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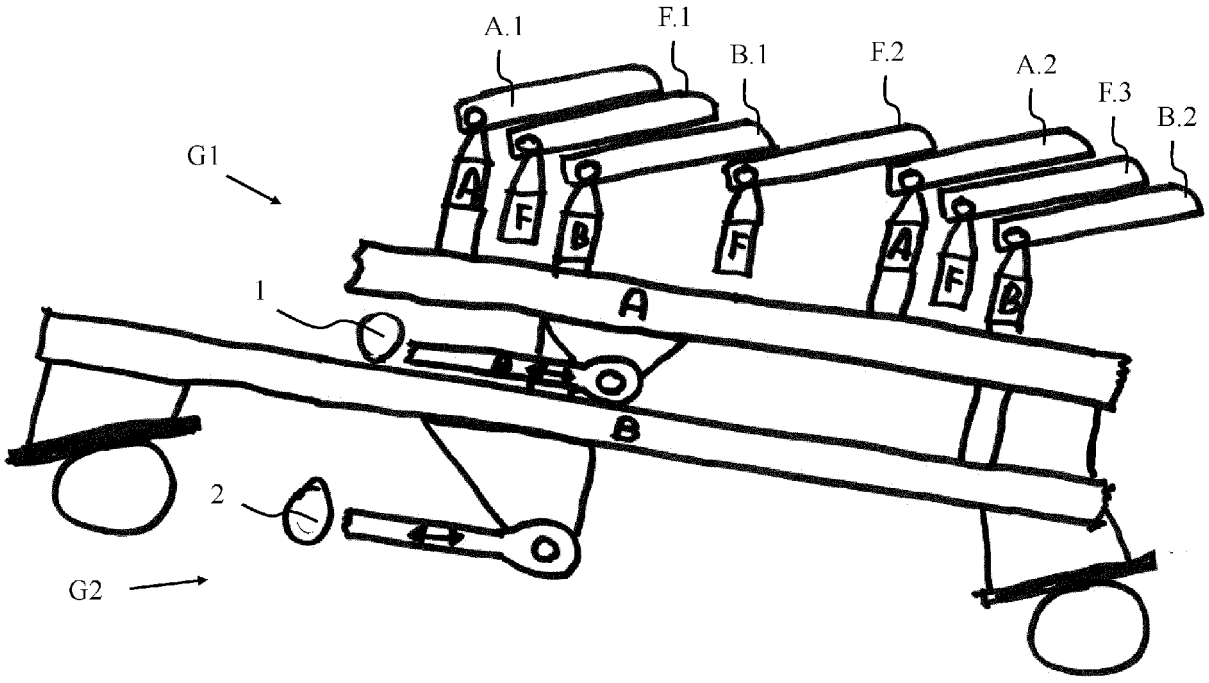
(54) STEPPED COMBUSTION GRATE

(57) The present invention relates to a combustion grate for combusting solid fuels, comprising
- at least two stationary grate steps (F.1, F.2, F.3),
- at least four movable grate steps (A.1, A.2, B.1, B.2), wherein
- the grate steps are arranged behind each other in a stairway formation,
- at least two movable grate steps (A.1, A.2) are interconnected to form a first grate step group (G1) and

- at least two further movable grate steps (B.1, B.2) are interconnected to form a second grate step group (G2).



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Description

[0001] The present invention relates to a combustion grate for the combustion of solid fuels (such as waste and biomass). The combustion grate comprises at least two stationary grate steps and at least four moveable grate steps, wherein the grate steps are arranged behind each other. Such combustion grates are used in incineration plants for solid fuels.

[0002] The moveable grate steps are moved back and forth with regard to the stationary grate steps, so that the solid fuel (such as waste or biomass) and its combusted solid residuals (such as ash) are advanced forward along the combustion grate (in the direction in which the grate steps are arranged behind each other and in which the moveable steps are moved back and forth). This direction of travel of the solid fuel and its solid combusted residuals is also referred to as advancing direction. Such combustion grates are also known as reciprocating grates.

[0003] Grate steps are also known as grate bar row or grate rod line (German: Roststabreihe). Each grate step is usually made of multiple grate plates which are arranged beside each other in a width direction of the grate. The multiple grate plates of each grate step may be interconnected by a support rod.

