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(54) Waste incinerator flue gas recirculation

Müllverbrennungsanlage mit Abgasrückführung

Recirculation des gaz de combustion d'un incinérateur d'ordures

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(73) Proprietor: **Gemeente Amsterdam, Gemeentelijke Dienst Afvalverwerking**
1045 BA Amsterdam (NL)

(72) Inventor: **Van Berlo, Marcellus Antonius Jozef**
1058 EN Amsterdam (NL)

(74) Representative: **Kupecz, Arpad**
Octrooibureau Los en Stigter B.V.
Postbox 20052
1000 HB Amsterdam (NL)

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- **PATENT ABSTRACTS OF JAPAN vol. 010, no. 342 (M-536), 19 November 1986 (1986-11-19) & JP 61 143615 A (HITACHI ZOSEN CORP), 1 July 1986 (1986-07-01)**

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Description

[0001] The invention in question relates to a method for burning waste in a waste incinerator according to the preamble of claim 1, as well as a high efficiency waste incinerator.

[0002] Waste incinerators, and the way in which they work, are known in practice. In general the waste material to be incinerated is placed on a support with holes in it, generally known as the incinerator grid, wherein combustion air as primary gas is brought from below up through the incinerator grid and the waste material. This combustion air supplies the necessary oxygen required for the incineration. This air is often pre-heated in order to make the waste burn better, since the hot combustion air has a heating effect on the material to be incinerated, and also partly helps to dry the waste material so that it is easier to ignite. However, because of the inhomogeneous content of the waste material in fact a surplus of oxygen or a shortage of oxygen may arise locally in the waste bed, depending on the position of the waste bed and the amount of incineration that takes place. The gases resulting from the incineration (identified as waste gases or flue gases) therefore also have an uneven composition.

[0003] In order to further burn these waste gases, which can contain carbon monoxide and particles of other incombustible waste in places, and to mix these with the parts of the gas that still contain oxygen, use is made of a so-called secondary injection. This injection of secondary gas takes place at a particular height above the waste bed, wherein the waste gases mix together sufficiently to form a homogenised whole. The secondary gas consists generally of air, which contains oxygen that can be used by the incineration reaction. This means that there is always a surplus of oxygen available from the point of feeding in the secondary gas.

[0004] In the case of large-scale incinerators it is not always possible to achieve a sufficient mix of the inhomogeneous waste gases by means of the addition of the secondary gas. In this case the addition of a third gas takes place at a height above the input of the secondary gas. For the addition of the third gas there is a preference for using waste gas (i.e. flue gas) from the waste incinerator (recirculation of waste gas). This avoids the fact that the third gas should be pre-heated, as might be the case if cold air from outside were to be used.

[0005] While the technique described here is generally adopted, there are a number of drawbacks. The efficiency of the usual waste incinerators is relatively low, and furthermore the waste gases created contain a large proportion of unwanted substances such as a large quantity of nitrous oxides, and carbon monoxide. In the publication DE-A-3915992 a number of improvements are proposed, especially for the reduction of amounts of nitrous oxides.

[0006] The invention aims at providing an improved technique as mentioned in the opening words, wherein these drawbacks can be lessened. In particular the invention aims at providing a technique wherein the efficiency of the installation can be improved and wherein the emission of dangerous substances can be lessened.

[0007] For this the invention provides a method as described in the preamble, which is characterised by the features of the characterizing part of claim 1. By using these measures a technique is provided which results in an improved efficiency and wherein the amount of dangerous substances is minimised.

[0008] A method according to the invention can especially be advantageously carried out using the measures as described in the claims stated later in this document.

[0009] According to the invention a primary gas is used in the first zone that has a low oxygen content. Because of the low oxygen content, an increase in temperature does not automatically result in the waste material actually combusting. Therefore, even a temperature higher than 300°C, for example 450°C or higher, can also be applied. Because the primary gas serves in the first instance to heat and dry the compact parts of the waste material, in principle this does not result in any problems. In the second instance the easily combustible parts of the waste material combust as a result of the primary part gas supply, which therefore takes place with a deficiency of oxygen. This means that the incineration on the waste bed only partly takes place. Consequently, a relatively large amount of carbon monoxide, CH_4, and other products arising from the reaction in the incineration can be released. Other parts of the first primary part gas supply will not result in any combustion and will therefore leave the waste bed with a low oxygen percentage. These parts of gas that are released in the first zone are mixed together with the secondary gas. The parts of the primary gas which contain a surplus of oxygen, as a result of the combustion not being good enough in parts of the waste bed, thereby ensure at least a part of the carbon monoxide being burnt, as described previously. Because of the limited combustion of the waste material in the first zone, the temperatures in the waste bed remain relatively low and the waste material will only be pyrolyzed to a limited extent. In a following zone where a greater amount of oxygen is added, this results in good combustion and a higher temperature in the waste bed than if combustion takes place in the first zone. Because of the waste material being inhomogeneous, and the inhomogeneous spread of the waste material on the incinerator grid, there will always be some parts of the waste material that receive too little oxygen.

[0010] As mentioned before, the primary gas in the first zone serves in the first place to dry the waste material that has been placed in the incinerator. To do this, the primary gas that is supplied to the first zone is fed in at a temperature from 50°C to 300°C, preferably from 150°C to 300°C. The pre-heating of the primary gas for a waste incinerator requires a great deal of energy, and is especially necessary if the waste material is difficult to burn. The pre-heating of the primary gases is therefore dependent on the so-called thermal value of the waste material. The preference is for the primary gas to be at a temperature of approximately 100°C in the case of a thermal value of 11,000 kilojoules per kilogram, while the temperature of the primary gases should be approximately 180°C in the case of waste material with a thermal value of around 7,000 kilojoules. These values are based on the use of air as the primary gas, both as pre-heating and as ignition gas.

[0011] As mentioned before, the waste material that is placed in a waste incinerator for incineration varies enormously both in its content and its humidity. As for the dampness that can exist in the waste material, it is important how this dampness is spread through the waste material. If one part of the waste material is relatively dry and therefore easily combustible, this part will ensure that the damper waste material surrounding it will dry rapidly and thereby combust. In practice the dry and damp parts of the waste material are not homogeneously divided, so the combustion takes place in a very irregular way. With the combinations of easily combustible waste, and waste that is difficult to burn, and waste material with a high thermal value and that with a low thermal value, one can see that there are, therefore, various different situations, which all pose specific demands on the temperature of the primary gas.

