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(54) **Furnace and plant for the treatment of special waste comprising said furnace**

(57) A furnace (14) for the heat treatment of special waste, which envisages a chamber (16) inside which the atomised waste, together with calcium carbonate in powder form, is introduced. A vortical current of combustion air draws the dust along the chamber, with a helical movement along the horizontal axis (X-X) of the chamber (16).

The vortical movement facilitates the reaction which leads to the formation of inert matter separated by means of feeder screws.

The fumes are treated before being introduced into the atmosphere, while the heat generated inside the furnace is re-utilised for the production of electric and thermal energy.

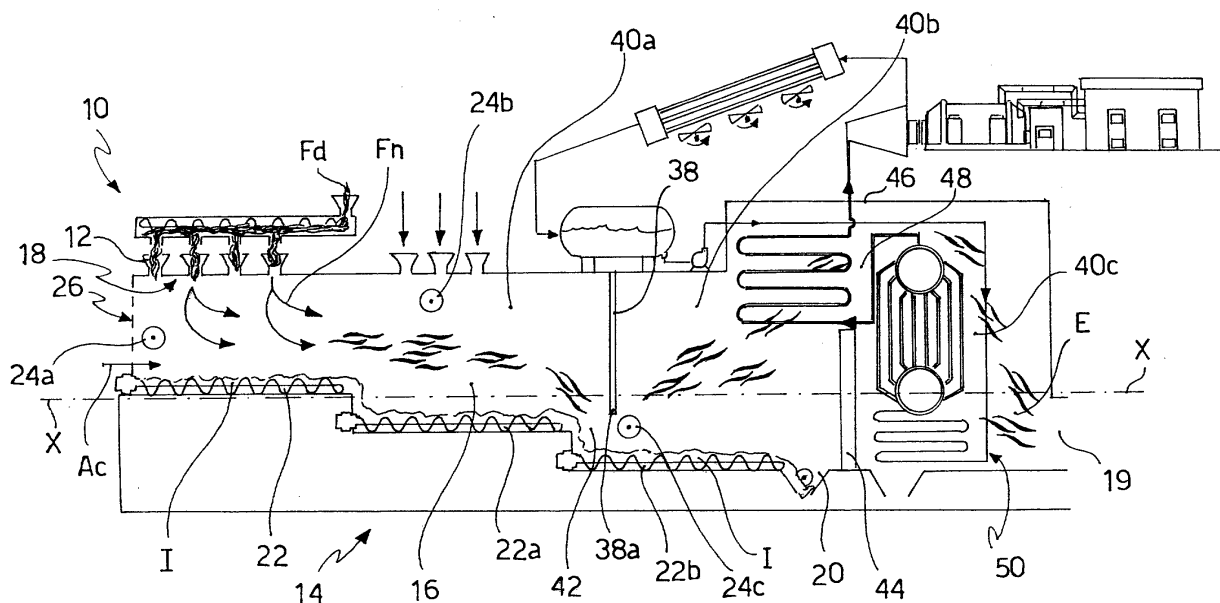


FIG. 2

Description

[0001] The present invention relates to a furnace for the heat treatment of special waste, for example the sludge produced by waste-water purification plants.

[0002] The present invention also relates to a plant comprising said furnace, in particular a plant for treatment of the sludge produced by waste-water purification plants.

[0003] It is known in the sector relating to sludge treatment plants to provide furnaces in which movement of the sludge inside the combustion chamber is performed mechanically, for example by means of bins or belts.

[0004] It is also known to provide vertically extending fluid-bed furnaces in which the sludge is introduced from above or from the sides and falls into the furnace by means of gravity.

[0005] The abovementioned solutions, however, have numerous drawbacks.

[0006] Mechanical-type movement does not ensure uniform treatment of the entire mass of sludge, while vertical fluid-bed furnaces are often affected by problems of mobility of the bed, due to the formation of high-melting residue.

[0007] There therefore exists a need to provide a furnace for the heat treatment of sludge and special waste and a plant comprising said furnace, which are able to ensure improved operativity of the working process, for example a more effective treatment action.

[0008] The problem forming the basis of the present invention is that of devising a heat treatment furnace and a sludge processing plant containing said furnace, which have structural and functional characteristics such as to satisfy the abovementioned requirements and overcome at the same time the drawbacks mentioned with reference to the known art.

[0009] This problem is solved by a heat treatment furnace, which operates using a sludge processing method, as well as a sludge treatment plant in accordance with the following claims. The dependent claims describe further variations of embodiment.

[0010] The characteristic features and the advantages of the heat treatment furnace, the processing plant and the sludge treatment method according to the present invention will emerge from the following description of a preferred and non-limiting example of embodiment in which:

[0011] Figure 1 shows a diagram of the sludge processing plant comprising a heat treatment furnace;

[0012] Figure 2 shows a longitudinal schematic view of the heat treatment furnace according to Figure 1;

[0013] Figure 3 shows a cross-sectional diagram of the furnace according to Figure 1; and

[0014] Figure 4 shows a longitudinal schematic view of means for extraction of inert matter and blowing means of the furnace according to Figure 1.

[0015] With reference to the accompanying figures, 1 denotes in its entirety a plant for the treatment of sludge

and special waste F resulting from recycled waste water, in particular resulting from the biological treatment of waste water.

