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(54) **ROLLER GRATE WITH HYDRAULIC DRIVE AND A METHOD FOR OPERATING THE ROLLER GRATE**

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(57) **ABSTRACT**

A roller grate consists of rollers disposed one behind the other by means of which the material to be burned is moved, and of a drive for the rollers that constitutes a hydraulic motor for driving one or several rollers. A method for operating the roller grate consists of operating the hydraulic motor in angular steps. The roller grate has the advantage that roller grates having low-weight drive units can be operated with high reliability and with little wear of the drive units.

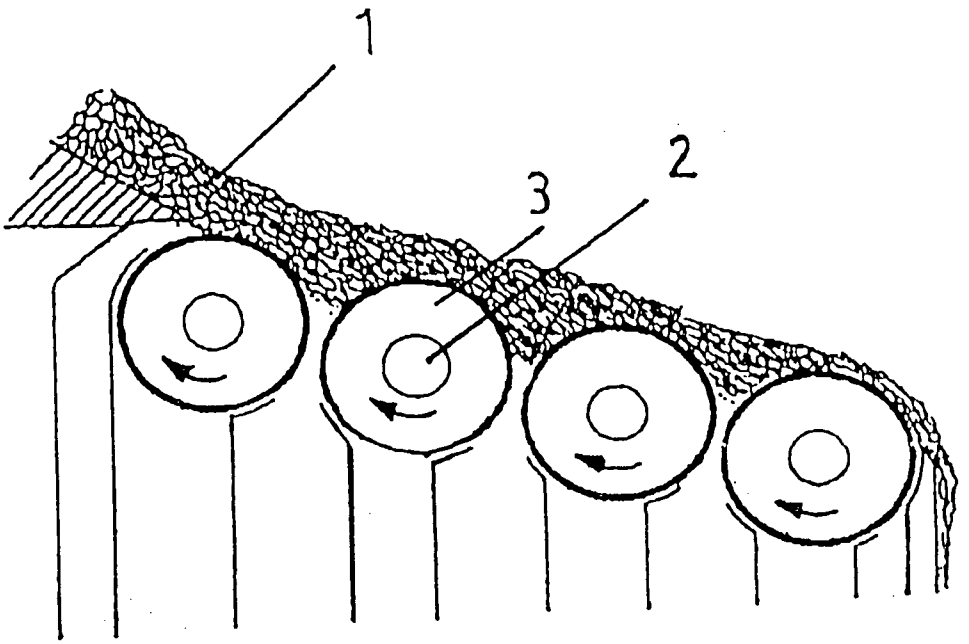


Fig. 1

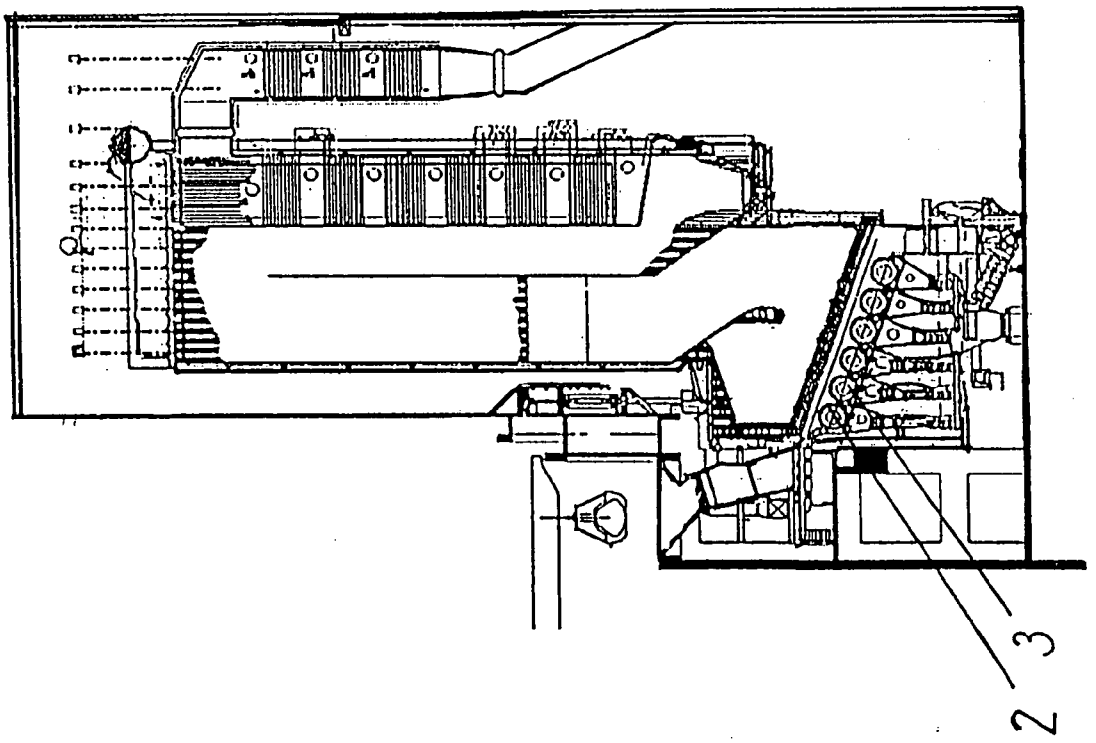
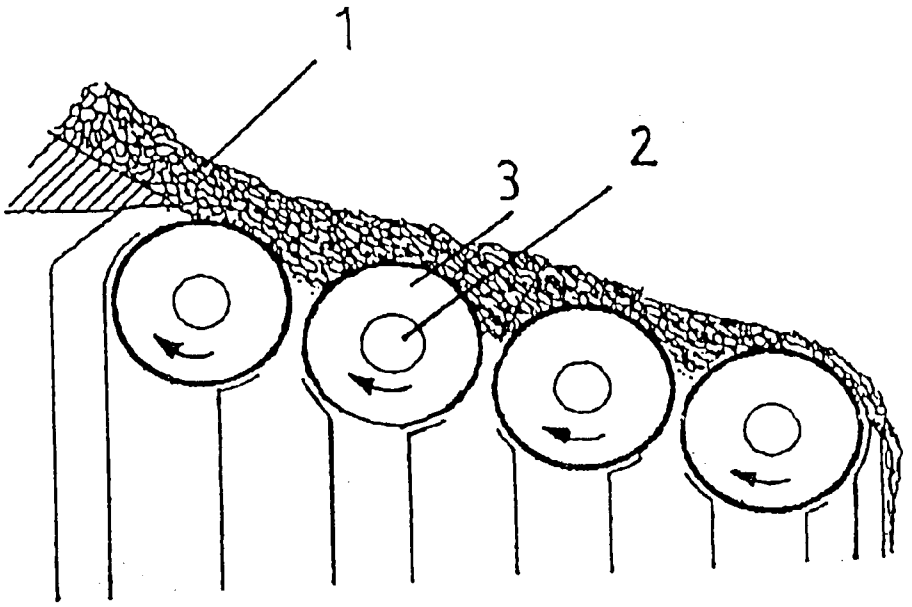


