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(54) Method of operating a vibrating grate in a biomass-fired plant

(57) The method of operating a vibrating grate (2) in a biomass-fired plant comprises said grate being vibrated for a short period and left to rest for a substantially longer period of time. The incineration of combustible material (4) on top of the grate is controlled by the supply of primary air (8) through openings in the vibrating grate and secondary air (9) through nozzles in the walls of the

combustion chamber, the amount of combustible material supplied to the grate, and the repetition frequency of the intermittent vibration of the vibrating grate. By performing the vibration of the vibrating grate for sufficiently short periods and at corresponding high repetition frequency, the level and variation of carbon monoxide emission can be kept below certain limits.

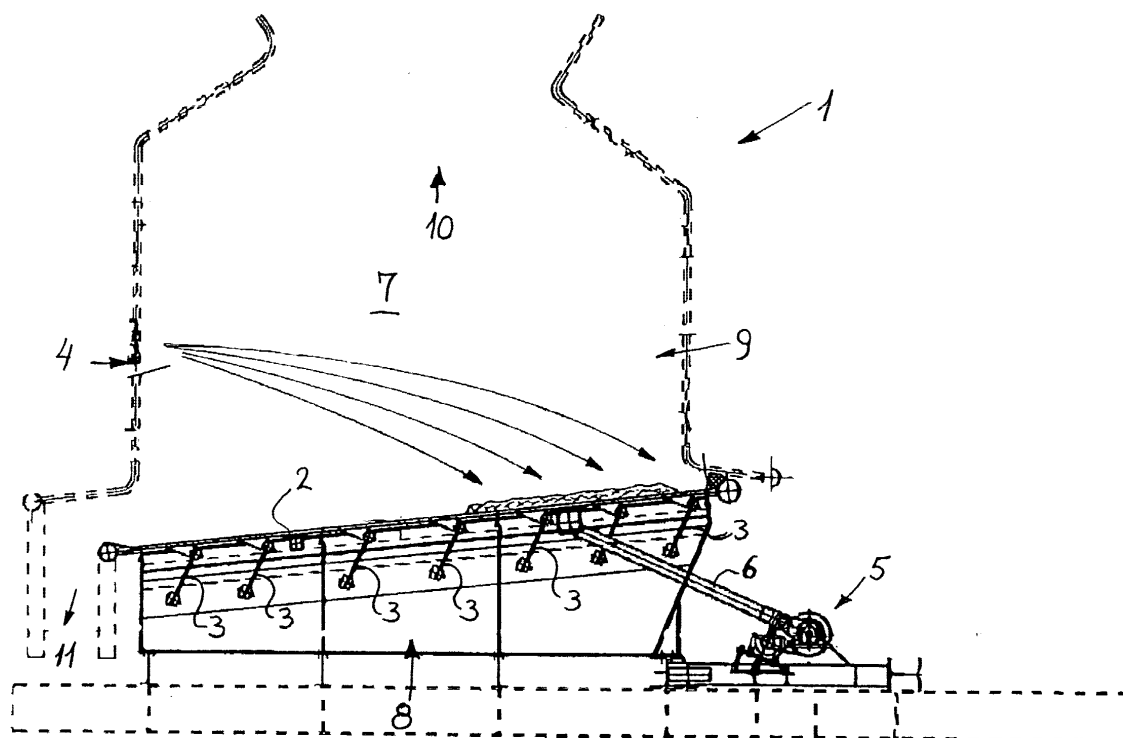


Fig. 1

Description

TECHNICAL FIELD

[0001] The present invention relates to a method of operating a vibrating grate for use in a combustion chamber for firing material such as biomass. The grate is mounted in the combustion chamber to perform a mainly reciprocating movement and is connected to a drive mechanism for vibrating the grate.

BACKGROUND ART

[0002] In combustion chambers of this kind, it is known to perform the vibration intermittently. It is possible to use the repetition frequency of the intermittent vibration as one parameter for controlling the combustion. The typical cycle of such intermittent vibration has been approximately 5-20 seconds of vibrating at approximately 5-30 minutes intervals. The vibrating frequency has typically been in the range of 5-15 hertz, depending on the fuel and the thermal load of the grate. When the vibrating grate is mounted on springs for supporting the grate, the vibrating frequency is typically chosen in consideration of the transport capability of the grate. The natural frequency of the mechanical system consisting of vibrating grate, combustible material on the grate and the springs supporting the grate is dimensioned to be close to the vibrating frequency needed to provide this transport capability. If desired, external springs may be provided to enable an adjustment of the natural frequency.