[0004] EP 0 874 195 B1 discloses a combustion grate, in which each moveable grate step is connected to a separate drive. Accordingly, there must be a drive (such as a hydraulicly actuated piston) for each moveable grate step, which makes the combustion grate expensive and complex in controlling.

[0005] In order that only one drive is needed to move the moveable grate steps, it is known to interconnect all moveable grate steps by one moveable frame, wherein one drive is connected to the moveable frame, so that all moveable grate steps are driven simultaneously in the same direction. Such a combustion grate is also known as forward moving type reciprocating grate (German: Vorschubrost). A forward moving type reciprocating grate is for example known from EP 1 635 114 A2.

[0006] In order to enhance stoking of the solid fuel and of the ash it is known that multiple moveable grate steps are interconnected by a first moveable frame to form a first grate step group and that further multiple grate steps are interconnected by a second moveable frame to form a second grate step group. The first moveable frame and the second moveable frame are driven by one drive and are interconnected with each other in such a way, that the moveable grate steps of the first grate step group move in the opposite direction to the moveable grate steps of the second grate step group. Such a combustion grate is also known as counter moving type reciprocating grate (German: Gegenlaufvorschubrost oder Gegenlaufrost). For example, in "Rostfeuerungssysteme zur Verbrennung von Abfall- und Reststoffen", Dieter O. Reimann, ISBN-10: 3-924511-55-1 (see page 243, German: "Gegenlaufrost") such a counter moving type reciprocating grate is disclosed, which also comprises the features of the preamble of independent claim 1.

[0007] It is an object of the present invention to enhance the combustion grate and in particular to provide a combustion grate, with which the solid fuel and the ash can be more efficiently stoked with the less possible effort.

[0008] This object is achieved with a combustion grate with the features of the independent claim. Preferred embodiments of the combustion grate are described in the above and in the following description and in the dependent claims, whereas single features of the preferred embodiments can be combined with each other in a technical meaningful manner.

[0009] The object is in particular achieved with a combustion grate for combusting solid fuels (for example waste or biomass), which combustion grate comprises at least two stationary grate steps and at least four moveable grate steps, wherein the grate steps are arranged behind each other in a stairway formation in the advancing direction of the solid fuel, wherein at least two moveable grate steps are interconnected to form a first grate step group and at least two further moveable grate steps are interconnected to form a second grate step group, wherein the first grate step group is connected to and drivable by a first drive and the second grate step group is connected to and drivable by a second drive, wherein the second drive is drivable independently from the first drive.

[0010] With other words, the invention suggests that two groups of moveable grate steps can be driven independently from each other in a reciprocating manner with regard to the stationary grate steps, so that the most efficient stoking (eventually depending on the kind and/or composition of the solid fuel) can be achieved without the need to have a drive for each moveable grate step. For example, the reciprocating movement of the moveable grate steps of the first grate step group may differ in velocity, amplitude and/or phase to the reciprocating movement of the moveable grate steps of the second grate step group.

[0011] For controlling the reciprocating movements the first drive and the second drive may be connected to a control unit, wherein the control unit is embodied to set at least one parameter (for example amplitude, velocity and/or phase) of the reciprocating movement of the grate step groups. In a preferred embodiment, the control unit is embodied to alter the parameters of the reciprocating movement of at least one of the two grate step groups during operation. For such an alteration of the parameter(s) of the reciprocating movement the control unit may be connected to a monitoring system, with which the combustion of the solid fuel on top of the combustion grate is monitored. For example, the monitoring system may comprise a camera, a pyrometer, sensor(s) or the like, with which the temperature of the combusting solid fuel can be derived in particular in a spatially resolved manner. This way the parameters of the reciprocating movements can be adapted to the present combustion situa-

tion.

[0012] In this regard it is also suggested that the control unit is embodied to alter the reciprocating movements of the two grate step groups during operation, such that in a first mode the reciprocating movements embody a forward moving type reciprocating grate (meaning that the reciprocating movement of the moveable grate steps of the first grate step group is equal in amplitude, phase and velocity to the reciprocating movement of the moveable grate steps of the second grate step group) and wherein in a second mode the reciprocating movements embody a counter moving type reciprocating grate (meaning that the reciprocating movement of the moveable grate steps of the first grate step group is opposite in direction to the reciprocating movement of the moveable grate steps of the second grate step group but is equal in velocity and amplitude). Accordingly, the inventive combustion grate can be operated as forward moving type or counter moving type reciprocating grate, when desired, for example depending on the kind and/or composition of the to be combusted solid fuel.

