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(54) **AN ENERGY RECOVERY APPARATUS SUITABLE FOR HEAT TREATMENT OF FLUIDS OR SOLIDS**

ENERGIERÜCKGEWINNUNGSVORRCHTUNG ZUR WÄRMEBEHANDLUNG VON FLUIDEN ODER FESTSTOFFEN

APPAREIL DE RÉCUPÉRATION D'ÉNERGIE ADAPTÉ AU TRAITEMENT THERMIQUE DE FLUIDES OU DE SOLIDES

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Description

[0001] The present invention refers to the technological sector of the thermal treatment and valorisation of solid or fluid materials, polluted or not polluted, such as gases, vapours, liquids, soils, rocks, sludges and industrial or civil wastes.

[0002] In the state-of-art, for the treatment of solid or fluid materials, polluted or not polluted, different technologies are well known: chemical, biological, thermal ones and their combination.

[0003] For polluted materials, the mechanical way normally has problems of both constructive difficulties and of plant dimensions, the chemical way could involve in additional problems tied to the use of chemical components that can generate chemical products having difficult environmental disposal. The biological way generally acts with time that often do not correspond to the industrial necessities, and thus presents limitations in the application. The thermal way presents plant complexity problems and efficiency problems.

[0004] In general, therefore, the solutions proposed and known by the state-of-art still have a lot of not solved problems such as plant complexity, chemical components dangerousness, long operative times, low flexibility.

[0005] In the state-of-art, for the thermal recovery different technologies are known such as heat exchangers of different kinds (concentric pipe, pipe-in-pipe, finned pipes, plates types, etc.).

[0006] However, still now the known solutions present numerous problems related to not desired and difficult-to-control chemical reactions, materials flows containing corrosive substances and/or powder formation during the treatment. These are events that could imply obstructions of parts of treatment apparatus, low rates of thermal exchange, elevated dimensions, and, also in this case, low flexibility.

[0007] The present invention intends to propose an energy recovery apparatus suitable for the thermal treatment of materials and able to solve state-of-art problems, in particular giving a simple plant solution, with high yield, high thermal exchange rate, reduced dimensions, to be used also locally on-site near the same areas where the polluted material to be treated has been generated.

[0008] This proposal of plant solution, concerning the energy recovery, permits both to heat a fluid by subsequent application and to rapidly remove heat from a fluid or from a plant zone in order to obtain a quick cooling of the affected zone, thus avoiding the continuation of not desired chemical reactions, favoured by high temperature values, such as the ones that brings to dioxins formation.

[0009] It is subject-matter of the present invention an energy recovery apparatus suitable for thermal treating fluids or solids, comprising:

- means for the first fluid inflow;
- a first containment chamber (2) for the containment of a first fluid, provided with a deflector (2') that develops itself in the chamber interior substantially along its whole length giving it the form of a first hollow annulus (or first interspace) (2");
- thermal exchange means for thermal exchange (3) between the first fluid and the second fluid or a solid, comprising a second chamber (5) for a solid or, for the second fluid, a second hollow annulus (or second interspace) placed in contact, externally or internally, with said containment chamber (2) of the first fluid and having parallel longitudinal symmetry axis preferably coinciding with the longitudinal symmetry axis of said containment chamber (2), said second hollow annulus being suitable for containing conduits that extend over at least one of the external wall of the containment chamber (2), in helicoidal form or in linear form with longitudinal symmetry axis parallel to the longitudinal symmetry axis of said containment chamber, which are suitable for making the second fluid flow, between entrance and exit, in equicurrent, in countercurrent or in equicurrent and countercurrent sequence with the circulation direction of the first fluid;
- means for the first fluid outflow;
- possible means for the treatment of emitted fluids or solids;

the means for the first fluid inflow being suitable for sending in equicurrent o in countercurrent with the circulation direction of the second fluid or of the solid, said means for the inflow and outflow of the first fluid comprising connections, as the containment means (2) and the heat exchange means, realised in metallic material resistant to high temperature, and the first chamber and the second chamber being made of materials resistant to temperatures in the range 200-1000°C.The containment chamber (2) suitable for making circulate fluids within itself is substantially cylindrical, or prismatic, and with longitudinal axis eventually incident with an horizontal axis.