[0003] It has been recognized that the intermittent vibration scheme gives rise to an unacceptable increase of the CO-content in the flue gases during and immediately following the vibrating operations, especially when firing with biomass fuel.

[0004] From EP-754,907, it is known to reduce the negative effects of the intermittent vibrating by controlling the air supply to the combustion process in connection with the vibrating. This document prescribes reducing the primary air supply during and immediately following the vibrating operation, in order to reduce the increase of CO-content in the flue gases during and immediately following the vibrating operation. With this scheme, vibration will induce substantial fluctuations in energy production and the optimization of the combustion will be influenced by the reduction of the primary air supply during and immediately following the vibrating.

DISCLOSURE OF THE INVENTION

[0005] It is the object of the present invention to provide a method of controlling such a system, where the combustion is substantially unchanged and no major changes of the air supply are necessary in order to keep the emission of CO below the desired limits, and this object is achieved with a method of said kind, which in

accordance with the present invention also comprises the features set forth in the characterizing clause of claim 1. With this arrangement, it is possible to provide a controlled vibrating of the grate at controlled repetition frequency, and the repetition frequency can be chosen sufficiently high to keep CO emission substantially constant and below certain limits during the whole combustion process, including the vibrating operation without substantially changing the supply of fuel, primary air and secondary air.

[0006] Preferred embodiments of the method are revealed in the subordinate claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] In the following detailed part of the present description, the invention will be explained in more detail with reference to exemplary embodiments of a combustion plant with a vibrating grate which is suited for operation in accordance with the invention, as shown in the drawings, in which

Figure 1 schematically shows a combustion plant with a vibrating grate suited for operation in accordance with the invention,

Figure 2 schematically shows details of a drive mechanism suitable for performing the method in accordance with the invention,

Figures 3 and 4 schematically show variants of a drive mechanism,

Figures 5 and 6 schematically show different possible vibration schemes for the vibrating grate.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0008] The combustion plant shown in Figure 1 is suited to operate in accordance with the present invention. The combustion plant 1 comprises a vibrating grate 2 supported on leaf springs 3 allowing the vibrating grate 2 to perform a reciprocating vibrating movement. A drive mechanism 5 is connected to the vibrating grate 2 through a drive rod 6, said drive mechanism 5 providing the reciprocating movement of the grate 2. Combustible material is supplied to the grate 2 through an air spout 4 and the combustible material is transported down the vibrating grate 2 by the vibration of the grate. Primary air 8 for the combustion of the combustible material on the grate 2 is supplied through openings in the grate 2. The grate 2 is positioned in a combustion chamber 7 and secondary air 9 is supplied into the combustion chamber 7 via nozzles provided in said chamber. The hot gases supply energy to a boiler for absorption of the energy from the hot gases. The combustible material on the vibrating grate 2 is transported down the vibrating grate 2 by the vibration, which also conveys the ashes from the combustion to the slag chute 11. Furthermore, the vibration provides a distribution and mixing of the

fuel positioned on the vibrating grate.

[0009] The normal vibration scheme used for such a vibrating grate comprises vibrating the grate 2 intermittently. A typical vibration period is approximately 5-20 seconds at a frequency of 5-15 hertz, i.e. between 25 and 300 full cycles of vibrating, followed by a standstill period of 5-30 minutes. This vibrating scheme provides a substantial change in the combustion of the fuel on the vibrating grate during vibration, as the combustible material is mixed and volatile combustibles are released from the fuel on the grate, thereby significantly increasing the combustion rate and the consumption of oxygen inside the combustion chamber 7 during and immediately following the vibration.

[0010] However, in accordance with the present invention, the vibration is performed in sufficiently short periods, e.g. only providing five or less full cycles of reciprocating movement of the grate. In order to provide a sufficient transport of the fuel on the grate, the standstill periods between the vibrating procedures will naturally have to be reduced correspondingly to approximately 10-120 seconds.

