

In order on the one hand to be able to ensure a constant gap 22 between all grate bars during installation of the grate covering in spite of production tolerances in the manufacture of the coupling, and on the other hand to be able to restore the gap 22 to its original dimension after wear at the flanks 23 and 24, an adjustable coupling 25, which comprises a tie bar 26 and two hooklike abutments 27, is provided according to the embodiment of Figs. 3 to 6. One of the abutments 27 is provided with a threaded bore 28, into which a set screw 29 is screwed. The set screw bears against the inside of the outside rib 13 of the one of the two intercoupled grate bars 1 and thus permits the spacing of the two stationary grate bars 1 and thereby the width of the gap 22 to be adjusted.

In the case of embodiment illustrated in Figs. 3 to 6, an entry opening 30, the width of which is substantially adapted to the width of the rectangular section tie bar 26 and the height of which corresponds to the height of the abutment 27 increased by a certain amount to allow motional play, is provided in each outside rib 13 of each stationary grate bar 1. An elongate slot 31, which communicates with the entry opening 30 and the height of which also corresponds to the height of the abutment 27, is provided in the movable grate bar 2 so that the coupling 25 can be guided through the movable grate bar 2. A special entry opening, as in the embodiment according to Figs. 1 and 2, is not required in the movable grate bar. In order that the coupling 25 can now be latched in its operative setting after insertion into place, two locking bars 32 are displaceably mounted at the underside of the tie bar 26 and correspond in width to the width of the tie bar 26 and in height to the height of the abutment 27. The stationary grate bars 1 are then raised until the abutment 27 can be introduced through the entry openings 30, whereupon the grate bars 1 are lowered so that the abutments 27 engage behind the outside ribs 13 of the grate bars 1.

Each locking bar 32 has an elongate slot 33 receiving a bolt which is fixed to the tie bar 26 and which has a head 34 to hold the respective locking bar 32 against the underside of the tie bar 26. A double-armed lever 35, which is pivotably mounted at the underside of the tie bar 26 and the ends of which are pivotally connected to the locking bars 32 by means of pins 36, serves for the displacement of the locking bars 32. The pins 36 protrude beyond the locking bars 32 and their projecting ends can engage into detent recesses 37 in the tie bar 26 when the locking bars 32 are disposed in the locking setting illustrated in Fig. 4. In this setting, the stationary grate bars can no longer be raised, as the entry openings 30 are filled by the tie bar 26 plus locking bars 32, so that movement of the grate bar 1 relative to the tie bar is no longer possible. In order that the projecting ends of the pins 26 can be pivoted past the tie bar 26 so as to engage in the recesses 37, the pivotal lever 35 is lowered by means of a

securing screw 38 defining the pivot axis for the lever. After the locking bars 32 are disposed in their locking setting, the screw 38 is again tightened and the pins 36 engage in the recesses 37.

To avoid the need to actuate a screw such as the screw 38, the lever 35 can be loaded by a compression spring 39 according to the modification shown in Fig. 6, so that the lever 35 can displace away from the tie bar 26 against the effect of the compression spring 39 to allow pins 36 to pivot without contacting the tie bar 26. When, after the pivotation of the lever 35, the pins 36 engage in the detent recesses 37, the lever is held in this setting by the compression spring 39 so that the locking bars 32 are secured in their locking setting.

In the case of the embodiment according to Figs. 7 to 9, a coupling 40 with a round tie bar 41 is provided. Arranged at the ends of the tie bar are hook-shaped abutments 42, one of which carries a set screw 43. This embodiment corresponds to that of Fig. 4 apart from the round construction of the tie bar 41. The latching of the coupling 40 takes place through turning of the same after plugging the abutments 42 through a correspondingly shaped entry opening 44. As is evident from Fig. 8, the abutments 42, after turning of the coupling by means of a lever 45 fastened to the tie bar 41, are disposed in a setting in which they are no longer aligned with the entry openings 44, so that the grate bars 1 can no longer be moved apart. The ribs 11 and 12 of the movable grate bar 2 have elongate slots 46 and 46', respectively, and a respective slide ring 47, which is mounted on the tie bar 41, is arranged in each of the slots 46. Each slide ring 47 is rectangular in shape and thus cannot be turned in its slot 46 even when forces act on the slide ring 47 during displacement of the movable grate bar 2. For this reason, the coupling 40 cannot be turned, so that the latching which has been achieved through turning cannot be reversed without a deliberate action.