Fig. 2



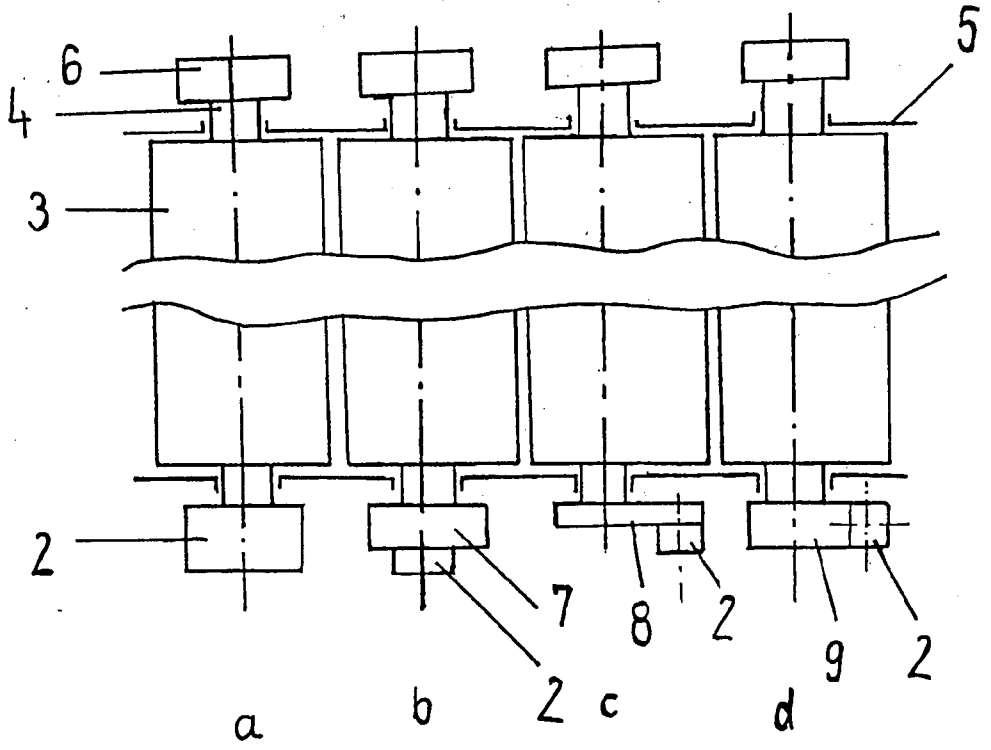
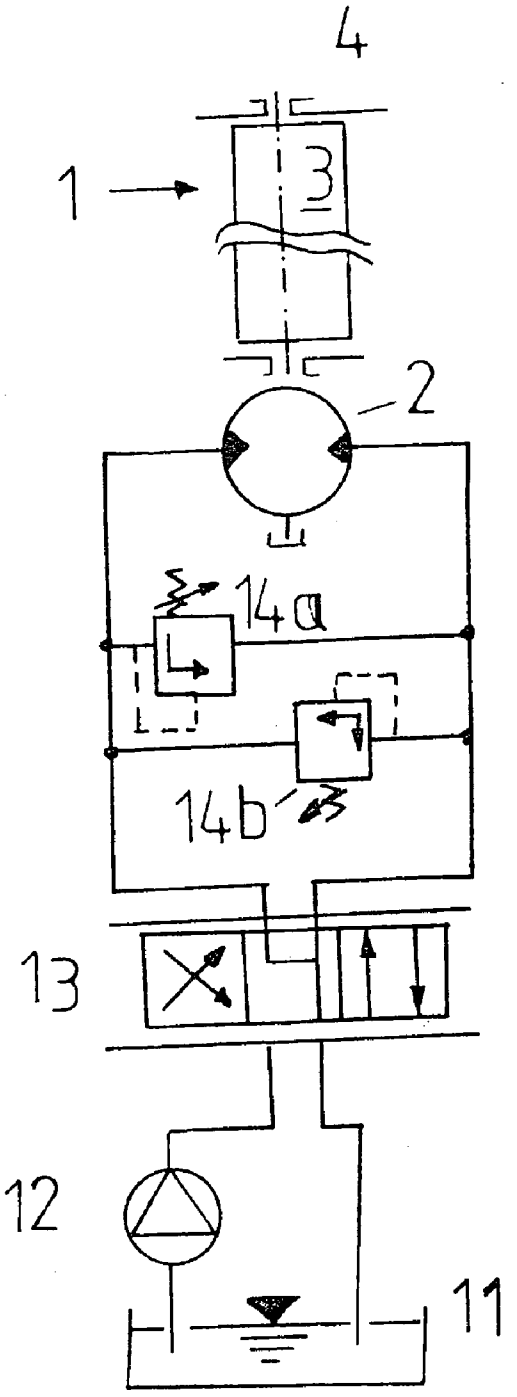


Fig.3

Fig. 4



ROLLER GRATE WITH HYDRAULIC DRIVE AND A METHOD FOR OPERATING THE ROLLER GRATE

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] Applicants claim priority under 35 U.S.C. 119 of German Application No. 10 2007 033 825.4 filed Jul. 18, 2007.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The invention relates to a roller grate with hydraulic drive and to a method for operating the roller grate. The invention is applicable wherever roller grates are being utilized, preferably in waste incinerators.

[0004] 2. The Prior Art

[0005] For grate firing in waste incinerators, either slide grates or roller grates are utilized. The known roller grates consist of several grate rollers, which generally may have a diameter of 1.5 m and a width of between 2 and 9 m. The dimensions comply with the size and the desired combustion performance. The grate rollers are provided with air slots through which primary combustion air is led into the burning waste bed. The burning waste bed lies on the grate rollers and is slowly conveyed over the firing grate by the rotating rollers, with the firing proceeding continuously.

[0006] German Patent No. DE 1 187 761 describes a roller grate for firing difficult-to-burn and highly inert combustibles, more specifically waste, in which the rollers constitute side-by-side hollow bodies that are cooled inside.

[0007] Another roller grate for incinerators is described in DE 33 16 363 C2, this document however does not mention how the rollers are driven.