[0011] By increasing the repetition frequency of the intermittent vibrating and reducing the vibrating time, the variations in combustion rate due to the vibrating will be reduced and furthermore, the time constant of the whole combustion chamber and combustion process will equalize such changes. Totally, a more stable operation is obtained, whereby further improvements of the combustion process are possible.

[0012] The drive mechanism schematically shown in Figure 2 is constructed to be able to perform the vibration in accordance with the present invention with only one full cycle of reciprocating movement of the grate for each vibrating period. The drive mechanism comprises a drive axle 14 with a one-way engagement construction engaging a rotatably mounted ring 15, said ring 15 being connected as a crank mechanism with the drive rod 6 connected to the vibrating grate 2, the connection being provided by means of a connection rod 12. In the construction shown in Figure 1, a supplementary spring mechanism is provided between the drive axle 14 and the ring 15, said spring 13 providing a supplementary force which may be adjustable, said spring force supplementing the spring force of the leaf springs 3 shown in Figure 1, or similar springs. The mechanism 5 shown in Figure 2 functions in the following way: The drive axle 14 rotates and engages the ring 15, whereby the ring is rotated and the connection rod 12 and drive rod 6 pull the vibrating grate 2 in a first direction, whereby the leaf springs 3 are tensioned. When the crank mechanism 12,15 passes the dead point of the crank mechanism, the engagement between the drive axle 14 and the ring 15 is released and the springs 3 and the possible spring 13 will drive the ring 15 to the opposite dead point position. The drive axle 14 rotates slowly onwards and during the next half revolution, the spring 13 is tensioned and after this half turn, the drive axle 14 again engages

the ring construction 15. The movement of the vibrating grate 2 will be as shown in Figure 5, when using this drive mechanism, where Figure 5 shows the movement of the grate 2 as a function of time.

[0013] Other possibilities of driving the vibrating grate in accordance with the present method are shown in Figures 3 and 4. Figure 3 shows a piston-cylinder drive unit 16 connected to the vibrating grate 2 via a drive rod 6'. A spring mechanism is integrated in the piston-cylinder unit to move the piston in one direction. This piston-cylinder-drive unit 16 may provide a movement scheme as shown in Figure 5 or alternatively a scheme comprising more than one single stroke for each vibrating period, e.g. as shown in Figure 6. The driving is performed by pumping fluid into the piston-cylinder unit, whereby the piston and the grate 2 are moved against the spring force of the spring mechanism 3'. After a certain movement of the grate, the fluid pressure in the piston cylinder unit is released, whereby the grate is moved backwards by the forces of the spring mechanism 3'.

[0014] Figure 4 shows yet another drive mechanism, where a cam surface 17 influences a cam follower connected to the drive rod 6" for moving the vibrating grate 2 against the forces of a spring mechanism 3".

Claims

1. Method of operating a vibrating grate in a biomass-fired plant, said grate being vibrated for a short period and left to rest for a substantially longer period of time, the incineration of combustible material on top of the grate being controlled by the supply of primary air through openings in the vibrating grate and secondary air through nozzles in the walls of the combustion chamber, the amount of combustible material supplied to the grate, and the repetition frequency of the intermittent vibration of the vibrating grate, **characterized by** the vibration of the vibrating grate being performed in sufficiently short periods and at corresponding high repetition frequency to keep the level and variation of carbon monoxide emission below certain limits.
2. Method in accordance with claim 1, **characterized** by the vibration being performed with a vibrating period which provides no more than five full cycles of reciprocating movements of the grate.
3. Method in accordance with claim 1, **characterized** by the vibration being performed with a vibrating period which provides no more than two full cycles of reciprocating movements of the grate.
4. Method in accordance with claim 1, **characterized** by the vibration being performed with a vibrating period which provides no more than one full cycle of

reciprocating movement of the grate.

5. Method in accordance with claim 4, **characterized** by the reciprocating movement of the vibrating grate comprising a relatively slow movement of the grate in a first direction, 5

a relatively faster movement of the grate in an opposite second direction, and

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possibly an interval of rest before resuming the relatively slow movement in the first direction.