A further embodiment is illustrated in Figs. 10 to 12. This embodiment is particularly simple, as the coupling designated by 48, comprises a simple straight tie bar 49, preferably of rectangular cross-section, which is provided at its ends with threaded bores 50 into which set screws 51 are screwed. Each set screw can, as illustrated, have an internal hexagon at one end for its actuation. At their opposite ends, the set screws have conical projections 53, which in the incorporated state of the coupling 48 co-operate with ramp or cam surfaces 54 at the inside of the outside ribs 13 of the respective stationary grate bar. As is evident from Fig. 10, the spacing between the two stationary grate bars 1 can be reduced by screwing the set screws further into the bores 50 or enlarged by unscrewing the set screws. The tie bar 49, which in the illustrated example has a rectangular cross-section, is guided during installation of the grate covering, without the set screws 51, through an elongate

stages can be held at an adjustable spacing from the lateral boundary plates of the furnace grate by securing means. This prevents edge gaps, which cannot be compensated for by compensating devices, from forming between the edge bars and the boundary plates. Such gaps may result from particles pushing in between the boundary plates and the edge bars immovable relative to the boundary plates. These particles may widen the edge gap, which allows increasingly larger particles to ingress. A self-cleaning effect is absent because there is no relative movement between the edge bar and the boundary plates in the fixed stages. By securing the edge bars to the boundary plates, the problem of edge gap formation with stationary stages may be overcome.

In order that the edge bars can follow possible pump movements of the grate stage, in which the grate bars move substantially perpendicularly to their surface, the securing means can be mounted on the boundary plates to be displaceable perpendicularly to the surface of the grate bars.

Embodiments of the present invention will now be more particularly described by way of example and with reference to the accompanying drawings, in which:—

Fig. 1 is a longitudinal sectional view of part of a grate covering for a furnace grate according to a first embodiment of the invention,

Fig. 2 is a cross-section along the line II—II of Fig. 1,

Fig. 3 is a longitudinal sectional view of part of a grate covering according to a second embodiment of the invention,

Fig. 4 is a cross-section along the line IV—IV of Fig. 3,

Fig. 5 is a sectional inverted plan view of the grate covering part of Fig. 3,

Fig. 6 is a cross-section, similar to Fig. 4, of a part of a grate covering which is modified in relation to that of Fig. 4,

Fig. 7 is a longitudinal sectional view, on the line VII—VII of Fig. 9, of part of a grate covering according to a third embodiment of the invention,

Fig. 8 is a sectional side view of part of an outside rib of a stationary grate bar in the grate covering of Fig. 7,

Fig. 9 is a cross-section along the line IX—IX of Fig. 7,

Fig. 10 is a cross-section, similar to the Fig. 9, of part of a grate covering according to a fourth embodiment of the invention,

Fig. 11 is a section along the line XI—XI of Fig. 10,

Fig. 12 is a section along the line XII—XII of Fig. 10,

Fig. 13 is a cross-section of part of a grate covering embodying the invention, showing an edge bar in the region of attachment to a boundary plate of the furnace grate,

Fig. 14 is a section along the line XIV—XIV of Fig. 13,

Fig. 15 is a cross-section, similar to that of Fig. 13, but showing a modified edge bar attachment,

Fig. 16 is a section along the line XVI—XVI of Fig. 15, and

Fig. 17 is a section along the line XVII—XVII of Fig. 16.