[0010] The second hollow annulus is circular or polygonal and preferably forms the external wall of the containment chamber (2).

[0011] The means for the treatment of fluid emissions include at least a filter or a deduster or a cyclone.

[0012] Besides, the apparatus (1) can comprise:

- means for the inflow (4) of solids to be treated; and
- means for the emission (7) of treated solid material,

wherein the second chamber (5), suitable for making circulate inside solids, is substantially cylindrical, placed externally to said first containment chamber (2) and suitable to rotate around its longitudinal symmetry axis that is preferably parallel or coincident with the longitudinal axis of the first chamber (2) and forming an interspace (6) with the external wall of the first chamber (2).

[0013] In an embodiment of the apparatus for the treatment of solids, the means for the inflow of solid material are selected from the group containing screw conveyer, conveyer belt, pneumatic injectors.

[0014] In another embodiment of this apparatus, the longitudinal symmetry axis of the second chamber (5) is preferably incident with respect to an horizontal axis of an angle ranging between 0° and 2.5°.

[0015] In a further embodiment of the apparatus, the means of the inflow of the solid material include at least a gravity system.

[0016] It is further subject-matter a multi-modular apparatus for energy recovery, suitable for the thermal treatment of fluids and solids, with modules in series or in parallel, wherein each module is composed by the previously described apparatus in a mono-modular form.

[0017] The apparatus according to the invention can be used for the energy recovery associated to the thermal treatment of fluids or solids, wherein the cooling rate of the first fluid is in the range of 250°C/s to 3000°C/s, preferably larger than 300°C/s.

[0018] The use can provide that a fluid with high thermal exchange capacity of flows in the helicoidal form ducts.

[0019] This fluid with high capacity of thermal exchange can be a diathermic oil.

[0020] It is also provided according to the invention the use of the apparatus, in which the first fluid, comprising fumes from the post-combustion chamber or from the combustion of traditional combustibles, is introduced at linear flow-rate in the range of 15m/s to 50m/s, preferably 35-45m/s, and exit at a temperature value lower than 250°C.

[0021] The apparatus of the invention can be used in situations where solid materials, submitted under thermal treatment, polluted and not polluted, include industrial and civil sludges, industrial soils, rocks, mixture of sable and material of organic matrix such as paper, plastic and sewage.

[0022] During the use of the apparatus, that is subject-matter of the present invention, the temperature in the interspace between the first and the second chamber can be in the range of 200°C to 1000°C.

[0023] During the use for the treatment of solids, the rotation rate of the second chamber (5) is in the range of 1 to 20 rpm.

[0024] The use of the apparatus, in this case, can provide that the flowrate of the solid material to be treated is in the range of 50 to 5000 Kg/h, its permanence time is between 10 and 180 min and its dimension is between 0,1 and 50 mm.

[0025] The present invention will be deeper explained by the description of its embodiments, provided by way of illustration but not by way of limitation, with the help of the following figures.

Figure 1 schematically represents the longitudinal section of an embodiment of the apparatus according to the invention suitable for the fluid treatment.

Figure 2 schematically represents the longitudinal section of an embodiment of the apparatus according to the invention suitable for the solid treatment.

[0026] Referring to figure 1, the apparatus (1), proposed by the present invention, provides for its use a first hot fluid, generated for example by effluents post-combustion, coming from thermal treatment of organic material matrix (polluted and not), or generated by the combustion of traditional combustibles. This fluid is conveyed, through inlet connectors, to a containment chamber (2) where a deflector (2') of elongated form creates afirst hollow annulus (or first interspace) (2") and from where, subsequently, it flows out through exit link pipes. The external wall of the containment chamber (2) is realized using high thermal exchange elements (3) realized thanks to a hollow annulus constituted by helicoidal or longitudinal conducts inside which circulates a second fluid, that, in the proposed solution, is a diathermic oil. During the running, the hot fumes are introduced from the outside and, circulating in the containment chamber (2), lick the internal wall of the hollow annulus. They are rapidly cooled thanks to the action of the diathermic oil that circulates in countercurrent. The fumes, thus cooled, are subsequently emitted outside. The inlet and exit of the first and second fluid are indicated, but not referenced, in the figure.