[0013] In order to interconnect the moveable grate steps of one group, a moveable frame may be provided for each group. For example, the moveable grate steps of the first grate step group are interconnected by a first moveable frame and the moveable grate steps of the second grate step group are interconnected by a second moveable frame, wherein the first drive is connected to the first moveable frame and the second drive is connected to the second moveable frame. For example, the moveable frames may each comprise a rectangular base structure to which each stationary grate step of the respective group is connected. Roller bearings or glide bearings may be connected to the base frame for guiding the reciprocating movement of the respective moveable frame with regard to a stationary structure.

[0014] Furthermore, the stationary grate steps may be interconnected by a stationary frame, which my embody the stationary structure to which the moveable frames are moveable.

[0015] In one embodiment the moveable grate steps of the first grate step group are arranged between two stationary grate steps and the moveable grate steps of the second grate step group are arranged between two stationary grate steps. This way a moveable grate step and a stationary grate step are arranged behind each other in the advancing direction, while every other moveable grate step belongs to a different grate step group.

[0016] In an alternative embodiment the moveable grate steps of the first grate step group are each arranged between a stationary grate step and a movable grate step of the second grate step group. Accordingly, in the advancing direction (meaning the direction of travel of the solid fuel) a stationary grate step is followed by a moveable grate step of the first group, which is followed by a moveable grate step of the second group, which is followed by a stationary grate step. This way moveable grate steps of the different groups are arranged directly behind each other.

[0017] The drives may be of any suitable type. Preferably, the drives are of the hydraulic type. For example, the drive may be embodied as a hydraulicly driven piston.

[0018] In such combustion grates the grate steps adjacent to each other in the advancing direction rest upon each other, so that the solid fuel can be advanced in the advancing direction, when the moveable grate steps are moving reciprocally.

[0019] Each grate step is usually made of multiple grate plates arranged besides each other in a width direction of the grate and therefore transversely to the advancing direction of the to be combusted solid fuel. In particular, the grate plates are arranged besides each other, so that the grate step extends across the (entire) width of the grate.

[0020] The combustion grate can be in particular used in an incineration plant having a combustion chamber, wherein the combustion grate is arranged within the combustion chamber to advance the to be combusted solid fuel from a combustion chamber inlet to a slag container. Depending on the width and length of the combustion chamber multiple combustion grates may be arranged besides and/or behind each other within the combustion chamber. For example, one row or two rows of combustion grates (each comprising stationary grate steps and moveable grate steps as described above) may be arranged within the combustion chamber. Each row of combustion grates may comprise two, three, four or even more combustion grates which are arranged behind each other in the advancing direction.

[0021] The invention and the technical background will now be described with regard to the figure.

[0022] The figures shows schematically a combustion grate for combusting solid fuels. The combustion grate comprises three stationary grate steps F.1, F.2, F.3. Additionally, the combustion grate a first grate step group G1 and second grate step group G2.

[0023] The first grate step group G1 comprises two movable grate steps A.1, A.2 which are fixedly interconnected to each other by a first movable frame A. The movable frame A is connected to a first drive 1.

[0024] The second grate step group G2 comprises two movable grate steps B.1, B.2 which are fixedly interconnected to each other by a second movable frame B. The movable frame B is connected to a second drive 2.

[0025] The grate steps A.1, A.2, B.1, B.2, F.1, F.2, F. 3 are arranged behind each other in a stairway formation, so that the moveable grate steps A.1, A.2, B.1, B.2 can be moved relative to the stationary grate steps F1, F.2, F.3.

[0026] For controlling the reciprocating movements the first drive 1 and the second drive 2 may be connected to a (not shown) control unit, wherein the control unit is embodied to set the parameters (for example amplitude, velocity and/or phase) of the reciprocating movement of the grate step groups G1, G2.

[0027] As the second drive 2 is drivable independently

from the first drive 1, the two groups G1, G2 can be driven independently from each other in a reciprocating manner with regard to the stationary grate steps F.1, F.2, F.3. Accordingly, the most efficient stoking (eventually depending on the kind and/or composition of the solid fuel) can be achieved without the need to have a drive for each moveable grate step. For example, the reciprocating movement of the moveable grate steps of the first grate step group G1 may differ in velocity, amplitude and/or phase to the reciprocating movement of the moveable grate steps of the second grate step group G2. For example, in a first mode of operation the reciprocating movements embody a forward moving type reciprocating grate and in a second mode the reciprocating movements embody a counter moving type reciprocating grate.