[0012] Waste material that is easily combustible and has a high thermal value demands a very low pre-heating of the primary gas. If air pre-heating is used, this results in a very fierce fire above the waste bed, wherein the firing in the waste bed is very strongly sub-stoichiometric, which results in very high temperatures locally in the incineration chamber. In this case air pre-heating is unnecessary.

[0013] Waste material that is easily combustible but that has a low thermal value also does not require air pre-heating. In addition, there is less chance of a strong sub-stoichiometric combustion.

[0014] Waste material that is not easily combustible and that has a high thermal value requires primary air at a high temperature in order to achieve enough combustion of the waste material on the one hand, and on the other hand because of this the actual burning of the waste material will easily result in a simple sub-stoichiometric combustion. A careful regulation of the temperature of the primary gases is therefore necessary to control the combustion.

[0015] Finally, it is essential to have pre-heated air for waste material that is not easily combustible and has a low thermal value.

[0016] In general current techniques can only provide a single temperature for the primary gases. This means that in general the primary gases are pre-heated, which in many cases will be done in sub-stoichiometric conditions.

[0017] From another viewpoint the invention provides an improved technique as stated previously, wherein the temperature is controlled for each partial primary gas supply. This enables a regulation wherein the temperature of the primary gas is increased only in the zones where it is necessary, because of the composition of the waste material. For this the primary gas that is supplied to the first zone is at a temperature of from 50°C to 450°C, preferably in the range 50°C to 300°C, with the strongest preference for the range 150°C to 300°C. By choosing for a relatively high temperature in the first zone the heating of the following zones can be a lot lower. The aim is to choose a temperature in the first zone that is so high that in many cases pre-heating can be reduced to zero in the other zones. Besides, by choosing a relatively low airflow for the first zone (from 5% to 15% of the total primary airflow), relatively little energy is used for the pre-heating.

[0018] The following paragraphs describe the invention in more detail, based on the illustrations.

[0019] The figure shows a schematic outline of a waste incinerator according to the preferred design of the invention. The incinerator shown has four different part gas supplies for primary gas (1, 2, 3, 4). These are introduced under the incinerator grid (5), on top of which is the waste bed (6). In the design shown the supply pipes for the first, second and third part supplies of the primary gas are equipped with an air pre-heater (7, 8).

[0020] Waste material is placed on the incinerator grid (5) above the first primary gas supply (1), wherein it is pervaded from below by waste gas that originates from the waste incinerator. This waste gas has a low oxygen content. The primary gas from the first part gas supply (1) will flow through the waste bed (6) by means of the available gas channels. The waste material that comes into direct contact with such a channel is dried more than the rest of the waste material. If the partly dried waste material is moved on to a position where the second part of the primary gas (2) is supplied, because this secondary part of the supply contains oxygen, the flame front is practically immediately progressing downwards through these channels. For this reason it is useful to somewhat mix the waste material and to disturb the existing channels, by placing the grids (5) for the second and successive zones somewhat lower, and preferably at a height that is somewhat less than the average bed height. The result of this mixing is that the parts of the surface already burning in the first zone (1) arrive on the waste bed (6) and ignite or further dry the other waste material, wherein the waste material in the second zone (2) burns more homogeneously. In addition the possibility of being able to regulate the process is increased because in this case the grid in the first zone can be used to fine-tune the regulation of the supply for the remaining part of the process. The flame front above the waste material will reach to the first height. Near this height is a supply of secondary gas (9). It is preferable that a number of supplies (9) are placed around the circumference of the installation. The flue gases that are formed in the flame front above the waste bed are not made up of homogeneous parts. Because of the inhomogeneous composition of the waste material, some parts of it are well incinerated and therefore in those places the oxygen in the primary gas will have reacted. In other parts, where the incineration has not taken place to any large extent, part of the oxygen supplied by the primary gas supply will not have reacted and thereby will remain in the flue gas. By adding a secondary gas a good mix of these flue gasses can be achieved. By using gases that are low in oxygen content, such as the waste gases from the waste incinerator, as secondary gases, a lot of mixing is created at the first height, the top of the flames where the hottest place in the flue is, but only a limited surplus of oxygen is created so that the forming of NO_x is minimised. Via the supply of the third gas (10) at a position downstream the supply of the secondary gas (9), an oxygen bearing gas is supplied with an adequate O_2 content (preferably a surplus) in order to burn off the remaining CO and any other possible combustible waste products in the flue gases. Because this occurs downstream, the flue gases are homogenous and already somewhat cooler and so the formation of nitrous oxides is less. Especially the fact that the flue gases are now already mixed, local peak temperatures that cause the most formation of nitrous oxides do not arise.

[0021] The subdivision of the supply of primary gas into several zones, as shown in the four zones in the illustration (1, 2, 3, 4), which successively pass through the waste material to be incinerated (6) achieves an optimum combustion. This can especially be achieved because the temperature can be independently regulated for each zone. Because in practice it is difficult to judge the thermal value of the waste material and its ignition behaviour in advance well enough to depend on it, the regulation of the temperature setting of the primary gas takes place by tracking the flame front for each zone. This can be done by hand or via an automatic measurement of the flame front with the help of video cameras for visible light and/or infrared light.

[0022] The primary gases that are supplied to the first zone (1) can be of a high temperature without any problem, because the oxygen content of these is very low. The oxygen content can be 0% by volume or more. The incineration above the first zone is therefore limited. The maximum temperature of the flames in the first zone is thereby reduced in proportion to the available oxygen percentage, wherein no damage to the waste grid can arise. In particular damage by drops of melted metal that weld themselves to the surface of the grid is avoided. With current techniques wherein a water-cooled grid is usually used, it is not possible to obtain this advantage to such a high degree.

[0023] Because the available energy that is released in the first zone is limited, because only a limited oxygen-based combustion takes place, the reaction of waste gas in the first zone is also limited. The waste material can therefore be fully pre-dried without all the material being incinerated in the first zone. This results in a good combustion situation in the second zone, where it is possible that no more air pre-heating is necessary, but where the incineration can still be well regulated. A homogeneous incineration can especially be achieved in the second zone when the incinerator grid (5) is placed at a lower point, as described earlier.

[0024] As mentioned previously, it is preferable that the waste gas recirculation is supplied as the primary gas in the first zone. In this way the waste gas from the incinerator flue after passing through a dust filter (11) are recirculated to the first zone. The oxygen percentage and the temperature are in this case reasonably firmly fixed (depending on the process design) and cannot be used for the actual control of the combustion process. The amount (the flow) of primary gas in the first zone is very easy to vary across a wide range.

