

GRATE ELEMENT AND GRATE FOR COMBUSTION PLANTS

The present invention relates to a grate element for a firing grate constructed of grate elements which overlap each other like roof tiles and can move longitudinally relative to each other, through which the primary combustion air, which is fed from below, can be guided to the material to be burned which is lying on top of the firing grate, with an attachment or drive end and a grate element head. The invention also relates to a grate for a combustion plant and a process for operating the grate.

The term "grate element" is to be understood as applying to every element which is suitable for forming a grate floor, independently of whether it is an air-cooled or a water-cooled grate floor, irrespective of the construction of the grate firing system, so long as it employs grate elements which overlap each other like roof tiles to form grating stages.

In grate floors where the grate elements overlap each other like roof tiles, the grate elements must have air escape orifices in order to be able to feed the primary combustion air from below. In grate floors which are constructed of individual air-cooled grate bars, the air escape orifices are formed either at the head ends of the individual grate bars, or on the flanks of neighboring grate bars. With this configuration, especially in waste incineration plants, hard particles of cinder or small pieces of metal scrap can penetrate into these air escape orifices, and this effect is further intensified by the stoking movement of the grating stages. Molten non-ferrous metals or bitumen-like substances can also penetrate into these air escape orifices, impairing the even flow of air to the material to be burned.

To counter the danger of such air escape orifices becoming plugged, German Patent 41 05 330 C1 discloses a grate bar which has at the head end of the air-cooled grate bar an

air escape orifice which is directed obliquely downward and which expands outward. In the case of another disclosed air-cooled grate bar in accordance with German Patent 42 05 502 C1, the back of the grate bar at the head end is extended and angled downward over the face of the end of the grate bar, so that the back of the grate bar, which is pulled downward, forms a lip overlapping the face end, which lip limits the air escape orifice, whose outflow emerges parallel to the face of the head end. Both known implementations reduce the problems explained above, but fail to eliminate them completely.

The object of the present invention is to create a grate element and a grate for combustion plants which eliminates the danger of a stoppage of the air passage and makes cleaning the air passage simple.

Under this invention, this problem is solved on the basis of a grate element of the type described at the beginning, by the fact that the air outlet for the primary combustion air is on the bottom side of the grate element head, opening downward, and that there is at least one fixed cleaning projection on the top of each grate element for the air outlet of the grate element which lies above it in the assembled state.

Configuring the air outlet on the underside of the grate element head is an especially favorable means of providing a way for blowing out light and small particles which have entered the air outlet, and furthermore the cleaning projection or projections necessarily bring about a cleaning of the air outlet, even in the case of strongly wedged cinder particles or even molten masses. This ensures the avoidance of incomplete combustion processes or overheating and consequent damage to grate elements, which lead to relatively long periods of down time for the replacement of such damaged grate elements. Since the air outlet on the underside of each grate element opens downward, the restricting wall of the air outlet, which is formed by the grate element which lies beneath it in an assembled firing grate, is in motion relative to the upper limiting wall assigned to the grate element during every stoking stroke, so that this relative motion itself brings about a good cleaning of solid particles from the air flow path.

An additional advantageous extension of the invention consists in positioning the cleaning projection or projections in the rear area which faces the attachment or drive end of the grate

element. By this means, regardless of whether the grate element belongs to a fixed grating stage or a moving grating stage, the cleaning process takes place by means of every cleaning projection during an operating phase in which pushing pressure is relieved at the face of the grate element head, between the grate element head and the material to be burned in front of it. This prevents additional material to be burned from being pressed through the air outlet by the relative movement between the cleaning projection and the grate element, which would increase the quantity which falls through the grate. In this configuration in accordance with the invention, the cleaning projection or projections are always pushed into the air outlet when the corresponding grate elements move to their position of greatest distance from each other, i.e. when the grate element head of the above, driven grate element moves toward the rear attachment or drive end of the lower, fixed grate element, or the grate element head of the lower, driven grate element moves forward against the above, fixed grate element from the latter's grate element head.

An especially advantageous implementation of the invention is distinguished by the fact that every cleaning projection has a tongue-like shape and every end which enters into the air outlet is tapered. The tapering of the end of the cleaning projection or projections which enters into the air outlet exercises a wedge effect on the jammed particles, which makes the cleaning easier.