In all the grate coverings illustrated in the drawings grate stages are provided, which consist of grate bars 1 stationary during a relative stroke and grate bars 2 movable relative thereto during the stroke, and which lie on displaceable carrier frames 3 in the case of movable stages and on stationary carrier frames 4 in the case of stationary stages. The respective stationary grate bars 1 are suspended substantially without play at their suspension end 5 from suspension rails 6 and 7 of, respectively, the carrier frames 3 and 4, while the grate bars 2 which are movable relative to the grate bars 1 rest with longitudinal play on the carrier frame of the movable and the stationary stage, respectively.

In the case of all the embodiments illustrated in Figs. 1 to 12, two stationary grate bars 1, each stationary in relation to its carrier frame, are held at a fixed spacing from each other by means of a coupling, while the grate bar 2, which is displaceable relative to these stationary grate bars, moves relative to not only its neighbouring grate bars 1 and the suspension rail 6 and 7, respectively, but also the coupling which prevents its neighbouring bars from a mutual moving apart.

In the case of the embodiment illustrated in Figs. 1 and 2, the coupling which holds the stationary grate bars 1 together is designated by 8 and comprises a tie bar 9 with hooklike projections 10, which are constructed integrally with the ends of the tie bar and which protrude transversely of the tie bar at opposite sides thereof, in order to be able to unite two stationary grate bars and one movable grate bar, inside ribs 11 and outside ribs 12 of the movable grate bar 2 and outside ribs 13 of the stationary grate bars 1 have entry openings 14 and 15, respectively. The entry opening 15 in the outside rib 13 of each stationary grate bar 1 is adapted to the shape of the hooklike projection 10 and extends perpendicularly to the back surface of the grate bar 1.

In order that the coupling 8 can hold the stationary grate bars 1 at a desired spacing from one another and that the abutments 10 cannot, in use, slip back out through the entry opening 15, the coupling 8 is turned by means of a wrench 16, which engages a lever 17 securely connected to the tie bar 9. The wrench 16 is provided at its forward end with a socket 18 having two abutments 19, the lever being received in the socket and the abutments 19 alternately engaging the lever during turning of the coupling 8.

The movable grate bar 2 has an elongate slot 20, which communicates with the associated entry opening 14 and which is so dimensioned that the movable grate bar 2 can displace relative to the tie bar 9 of the coupling 8 to accommodate its displacement relative to the stationary grate bars 1.

resistance to displacement of the movable grate bar due to jamming is constant independently of whether the jamming occurs in either or both gaps between the coupled movable grate bar and stationary grate bars. In the known construction, the resistance to displacement is, by contrast, doubled when jamming occurs in the gaps at both sides of the movable grate bar, as the couplings at the two sides of the movable grate bar are

independent of each other so that the forces arising at the hooks are added together.

If the stop means are integrally formed on the ends of the tie bar, then the gap width between the adjacent grate bars depends on the

production accuracy of the grate bars and the coupling means, which for economic reasons cannot necessarily be improved as may be desired. In order on the one hand to provide the smallest possible gaps between the grate bars at the start of the operating life and on the other hand to be able to correct the widths of these gaps after a longer operational time when perhaps a degree of wear has occurred, the effective length of the coupling means is preferably adjustable.

In a first possibility of providing an adjustment facility in such coupling means, the stop means at at least one end of the tie bar comprises an abutment provided with a threaded element, such as a set screw, which bears against the inside surface of the associated outer rib member, the abutment itself being constructed integrally with the tie bar.

In a further possibility of providing such a facility, the stop means are provided by threaded elements, such as set screws, which extend transversely of the tie bar through its ends and which are provided with projecting conical end portions which, in an operative setting of the tie bar, co-operate with cam surfaces at the insides of the associated outer rib members. The coupling means thus comprises a simple straight tie bar provided at its ends with threaded bores, which extend substantially transversely of the longitudinal axis of the bar and into which the set screws are threaded. Since the set screws as well as the insides of the rib members have contacting cam surfaces, the desired spacings can be set and re-adjusted.