[0025] Other possibilities for application as the first primary part of the gas supply are the use of waste gases from gas burners, gas-driven boilers, gas motors or gas turbines, for example. Especially important is the use of gas motors on the basis of available waste gas such as the biological gas that results from fermentation produced by purifying sewage water, for example. Because in this case the heat from the waste gases from the motor are also used efficiently, the efficiency increases significantly compared to the conventional separate set-up of the bio-gas motor wherein only the generated electricity and heat from the cooling water is used.

[0026] The waste gases arising from this can be mixed with air from the outside in order to achieve the required temperature combined with the required oxygen percentage, wherein a certain percentage of oxygen is still added to these gases. The amount of air that is added to the waste gases from the outside depends on the temperature that is necessary for the primary gas in the first zone. In general this will be from 100°C to 270°C. In the case of waste gases from a gas boiler, part of the heat of the waste gas will be recovered, wherein this gas will have a lowered temperature when it is supplied to the first zone. The oxygen percentage in this case will be from 0 % to 15 %. In addition the recovery of the heat from the burning of the gas in the gas boiler will result in a higher efficiency for the entire installation. Waste gas from a gas turbine can also be used in a suitable way. Especially in the case of waste gases from a gas turbine or gas motor, these can have a temperature higher than 270°C, for example 450°C or higher. If the waste contains some humidity and the flow in the first primary zone is not too high, even with these temperatures the pyrolisis may be limited so that sufficient caloric value remains in the waste, so as to get a good combustion in the successive (second) zone. Mixing with cool air or cooler recirculation waste gas is possible as well. The invention is therefore also adaptable for similar cases wherein the temperature of the primary gas supply is higher than 300°C.

[0027] The waste gases from the waste incinerator, as shown in the figure, which are extracted after they have passed through the dust filter (11), are at a temperature of from 100°C to 270°C. A problem that can occur using similar waste gas recirculation is corrosion at 'cold spots' and the leaking of the recirculation gases to the outside in places where high pressure is present. Because of the temperature of the recirculation gases, similar corrosion is possible as the result of condensation of the recirculating gas in the pipes supplying gas to the incineration zone, for example underneath the incinerator grid (5). According to the preferred implementation it is best to enclose the supply of the first part of the primary gas (1) in a housing (12) which will be fed with gases, as shown in Figure 2. This makes good insulation possible. In addition, any leakage of the recirculating gases in this housing (12) will not lead to direct problems in the surrounding area because the leaked gases will be taken up and diluted in the housing (12). These gases can then be passed on to the incineration zone. As shown in Figure 2, the second part of the supply of the primary gas is used to maintain the surroundings of the supply of the first part of the gas supply (1) at the required, higher, temperature so that no condensation can take place. The supply (1), and especially the funnel under the grid (5) for the first zone, as shown in Figure 2, are situated in this case in a casing (12) which is kept at a temperature that is regulated by the second part of the gas supply, and which can also be kept at a higher pressure according to a further recommended implementation. Because this supply of the first part of the gas is insulated and surrounded by the air pre-heated by an air pre-heater, cold bridges can be prevented by this construction. If this air-preheater is the heater of the second part of the primary gas supply (7) this heater should work continuously at a sufficiently high temperature. If necessary, a bypass can be provided in this case wherein the primary gas that is supplied to the second zone does not pass through the air pre-heater (7). It is also possible, using a control valve, to provide a connection between the pre-heated air coming from the housing and the funnel for the first part of the gas supply in order to add oxygen-rich air to the first part of the supply.

[0028] The waste gas that is used for recirculation should preferably be withdrawn from the waste incinerator via a baghouse filter or electrostatic filter (11), so that the amount of dust in the recirculating gas is low and no problems arise with deposits occurring in the pipes. The temperature of the recirculation gas is from 170°C to 270°C, preferably in the area of 190°C and 230°C. This temperature must be high enough to prevent problems with the condensation of the waste gases, but also low enough for it to be treated by common baghouse filter materials, for example a special catalytic layer on the baghouse filter material. By means of an injection of a common and well-known ammonia in the first draught of the waste gas exhaust (SNCR) a catalytic conversion of NO_x with NH_3 is possible at this temperature, in combination with a breakdown of dioxin/furan.

[0029] The primary air for the first zone is regulated in order to control the fire in the second and third zones. The range of the gas supply via the first zone must be approximately 2.5% to 25% of the total amount of primary gas. For normal household waste with a thermal value of approximately 10,000 kilojoules per kilogram, 10% of the total is enough to dry the waste material well, through the high temperature of the recirculation gases used. In the case of good incineration (a short fierce fire in the second zone and a low percentage of remaining material) the drying process is more than good and the amount of the gas supply can be reduced to 5%. In the case where the waste does not combust enough the amount can be increased to 20%.

[0030] The incinerator grid (5) in the first zone, on which the waste material to be burnt (6) is initially placed does not have to be equipped with water cooling. When water cooling is used condensation of water from the recirculated gas can especially occur on the cooled parts. As mentioned previously, the recirculation gases have a very low oxygen content but a relatively high temperature, so that virtually no combustion takes place in the waste material above the first zone. In addition, because of the low oxygen content (at least lower than 20% by volume) flame temperatures can exist of up to a maximum of 500°C if the oxygen content is lower than 10% by volume. Because of the low oxygen content and the low temperature, the flame front can however hardly creep downwards. This means that damage to the incinerator grid (5) in the first zone by overheating of the grid cannot occur.

[0031] The waste material from the first zone that reaches the second zone is, however, very well dried and easily combustible. When this waste material reaches the second zone, a primary air supply is added with a normal oxygen content. This causes the flame front to move downwards virtually instantaneously. For this reason it is preferable that the incinerator grid in the second zone (5) is water-cooled. Because of the oxygen content as well as the good mix of the oxygen and the waste material to be burned, a very fierce fire will occur in the incinerator bed that burns right up to the grid (5). Because of the partial pyrolysis as a result of the high temperature of the primary gas, in the first zone the very easily combustible parts of the waste material (especially synthetic materials) already lose part of their thermal values and the peak temperatures in the second and third zones are lower than in the case where the waste material in the first zone is completely incinerated, as is the usual case when oxygen-rich air is used. The heat that the grid (5) absorbs and gives off to the cooling water is re-used in a suitable way.

[0032] If the combustion in the second and third zones goes very well, the primary gas for the second and third zones can be used without any further air pre-heating (7, 8), thereby lowering grid and flame temperature as well as reducing NO_x formation. For normal household waste (9,000 to 11,000 kilojoules per kilogram) this will generally be the case when the waste material (6) is pre-dried in the first zone with the aid of recirculation gas. The gas that is supplied to the second and third zones can therefore be fresh air that can be supplied directly from the outside. As well as the energy saving that is achieved by this, it has the advantage that when the air is cold, the air speed will be lower for an equal supply of oxygen, wherein less flue dust will be created.