[0016] Said treatment plant 1 comprises a storage zone in which said sludge F is stored, preferably in a closed warehouse which is kept under vacuum conditions by means of fans which draw out air contained therein.

[0017] The sludge F is conveyed away from said storage zone, preferably by means of a feeding bin, to a kneading machine 2.

[0018] Said kneading machine 2 is also fed with fume dust Pf obtained from fumes E produced during the heat treatment owing to the separation performed by sleeve filters 4.

[0019] A reaction agent R is also fed to said kneading machine 2.

[0020] Preferably, said reaction agent R is calcium carbonate in powder form.

[0021] Inside said kneading machine 2, the sludge F is kneaded together with the reaction agent R and with the fume dust Pf, producing kneaded sludge Fi.

[0022] Advantageously the kneaded sludge Fi forms a mass which is less cohesive than the initial sludge, i. e. is less sticky than the sludge F and basically suitable for subsequent handling.

[0023] The kneaded sludge Fi is conveyed away to a dehydrator 6 which is suitable for dehydrating said kneaded sludge.

[0024] Preferably, said dehydrator 6 is a rotating-drum dehydrator in which the water contained in the kneaded sludge Fi evaporates owing to action of heating of said sludge by the fumes E produced inside the furnace.

[0025] Dehydrated sludge Fd emerges from said dehydrator 6 and is preferably conveyed away to means suitable for separating any foreign bodies from said dehydrated sludge.

[0026] Preferably said separation means comprise a sieve or rotating drum 8.

[0027] The dehydrated sludge Fd is conveyed to an atomisation system 10. Preferably said atomisation system 10 is a compressed-air atomisation system comprising at least one diffuser 12 able to introduce atomised sludge Fn into a furnace 14.

[0028] Treatment of the atomised sludge Fn is performed inside the furnace 14, resulting in the formation of inert matter I discharged from the furnace. The details of treatment of said atomised sludge will be illustrated in detail in the remainder of the description.

[0029] The furnace 14 comprises a chamber 16 which preferably extends substantially along a horizontal axis X-X, between at least one supply inlet 18 from where said atomised sludge Fn is introduced into the chamber 16 and a discharge opening 19 for the fumes E produced during the heat treatment.

[0030] The atomisation means introduce the atomised sludge Fn into the furnace 14 in the region of said

supply inlet 18 of the chamber 16.

[0031] The chamber 16 of the furnace 14 also comprises an extraction zone 20 from where said inert matter I resulting from treatment of the atomised sludge Fn is extracted and conveyed outside of the furnace 14.

[0032] The furnace 14 also comprises extraction means able to extract said inert matter I from the furnace 14 and convey it outside of the furnace.

[0033] Preferably, said extraction means comprise at least one feeder screw 22 arranged at a lower height than the supply inlet 18 for the atomised sludge Fn.

[0034] Preferably said extraction means comprise a plurality of feeder screws 22, 22a, 22b arranged in succession along said horizontal axis X-X of the furnace chamber 16.

[0035] In particular a following feeder screw is arranged at a lower height than the preceding feeder screw, extending from the supply inlet 18 for the atomised sludge Fn to the discharge opening 19 for the fumes E.

[0036] In other words, the first feeder screw 22 is arranged higher than the second feeder screw 22a and said second feeder screw 22a is arranged higher than the third feeder screw 22b, resulting in a stepped configuration.

[0037] The furnace 14 also comprises burner means suitable for performing the combustion of a fuel in order to provide a predetermined process temperature inside said chamber 16 of the furnace 14.

[0038] Preferably said burner means comprise burners arranged in pairs, for example a first burner 24a, a second burner 24b and a third burner 24c.

[0039] Preferably said fuel is methane. In further embodiments, said fuel is waste-derived fuel (CDR) or organic dust resulting from the demolition of cars (fluff) or carbon coke.

[0040] Furthermore, said furnace 14 comprises conveying means able to convey the atomised sludge Fn along a path between said supply inlet 18 and said discharge opening 19 for the fumes.

[0041] Preferably said path is substantially horizontal, along said horizontal axis X-X of said chamber 16.

[0042] In further embodiments, said path is substantially helical. In a further variation of embodiment, said path is undulating or, alternatively, labyrinth-like.

[0043] Advantageously, said path extends from the inlet to the discharge opening along a path which may be a combination of one or more of the abovementioned paths, for example helical or also undulating.

[0044] The conveying means comprise means which generate a flow of combustion air Ac suitable for drawing the atomised sludge Fn along said path.

[0045] Preferably said conveying means comprise means for sucking combustion air Ac from an air inlet 26 arranged in the vicinity of the supply inlet 18 for the atomised sludge Fn, from where said combustion air enters into the chamber 16, towards the discharge opening 19 for the fumes E.

[0046] Said suction means are suitable for conveying, by means of the air flow, the atomised sludge along said longitudinal axis X-X of the chamber 16 for carrying out the heat treatment.

[0047] Said conveying means also comprise blowing means suitable for performing swirled and turbulent conveying of said atomised sludge Fn along said longitudinal axis X-X of the chamber 16.

[0048] Said blowing means comprise at least one blowing plate.

[0049] In a preferred embodiment, said blowing means comprise a first right-hand plate 28a and a first left-hand plate 30a.

[0050] Said plates 28a, 30a extend along the path of the chamber, namely along the horizontal axis X-X of the chamber 16, each on one side of the chamber 16, that is so as to be facing each other along said horizontal axis X-X.