A further possibility of providing an adjustment facility consists in providing, as the stop means, nuts threadedly engaged on the ends of the tie bar.

Entry openings for the stop means are preferably provided at least in said outer rib members of the stationary grate bars to enable the grate covering to be assembled. If these stop means are rigidly connected with the tie bar, the movable grate bar also has corresponding openings. In order that the connection cannot undo of its own accord during operation, the coupling means is preferably locked in place after introduction into the rib members. Expediently, this is achieved by turning the coupling means from an entry setting to an operational setting.

If, however, the tie bar is of round cross-section, the possibility can arise that the bar turns back by itself during use. To securely exclude this possibility, the tie bar may be provided with slide sleeves on which the movable grate bar is slidably guided. It is in that case advantageous if the shape of the slide sleeves deviates from purely circular, so that they are excluded from rotary movement. The arrangement of slide sleeves on the tie bar also has the advantage that wear-resistant materials can be used, as it is not impossible, despite the motional play in the elongate slot, that a relative movement perpendicularly to the grate bar backs occurs between neighbouring grate bars during the raking motions, so that the movable grate bar grinds on the tie bar. The slide sleeves reduce any wear from this source without it being necessary to manufacture the entire coupling means of a particularly wear-resistant material.

Another possibility of locking the coupling means in its operational setting consists in providing locking elements at the underside of the tie bar, the locking elements being insertable, after introduction of the stop means through the entry openings, into these openings so as to hold the coupling means in a setting displaced relative to the entry setting and thereby locked in place. The locking elements can be secured in their locking setting against unintended displacement.

In the case of a coupling means with threaded elements such as set screws arranged at the ends of the tie bar as previously mentioned, the locking of the coupling means can be achieved in simple manner by arranging the set screw entry openings in the outer rib members at that side of the tie bar which is opposite to the afore-mentioned projecting conical end portions. For introduction of the tie bar, the set screws are brought into a position in which the conical end portions are disposed substantially within the tie bar, and, after insertion through the outer rib members, are then brought into an operational setting in which the conical end portions protrude beyond the tie bar. As the entry openings are provided on the side opposite the conical end portions, the coupling means is prevented from detaching from the stationary grate bars.

With the described coupling method, two stationary grate bars and one movable grate bar of one stage are each time formed into one unit. However, it is quite possible that five, seven or a greater uneven number of grate bars are formed into a unit. In this case, only the spacing between the two outer grate bars of a unit is determined. The spacings between the individual grate bars of the unit can vary within the unit. The grate bars of a unit are thus held by the coupling means at a certain maximum spacing among one another.

A gap can, however, arise not only between the grate bars, but also between the grate bar of one stage and the boundary plates. To prevent the edge bars of stationary stages from displacing away from the boundary plates, the edge bars of the one grate covering side of the stationary grate

SPECIFICATION

Grate Covering for a Furnace Grate

The present invention relates to a grate covering for a mechanically moved step-shaped furnace grates and has particular reference to large furnaces in which several grate bars are arranged to be movable relative to one another in individual stages and are coupled together.

In a known grate covering of this kind (German (Fed. Rep.) patent specification No. 911 317), a laterally projecting hook is provided on one outside rib of each grate bar and is guided in an elongate slot of the outside rib of an adjacent grate bar after introduction through a special entry opening, the hook sliding along the inside wall of the outside rib during the relative movement. The mutual spacings of adjacent grate bars cannot be set exactly with this method of coupling, as the inside of the cast outside rib is not finished and the hook is also cast or forged, so that dimensional tolerances and, as consequence, gaps arise between the grate bars. During relative displacement of adjacent bars, the unfinished hook slides on an unfinished rib surface so that large frictional forces can arise, which so act on a narrow hook, for example 20 millimetres wide, that the hook wears relatively rapidly, whereby the gap enlarges. The consequence of this is that with increasing operational life, increasingly larger particles can penetrate through the gaps, which can lead to the impairment of the relative movement and even to jamming. If such jamming is present at many locations, the driving force for the movement of the grate bars in the relative stroke, i.e. for the relative displacement of the grate bars, becomes so high that the driving mechanism of the grate may stall. Since the coupling in the known construction is effected between each bar and its respective neighbouring bar, the frictional force doubles, and thus the force needed for execution of the relative stroke, when jamming occurs at both flanks of a grate bar. A jamming of the grate bar can be caused by stones and slag as well as by ingressed iron debris in the case of firing of refuse.