[0033] As described previously, the amount of oxygen that is supplied via the second and third zones to the waste material that is to be burnt (6) must be approximately stoichiometric or somewhat less (from 0.8 to 1.0 times the amount of oxygen necessary for the combustion). Depending on the type of waste material, for each zone approximately 15% to 40% of the total amount of the primary and third gas supply must be supplied to the second and third zones. The preference is that the amount of air that is supplied to the second and third zones is approximately from 25% to 30% of the total amount of gas that is used as the primary and third air supply. The result of this is that the highest heat develops in the waste bed itself. The coal residue, that is to say the percentage of unburned carbon, is therefore improved, and, because of the high temperatures, a maximum of heavy metals is driven out of the resulting slag. The quality of the resulting slag is therefore improved on account of the good drying in the first zone. As mentioned previously, the gas that is used for the second and third zones should preferably not be pre-heated, and in the case of a good enough supply of waste material that can therefore be pre-dried in order to achieve a rapid combustion in the second zone, an air pre-heater (7, 8) can be omitted if required. Contrary to the patent DE3915992A1 mentioned previously, it is not advisable to use a tailored oxygen content in the main combustion zone as well, because the combustion there occurs in a sub-stoichiometric way in any case.

[0034] The last zone, for example a fourth zone or even possibly a fifth zone or even a further zone if several similar zones are used, is a final incineration and cooling zone that only receives from 5% to 15% of the total amount of gas. Recirculated gas can possibly be used here. This has the advantage that the CO_2 and H_2O contained in the recirculated gas, if necessary supplemented with extra water, reacts with the calcium in the slag, wherein this goes through a rapid ageing process and there exists a lower pH value in any later leaching. In this way the quality of the slag is improved because there is less leaching. At times when the incineration in the main incineration zone is not going very well it can be useful to temporarily use an increased oxygen content directly after the main incineration zone in order to bring about a good combustion of the lower ash layer.

[0035] In order to obtain the stated low oxygen content in the secondary gas, it is preferable to supply recirculated gas, that is to say waste gas from the incinerator, as secondary gas.

[0036] For the third air supply the preference is the percentage is from 5% to 30% of the total amount of air supplied, preferably from 10% to 20%.

[0037] When the height of the flames above the waste bed (6) lessens due to inadequate combustion or insufficient ignition, it is preferable to reduce the amount of the third air supply, or possibly even shut if off completely, in order to correct the increasing oxygen percentage in the flue gases that is the result of inadequate combustion.

[0038] To regulate the capacity of the fire, the position of the main combustion zone and the extent to which the waste material is incinerated at the end of the grid, the following control quantities are available:

- the quantity of waste material being fed to the grid
- the transport of the waste material on the grid
- the amount of air supplied to each zone
- the air temperature in each zone
- the oxygen content in the first zone.

[0039] This means that there are a large number of combinations possible. It is preferable to use the waste transport as the primary regulator for the capacity of the plant. The supply of waste material to the grid must be adjusted in order to obtain a good layer thickness. With respect to the creation of low emissions it is not recommended to regulate the amount of air in the main combustion zone, because this would upset the stoichiometry and therefore the balance of the combustion. Only adjustments smaller than approximately 10% of this flow or slow adjustments that are not faster than the supply of waste material to the combustion zone are possible here in order to manage the capacity and the position of the fire, respectively. With the individual regulating of the temperature in each zone proposed in Claim 2 it is possible to temporarily support a local lack of combustion in the main combustion zone without adapting the amount of the air supply. As regards the energy use, the limiting of the formation of NO_x and the negative influence on the waste throughput, aim to keep the nominal air temperature in the main combustion zone as low as possible. This can be controlled by influencing the drying process in the first zone. For this a fixed, as low as possible, oxygen percentage is aimed for in principle, and a high temperature in the first primary gas supply. In this way the first primary gas supply becomes the primary regulating quantity for the drying of the waste material. This flow is regulated such that a good combustion takes place in the second zone, but not more than what is needed to prevent too fierce combustion.

[0040] From the above information it can be seen that the invention provides a much-improved technique for burning waste material in a waste incinerator. The extra investments that are necessary for the recirculation of the waste gas and the more complex construction for the supply of the recirculation gases to the first zone are compensated for by the fact that the waste gas cleaning can be carried out on a smaller scale, and the fact that a lot less energy is needed for the preheating of the primary part of the gas supply. The advantages are especially achieved because the incineration is better and because this results in an ash layer of a better quality. In addition there is an advantage in that waste material with a wide range of thermal values (from 5,000 to 16,000 kilojoules per kilogram) can be processed with incineration that is easily manageable. Because of the good pre-drying in the first zone, a more constant flame temperature and flame height can be achieved, wherein peaks and troughs in the steam production can be avoided. All these measures lead to improved energy efficiency. This makes it possible to achieve an efficiency of electricity production of at least

30% gross / 26% net, 33% gross / 29% net with improved performance, or 36% gross / 33% net with the best performance, when a method described in the present invention is combined with a method such as those described in the patent applications from the same inventors that are submitted together with this patent application. In addition the NO_x content is reduced, first by the lower temperature in the incinerator, and secondly by the catalytic dust filter that can be effectively applied to this technique.

[0041] The invention is not limited to the implementation as shown in the figures and the description given above, but only by the attached claims.

Claims

1. A method for the incineration of waste material in an incinerator, comprising:

   supplying waste material to an incineration zone which contains an incineration grid, wherein the waste material is supplied to a first side of the incineration grid and is moved to a second side during the method,
   supplying from below through the incineration grid and the waste material placed thereon a primary gas so as to at least partially incinerate said waste material in a combustion area that stretches from the incineration grid to a first level above the incineration grid,

   wherein the incineration zone comprises at least two zones, the waste material being supplied to a first zone, and wherein during the method the waste material is moved to a successive connected zone; a first partial primary gas is supplied to the first zone with an oxygen content of less than 20% by volume and a temperature of from 50°C to 450°C, preferably from 50°C to 300°C, and a successive partial primary gas is supplied to the at least one successive zone; and
   characterized in that the temperature is controlled for each partial primary gas supply.

2. A method according to Claim 1, **characterized in that** the first partial primary gas supply comprises waste gas from an incinerator, preferably waste gas from a waste incinerator, a gas boiler, a gas motor or a gas turbine, waste gas from a waste incinerator being most preferred.