[0027] Referring to figure 2, the apparatus (1), proposed by the present invention, provides, for its use, the inlet of the solid material to be treated, by means of a hopper (4) from where, subsequently, it goes in a rotating chamber (5). Inside this rotating chamber (5) a containment chamber (2) is positioned, that, as in figure 1, assumes the form of an interspace (second hollow annulus) by means of a deflector, and in which inside hot fumes are made circulating which have been obtained by post-combustion or traditional combustibles. In the interspace (6) between the external wall of the containment chamber (2) and the rotating chamber (5), the material to be treated is moved by means of the contact with the internal wall of the rotating chamber (5) and thermally treated, thanks to the thermal support mainly provided by the irradiation of the external wall of the chamber containing the fumes (2) and the conduction of the internal wall of the rotating chamber (5). Afterwards, the material is externally conducted by the suitable emission way (7).

[0028] In accordance with the subject-matter of the present invention, some embodiments of itself are illustrated in the following.

Example 1

[0029] For this embodiment, the apparatus according to the invention is utilised only in the part concerning the thermal exchange with the active use of the annulus containing a spiral-form duct, inside which the diathermic oil circulates.

[0030] The fluid to be cooled is represented by the off-gases at the exit of an electric furnace, containing dioxins precursors (general name of polychlorate organic compounds, highly toxic, that present in the molecular structure duple bonds conjugated between carbon atoms). The inlet fume flowrate is equal to 80000 Nm^3/h at an inlet temperature value of 600°C with a linear flow-rate 30 m/s. At the exit, the temperature value of the fume will be lower than 250°C thanks to the action of the thermal exchange of the oil that, after the contact with the off-gases, undergoes a temperature increase of about 100°C. In this manner, it is possible to simultaneously obtain a fluid at high temperature, that can be used as an additional energetic source, and a cooling rate of the fumes higher than 300°C/s (quencher), such that the realisation of a dangerous situation of the dioxin synthesis (De Novo) is avoided.

Example 2

[0031] Sludges (300 kg/h) of civil origin have been fed into the rotating chamber and have been treated by thermal way in order to dehydrate them and reduce the volume by means of fumes with a temperature value of 800°C at the inlet and 550°C at the exit and at a temperature of the internal wall of the rotating chamber equal to 400°C and at a temperature of the interspace equal to 450°C.

[0032] The rotating rate of the rotating drum has been of 9 rpm.

[0033] The permanence time of the civil sludge to be treated has been of 50 min.

Example 3

[0034] It has been fed into the rotating chamber, by means of a belt conveyer, a mixture of sand (40%), paper (20%), cartoon (20%) and plastic (20%) (100 kg/h) to be treated by thermal way with the aim of producing syngas and reduce its volume, using fumes at a temperature of 900°C at the inlet and of 700°C at the exit and at a temperature of the internal wall of the rotating chamber equal to 650°C and at a temperature of the interspace equal to 680°C.

[0035] The rotating rate of the rotating drum has been of 9 rpm.

[0036] The permanence time of the mixture to be treated has been of 40 min.

Example 4

[0037] It has been fed into the rotating chamber, having sloping axis of 1.5° with respect to the horizontal position, by means of a pneumatic injection system, polluted industrial soil (200 kg/h) containing dangerous organic materials (oils having 2% of poly-chloro-bis-phenils, PCB) that has been treated, with the aim of decontaminating it, using fumes at a temperature of 850°C at the inlet and of 600°C at the exit and at a temperature of the internal wall of the rotating chamber equal to 520°C and at a temperature of the interspace equal to 550°C and a temperature of treated material in exit of 450°C.

[0038] The rotating rate of the rotating drum has been of 12 rpm.

[0039] The permanence time of the material to be treated has been of 30 min.

Example 5

[0040] It has been fed into the rotating chamber, having sloping axis of 1° with respect to the horizontal position, by means of a belt conveyor injection system, calcareous rock (200 kg/h) that has been treated with the aim of transforming it in raw material, using fumes at a temperature of 600°C at the inlet and of 300°C at the exit and at a temperature of the internal wall of the rotating chamber equal to 400°C and at a temperature of the interspace equal to 450°C and a temperature of treated material in exit of 180°C. The so treated limestone can be used as inert material with bitumen for the production of asphalt.