There is accordingly a need for a grate covering in which the spacing between individual grate bars of the gaps between the grate bars can be kept to a minimum and the frictional forces during the relative displacement and associated thereby reduced.

According to the present invention there is provided a grate covering for a mechanically movable step-shaped furnace grate, comprising a plurality of grate bar stages each comprising a movable grate bar disposed between and movable relative to two stationary grate bars, the movable and stationary grate bars each comprising laterally outer rib members and being coupled together by coupling means comprising a tie bar which extends transversely to the grate bars through slot means in the outer rib members of the movable grate bar to permit said relative movement thereof and through openings in those

outer rib members of the stationary grate bars that are closest to the movable grate bar, the tie bar being provided at its ends with stop means so co-operable with said outer rib members of the stationary grate bars at mutually remote sides of the rib members as to hold the grate bars together.

Since the stop means in a grate covering embodying the invention bear against the inside surfaces of the outer ribs of the grate bars which are stationary during the relative movement, there is no displacement of the stop means relative to these outside ribs and consequently no wear at the ribs and the stop means. The grate bar movable during the relative stroke is thus displaced between two grate bars which are stationary during the relative stroke and which, by virtue of the coupling means, have a constant spacing. The movable grate bar is thus displaced relative to a unit consisting of the two neighbouring stationary bars and coupling means, the coupling means being engaged with play in the movable grate bar.

The reference to movable and stationary grate bars always signifies the relative stroke by which those grate bars suspended on a carrier frame to be limitedly displaceable are displaced relative to grate bars suspended on the carrier frame to be stationary relative thereto. This relative stroke occurs in movable as well as in stationary grate stages.

As the coupling means no longer slide along the outer ribs of the stationary grate bars, the motional play hitherto present due to dimensional tolerances is avoided. Due to the stationary arrangement of the coupling means relative to stationary grate bars, the widths of the gaps between bars can be reduced to below 1 millimetre. As a result, penetration of larger particles between relatively movable grate bars is avoided. Should jamming nevertheless occur as a result of an accumulation of small particles, then the force resulting from this leads to the movable grate bar being urged against a stationary grate bar and, under the effect of this force during the relative displacement, being caused to slide by its flank along the flank of the stationary grate bar.

Since the flanks of the grate bars can be precisely finished by parallel grinding so as to have smooth surfaces, correspondingly small frictional forces arise during the relative displacement. The reduction of the frictional forces or of the force necessary for the relative displacement is also due to the fact that only small particles, which do not lead to the strong jamming as can be the case with large particles, can penetrate into the relatively narrow gaps and that large ground surfaces will continue to slide on one another even in the presence of small particles, whereby the wear at the surfaces is small. In the known construction, the forces resulting from the jamming act on the very small surface of the hook, which in addition is unfinished, and thus increase the wear.

A further substantial advantage is that the

slot 56 in the grate bar 2, the slot 56 substantially corresponding to the thickness of the tie bar. The length of the slot 56 corresponds to the magnitude of the maximum relative displacement of neighbouring grate bars. For installation, the set screws 51 are screwed in only until the conical projections 53 are flush with the upper side of the tie bar 49, as is evident from the lefthand end of the tie bar in Fig. 10. In this setting, the tie bar with the set screws 51 is introduceable into an entry opening 55, which is provided in each outside rib 13 and which corresponds in cross-section to that of the tie bar 49 and the downwardly projecting set screw 51. When the set screws 51 are then screwed upwards so that the conical projections 53 come to bear on the surfaces 54, the resulting abutment can no longer be withdrawn from the entry opening 55. The coupling 48 is thus latched in its operative setting.