3. A method according to Claims 1 or 2,
   characterized in that the construction of the supply of the first partial primary gas supply, as far as these comprises waste gas from an incinerator, is enclosed by a housing, said housing being fed with gases at a temperature and/or pressure equal to or higher than the temperature or pressure, respectively, of the first primary gas supply.

4. A method according to Claim 2 or 3,
   characterized in that the waste gas from an incinerator is filtered, preferably through a dust filter.

5. A method according to Claims 1 - 4,
   characterized in that secondary gas is supplied near the first level above the incineration grid and a third gas is supplied at a second level above the first level, wherein the secondary gas has an oxygen content of < 20% by volume and the third gas has a higher oxygen content than the secondary gas.

6. A method according to Claim 5, **characterized in that** the secondary gas contains waste gas from a waste incinerator.

7. A method according to Claims 5 or 6,
   characterized in that the third gas comprises outside air.

8. A method according to Claims 1 - 7,
   characterized in that the primary gas in the first zone has an oxygen content of from 0% to 15%, preferably from 0% to 10%.

9. A method according to Claims 1 - 8,
   characterized in that the primary gas is supplied by at least three partial supplies, wherein at least:

   - a first partial gas supply has an O_2 content of from 0% to 15% and makes up from 2% to 25% of the total amount of primary gas;
   - one or more successive partial gas supplies make up from 15% to 90% of the total amount of primary gas; and

- a last partial gas supply makes up from 5% to 25% of the total amount of primary gas.

10. A method according to Claims 1 - 9,
characterized in that the housing is supplied with gases from a successive partial primary gas supply.

11. A method according to Claim 10, **characterized in that** the gases from the housing are subsequently supplied to the incineration zone, for example by mixing them with the first partial primary gas supply.

12. A method according to Claim 10, **characterized in that** the gases from the housing are subsequently supplied to a successive incineration zone, for example via a sidewall, or as secondary gas in the boiler as incineration gas.

13. A method according to Claims 10 - 12,
characterized in that the housing is supplied with gases at a temperature of at least 150°C.

14. A method according to Claims 1 - 13,
characterized in that the pipe for the supply of recirculation gases is enclosed in a pipe that is supplied with gases at a temperature and/or pressure equal to or higher than that of the first partial primary gas supply.

15. A method according to Claims 1 to 14,
characterized in that the first primary partial gas supply is controlled in order to influence the incineration in the connected main incineration zone by mainly varying the flow of the first primary partial gas supply and the oxygen content and/or temperature is subsequently or simultaneously varied.

16. Waste incineration oven for a waste incinerator, consisting of an incinerator grid (5) for the waste (6) material to be incinerated, means for moving the waste to be incinerated from a first to a second side, primary gas supply means (1, 2, 3, 4) under the incinerator grid, secondary gas supply means (9) at a first level above the incinerator grid and tertiary gas supply means (10) at a second level above the incinerator grid and above the secondary gas supply means, wherein the secondary gas supply means is connected to an exhaust of waste gas from the waste incinerator, **characterized in that** a temperature sensor and a heater are provided for control of each primary gas supply temperature.

17. Waste incineration oven according to claim 16,
characterized in that the primary gas supply means is connected to an exhaust of waste gas from a gas burner, a gas boiler, a gas motor, a gas turbine, a sewage water fermentation plant, or a bio-gas motor.

18. Waste incineration oven according to claim 16,
characterized in that the primary gas supply means consists of at least two separate supplies, the first primary gas supply means being located near the first side under the incinerator grid and the second primary gas supply means being located near the second side under the incinerator grid, and the first primary gas supply means being connected to an exhaust of waste gas from a waste incinerator.

Patentansprüche

1. Verfahren zur Müllverbrennung in einem Verbrennungsapparat mit den Schritten:

Zuführen von Müll zu einem Verbrennungsbereich, der ein Verbrennungsgitter enthält, wobei der Müll zu einer ersten Seite des Verbrennungsgitters zugeführt wird und während des Verfahrens zu einer zweiten Seite bewegt wird,
Zuführen eines Primärgases von unten durch das Verbrennungsgitter und den darauf angeordneten Müll, um den Müll in einem Verbrennungsbereich, der sich von dem Verbrennungsgitter zu einer ersten Stufe oberhalb des Verbrennungsgitters erstreckt, zumindest teilweise zu verbrennen,

wobei der Verbrennungsbereich zumindest zwei Bereiche aufweist, und der Müll zu einem ersten Bereich zugeführt wird, und wobei während des Verfahrens der Müll zu einem nachfolgenden verbundenen Bereich bewegt wird; ein erstes Partialprimärgas zu dem ersten Bereich mit einem Sauerstoffgehalt von weniger als 20 Vol.% und einer Temperatur von 50°C bis 450°C, vorzugsweise von 50°C bis 300°C, zugeführt wird, und ein nachfolgendes Partialprimärgas zu dem zumindest einen nachfolgenden Bereich zugeführt wird; und

dadurch gekennzeichnet, dass die Temperatur für jede einzelne Partialprimärgaszufuhr gesteuert wird.

2. Verfahren nach Anspruch 1,
dadurch gekennzeichnet, dass die erste Partialprimärgaszufuhr Abgas von einem Verbrennungsapparat enthält, vorzugsweise Abgas von einem Müllverbrennungsapparat, einem Gaskessel, einem Gasdruckerzeuger oder einer Gasturbine, wobei Abgas von einem Müllverbrennungsapparat am vorteilhaftesten ist.

3. Verfahren nach Anspruch 1 oder 2,
dadurch gekennzeichnet, dass der Aufbau der ersten Partialprimärgaszufuhr, soweit diese Abgas aus einem Verbrennungsapparat enthält, durch ein Gehäuse eingeschlossen ist, und das Gehäuse mit Gasen einer Temperatur und/oder einem Druck, die gleich oder höher sind als die Temperatur oder der Druck der ersten Primärgaszufuhr, versorgt wird.

4. Verfahren nach Anspruch 2 oder 3,
dadurch gekennzeichnet, dass das Abgas von einem Verbrennungsapparat gefiltert wird, vorzugsweise durch einen Staubfilter.

5. Verfahren nach einem der Ansprüche 1 bis 4,
dadurch gekennzeichnet, dass Sekundärgas nahe der ersten Stufe oberhalb des Verbrennungsgitters zugeführt wird und ein drittes Gas bei einer zweiten Stufe oberhalb der ersten Stufe zugeführt wird, wobei das Sekundärgas einen Sauerstoffgehalt von < 20 Vol.% aufweist, und das dritte Gas einen höheren Sauerstoffgehalt als das Sekundärgas aufweist.