[0051] Furthermore, said blowing means comprise a second right-hand plate 28b and a second left-hand plate 30b.

[0052] Said plates 28b, 30b extend along the horizontal axis X-X of the chamber 16, each on one side of the chamber 16, i.e. so as to be facing each other along said horizontal axis X-X, at a height closer to that of the feeder screws than to the height of the first right-hand plate 28a and the first left-hand plate 30a.

[0053] Said plates 28a, 28b, 30a, 30b have a respective main surface 32 which extends along the path of the chamber 16, namely along the horizontal axis X-X, and which is directed towards the inside of the chamber 16, namely towards the middle of the latter.

[0054] Said main surface 32 is inclined with respect to the horizontal reference surface Z-Z.

[0055] In particular said first left-hand plate and said first right-hand plate have respective main surfaces lying in planes which, intersecting each other, form an acute angle, preferably equal to 60°.

[0056] In particular said second left-hand plate and said second right-hand plate have respective main surfaces lying in planes which, intersecting each other, form an acute angle, preferably equal to 60°.

[0057] Said main surfaces have at least one blowing opening, from where further combustion air is blown towards the middle of the chamber.

[0058] Preferably, said main surfaces have at least one plurality of blowing holes 33.

[0059] The combustion air blown through said blowing holes of the plates is heated beforehand, preferably using the heat of the feeder screws and blowing said air by means of fans 34a, 34b.

[0060] Said perforated plates 28a, 28b, 30a, 30b of the furnace 14 define, together with the side walls 35a, 35b of the chamber 16, a central region 36 of the chamber 16 which, transversely, has a substantially trapezoidal cross-section.

[0061] In other words, said main surfaces 32 of the perforated plates and the internal surfaces of the side

walls 35a, 35b of the furnace chamber 16 have a relative inclination such as to define said substantially trapezoidal central region 36.

[0062] Furthermore, said furnace 14 comprises separating means for the chamber 16 able to define combustion zones inside said chamber 16.

[0063] In a preferred embodiment, said separating means comprise a first wall 38, arranged substantially perpendicular to said horizontal axis X-X of the chamber 16.

[0064] The wall 38 is suitable for defining inside said chamber 16 a preliminary combustion zone 40a and a post-combustion zone 40b.

[0065] According to a preferred arrangement of the burners 24a, 24b, 24c, the first burner 24a is arranged in the preliminary combustion zone 40a, in the vicinity of the supply inlet 18 of the chamber 16, and the second burner 24b is arranged in the preliminary combustion zone 40a, situated substantially in the middle of said zone and at height higher than that of the first burner 24a.

[0066] The third burner 24c is preferably arranged at a free end 38a of the wall 38.

[0067] The free end 38a of the wall 38 and the third feeder screw 22b define a forced through-opening 42 for the atomised sludge being treated, opposite which the third burner 24c is arranged.

[0068] Said separator means also comprise a second wall 44 arranged closer to the discharge opening 19 for the fumes E than the first wall 38, in the direction of the horizontal axis X-X.

[0069] The second wall 44 is able to define, between said post-combustion zone 40b and said discharge opening 19 for the fumes E, an exchange zone 40c for the heat of the fumes.

[0070] The second wall 44 forms, together with an upper wall 46 of the chamber 16 of the furnace, a through-opening 48 for the fumes between said post-combustion zone 40b and said exchange zone 40c for the heat of the fumes.

[0071] The furnace 14 also comprises a heat exchanger 50 arranged in said heat exchange zone 40c and able to extract the heat from the fumes E and transfer it to a working fluid so as to convert said fluid into a condition for supplying, for example, a plant for the production of energy.

[0072] Preferably said heat exchanger is able to generate steam for supplying a turbine of a plant 60 for the production of electrical energy.

[0073] In a preferred embodiment, said plant for the production of energy uses a cycle of the Rankine type.

[0074] The fumes E, after passing through the heat exchanger 50, emerge from the discharge opening 19 for the fumes and then enter into the dehydrator; after passing through said sleeve filters 4 for separation of the fume dust Pf, they then pass into a plant 70 for treating the fumes.

[0075] Said plant 70 for treating the fumes comprises,

in a preferred embodiment, a spray column for cooling and basic washing of the fumes.

[0076] Furthermore, said plant 70 comprises columns with polypropylene filled bodies for washing with water and automatic control of the acidity by means of the introduction of soda, a washing tank for adding oxygenated water for sterilisation, and an expansion chamber for condensation of the water present in the fumes and separation of the water droplets by means of gravity.

[0077] Furthermore, said plant 70 comprises final absorbers for final purification of the fumes by means of adsorption.

[0078] Prior to emission of the fumes into the atmosphere, for example from a chimney, said fumes are monitored, for example by controlling the level of the nitrogen oxides (NOx), the carbon monoxide (CO), water vapour (H₂O), acids (HCl and HF), sulphur dioxide (SO₂), total organic components (COT), dust levels and throughput.

[0079] An automatic system, which is operated by a computer, interrupts the supply of sludge during the production cycle should the emission values of any one of the environmental parameters exceed the values stipulated by the regulations governing protection of the environment.

[0080] During normal operation of the sludge treatment plant, the atomised sludge Fn is introduced into the chamber 16 of the furnace 14 via the supply inlet 18.