One possible embodiment of a coupling for a stationary edge bar 1' of a stationary grate stage is illustrated in Figs. 13 and 14. Designated by 78 is a boundary plate of a furnace grate, with which the edge bar 1' is associated. Fastened to this boundary plate 78 is a lug 80 with a guide slot 57, which extends perpendicularly to the grate bar back of the edge bar 1'. Guided in this slot 57 is a pin 58, which carries a securing member 59. The member 59 is substantially U-shaped and comprises a base part 60 and two limbs 61 and 62. Set screws 63, which correspond to the set screws 51 in the embodiment according to Fig. 11, are screwed into the limbs 61 and 62, which extend parallel to the grate bar back. The set screws 63 have conical projections 64 which bear against ramp or cam surfaces 65 and 66 of the outside rib 13' of the edge bar 1'. When the set screws are screwed upwards, the gap 67 between the edge bar 1' and the boundary plate 78 is reduced. Through the arrangement of the slot 57 and pin 58, which is connected with the member 59 through retaining eyelets 79 arranged on the base part 60, the edge bar 1' can move perpendicularly to its bar surface. In order that the member 59 cannot detach from the outside rib 13', the upper limb 61 is inserted through an entry opening 68, which is comparable with the entry opening 55 in the embodiment according to Fig. 11. The entry opening 68 is adapted to the upper limb 61 and in the lower region has a recess 69 for passage of the set screws 63 when this is disposed in a position in which the conical projection 64 does not protrude beyond the limb 61.

In the embodiment according to Fig. 15 to 17, the coupling which serves for retention of the stationary edge bar 1' of a stationary grate stage comprises an angle member, one limb 71 of which is guided through an entry opening 72 in the outside rib 13' of the edge bar 1' and the other limb 73 of which is displaceably engaged in a retaining bracket 74 fastened to the boundary plate 78. The displaceable mounting is provided so that the grate bar can move perpendicularly to

its bar surface and thus follow the movement of the remaining grate bars of the grate stage when required to move vertically. The outer end of the limb 71 is provided with a threaded portion 75 on which a nut 76 is threaded, the nut 76 serving, together with a washer 77, as an abutment which bears against the inside of the outside rib 13'. The gap 67 between the edge bar 1' and the boundary plate 78 can be adjusted through turning the nut 76.

Claims

1. A grate covering for a mechanically movable step-shaped furnace grate, comprising a plurality of grate bar stages each comprising a movable grate bar disposed between and movable relative to two stationary grate bars, the movable and stationary grate bars each comprising laterally outer rib members and being coupled together by coupling means comprising a tie bar which extends transversely to the grate bars through slot means in the outer rib members of the movable grate bar to permit said relative movement thereof and through openings in those outer rib members of the stationary grate bars that are closest to the movable grate bar, the tie bar being provided at its ends with stop means so co-operable with said outer rib members of the stationary grate bars at mutually remote sides of the rib members as to hold the grate bars together.

2. A grate covering as claimed in claim 1, the stop means comprising abutment projections rigidly connected to the tie bar and the openings in said outer rib members of the stationary grate bars being shaped in correspondence with the profile shape of the abutment projections.

3. A grate covering as claimed in either claim 1 or claim 2, wherein the effective length of the coupling means is adjustable.

4. A grate covering as claimed in any one of the preceding claims, wherein the stop means at at least one end of the tie bar comprises an abutment projection provided with an adjusting screw engaging said outer rib member of a respective one of the stationary grate bars.