The cross-sectional shape of a cleaning projection does not necessarily need to be adapted to the cross-sectional shape of the air outlet, especially not if possible blockages of the air outlet consist primarily of solid particles, since the relative movement of the one limiting wall described earlier, in combination with high orifice velocities, make it possible to achieve a good cleaning effect. But if molten masses in doughy condition are to be expected, it is advisable for the cleaning projection or projections to be adapted to the cross section of the air outlet, except for a requisite freedom of play. Such an extension is advantageous, especially in combination with the configuration of the cleaning projection with tapered end described further above, since the tapered end creates an aid to insertion, because lateral play of a grate element cannot be entirely prevented.

If, in a further extension of the invention, the supporting and guiding surface of the grate element has an overlay consisting of wear-resistant material, this avoids constriction of the

air outlet due to wear, which prolongs the useful life of such grate elements. Because without such a wear-resistant overlay the grate element would drop down because of wear, which would make the air outlet on the bottom side smaller.

To correct such wear-related constriction of the air outlet, regardless of whether or not the grate element has a wear-resistant overlay, each cleaning projection can have an aggressively abrasive surface, so that with increasing wearing of the support and guide surface of the grate element the air outlet is ground free by the abrasive surface of the cleaning projection.

The air outlet can take different forms. In a first embodiment, the air outlet can extend across the entire width of the grate element. As will be explained in greater detail in connection with a grate designed in accordance with the invention, such a configuration requires an additional guide for each grate element, since in this embodiment the head area of the grate element cannot lie on the grate element beneath. According to a different embodiment under the invention, the air outlet can extend over the remaining width of the grate element, except for two lateral ridges which serve as guides and supports. In this configuration the additional guide can be dispensed with, since the ridges which are left in the area of the flanks can rest on the grate element beneath. In a preferred embodiment, the air outlet consists of several air orifices which are separated from each other by ridges. In this sort of embodiment it is advantageous to have cleaning projections on the top of each grate element corresponding to the number of downward-opening air orifices. This ensures that all of the air orifices, which in the aggregate constitute the air outlet, can be cleaned by corresponding cleaning projections.

A grate for combustion plants, having grating stages which lie in longitudinal rows in the direction in which the material to be burned is fed, overlapping each other like roof tiles and alternating between movable and stationary grating stages, constructed of individual grate elements which extend across the entire width of the grate or of multiple grate elements lying adjacent to each other in accordance with one of the claims 1 through 10, is characterized by a support arrangement (16) on the grate element head (7) on the stationary grate element (2), and a guiding arrangement for each grate element, which hold the underside of the grate element head at a distance above the underlying grate element, to form an air outlet extending across the entire width of the grate element. Hence the air outlet is formed by the

fact that the underside of the grate element head of the grate element which is lying on top in each case does not lie directly on top of the grate element beneath, but is held at a slight distance from the grate element beneath by the guide arrangement, corresponding to the desired air passage cross section.

If there are ridges in the area of the air outlet, either in the edge areas of the grate element or distributed over the width of the grate element, then the ridges which are located in the outlet area can serve advantageously as a support and guide arrangement for each grate element on the grate element beneath.

In an additional advantageous configuration of the invention, if the cleaning projections are located within the air outlet at the stroke reversal state, closing it to a substantial degree, this creates a brief air blockage, which leads to a more vigorous blowing out of the loosened particles when the air outlet is subsequently cleared.

To prevent fluid particles from slipping or flowing into the air outlet at the stroke reversal state, in an additional configuration of the invention the cleaning projection or projections can protrude slightly over the head ends of the grate elements at the stroke reversal state. However, it is often sufficient for the cleaning projection or projections to merely stop flush with the head of the grate element in the stroke reversal position.

A procedure for operating a grate in accordance with one of the claims 11 to 15, with adjustable stroke length for the movable grate elements, is characterized by the fact that after an optional number of stoking strokes the system is set to produce a longer cleaning stroke, where the cleaning projection or projections will enter the air outlet. It is advantageous in this case to set a cleaning stroke dependent upon the air pressure which exists underneath the grate element which is to be regulated, and/or upon the velocity of the primary air in this area.

