Claims

1. A movable grate for a furnace including a number of grate lanes arranged side by side between a left side section and a right side section, neighbouring grate lanes being connected by means of a midsection, each grate lane including at least one lane section having a number of pivotal grate shafts carrying grate bars and thereby defining an inclined grate surface of said lane section, each midsection including an upper relatively narrow housing section arranged between grate bars of the corresponding neighbouring grate lanes and a lower relatively broad housing section protruding at least partly under grate bars of said corresponding neighbouring grate lanes , each grate shaft having a driven grate shaft end and a non-driven grate shaft end, each grate shaft end being journalled in a respective bearing, the left and right side sections enclosing bearings for corresponding grate shaft ends of the left and right outermost grate lanes, respectively, and the upper relatively narrow housing section of each midsection enclosing bearings for corresponding grate shaft ends of corresponding neighbouring grate lanes, each lane section being provided with a drive mechanism including an actuator for pivoting back and forth neighbouring grate shafts in opposite rotational directions so as to impart a wave-like movement to material on the grate surface in order to transport such material downwards, a synchronising mechanism being arranged to maintain a predetermined clearance between edge portions of grate bars of neighbouring grate shafts, wherein at least one midsection includes the drive mechanism and the synchronising mechanism of at least one lane section, and in that the actuator of said drive mechanism and said synchronising mechanism are located in the lower relatively broad housing section of said at least one midsection.

2. A movable grate according to claim 1, wherein, in the at least one midsection including the drive mechanism and the synchronising mechanism of the at least one lane section, the mutual relative pivotal positions of the respective grate shafts of the at least one lane section are individually adjustable by means of respective clearance adjustment mechanisms located in the lower relatively broad housing section of said at least one midsection.

3. A movable grate according to claim 1 or 2, wherein, in the at least one midsection including the drive mechanism and the synchronising mechanism of the at least one lane section, the mutual relative pivotal positions of the respective grate shafts of the at least one lane section are individually elastically biased towards respective predetermined relative pivotal positions by means of respective biasing mechanisms located in the lower relatively broad housing section of said at least one midsection.

4. A movable grate according to any one of the preceding claims, wherein, in the at least one midsection including the drive mechanism and the synchronising mechanism of the at least one lane section, a number of drive shafts corresponding to the respective grate shafts of the at least one lane section are located in the lower relatively broad housing section of said at least one midsection, and the driven grate shaft end of each said grate shaft is individually in driven connection with a corresponding one of said drive shafts.

5. A movable grate according to any one of the preceding claims, wherein the driven grate shaft end of the respective grate shafts of the at least one lane section is provided with a respective grate shaft lever arm, wherein a first end of the grate shaft lever arm is in driving connection with the grate shaft and a second end of the grate shaft lever arm is pivotally connected to a first end of a corresponding connection rod extending down into the lower relatively broad housing section of said at least one midsection, and wherein a second end of said connection rod located in said relatively broad housing section is in driven connection with the actuator of said drive mechanism.

6. A movable grate according to claim 5, wherein the driven connection between the second end of said respective connection rods and the actuator of said drive mechanism is individually adjustable in order to adjust the individual predetermined clearance between edge portions of grate bars of neighbouring grate shafts.

7. A movable grate according to claim 4, wherein the driven grate shaft end of each said grate shaft is provided with a grate shaft lever arm, wherein a first end of the grate shaft lever arm is in driving connection with the grate shaft and a second end of the grate shaft lever arm is pivotally connected to a

first end of a corresponding connection rod, wherein each said drive shaft is provided with a drive shaft lever arm, and wherein a first end of the drive shaft lever arm is in driven connection with the drive shaft and a second end of the drive shaft lever arm is pivotally connected to a second end of a corresponding connection rod so that each grate shaft lever arm is connected with a corresponding drive shaft lever arm by means of a corresponding connection rod.

8. A movable grate according to claim 7, wherein each connection rod is pivotally connected to the corresponding grate shaft lever arm by means of a first ball joint, and wherein each connection rod is pivotally connected to the corresponding drive shaft lever arm by means of a second ball joint.

