this is compensated for by insert plates 43, 44, which have a particularly high thermal expansion and thus press the webs 41 and 42 together.

[41] Figure 6 shows a pin connection, in which a pin 50 is inserted between two grate bars 2 and 12 in order to hold together the grate bars 2 and 12. Washers 53 and 54 are arranged between the pin 50 and the webs 51 and 52 of the grate bars 2 and 12, which washers 53 and 54 balance out the different thermal expansion coefficients between the grate bars 2 and 12 and the pin 50 so that an elongation of the pin 50 does not lead to the connection between the grate bars 2 and 12 coming loose.

[42] Figures 4 to 6 show that the clamps 30 and 40, serving as a holder 9, and the pin 50 can have washers 43, 44 or washers 53, 54 as elements in order to balance out the different thermal expansion coefficients.

[43] Provided that the pin 50 has a threaded rod 56 as connecting element and two nuts 57, 58 as clamping element, the thermal expansion coefficient can also be determined by the selection of materials and thus adjusted so that the grate bars are securely held together even in the event of severe temperature fluctuations.

[44] In the exemplary embodiment shown in Figures 1 to 3, assembly takes place by placing the grate bars onto the grate. The grate carriage is usually in the central position here. The screw fitting inserted into the opening between two grate bars is tightened by

means of a wrench on the screw head and another one on the nut. The closing plate 16 is then inserted and moved to the side. Finally, the wedge 17 is inserted for locking and welded to the plate.

[45] During disassembly, the welding seam is initially cut open and the wedge then pried out. The plate can then be removed so that finally the screw connection can be loosened and removed.

[46] This method has the advantage that the complete cover can be screwed from above, regardless of the position of the grate carriages. Climbing into the grate funnels is no longer necessary. Even moving the carriages during assembly is no longer necessary. Although welding the wedges 17 to the plates 16 entails an additional assembly step, the overall assembly time is considerably reduced compared to previously known methods.

[47] Further improvements can be achieved from embodiments according to Figures 4 to 6.

Claims:

1. Method for holding together adjacent grate bars (2, 12), which have an upper side (3) formed as a grate cover (18), in which the grate bars (2, 12) are pressed together with a holder (9), *characterized in that* the holder (9) is operated through a recess (7, 8, 13, 14) on the upper side (3) of the grate bars (2, 12) and the recess (7, 8, 13, 14) is covered with a cover (15).
2. Method according to Claim 1, *characterized in that* the grate bars (2, 12) are screwed together from the upper side (3).
3. Method according to Claim 2, *characterized in that* recesses (7, 8, 13, 14) are provided on both longitudinal sides (19, 20) of a grate bar (2, 12), through which the screw fittings (10) can be inserted and tightened from above.
4. Method according to Claim 3, *characterized in that* the size of the recess (7, 8, 13, 14) is selected such that a wrench can be applied to the screw head (22) and another one can be applied to the nut (23) and tightened.
5. Method according to one of the preceding claims, *characterized in that* the recess (7, 8, 13, 14) is covered with a plate (16).
6. Method according to Claim 5, *characterized in that* the plate (16) is part of the holder (9) or is arranged as an individual part above the holder.
7. Method according to Claim 5 or 6, *characterized in that* the plate (16) covers the recess (7, 8, 13, 14) such that the upper side of the grate is as flat as possible.
8. Method according to one of Claims 5 to 7, *characterized in that* the cover (15) has a plate (16) and a wedge (17), with which the plate (16) is secured.
9. Method according to Claim 8, *characterized in that* the plate (16) is welded to the wedge (17).

10. Grate bar arrangement having a grate bar (2, 12) having an upper side (3) formed as a grate cover (18) and a holder (9) in order to hold together adjacent grate bars (2, 12), ***characterized in that*** the upper side (3) of the grate bar (2, 12) has a recess (7, 8, 13, 14) and the grate bar arrangement has a cover (15).
11. Grate bar arrangement according to Claim 10, ***characterized in that*** the holder (9) has a screw connection (10).
12. Grate bar arrangement according to one of Claims 10 or 11, ***characterized in that*** the holder (9) has a clamp (30, 40).
13. Grate bar arrangement according to one of Claims 10 to 12, ***characterized in that*** the holder (9) or an element (43, 44, 53, 54) of the holder (9) has a smaller thermal expansion coefficient than the grate bars (2, 12).
14. Grate bar arrangement according to one of Claims 10 to 13, ***characterized in that*** the holder (9) has a connecting element (56) and a clamping element (57, 58), wherein the connecting element (56) and clamping element (57, 58) have different thermal expansion coefficients.
15. Grate bar arrangement according to one of Claims 10 to 14, ***characterized in that*** elements (43, 44, 53, 54) having a thermal expansion coefficient larger than that of the holder (9) are arranged between the holder (9) and the grate bars (2, 12).
16. Grate bar arrangement according to one of Claims 10 to 15, ***characterized in that*** the cover (15) has an undercut (24, 25) in order to engage laterally under an upper side (3) of a grate bar (2, 12).
17. Grate bar arrangement according to one of Claims 10 or 16, ***characterized in that*** the cover is connected to the holder (9) or to part of the holder (9).

18. Grate bar arrangement according to one of Claims 10 to 17, *characterized in that* only one holder (9) is arranged between two grate bars (2, 12) in order to hold together adjacent grate bars (2, 12).