[0081] Inside the chamber 16, the suction and blowing means produce currents of combustion air Ac which convey said atomised sludge Fn along the chamber 16 in the direction of the horizontal axis X-X.

[0082] Said air current travels from the air suction inlet, close to the supply inlet for the atomised sludge, to the fume discharge opening 19.

[0083] The suction means assist said air current by substantially imparting an axial movement, in the direction of the horizontal axis X-X, to the air current.

[0084] The blowing means assist said air current by substantially imparting a transverse movement due to the combustion air blown through the plates.

[0085] The atomised sludge Fn is transported by the resultant air current from the supply inlet to the fume discharge opening.

[0086] Said atomised sludge has, owing to the combined action of said suction and blowing means, a vortical, i.e. substantially helical, motion.

[0087] In other words, said atomised sludge Fn moves towards the fume discharge opening along a fluid-vortex path.

[0088] Or in other words, said atomised sludge, owing to the combined action of said suction and blowing means, undergoes continuous remixing inside the chamber, gradually being conveyed towards the fume discharge opening.

[0089] Said separating means also form means for directing the flow of the combustion air current.

[0090] In other words, the first wall constitutes an obstacle to the exclusively axial advancing movement of

the air current, so that said current is deviated towards said forced through-opening, passing in the vicinity of the third burner 24c.

[0091] Similarly, said second wall constitutes a further obstacle to the exclusively axial advancing movement of the current, causing it to pass through the forced through-opening.

[0092] The atomised sludge Fn, which is conveyed by the air current, has an undulating movement with an overall progression which is approximately sinusoidal.

[0093] The atomised sludge Fn is thoroughly mixed with the reaction agent R, namely the calcium carbonate in powder form, together with said sludge inside the kneading machine 2.

[0094] Inside the chamber 16 of the furnace a calcination process occurs as a result of the temperatures reached by means of the burners and, if necessary, owing to the heat produced or extracted from the said reactions.

[0095] The calcium carbonate, owing to the high temperatures, produces caustic lime (CaO) and free carbon dioxide (CO₂) as a result of the reaction: $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$.

[0096] If the sludge contains calcium hydroxide (Ca(OH)₂) the latter results in the reactive formation of caustic lime and released water vapour as a result of the reaction: $\text{Ca(OH)}_2 \rightarrow \text{CaO} + \text{H}_2\text{O}$.

[0097] Inside the chamber 16 of the furnace 2 combustion of the organic phase contained in the sludge occurs as a result of the reaction: $\text{Organic phase} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$.

[0098] The intermixing of the sludge dust and the basic dust resulting from calcination eliminates the acid components of said sludge dust.

[0099] In other words, the caustic lime which forms is basic and is highly reactive to the polluting acids which are present in the sludge dust and are due, for example, to the sulphur, chlorine, fluorine and nitrogen oxides.

[0100] At the same time, said caustic lime together with the heavy metal salts tends to form complex salts.

[0101] Said polluting acids combine with the caustic lime, forming inert calcium salts.

[0102] The intermixing of the sludge dust and the basic dust is facilitated and increased by the vortical movement with which said dust moves inside the furnace chamber.

[0103] Furthermore, said vortical remixing movement facilitates the production of the reactions as a result of elimination of the acid components from the sludge dust.

[0104] The lime resulting from the abovementioned reactions, in some cases together with the inert material already formed, the ashes and the heavy dust, forms the inert matter I which is deposited on the feeder screws and conveyed by them outside of the furnace chamber.

[0105] When the inert matter I emerges from the furnace chamber 16, as a result of lowering of the temperature to below 900°C, the caustic lime reacts with the

carbon dioxide, resulting in carbonation which produces an inert product based on calcium carbonate, as a result of the reaction: $\text{CaO} + \text{CO}_2 \rightarrow \text{CaCO}_3$.

[0106] Said carbonation reaction already takes place along the feeder screws conveying the inert matter I and is completed during storage of the latter.

[0107] Unusually, the furnace according to the present invention and the sludge treatment plant comprising said furnace result in the production of an effective sludge treatment action and the transformation of the said sludge into inert matter.

[0108] Advantageously the furnace extends in a substantially horizontal direction, which arrangement is able to ensure the deposition of the inert matter formed by the combusted sludge in the region of the extraction zone despite the conveying action of the combustion air flow.

[0109] Advantageously, the dehydrated sludge is combined with a reaction agent which, during the course of the heat treatment inside the furnace chamber, produces an agent able to be combined with the pollutants present in the sludge dust, for example with the acid pollutants, resulting in inert matter.

[0110] Advantageously, moreover, conveying of the atomised sludge inside the furnace chamber occurs by means of an air current which disperses the sludge dust, resulting in a more effective combustion action.

[0111] According to a further advantageous aspect, said combustion air current is vortical, resulting in a movement of the sludge dust and the basic dust which improves the intermixing of the latter and the formation of inert matter from the pollutants present in said sludge.

[0112] Advantageously, moreover, said vortical movement is obtained by perforated plates arranged axially, substantially parallel to the feeder screws for extraction of the inert matter, resulting in efficient extraction of the inert matter which is gradually formed, from the furnace chamber.

[0113] A further advantage consists in the provision of separating means inside the furnace chamber, which, in addition to defining zones where combustion occurs according to different parameters, for example with higher temperatures in the post-combustion zone, form guide means for the stream of dust which is advantageously directed into zones close to the burner means or to the feeder screws for extraction of the inert matter.