6. Verfahren nach Anspruch 5,
dadurch gekennzeichnet, dass das Sekundärgas Abgas von einem Müllverbrennungsapparat enthält.

7. Verfahren nach Anspruch 5 oder 6,
dadurch gekennzeichnet, dass das dritte Gas Außenluft enthält.

8. Verfahren nach einem der Ansprüche 1 bis 7,
dadurch gekennzeichnet, dass das Primärgas in dem ersten Bereich einen Sauerstoffgehalt von 0% bis 15%, vorzugsweise von 0% bis 10% aufweist.

9. Verfahren nach einem der Ansprüche 1 bis 8,
dadurch gekennzeichnet, dass das Primärgas über zumindest drei Partialzufuhren zugeführt wird, wobei zumindest:

- eine erste Partialgaszufuhr einen O_2-Gehalt von 0% bis 15% aufweist und 2% bis 25% der Gesamtmenge des Primärgases bildet;
- eine oder mehrere Partialgaszufuhren 15% bis 90% der Gesamtmenge an Primärgas bilden; und
- eine letzte Partialgaszufuhr 5% bis 25% der Gesamtmenge an Primärgas bildet.

10. Verfahren nach einem der Ansprüche 1 bis 9,
dadurch gekennzeichnet, dass das Gehäuse mit Gasen von einer nachfolgenden Partialprimärgaszufuhr versorgt wird.

11. Verfahren nach Anspruch 10,
dadurch gekennzeichnet, dass die Gase von dem Gehäuse anschließend dem Verbrennungsbereich zugeführt werden, beispielsweise durch deren Vermischen mit der ersten Partialprimärgaszufuhr.

12. Verfahren nach Anspruch 10,
dadurch gekennzeichnet, dass die Gase von dem Gehäuse anschließend einem nachfolgenden Verbrennungsbereich, beispielsweise über eine Seitenwandung oder als Sekundärgas in dem Heizkessel, als Verbrennungsgas zugeführt werden.

13. Verfahren nach einem der Ansprüche 10 bis 12,
dadurch gekennzeichnet, dass das Gehäuse mit Gasen bei einer Temperatur von mindestens 150°C versorgt wird.

14. Verfahren nach einem der Ansprüche 1 bis 13,
dadurch gekennzeichnet, dass die Leitung für die Zufuhr von Rezirkulationsgasen in einer Leitung eingeschlossen ist, die mit Gasen bei einer Temperatur und/oder einem Druck, die gleich oder höher sind als die der ersten Partialprimärgaszufuhr, versorgt wird.

15. Verfahren nach einem der Ansprüche 1 bis 14,
dadurch gekennzeichnet, dass die erste Partialgaszufuhr gesteuert wird, um die Verbrennung in dem verbundenen Hauptverbrennungsbereich hauptsächlich durch Variieren des Ausflusses der ersten Partialprimärgaszufuhr zu beeinflussen, und der Sauerstoffgehalt und/oder die Temperatur nachfolgend oder gleichzeitig variiert wird.

16. Müllverbrennungsofen für eine Müllverbrennungsapparatur, bestehend aus einem Verbrennungsgitter (5) für den zu verbrennenden Müll (6), Mitteln zum Bewegen des zu verbrennenden Mülls von einer ersten zu einer zweiten Seite, Primärgaszuführungsmitteln (1, 2, 3, 4) unterhalb des Verbrennungsgitters, Sekundärgaszuführungsmittel (9) bei einer ersten Stufe oberhalb des Verbrennungsgitters und Tertiärgaszuführungsmittel (10) bei einer zweiten Stufe oberhalb des Verbrennungsgitters und oberhalb des Sekundärgaszuführungsmittels, wobei das Sekundärgaszuführungsmittel mit einem Abgasauslass von der Müllverbrennungsapparatur verbunden ist,
dadurch gekennzeichnet, dass ein Temperaturfühler und ein Heizer zur Steuerung jeder einzelnen Primärgaszufuhrtemperatur vorgesehen sind.

17. Müllverbrennungsofen nach Anspruch 16,
dadurch gekennzeichnet, dass das Primärgaszuführungsmittel mit einem Abgasauslass von einem Gasbrenner, einem Gaskessel, einem Gasdruckerzeuger, einer Gasturbine, einer Kanalisationsabwasserkläranlage oder einem Biogasdruckerzeuger verbunden ist.

18. Müllverbrennungsofen nach Anspruch 16,
dadurch gekennzeichnet, dass das Primärgaszuführungsmittel aus zumindest zwei getrennten Zuführungen besteht, wobei das erste Primärgaszuführungsmittel nahe der ersten Seite unterhalb des Verbrennungsgitters angeordnet ist, und das zweite Primärgaszuführungsmittel nahe der zweiten Seite unterhalb des Verbrennungsgitters angeordnet ist, und das erste Primärgaszuführungsmittel mit einem Abgasauslass von einer Müllverbrennungsapparatur verbunden ist.

Revendications

1. Procédé d'incinération de matériaux de rebut dans un incinérateur, qui comprend :

- l'approvisionnement en matériau de rebut à une zone d'incinération qui contient une grille d'incinération, dans laquelle le matériau de rebut est fourni à une première face de la grille d'incinération et est transféré sur une seconde face pendant le processus.
- l'approvisionnement à partir d'en dessous à travers la grille d'incinération et le matériau de rebut placé au dessus, au gaz primaire de façon à incinérer au moins partiellement le dit matériau de rebut dans une zone de combustion qui s'étend de la grille d'incinération vers un premier niveau au dessus de la grille d'incinération, dans lequel la zone d'incinération comprend au moins deux zones, le matériau de rebut étant fourni à une première zone et dans laquelle pendant le processus, le matériau de rebut est déplacé vers une zone reliée consécutive ; un premier gaz partiel primaire est fourni à la première zone ayant une teneur en oxygène de moins de 20 % en volume et une température allant de 50°C à 450°C, de préférence de 50°C à 300°C, et un gaz primaire partiel consécutif est fourni à au moins la zone consécutive.

et
caractérisé en ce que la température est contrôlée pour chaque alimentation en gaz primaire partiel.

2. Procédé selon la revendication 1 **caractérisé en ce que** l'alimentation en premier gaz primaire partiel comprend du gaz de rebut provenant d'un incinérateur, de préférence du gaz de rebut provenant d'un incinérateur de rebuts, une chaudière à gaz, un moteur à gaz ou une turbine à gaz, du gaz de rebuts provenant d'un incinérateur de déchets étant davantage préféré.