[0008] Hydraulic drives are known in principle, but not for roller grates. German Patent No. DE 33 17 328 C1 describes a stepped grate for incinerators and an incinerator in which double acting hydraulic cylinders are disposed for driving the grate carriers. A linear movement is induced by these hydraulic cylinders.

[0009] German Patent No. DE 39 04 272 C3 describes a grate for incinerators in which the hopper for feeding the material to be burned is actuated hydraulically. Since hydraulic cylinders perform a linear movement with a high force and at low speed, they obviously do not seem suited for driving roller grates. Accordingly, according to the known state of the art, roller grates are usually driven by an electric motor. Usually, each grate roller has its own rotary drive so that it is capable of best adjusting the transport speed to the locally different combustion conditions. In the normal implementation, each drive unit consists of a three-phase electric motor with adjustable rpm by means of electric rotary frequency converters, a reduction gear and a slip clutch for limiting the torque. Drives are also known, which have continuously adjustable mechanical gear stages. The rotary drives are usually designed for continuous operation in an rpm range of between 12 revolutions per hour for fast evacuation and 0.6 revolutions per hour for minimum loads. The gear needed then comprises a transmission ratio of for example 7,500 revolutions to 1. The known electric rotary drives on roller grates suffer from the disadvantage that they are heavy and have a large construction volume due to the reduction gear. The slip clutches used are known to be delicate and difficult-to-adjust component parts that are subjected to very high thermal load in use and thus constitute a wearing part that needs to be exchanged often.

SUMMARY OF THE INVENTION

[0010] It is therefore an object of the invention to develop and operate a roller grate that functions reliably with little wear and with low-weight drive units.

[0011] The solution of the invention provides for a roller grate consisting of rollers disposed one behind the other for moving the material to be burned and of a drive for the rollers. The rotational movement is induced by one or several hydraulic motors, each driving one or several rollers.

[0012] An advantage is obtained if the hydraulic motor constitutes a hydraulic roller actuator. The actuator is operated such that the rollers rotate at an angular speed. A target value indicator is needed for this purpose. It is to be operated so as to prescribe the target value at the roller actuator on the basis of an addition of angular positions. As a result, the rollers are not rotated completely uniformly, but in minute angular steps separated by a waiting time. It is thereby advantageous if the angular steps range between 1 and 10 degrees, and preferably are of 5 degrees.

[0013] Another advantage is obtained if the hydraulic roller actuator has an angular position meter, a proportional valve and a controller for minimizing the difference from the prescribed position target value.

[0014] A further advantage may be obtained if a gear is interposed between hydraulic motor and roller. Hydraulic motors are designed for low rpm and high torques and are operated at hydraulic oil pressures ranging between 50 and 300 bar, preferably between 150 and 250 bar. However, it may be advantageous to reduce, by means of the gear, the rpm of the hydraulic motor to the required low roller rpm. Depending on technical/economical reasons, the reduction gear ratio may be approximately 500 to 1.

[0015] A further advantage is obtained if a pressure limitation valve is disposed in the hydraulic train for limiting the torque.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] Other objects and features of the present invention will become apparent from the following detailed description considered in connection with the accompanying drawings. It is to be understood, however, that the drawings are designed as an illustration only and not as a definition of the limits of the invention.

[0017] In the drawings, wherein similar reference characters denote similar elements throughout the several views:

[0018] FIG. **1** shows an incinerator with roller grates;

[0019] FIG. **2** shows a roller grate with a hydraulic drive on each roller;

[0020] FIG. **3** shows a top view of the roller grate with hydraulic drive on each roller; and

[0021] FIG. **4** shows a schematic drawing of the drive train of a roller grate according to an embodiment of the invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0022] Referring now in detail to the drawings, FIG. **1** shows the vessel of an incinerator, the firing grate of which consists of six rollers **3** disposed one behind the other and over which the material to be burned is moved, said rollers rotating

slowly. In accordance with the invention, rollers **3** are driven by a hydraulic motor **2**, one hydraulic motor **2** being disposed on every single roller **3**.

[0023] FIGS. **2** and **3** show four rollers **3** of a roller grate disposed one behind the other and over which the material to be burned **1** is led. Shaft journals **4** of the rollers **3** extend through wall **5** of the vessel and are carried on either side. They are carried on one side in a bearing **6** that is free to rotate and on the other side in a rotary drive with hydraulic motor **2**. In case a, roller **3** is driven directly by hydraulic motor **2**. In each of cases b, c and d, a reduction gear is provided. In case b, the gear is a coaxial gear **7**, which is usually implemented as a planetary gear. In case c, it is a spur gear **8** with axial offset. In case d, it is an angular gear **9** with a 90° axial offset.