[0114] According to yet another advantageous aspect, it is possible to produce from the sludge treatment plant electric energy by means of an electric energy production plant.

[0115] Furthermore, advantageously, the fumes produced inside the furnace chamber are used to heat the dust inside the dehydrator and are suitably treated before being introduced into the atmosphere.

[0116] A person skilled in the art may make modifications to the furnace and the sludge treatment plant according to the present invention.

[0117] For example, in one embodiment of said plant,

sludge having components with a low flash point is supplied directly into the furnace chamber without passing through the dehydrator.

[0118] It is obvious that these variants must also be understood as being included within the scope of protection as defined by the following claims.

Claims

1. Furnace (14) for the heat treatment of a material to be treated, comprising:

- a chamber (16) which extends between at least one supply inlet (18), which is suitable for the introduction of said material into said chamber, and at least one discharge opening (19) which is suitable for discharging fumes (E) generated by the combustion of said material to be treated;
- suitable burner means (24a, 24b, 24c) for producing a fuel combustion process so as to form inside said chamber (16) of the furnace (14) a predetermined process temperature;
- conveying means suitable for conveying said material to be treated along a path between said supply inlet (18) and said discharge opening (19) for the fumes (E);

characterized in that said conveying means comprise means which generate a flow of combustion air (Ac) suitable for conveying said material to be treated from said supply inlet (16) towards said opening (19) for discharging the fumes (E).

2. Furnace according to Claim 1, **characterized in that** said path of the material to be treated which is conveyed by said combustion air flow is substantially horizontal along a horizontal axis (X-X) of said chamber (16).

3. Furnace according to Claim 1 or 2, **characterized in that** said path of the material to be treated which is conveyed by said combustion air flow is substantially helical.

4. Furnace according to any one of the preceding claims, **characterized in that** said path of the material to be treated which is conveyed by said combustion air flow is substantially undulating.

5. Furnace according to any one of the preceding claims, **characterized in that** said path of the material to be treated which is conveyed by said combustion air flow is labyrinth-like.

6. Furnace according to any one of the preceding claims, **characterized in that** said material to be

treated comprises atomised material.

7. Furnace according to any one of the preceding claims, **characterized in that** said material to be treated comprises atomised sludge (Fn) resulting from the treatment of waste water and special waste.

8. Furnace according to any one of the preceding claims, **characterized in that** said material to be treated comprises atomised sludge (Fn) or special waste combined with a reaction agent (R).

9. Furnace according to Claim 8, **characterized in that** said reaction agent is calcium carbonate in powder form.

10. Furnace according to any one of the preceding claims, **characterized in that** said means which generate a combustion air flow comprise means for sucking the combustion air along said path.

11. Furnace according to any one of the preceding claims, **characterized in that** said means which generate a combustion air flow comprise means for blowing the air.

12. Furnace according to Claim 11, **characterized in that** said blowing means comprise at least one blowing plate (28a, 28b, 30a, 30b) which extends along said path.

13. Furnace according to Claim 12, **characterized in that** said blowing plate has a main surface (32) directed towards the middle of the chamber (16) and inclined with respect to the horizontal reference surface (Z-Z) of said furnace (14) and provided with at least one blowing opening (33).

14. Furnace according to Claim 12 or 13, **characterized in that** said blowing plates define, together with said walls (35a, 35b) of the chamber (16) of the furnace (14), a central region (36) which is substantially trapezoidal transversely.

15. Furnace according to any one of the preceding claims, also comprising means (38,44) for separating the chamber (16), suitable for defining combustion zones (40a, 40b, 40c) inside said chamber (16).

16. Furnace according to Claim 15, **characterized in that** said separating means comprise at least one wall arranged perpendicularly with respect to a horizontal axis (X-X) of said chamber.

17. Furnace according to Claim 16, **characterized in that** said walls define, together with respective free ends, forced through-openings (42,48) for the flow

of said material to be treated.

18. Furnace according to any one of the preceding claims, also comprising means for extracting the inert matter (I).

19. Furnace according to Claim 18, comprising at least one feeder screw (22, 22a, 22b).

20. Plant (1) for the treatment of sludge produced from waste water, comprising at least one furnace (14) according to any one of the preceding claims.

21. Plant according to Claim 20, also comprising means suitable for combining said sludge with a reaction agent (R).

22. Plant according to Claim 20 or 21, also comprising a plant for the production of electric energy (60).

23. Plant according to any one of Claims 20 to 22, also comprising a plant (70) for treating the fumes.

24. Method for the heat treatment of a material to be treated and the production, from the latter, of inert matter (I) inside a furnace (14) provided with a chamber (16) which extends between a supply inlet (18) and a discharge opening (19) for the fumes (E), said method comprising the steps of:

- introducing said material to be treated into said chamber;
- generating a flow of combustion air which follows a path between said supply inlet (18) and said discharge opening (19) for the fumes inside the chamber (16);
- conveying said material to be treated by means of said flow of combustion air (Ac) along said path;
- performing said heat treatment of the material so as to obtain said inert matter along said path.

25. Method according to Claim 24, **characterized in that** the step of introducing said material to be treated comprises the step of atomising said material.

26. Method according to Claim 24 or 25, **characterized in that** said step of generating a combustion air flow comprises the step of sucking combustion air so as to generate a sucked air flow between said supply inlet (18) and said discharge opening (19).