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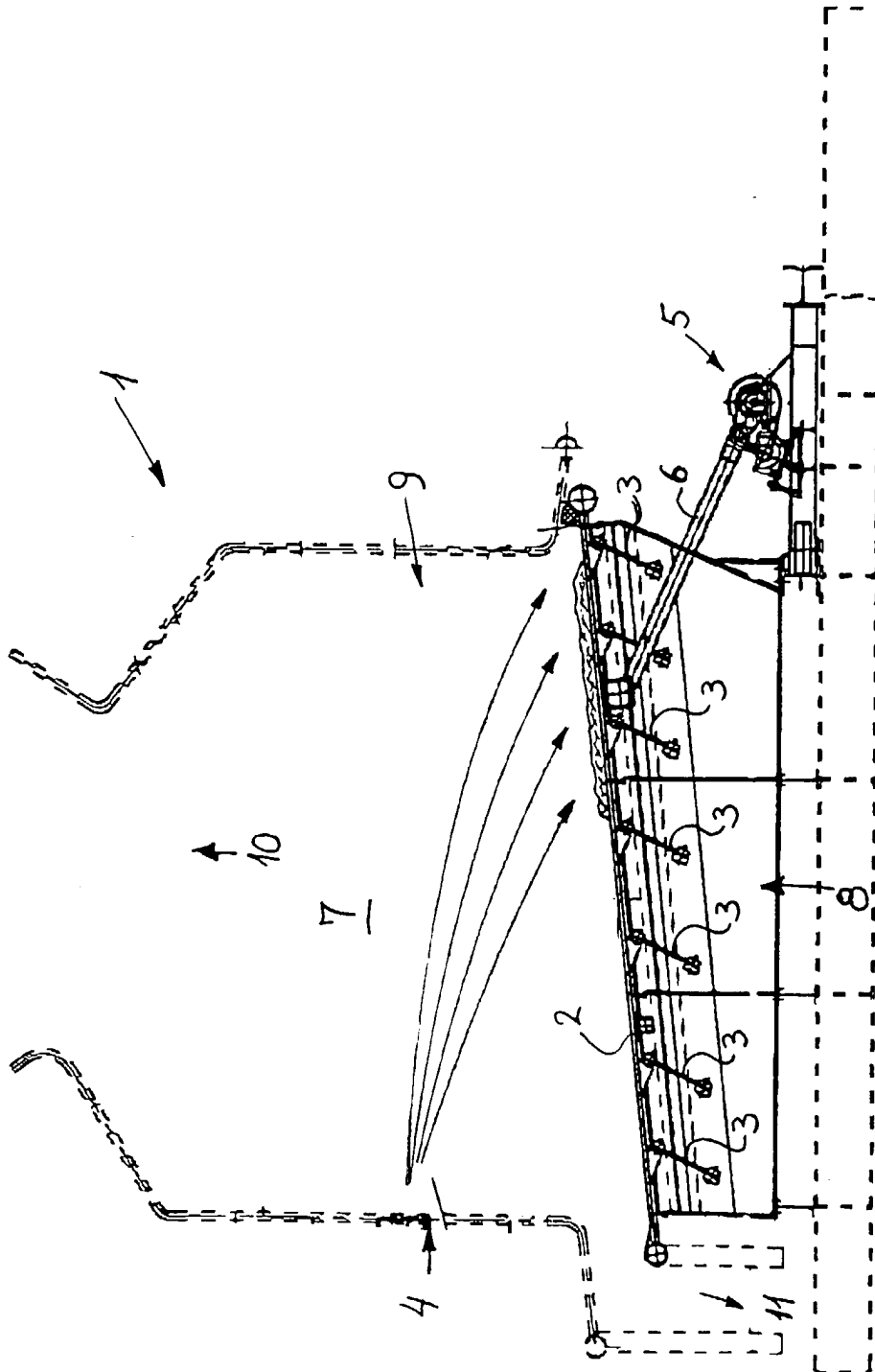
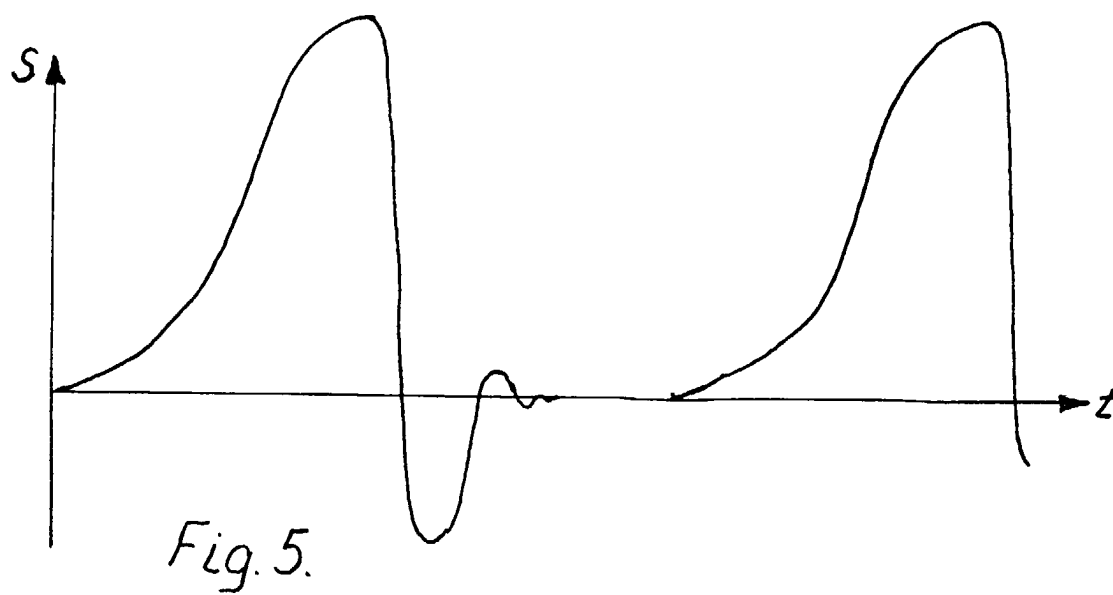
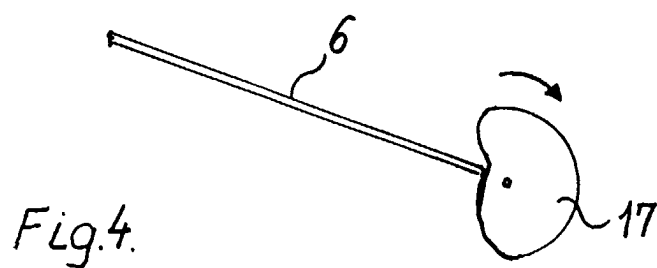
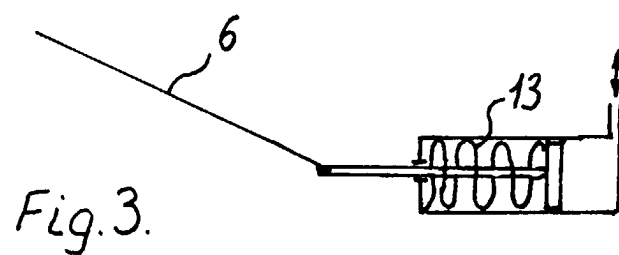
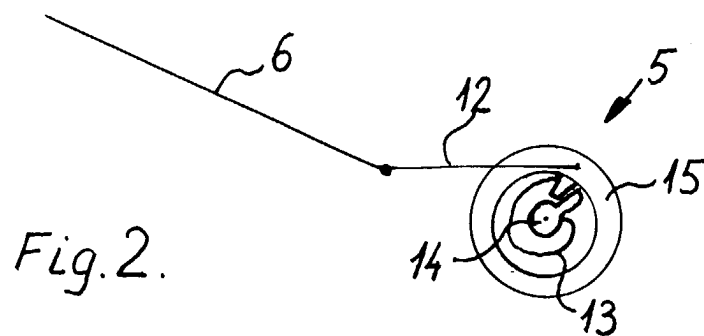
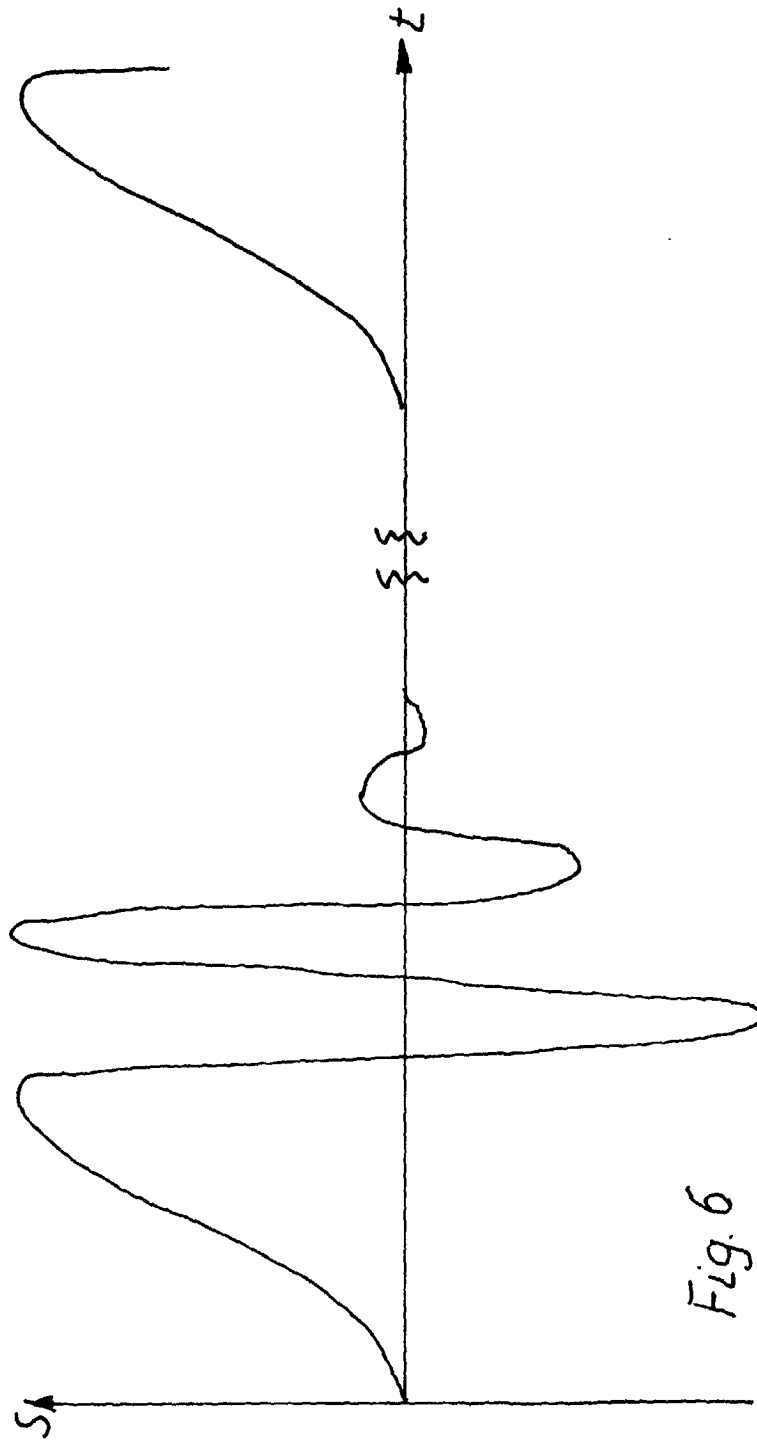


Fig. 1







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EUROPEAN SEARCH REPORT

Application Number
EP 99 12 4587

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
Y,D	EP 0 754 907 A (BURMEISTER & WAINS ENERGI) 22 January 1997 (1997-01-22) * column 1, line 3 - line 45 * * column 6, line 47 - line 57; figure 1 * ---	1-4	F23G5/00 F23G7/10
Y	DE 39 07 463 C (STEINMÜLLER) 29 March 1990 (1990-03-29) * column 1, line 3 - line 58 * * column 1, line 65 - column 2, line 56 * * figure 4 * ---	1-4	
A	GB 686 590 A (S.F.C.M.) * page 1, line 81 - page 2, line 42; figure 2 * -----	5	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			F23G F23H
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 19 April 2000	Examiner Col1, E
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 99 12 4587

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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19-04-2000

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