3. Procédé selon la revendication 1 ou la revendication 2 **caractérisé en ce que** la construction de l'alimentation de la fourniture en premier gaz primaire partiel, pour autant que celui-ci comprend du gaz de rebut provenant d'un incinérateur, est enfermée dans un coffrage, le dit coffrage étant alimenté par des gaz à des températures et/ou à des pressions égales à ou supérieures à la température ou à la pression respectivement de la première alimentation en gaz primaire.

4. Procédé selon la revendication 2 ou la revendication 3 **caractérisé en ce que** le gaz de rebuts provenant d'un incinérateur, est filtré, de préférence à travers un filtre à poussières.

5. Procédé selon la revendication 1 à 4, **caractérisé en ce que** du gaz secondaire est fourni près du premier niveau au-dessus de la grille d'incinération et un troisième gaz est fourni à un second niveau au-dessus du premier niveau, pour lequel le gaz secondaire possède une teneur en oxygène de < 20 % en volume et le troisième gaz a une teneur en oxygène plus élevée que celle du gaz secondaire.

6. Procédé selon la revendication 5, **caractérisé en ce que** le gaz secondaire contient des gaz de rebuts provenant d'un incinérateur de déchets.

7. Procédé selon la revendication 5 ou la revendication 6 **caractérisé en ce que** le troisième gaz contient de l'air de l'extérieur.

8. Procédé selon la revendication 1 à 7, **caractérisé en ce que** le gaz primaire dans la première zone possède une teneur en oxygène allant de 0 à 15 % -de préférence de 0 à 10 %.

9. Procédé selon la revendication 1 à 8, **caractérisé en ce que** le gaz primaire est alimenté par au moins trois alimentations partielles dans lesquelles au moins :

- une première alimentation en gaz partielle possède une teneur en O_2 allant de 0 % à 15 % et représente de 2 à 25 % de la quantité totale de gaz primaire ;
- un ou plusieurs alimentations en gaz successives partielles constituant de 15 à 90 % de la quantité totale de gaz primaire ;
- une dernière alimentation en gaz partielle constituant de 5 à 25 % de la quantité totale de gaz primaire.

10. Un procédé selon la revendication 1 à 9, **caractérisé en ce que** le coffrage est garni avec du gaz provenant d'une alimentation en gaz primaire partielle consécutive.

11. Procédé selon la revendication 10, **caractérisé en ce que** les gaz provenant du coffrage sont ensuite fournis à la zone d'incinération, par exemple en les mélangeant avec la première alimentation en gaz primaire partiel.

12. Procédé selon la revendication 10, **caractérisé en ce que** les gaz provenant du coffrage sont ensuite fournis à une zone d'incinération successive, par exemple par l'intermédiaire d'une paroi latérale ou en tant que gaz secondaire dans la chaudière en tant que gaz d'incinération.

13. Procédé selon les revendications 10 à 12, **caractérisé en ce que** le coffrage est alimenté avec des gaz à une température d'au moins 150°C.

14. Procédé selon les revendications 1 à 13, **caractérisé en ce que** le tube pour l'alimentation des gaz de recirculation est inclus dans un tube qui est alimenté en gaz à une température et/ou à une pression égale à ou supérieure à celle de la première alimentation en gaz partielle primaire.

15. Procédé selon les revendications 1 à 14, **caractérisé en ce que** la première alimentation en gaz partielle primaire est régulée de façon à exercer une influence sur l'incinération dans la zone d'incinération principale connectée, en variant principalement le flux de la première alimentation en gaz partielle primaire, et la teneur en oxygène et/ou la température est ensuite ou en même temps variée.

16. Four d'incinération pour les déchets destiné à un incinérateur de déchets, qui consiste en une grille d'incinérateur (8) pour les matériaux de déchets (4) qui doivent être incinérés, des moyens pour déplacer les déchets qui doivent être incinérés en partant d'un premier côté vers un second côté, des moyens d'alimentation en gaz primaire (1,2,3,4) sous la grille de l'incinérateur, des moyens d'alimentation (9) en gaz secondaire à un premier niveau au dessus de la grille d'incinérateur et des moyens d'alimentation en gaz tertiaire (10) à un second niveau au dessus de la grille de l'incinérateur et au dessus des moyens d'alimentation en gaz secondaire dans lequel les moyens d'alimentation en gaz secondaire sont reliés à un échappement de gaz de déchet provenant de l'incinérateur de déchets **caractérisé en ce qu'**un détecteur de température et un réchauffeur sont disposés pour la commande de chaque température d'alimentation en gaz primaire.

17. Four d'incinération de déchets selon la revendication 16, **caractérisé en ce que** les moyens d'alimentation en gaz primaire, sont reliés à un échappement de gaz de déchet à partir d'un brûleur à gaz, une chaudière de gaz, un moteur à gaz, une turbine à gaz, une installation de fermentation à eau pour eaux d'égout ou un moteur à bio gaz.

18. Four d'incinération pour déchets selon la revendication 16, **caractérisé en ce que** les moyens d'alimentation en gaz primaire consistent en au moins deux alimentations séparées, le premier moyen d'alimentation en gaz primaire étant placé près du premier côté sous la grille d'incinérateur et le second moyen d'alimentation en gaz primaire étant placé près du second côté sous la grille d'incinérateur et le premier moyen d'alimentation en gaz primaire étant connecté à un échappement de gaz de déchets provenant d'un incinérateur pour déchets.