5. A grate covering as claimed in claim 1, the stop means at each end of the tie bar comprising a threaded element which is threadedly engaged in the tie bar to extend transversely thereof and which is provided with a substantially conical end portion projecting from the tie bar by an adjustable amount and co-operable with a cam surface of said outer rib members of the associated one of the stationary grate bars.

6. A grate covering as claimed in claim 1, the stop means at each end of the tie bar comprising a nut threadedly engaged thereon.

7. A grate covering as claimed in any one of claims 1 to 4, the coupling means being angularly displaceable into a setting in which it is movable through the openings and slot means.

8. A grate covering as claimed in any one of the preceding claims, wherein the tie bar is provided with slide sleeves from guiding the



slot 56 in the grate bar 2, the slot 56 substantially corresponding to the thickness of the tie bar. The length of the slot 56 corresponds to the magnitude of the maximum relative displacement of neighbouring grate bars. For installation, the set screws 51 are screwed in only until the conical projections 53 are flush with the upper side of the tie bar 49, as is evident from the lefthand end of the tie bar in Fig. 10. In this setting, the tie bar with the set screws 51 is introduceable into an entry opening 55, which is provided in each outside rib 13 and which corresponds in cross-section to that of the tie bar 49 and the downwardly projecting set screw 51.

When the set screws 51 are then screwed upwards so that the conical projections 53 come to bear on the surfaces 54, the resulting abutment can no longer be withdrawn from the entry opening 55. The coupling 48 is thus latched in its operative setting.

One possible embodiment of a coupling for a stationary edge bar 1' of a stationary grate stage is illustrated in Figs. 13 and 14. Designated by 78 is a boundary plate of a furnace grate, with which the edge bar 1' is associated. Fastened to this boundary plate 78 is a lug 80 with a guide slot 57, which extends perpendicularly to the grate bar back of the edge bar 1'. Guided in this slot 57 is a pin 58, which carries a securing member 59.

The member 59 is substantially U-shaped and comprises a base part 60 and two limbs 61 and 62. Set screws 63, which correspond to the set screws 51 in the embodiment according to Fig. 11, are screwed into the limbs 61 and 62, which extend parallel to the grate bar back. The set screws 63 have conical projections 64 which bear against ramp or cam surfaces 65 and 66 of the outside rib 13' of the edge bar 1'. When the set screws are screwed upwards, the gap 67 between the edge bar 1' and the boundary plate 78 is reduced. Through the arrangement of the slot 57 and pin 58, which is connected with the member 59 through retaining eyelets 79 arranged on the base part 60, the edge bar 1' can move perpendicularly to its bar surface. In order that the member 59 cannot detach from the outside rib 13', the upper limb 61 is inserted through an entry opening 68, which is comparable with the entry opening 55 in the embodiment according to Fig. 11. The entry opening 68 is adapted to the upper limb 61 and in the lower region has a recess 69 for passage of the set screws 63 when this is disposed in a position in which the conical projection 64 does not protrude beyond the limb 61.

In the embodiment according to Fig. 15 to 17, the coupling which serves for retention of the stationary edge bar 1' of a stationary grate stage comprises an angle member, one limb 71 of which is guided through an entry opening 72 in the outside rib 13' of the edge bar 1' and the other limb 73 of which is displaceably engaged in a retaining bracket 74 fastened to the boundary plate 78. The displaceable mounting is provided so that the grate bar can move perpendicularly to

its bar surface and thus follow the movement of the remaining grate bars of the grate stage when required to move vertically. The outer end of the limb 71 is provided with a threaded portion 75 on which a nut 76 is threaded, the nut 76 serving, together with a washer 77, as an abutment which bears against the inside of the outside rib 13'. The gap 67 between the edge bar 1' and the boundary plate 78 can be adjusted through turning the nut 76.