The invention will be described in greater detail in the following section, on the basis of a number of sample embodiments illustrated in the drawing. The drawing shows the following:

Figure 1: a graphical representation of a first version of grate elements which

are overlapped like roof tiles; and

Figures 2 to 4: additional versions of grate elements.

As may be seen from Figure 1, a grate for a combustion plant is constructed of a number of grate elements 1 and 2 which overlap each other like roof tiles; the grate elements 1 can be moved back and forth in the direction of arrows 12 and 13, and the grate elements 2 are fixed in position. The grate elements 1 are assigned to a drive mechanism 4, which generates the requisite stroke for the necessary stoking movement. The length of stroke and the stoking speed are adjustable; this, along with a variety of other influencing factors, make it possible to influence the combustion process on the grate. Every grate element, independent of how it is constructed, has an attachment or drive end 5 which is hooked into a holder 6, where this holder is firmly connected to the drive device 4 in the case of the driven grate elements. In addition, each grate elements has a head end 7, a foot 8 and a back 9.

On the foot 8 of the grate element there are a number of recesses 10 which open downward, which serve as air escape orifices for the primary air, which is fed from below. These air escape orifices constitute the air outlet.

On the back 9 of each grate element, preferably in the rear area which faces the attachment or drive end 5, there are cleaning projections 11 in fixed position; their number corresponds to the number of air escape orifices 10. The cross sectional shape of each cleaning projection 11 is adapted to the cross sectional shape of the air escape orifice 10, except for requisite free play, and the cleaning projections 11 are located within the attainable stroke range of the overlying grate element. In this way, with each cleaning push the cleaning projections 11 penetrate into the air escape orifices 10 between two corresponding grate elements 1 and 2, and in so doing they remove the solid particles or molten masses which have entered there. The cleaning projections can have tapered ends, to make it easier to introduce them into the air escape orifices 10 and to exercise a certain wedge effect on the particles which are jammed there.

The term cleaning stroke is used for the longest stroke which can be set with the drive mechanism 4. Depending upon how much risk there is of blockage of the air outlet formed

by the air exit orifices 10, cleaning strokes can be set with the appropriate frequency. The corresponding adjustment procedures are carried out in accordance with the air pressure and/or air velocity which prevail in the area beneath the grate element which is to be regulated.

If the cleaning projections are located in the rear area of each grate element, and still within the cleaning stroke, then the air escape orifices 10, for example in the overlying stationary grate element 2, are cleared at the end of the forward movement in the direction of arrow 12 by the cleaning projections 11 which are positioned on the moving grate element 1. However, in this phase of the movement, because of the forward movement of the grate element 1, there is no pushing force present at the grate element head 7 of the overlying stationary grate element 2. The air escape orifices 10 of the movable grate element 1, in contrast, are penetrated by the cleaning projections 11 of the underlying stationary grate element at the end of the backward cleaning stroke, whose direction of movement is indicated by arrow 13. Due to this backward movement there is also no pushing force present at the grate element head 7 of the moving grate element 1, which prevents solid particles from being pushed into the air escape orifices 10 by the cleaning projections 11. The cleaning projections 11 can also be positioned at other locations, however, so long as care is taken to ensure that they can penetrate into the air escape orifices 10 and clear them within the attainable stroke range.

The ridges 3 which remain in the marginal area and between the air escape orifices 10, which are in the form of downward-opening recesses, serve as a support and guide arrangement, and rest on the respective grate back 9 of the underlying grate element.

To avoid excessive abrasion of the ridges 3 on the foot 8 of the grate element, which would lead to a reduction in size of the air escape orifices, each ridge 3 can be equipped with a wear-resistant overlay 14. In the absence of such an abrasion-resistant overlay 14, each cleaning projection 11 can have an abrasive surface 15 on its top, so that with each cleaning stroke the upper edges of the air escape orifices 10 are ground off to correspond to the wear on the ridges 3, so that for a certain operating period this re-grinding of the air escape orifices 10 makes it possible to continue operation of the grate elements despite the wear which has occurred, since the reduction in size of the air escape orifices which usually occurs due to the wear on the foot of the grate element or on the ridges 3 is canceled by this grinding effect.