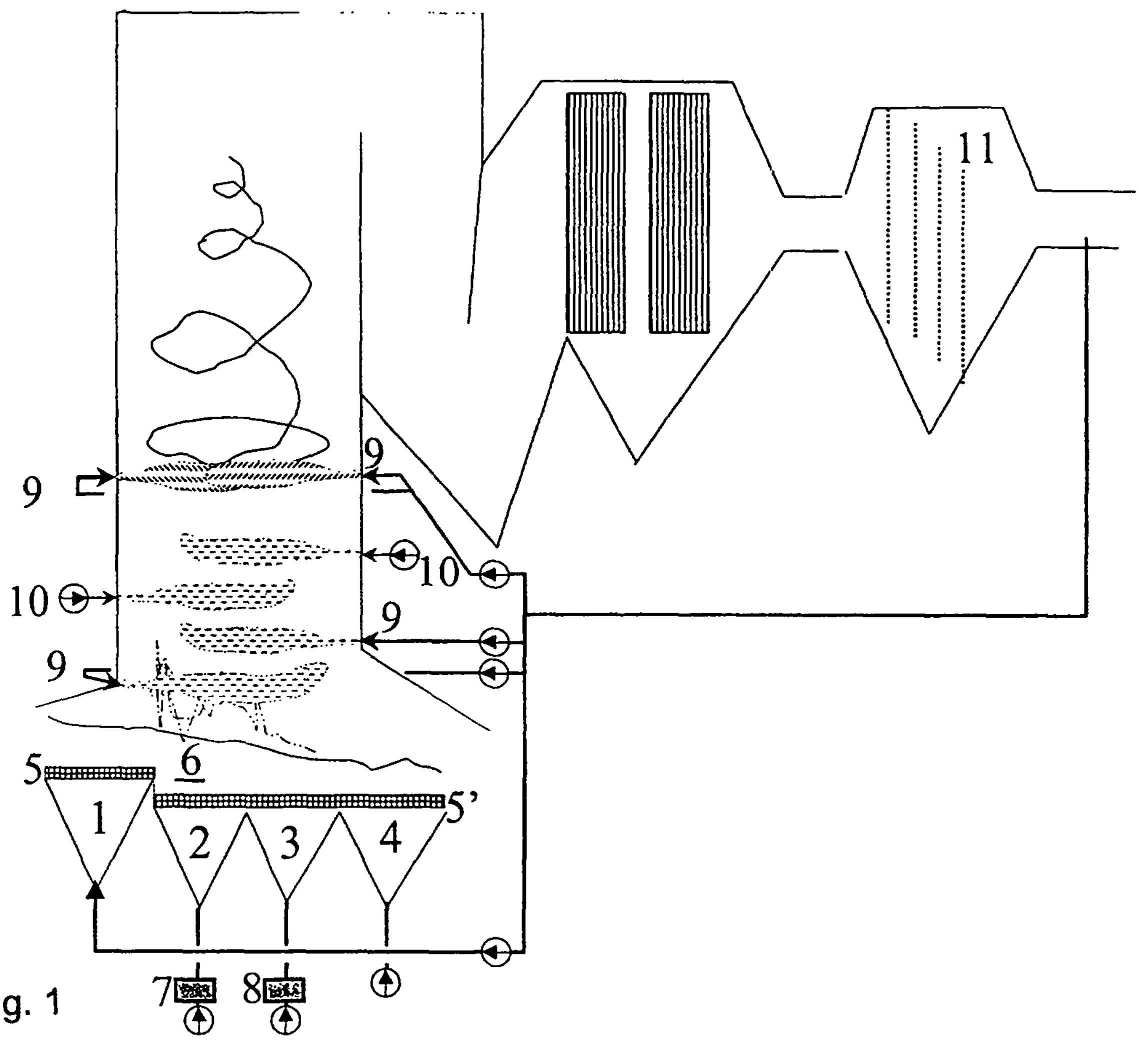

Fig. 1

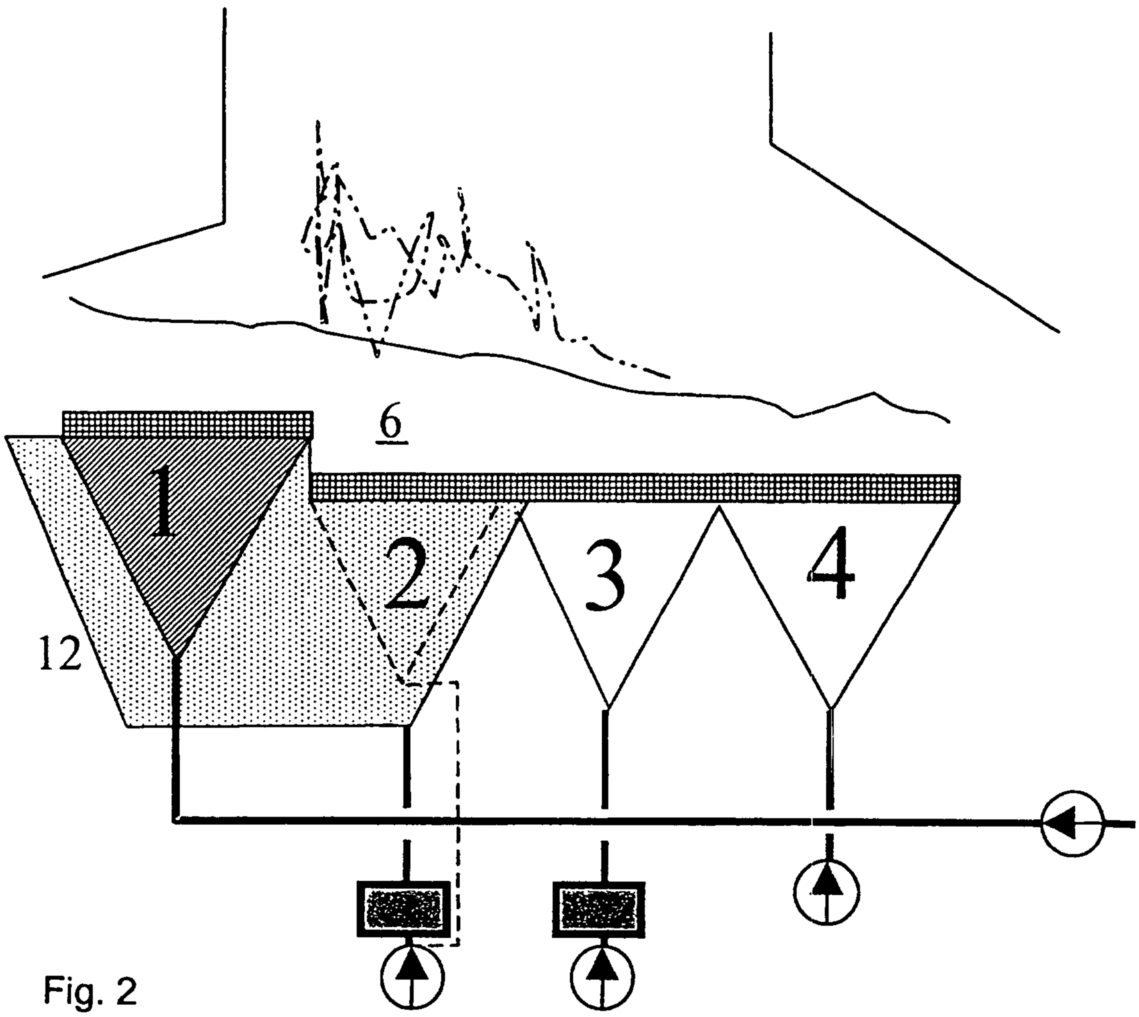

Fig. 2