Claims

1. A grate covering for a mechanically movable step-shaped furnace grate, comprising a plurality of grate bar stages each comprising a movable grate bar disposed between and movable relative to two stationary grate bars, the movable and stationary grate bars each comprising laterally outer rib members and being coupled together by coupling means comprising a tie bar which extends transversely to the grate bars through slot means in the outer rib members of the movable grate bar to permit said relative movement thereof and through openings in those outer rib members of the stationary grate bars that are closest to the movable grate bar, the tie bar being provided at its ends with stop means so co-operable with said outer rib members of the stationary grate bars at mutually remote sides of the rib members as to hold the grate bars together.

2. A grate covering as claimed in claim 1, the stop means comprising abutment projections rigidly connected to the tie bar and the openings in said outer rib members of the stationary grate bars being shaped in correspondence with the profile shape of the abutment projections.

3. A grate covering as claimed in either claim 1 or claim 2, wherein the effective length of the coupling means is adjustable.

4. A grate covering as claimed in any one of the preceding claims, wherein the stop means at at least one end of the tie bar comprises an abutment projection provided with an adjusting screw engaging said outer rib member of a respective one of the stationary grate bars.

5. A grate covering as claimed in claim 1, the stop means at each end of the tie bar comprising a threaded element which is threadedly engaged in the tie bar to extend transversely thereof and which is provided with a substantially conical end portion projecting from the tie bar by an adjustable amount and co-operable with a cam surface of said outer rib members of the associated one of the stationary grate bars.

6. A grate covering as claimed in claim 1, the stop means at each end of the tie bar comprising a nut threadedly engaged thereon.

7. A grate covering as claimed in any one of claims 1 to 4, the coupling means being angularly displaceable into a setting in which it is movable through the openings and slot means.

8. A grate covering as claimed in any one of the preceding claims, wherein the tie bar is provided with slide sleeves from guiding the



movable grate bar during said relative movement thereof.

9. A grate covering as claimed in any one of the preceding claims, the coupling means further comprising locking elements arranged at the underside of the tie bar and removably engaged in said openings to lock the tie bar in place.

10. A grate covering as claimed in claim 5, wherein each of said openings comprises an extension permitting movement of the associated threaded element therethrough in a predetermined angular setting of the tie bar, the extension being disposed at a side of the opening opposite to said projecting end portion of the threaded element.

11. A grate covering as claimed in any one of the preceding claims, comprising stationary and movable grate bar stages bordered by lateral boundary members of the furnace grate, the stationary grate bar stages comprising lateral grate bars adjustably secured by securing means to the boundary members.

12. A grate covering as claimed in claim 11, the securing means being mounted on the boundary members to be displaceable substantially perpendicular to the upper surfaces of the lateral grate bars.

13. A grate covering as claimed in either claim 11 or claim 12, wherein the securing means securing each lateral grate bar to a boundary member comprises a substantially U-shaped

fastening member provided at the base of the U-shape with lugs carrying a pin which is slidably engaged in a slot in a bracket rigidly mounted on the boundary member, the limbs of the fastening member being arranged to extend substantially parallel to a rear side of the respective lateral grate bar and being each provided with stop means in the form of a threaded element, which extends substantially parallel to the plane of a laterally outer rib member of the grate bar and which is provided with a substantially conical portion projecting from the respective limb and bearing against a cam surface on the side of the rib member facing inwardly of the grate bar.

14. A grate bar covering as claimed in either claim 11 or claim 12, wherein the securing means securing each lateral grate bar to a boundary member comprises an angle member, one limb of the angle member being so slidably engaged in a mounting bracket rigidly mounted on the boundary member as to be displaceable perpendicularly to a rear side of the grate bar and the other limb of the angle member extending through a laterally outer rib of the grate bar and being provided at its free end with stop means engaging the rib members.

15. A grate covering for a furnace grate, the grate covering being substantially as hereinbefore described with reference to Figs. 1 and 2, Figs. 3 to 6, Figs. 7 to 9, Figs. 10 to 12, Figs. 13 and 14, or Figs. 15 to 17 of the accompanying drawings.