Claims

1. Combustion grate for combusting solid fuels, comprising

- at least two stationary grate steps (F.1, F.2, F. 3),
- at least four movable grate steps (A.1, A.2, B. 1, B.2), wherein
- the grate steps are arranged behind each other in a stairway formation,
- at least two movable grate steps (A.1, A.2) are interconnected to form a first grate step group (G1) and
- at least two further movable grate steps (B.1, B.2) are interconnected to form a second grate step group (G2),

characterized in that

- the first grate step group (G1) is connected to a first drive (1) and
- the second grate step group (G2) is connected to a second drive (2), the second drive (2) being drivable independently from the first drive (1).

2. Combustion grate according to claim 1, wherein the movable grate steps (A.1, A.2) of the first grate step group (G1) are interconnected by a first movable frame (A) and wherein the movable grate steps (B. 1, B.2) of the second grate step group (G2) are interconnected by a second movable frame (B).

3. Combustion grate according to claim 2, wherein the first drive (1) is connected to the first movable frame (A) and the second drive (2) is connected to the second movable frame (B).

4. Combustion grate according to one of the preceding claims, wherein the stationary grate steps (F.1, F.2, F.3) are interconnected by a stationary frame.

5. Combustion grate according to one of the preceding claims, wherein the movable grate steps (A.1, A.2) of the first grate step group (G1) are arranged between two stationary grate steps (F.1, F.2, F.3).

6. Combustion grate according to one of the preceding claims, wherein the movable grate steps (B.1, B.2) of the second grate step group (G2) are arranged between two stationary grate steps (F.1, F.2, F.3).

7. Combustion grate according to one of claims 1 to 4, wherein the movable grate steps (A.1, A.2) of the first grate step group (G1) are arranged between a stationary grate step (F.1, F.2, F.3) and a movable grate step (B.1, B.2) of the second grate step group (G2).

8. Combustion grate according to one of the preceding claims, wherein the drives (1, 2) are hydraulic drives.

9. Combustion grate according to one of the preceding claims, wherein adjacent grate step (A.1, A.2, B.1, B.2, F.1, F.2, F.3) rest one upon each other.

10. Combustion grate according to one of the preceding claims, wherein the grate steps (A.1, A.2, B.1, B.2, F.1, F.2, F.3) extend across the entire width of the grate.

11. Combustion grate according to one of the preceding claims, wherein each grate step (A.1, A.2, B.1, B.2, F.1, F.2, F.3) comprises multiple grate plates arranged besides each other in a width direction of the grate.