[0024] Hydraulic motor **2** constitutes a hydraulic roller actuator that moves roller **2** at an angular speed of 5° and at a cycle time of 30 seconds, for example, so that one revolution occurs in 72 steps and one entire revolution of a roller **3** takes 36 minutes.

[0025] The hydraulic valves, which are for example configured to be proportional valves, are disposed together with the hydraulic pump in a hydraulic station that is placed at a distance from the vessel.

[0026] FIG. **4** schematically shows the drive train of a grate roller with the necessary component parts of the oil hydraulic circuit. Hydraulic oil is drawn from oil reservoir **11** by hydraulic pump **12** and is brought to the working pressure of about 250 bar. This pump **12** is dimensioned so as to supply several grate rollers of which only one has been illustrated herein.

[0027] Pump **12** delivers the hydraulic oil to flow control valve **13** which is shown as usual in the position of rest. If the flow control valve is set to the left, the hydraulic oil flows from the pump through the left pipeline to hydraulic motor **2** that moves grate roller **3** forward in normal operation. The oil pressure upstream of motor **2** depends on the torque by which the grate roller is operated. The hydraulic oil leaves motor **2** through the right line and flows at low pressure through the flow control valve back into reservoir **11**.

[0028] If flow control valve **13** is set to the right, the direction of rotation of the grate roller is switched to backward. The oil flow is then delivered by the pump into the right pipeline and flows back to the reservoir through the left line.

[0029] In case of a mechanical blockade of grate roller **3**, the torque increases so that the pressure in the line upstream of the motor **2** also increases directly. From a certain pressure that may be set through a set screw, the spring-loaded pressure limitation valve **14***a* opens in the forward flow and **14***b* in the backward flow and clears the way from the inlet line into the return line. The oil then flows past the motor. The oil pressure upstream of motor **2** or pressure limitation valve **14** is then equal to the adjusted maximum pressure and the motor torque equal to the admissible maximum value.

[0030] The solution of the invention offers the advantage that roller grates having low-weight drive units can be operated with high reliability and with little wear of the drive units.

[0031] Accordingly, while only a few embodiments of the present invention have been shown and described, it is obvious that many changes and modifications may be made thereunto without departing from the spirit and scope of the invention.

What is claimed is:

1. A roller grate, comprising:
a plurality of rollers disposed one behind the other for moving material to be burned; and
at least one hydraulic motor for driving at least one of the rollers.

2. The roller grate as set forth in claim **1**, wherein the hydraulic motor is a hydraulic roller actuator.

3. The roller grate as set forth in claim **2**, further comprising a target value indicator for prescribing a target value for the roller actuator.

4. The roller grate as set forth in claim **2**, wherein the hydraulic roller actuator is coupled with an angular position metering device and further comprising a proportional two-way valve and a controller for measuring a difference from a prescribed position target value and for zeroing said difference.

5. The roller grate as set forth in claim **1**, wherein a gear is interposed between the hydraulic motor and one of the rollers.

6. The roller grate as set forth in claim **1**, wherein a pressure limiting valve is disposed in a hydraulic train of the motor.

7. The roller grate as set forth in claim **6**, wherein the pressure limiting valve is an overflow valve.

8. A method of operating a roller grate having rollers disposed one behind the other for moving material to be burned and at least one hydraulic motor comprising a hydraulic roller actuator for driving at least one of the rollers, comprising the step of rotating the rollers in angular steps via the hydraulic roller actuator.

9. The method as set forth in claim **8**, further comprising the step of prescribing a target value for the hydraulic roller actuator with a target value indicator by adding angular positions of the rollers.

10. The method as set forth in the claim **8**, wherein the angular steps of the rollers range between 1 and 10 degrees.

11. The method as set forth in claim **10**, wherein the angular steps of the rollers are of 5 degrees.

12. The method as set forth in claim **8**, wherein the hydraulic actuator is operated at a pressure ranging between 50 and 300 bar.

13. The method as set forth in claim **12**, wherein the hydraulic actuator is operated at a pressure ranging between 150 and 250 bar.

14. The method as set forth in claim **8**, wherein the rpm of the hydraulic actuator is reduced to a reduction gear ratio of 500 to 1.

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