9. A movable grate according to any one of the claims 4, 7 or 8, wherein the grate shafts of said at least one lane section are numbered consecutively in downward direction, wherein the corresponding drive shafts are numbered correspondingly, wherein each drive shaft is provided with a crank arm, wherein the crank arms of drive shafts having odd numbers are connected by means of a first linking rod and the crank arms of drive shafts having even numbers are connected by means of a second linking rod, wherein the actuator of said drive mechanism is a linear actuator, such as a hydraulic piston actuator, and wherein the first linking rod and the second linking rod are interconnected by means of the linear actuator.

10. A movable grate according to claim 9, wherein each crank arm is mounted pivotally adjustably on the corresponding drive shaft.

11. A movable grate according to claim 9 or 10, wherein each crank arm is mounted on the corresponding drive shaft elastically biased towards a predetermined relative pivotal position in relation to said drive shaft.

12. A movable grate according to any one of the claims 9 to 11, wherein one of the drive shafts having odd numbers is connected to one of the drive shafts having even numbers by means of the synchronising mechanism of at the least one lane section.

13. A movable grate according to claim 12, wherein said synchronising mechanism includes a first synchronising lever arm having a first end fixedly connected to said one of the drive shafts having odd numbers and a second end pivotally connected to a first end of a synchronising rod and a second synchronising lever arm having a first end fixedly connected to said one of the drive shafts having even numbers and a second end pivotally connected to a second end of the synchronising rod.

14. A movable grate according to any one of the preceding claims, wherein at least one midsection includes axially displaceable bearings in which corresponding grate shaft ends of at least one lane section are journalled, wherein each said axially displaceable bearing is mounted in a displaceable bearing house mounted displaceably in relation to a stationary bearing house support mounted in fixed relationship to said at least one midsection so that said displaceable bearing house is displaceable in the axial direction of the corresponding grate shaft and fixed against rotation about said axial direction, wherein a non-pivotal side cover plate is coupled to and axially displaceable with said displaceable bearing house, wherein the non-pivotal side cover plate forms part of a side wall of the upper relatively narrow housing section of said at least one midsection including axially displaceable bearings, and wherein the non-pivotal side cover plate is mounted in proximity to the outermost grate bars carried by the grate shafts of said at least one lane section.

15. A movable grate according to claim 14, wherein the displaceable bearing house has an outer cylindrical surface arranged slidingly in a cylindrical boring in the stationary bearing house support.

16. A movable grate according to claim 14 or 15, wherein a pivotal side cover plate is fixed on each said grate shaft end journalled in an axially displaceable bearing, wherein the pivotal side cover plate forms part of said side wall of the upper relatively narrow housing section, and wherein the pivotal side cover plate is arranged pivotally in a cut-out of the corresponding non-pivotal side cover plate so that an outer edge of the pivotal side cover plate forming an arc of a circle is in close proximity to a corresponding inner edge of the cut-out of the corresponding non-pivotal side cover plate forming a corresponding arc of a circle.

17. A movable grate according to any one of the claims 14 to 16, wherein the axially displaceable bearings are arranged at non-driven grate shaft ends.

18. A movable grate according to any one of the preceding claims, wherein, in the at least one midsection including the drive mechanism and the synchronising mechanism of the at least one lane section, a stationary frame of said midsection is formed by means of two spaced grate beams extending in the longitudinal direction of said midsection in the lower relatively broad housing section of said midsection, wherein two grate plates in the form of longitudinal L-formed brackets are mounted with a first lower flange on top of the respective spaced grate beams and with a second upright flange extending vertically, and wherein bearing houses arranged in said midsection are carried by the respective second upright flanges of the two longitudinal L-formed brackets.

19. A movable grate according to any one of the preceding claims, wherein, in the at least one midsection including the drive mechanism and the synchronising mechanism of the at least one lane section, a dust shield is arranged inside an outer enclosure of the at least one midsection, wherein non-displaceable bearing houses or stationary bearing house supports carrying bearings in which respective driven grate shaft ends are journalled extend sealingly through respective openings in the dust shield, wherein the dust shield thereby separates the inside of the outer enclosure of the at least one midsection into an outer room section next to the outer enclosure and an inner room section enclosing the drive mechanism including the actuator and the synchronising mechanism of at least one lane section.