27. Method according to Claim 26, **characterized in that** said step of generating a combustion air flow comprises the step of blowing combustion air so as to generate a blown air flow which is combined with said sucked air flow so as to generate a vortical movement of the material to be treated.

28. Method according to any one of Claims 24 to 27, **characterized in that** said heat treatment step comprises a combustion step.

5 29. Method according to any one of Claims 24 to 27, **characterized in that** said heat treatment step comprises a calcination step.

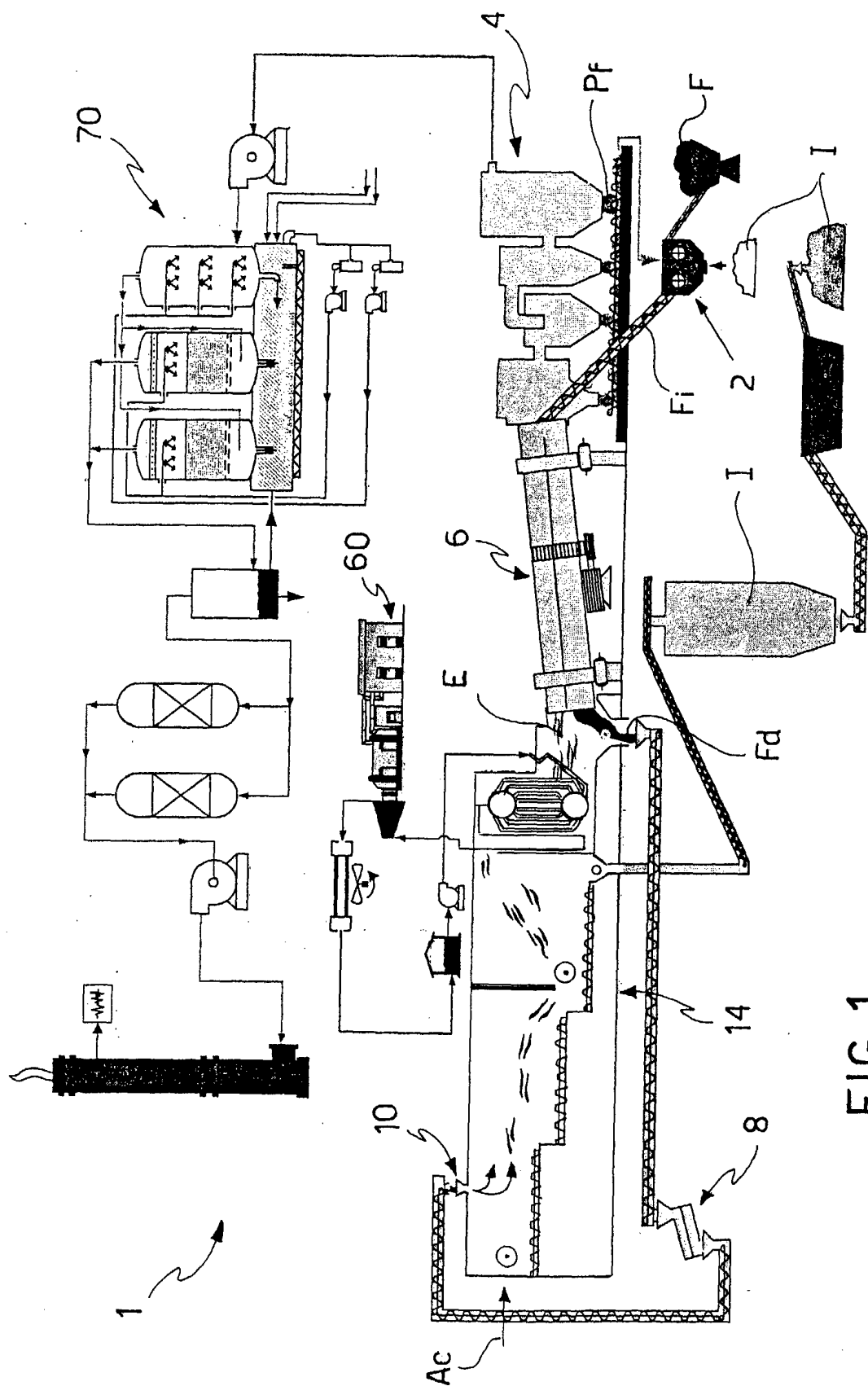


FIG. 1

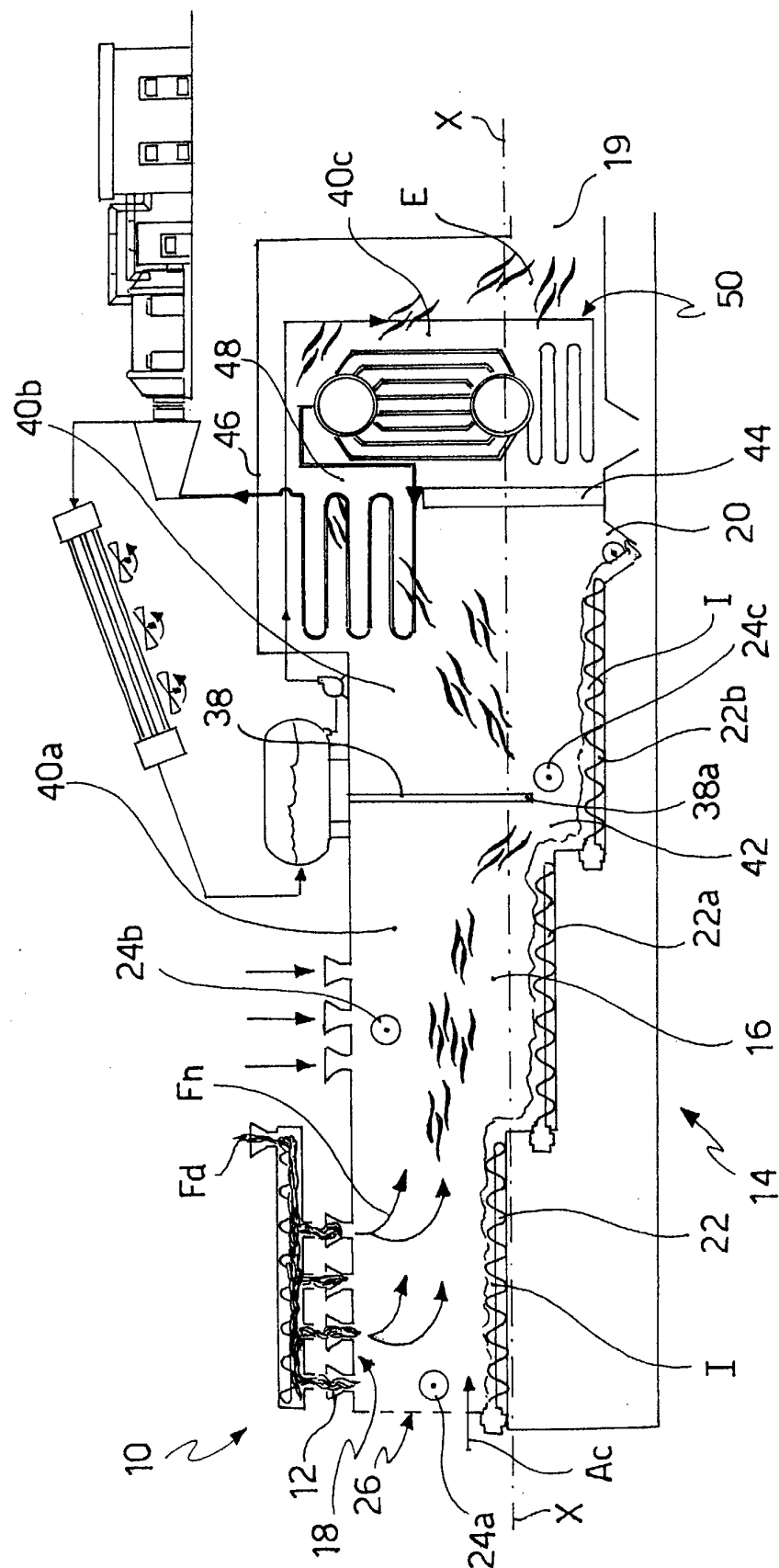


FIG. 2

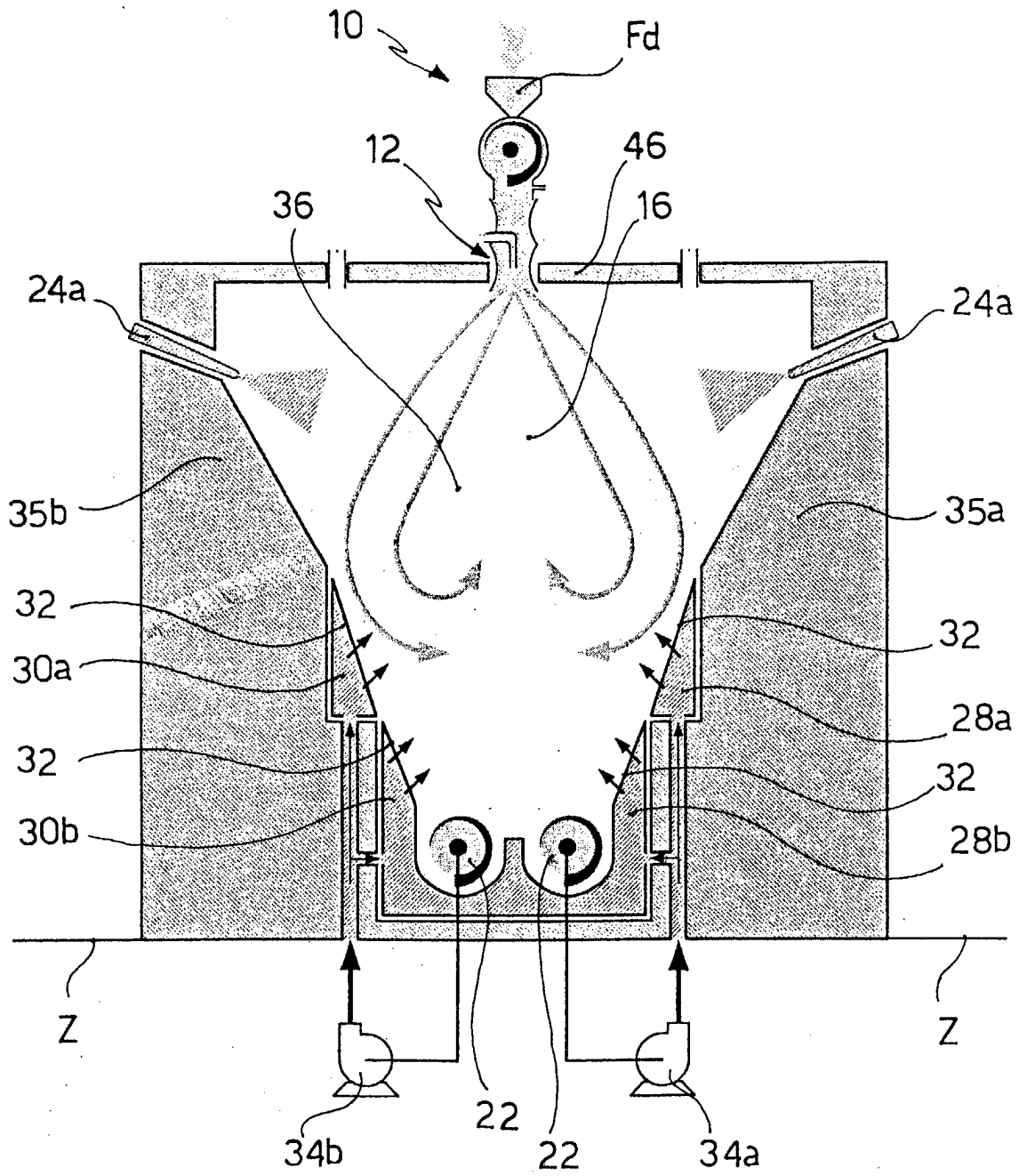


FIG. 3

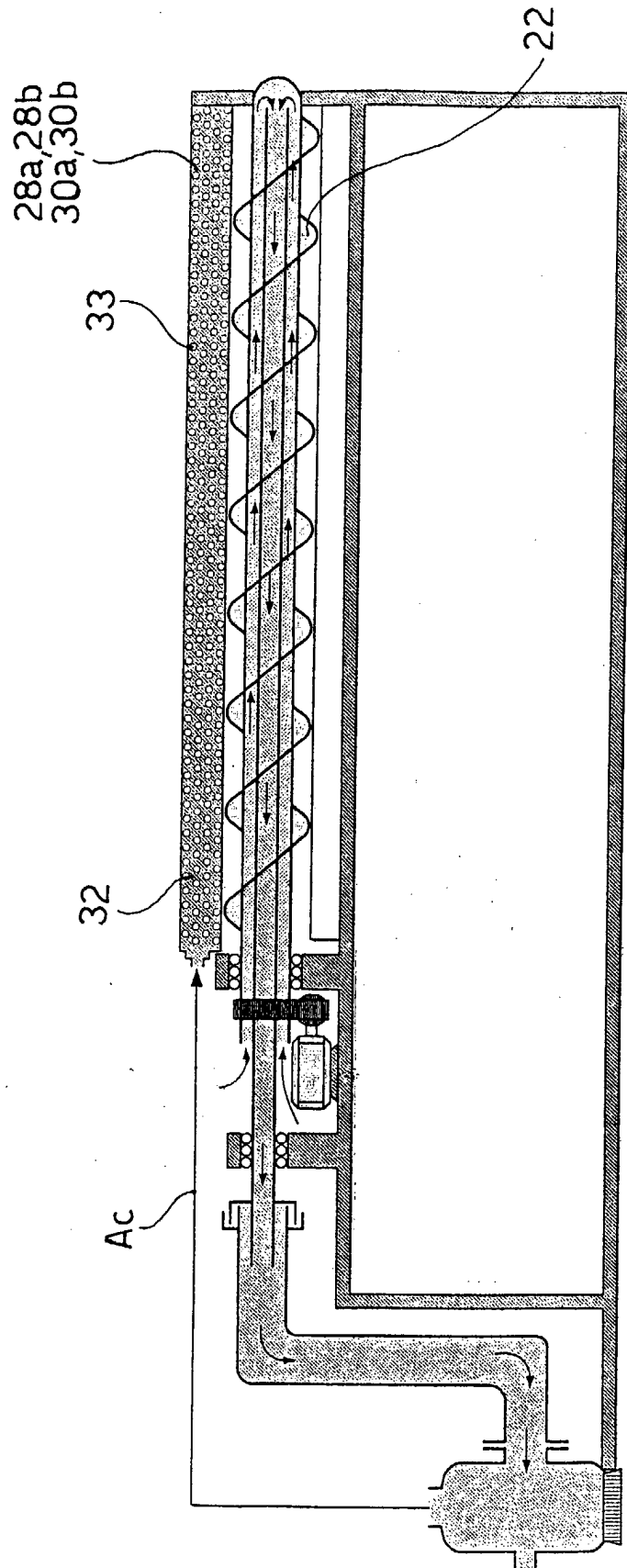


FIG. 4



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 42 5192

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)
X	US 5 727 482 A (YOUNG BOB W) 17 March 1998 (1998-03-17)	1-3, 10, 11, 18, 24-29	F23G7/00 F23G5/32 F23G5/00
A	* the whole document *	12-14, 20, 22, 23	F23J15/00 F23G5/02 F23G5/46 F23G5/16
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	* the whole document *		
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 4 September 2003	Examiner Coli, 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			

EPO FORM 1503 03/02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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