PATENT CLAIMS

1. A grate element for a firing grate constructed of grate elements which overlap each other like roof tiles and can move longitudinally relative to each other, through which the primary air, which is fed from below, can be guided to the material to be burned which is lying on top of the firing grate, with an attachment or drive end and a grate element head, **characterized by the fact** that the cleaning projection (11) or projections are located in the rear area, which faces the attachment or drive end (5) of the grate element (1, 2).
2. The grate element in accordance with claim 1, **characterized by the fact** that the cleaning projection (11) or projections are located in the rear area which faces the attachment or drive end (5) of the grate element (1, 2).
3. The grate element in accordance with claim 1 or 2, **characterized by the fact** that each grate projection (11) is in the shape of a tongue and each end which enters the air outlet (10) is tapered.
4. The grate element in accordance with one of claims 1 through 3, **characterized by the fact** that the grate projection or projections is (are) adapted to the cross section of the air outlet (10), except for necessary free play.
5. The grate element in accordance with one of claims 1 through 4, **characterized by the fact** that its support and guide surface (3) has an overlay (14) made of wear-resistant material.
6. The grate element in accordance with one of claims 1 through 5, **characterized by**



the fact that each cleaning projection (11) has on its top side a highly abrasive surface (15).

7. The grate element in accordance with one of claims 1 through 6, **characterized by the fact** that the air outlet (10) extends across the entire width of the grate element (1, 2).

8. The grate element in accordance with one of claims 1 through 6, **characterized by the fact** that the air outlet (10) extends across the entire width of the grate element (1, 2) except for two ridges (3) at the sides which serve as guides and supports.

9. The grate element in accordance with one of claims 1 through 6, **characterized by the fact** that the air outlet (10) consists of a number of air escape orifices which are separated from each other by ridges (3).

10. The grate element in accordance with claim 9, **characterized by the fact** that there are cleaning projections (11) on the top of each grate element (1, 2) corresponding to the number of downward-opening air escape orifices (10), which take the form of recesses which open downward.

11. A grate for combustion plants, having grating stages which lie in longitudinal rows in the direction in which the material to be burned is fed, overlapping each other like roof tiles and alternating between movable and stationary grating stages, constructed of individual grate elements which extend over the entire width of the grate or of multiple grate elements lying adjacent to each other in accordance with one of the claims 1 through 10, **characterized by** a support arrangement (16) on the grate element head (7) on the stationary grate element (2), and a guiding arrangement (17, 18) for each movable grate element (1), which hold the underside (8) of the grate element head (7) at a distance above the underlying grate element, to form an air outlet (10) extending across the entire width of the grate element.

12. A grate for combustion plants, having grating stages which lie in longitudinal rows in the direction in which the material to be burned is fed, overlapping each other like roof tiles and alternating between movable and stationary grating stages, constructed of individual grate elements which extend over the entire width of the grate or of multiple grate elements



lying adjacent to each other in accordance with one of the claims 1 through 10, **characterized by the fact** that the ridges (3) in the area of the outlet (10) serve as a support and guide arrangement for each grate element (1, 2) on the underlying grate element.

13. The grate in accordance with claim 11 or 12, **characterized by the fact** that the cleaning projections (11) are located within the air outlet (10) in the stroke reversal state and close the latter to a significant degree.

14. The grate in accordance with claim 13, **characterized by the fact** that the cleaning projections (11) protrude slightly past the head end (7) of the grate element in the stroke reversal state.

15. The grate in accordance with claim 13, **characterized by the fact** that the cleaning projections (11) end up flush with the head end (7) of the grate element in the stroke reversal state.

16. A procedure for operating a grate which is in accordance with one of claims 11 through 15, with adjustable stroke length of the movable grate elements, **characterized by the fact** that after an optional number of stoking strokes the system is set to produce a longer cleaning stroke, where the cleaning projection or projections will enter the air outlet.

17. The procedure in accordance with claim 16, **characterized by the fact** that a cleaning stroke is set dependent upon the air pressure and/or speed of the primary air which prevail in the area beneath the grate element which is to be regulated.