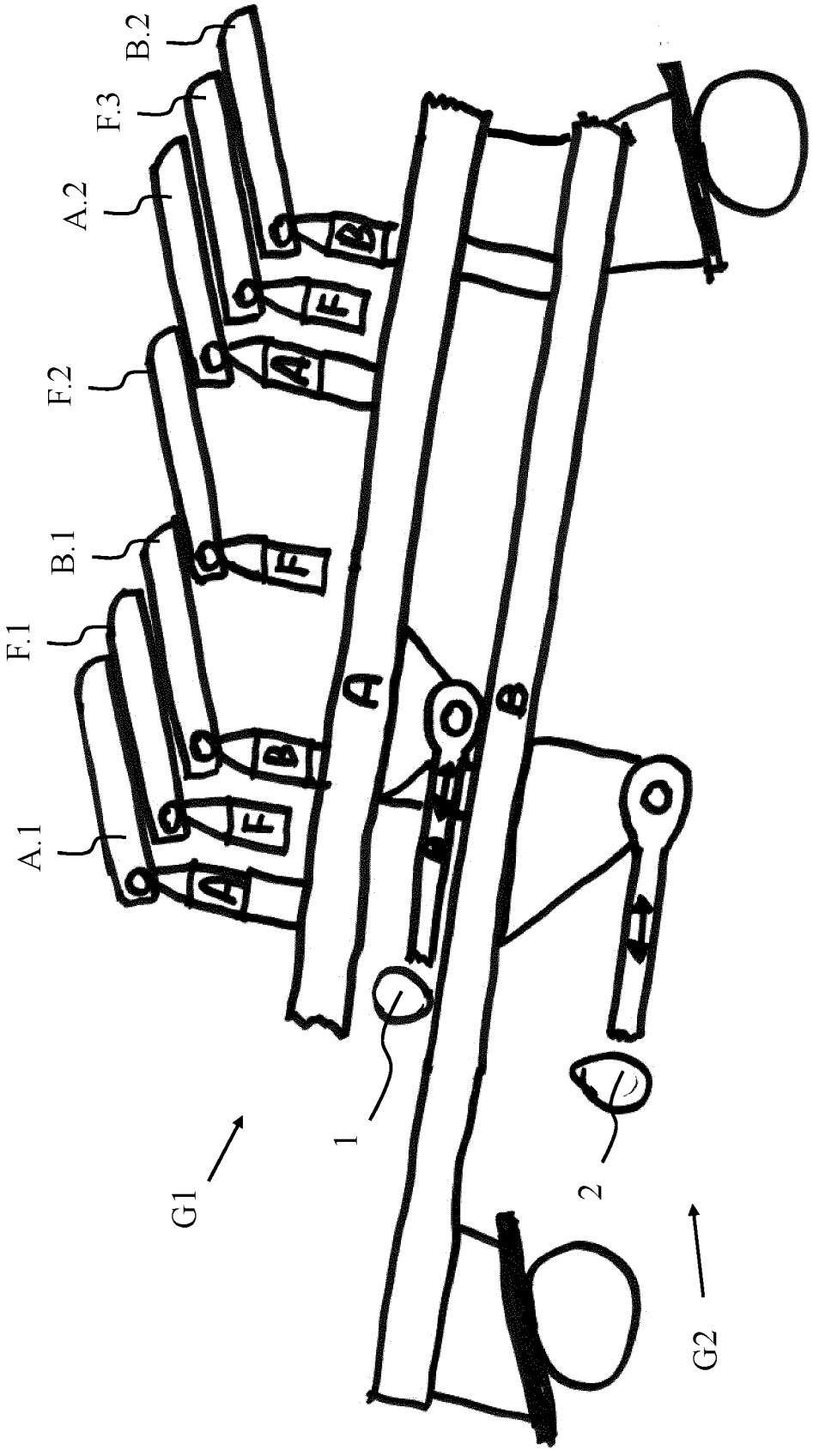
12. Combustion grate according to one of the preceding claims, wherein the first drive (1) and the second drive (2) are connected to a control unit, wherein the control unit allows to set the amplitude, phase and/or velocity of the reciprocating movements of the two grate step groups.

13. Combustion grate according to claim 12, wherein the control unit is embodied to alter the amplitude, phase and/or velocity of the reciprocating movement of at least one of the two grate step groups during operation.

14. Combustion grate according to claim 12 or 13, wherein the control unit is embodied to alter the reciprocating movements of the two grate step groups during operation such that in a first mode the reciprocating movements is a forward-moving type and in a second mode the reciprocating movements is counter-moving type.

15. Method for operating a combustion grate according to one of the preceding claims, wherein the first drive and the second drive are operated such that the re-

ciprocating movement of the movable grate steps of the first grate step group and the reciprocating movement of the movable grate steps of the second grate step differ from each other, in particular in that the phase, velocity and/or amplitude of the reciprocating movements differ.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EUROPEAN SEARCH REPORT

Application Number
EP 21 20 6508

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 3 413 938 A (MIRO DVIRKA) 3 December 1968 (1968-12-03) * column 4, line 8 - column 5, line 44 * * column 7, lines 36-45 * * figures 1-3 *	1-8, 11-15	INV. F23H7/08 F23H7/02
X	US 4 103 627 A (MAINKA CHRISTIAN M) 1 August 1978 (1978-08-01) * column 4, lines 4-32 * * figures 1, 2 *	1-15	
X	US 2004/231573 A1 (MARTIN JOHANNES [DE] ET AL) 25 November 2004 (2004-11-25) * paragraphs [0023] - [0026] * * figures 1, 3 *	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)
			F23H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	29 April 2022	Vogl, Paul

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29-04-2022

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US 3413938 A	03-12-1968	NONE	
US 4103627 A	01-08-1978	NONE	
US 2004231573 A1	25-11-2004	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 0874195 B1 **[0004]**
- EP 1635114 A2 **[0005]**

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- **DIETER O. REIMANN.** *Rostfeuerungssysteme zur Verbrennung von Abfall- und Reststoffen,* ISBN 3-924511-55-1, 243 **[0006]**