20. A movable grate according to claim 19, wherein the outer room section is connected to a supply of pressurised sealing gas.

21. A movable grate according to claim 18 and 19, wherein the dust shield includes a bottom wall extending between the two spaced grate beams, two spaced side walls extending from the bottom wall to a top part of the upper relatively narrow housing section of said midsection and a top wall connecting the two spaced side walls, wherein non-displaceable bearing houses

or stationary bearing house supports carrying bearings in which respective grate shaft ends are journalled extends sealingly through openingsin the respective two spaced side walls, and wherein the drive mechanism of the at least one lane section extends through an opening in the bottom wall.

22. A movable grate according to claim 21, wherein the two spaced grate beams forming the stationary frame of said midsection have the form of hollow rectangular tubes, wherein the inside of the hollow rectangular tubes are connected to a supply of pressurised sealing gas, and wherein the pressurised sealing gas is supplied to the outer room section from the inside of the hollow rectangular tubes through holes in the walls of the hollow rectangular tubes.

23. A movable grate according to any one of the preceding claims, wherein at least some of the grate bars of at least one grate lane extending between two midsections are adapted to be cooled by means of circulating cooling fluid, wherein a cooling fluid supply channel is formed as an axial bore in an inlet end of the grate shafts carrying grate bars and a cooling fluid outlet channel is formed as an axial bore in an outlet end of the grate shafts carrying grate bars, wherein the cooling fluid supply channels are connected to respective cooling fluid supply tubes extending in one of the two midsections, and wherein the cooling fluid outlet channels are connected to respective cooling fluid return tubes extending in the other of the two midsections.

24. A movable grate according to any one of the claims 14 to 17, wherein the non-pivotal side cover plates forming part of the side wall of the upper relatively narrow housing section of said at least one midsection and a top wall of said upper relatively narrow housing section are adapted to be cooled by means of circulating cooling fluid.

25. A movable grate according to any one of the preceding claims, wherein the left side section and the right side section include the drive mechanisms and the synchronising mechanisms of at least one lane section of the left outermost grate lane and of at least one lane section of the right outermost grate lane, respectively, wherein the grate shafts of said at least one lane section of the left outermost grate lane and of said at least one lane section of the right outermost grate lane, respectively, are numbered consecutively in downward

direction, wherein each grate shaft is provided with a crank arm, wherein the crank arms of grate shafts having odd numbers are connected by means of a first linking rod and the crank arms of grate shafts having even numbers are connected by means of a second linking rod, wherein the actuator of said drive mechanism is a linear actuator, such as a hydraulic piston actuator, and wherein the first linking rod and the second linking rod are interconnected by means of the linear actuator.

26. A movable grate according to any one of the preceding claims, wherein the movable grate includes a first grate lane , a second grate lane, and a third grate lane, wherein the left side section and the right side section includes axially displaceable bearings for driven grate shaft ends of the first and third grate lanes, respectively, wherein a first midsection includes axially non-displaceable bearings for non-driven grate shaft ends of the first grate lane and axially displaceable bearings for non-driven grate shaft ends of the second grate lane, and wherein a second midsection includes axially non-displaceable bearings for driven grate shaft ends of the second grate lane and axially non-displaceable bearings for non-driven grate shaft ends of the third grate lane.

27. A movable grate according to any one of the claims 1 to 25, wherein the movable grate includes a first grate lane, a second grate lane, a third grate lane, and a fourth grate lane, wherein the left side section and the right side section encloses axially displaceable driven grate shaft ends of the first and fourth grate lanes, respectively, wherein a first midsection includes axially non-displaceable bearings for non-driven grate shaft ends of the first grate lane and axially displaceable bearings for non-driven grate shaft ends of the second grate lane, wherein a second midsection includes axially non-displaceable bearings for driven grate shaft ends of the second grate lane and axially displaceable bearings for non-driven grate shaft ends of the third grate lane, and wherein a third midsection includes axially non-displaceable bearings for driven grate shaft ends of the third grate lane and axially non-displaceable bearings for non-driven grate shaft ends of the fourth grate lane.