[0041] The rotating rate of the rotating drum has been of 10 rpm.

[0042] The permanence time of the material to be treated has been of 30 min.

Claims

1. Energy recovery apparatus (1) suitable for the thermal treatment of fluids or solids, comprising:

   - means for the first fluid inflow;
   - a first containment chamber (2) for the containment of a first fluid, provided with a deflector (2') that develops itself in the chamber interior substantially along its whole length giving it the form of a first hollow annulus (2");
   - thermal exchange means for thermal exchange (3) between the first fluid and a second fluid or a solid, comprising a second chamber (5) for the solid or, for the second fluid, a second hollow annulus placed in contact, externally or internally, with said containment chamber (2) of the first fluid and having parallel longitudinal symmetry axis preferably coinciding with the longitudinal symmetry axis of said containment chamber (2), wherein in the thermal exchange between the first fluid and the second fluid, said second hollow annulus is suitable for containing conduits that extend over at least one of the external wall of the containment chamber (2), in helicoidal form or in linear form with longitudinal symmetry axis parallel to the longitudinal symmetry axis of said containment chamber (2), which are suitable for making the second fluid flow, between entrance and exit, in equicurrent,

in countercurrent or in equicurrent and countercurrent sequence with the circulation direction of the first fluid, wherein the second fluid is a diathermic oil and wherein the second chamber (5), suitable for circulating solids inside, substantially cylindrical, positioned externally to said first containment chamber (2), is suitable to rotate around its longitudinal symmetry axis preferably parallel or coincident with the longitudinal axis of the first containment chamber (2) and forming an interspace (6) with the external wall of the first containment chamber (2), the solids to be treated being moved by means of the contact with the internal wall of the rotating second chamber (5);
- means for the first fluid outflow;
- possible means for the treatment of emitted fluids or solids; the means for the first fluid inflow being suitable for sending in equicurrent or in countercurrent with the circulation direction of the second fluid or of the solid, said means for the inflow and outflow of the first fluid comprising connections, and the containment chamber (2) and the thermal exchange means being realised in metallic material resistant to high temperature, and the first chamber and the second chamber being made of materials resistant to temperatures in the range 200-1000 °C.

2. Apparatus (1) according to claim 1, wherein said chamber (2) suitable for the circulation of fluids in its inside is substantially cylindrical, or prismatic and with a longitudinal axis possibly incident with horizontal axis.

3. Apparatus according to claim 2, wherein said second hollow annulus is circular or polygonal and preferably forms the external wall of the containment chamber (2).

4. Apparatus according to claim 1, wherein said means for the treatment of the fluids emission include at least a filter or a deduster or a cyclone.

5. Apparatus (1) according to claim 1, further comprising:

- means for the inlet (4) of solids to be treated; and
- means for the emission (7) of treated solid material.

6. Apparatus according to claim 5, wherein said means for the solid materials inlet are selected in the group comprising: screw-conveyor, belt conveyor, pneumatic injectors.

7. Apparatus according to claim 5, wherein longitudinal symmetry axis of the second chamber (5) is preferably incident with respect to an horizontal axis with an angle between 0 and 2.5°.

8. Apparatus according to claim 5, wherein said means for the solid materials exit include at least a gravity system.

9. Energy recovery multi-modular apparatus, suitable for the thermal treatment of fluids or solids, with modules in series or in parallel, **characterized in that** each module is constituted by an apparatus according to claims 1 to 8.

10. Use of the apparatus according to any one of the previous claims 1 to 9, for the energy recovery associated to the thermal treatment of fluids or solids, wherein the cooling rate of the first fluid is in the range of 250 °C/s to 3000 °C/s, preferably it is higher than 300°C/s.

11. Use of the apparatus according to claim 10, wherein the first fluid, including fumes from the post-combustion chamber or from the combustion of traditional combustibles, is inlet at a linear flow-rate in the range of 15m/s to 50m/s, preferably 35-45m/s, and exit at a temperature lower than 250°C.

12. Use of the apparatus according to claim 10 or 11, wherein the solid materials, submitted to the thermal treatment, polluted or not polluted, include industrial or civil sludges, industrial solids, rocks, mixtures of sand and materials having organic matrix such as paper, plastics, sewage.

13. Use of the apparatus according to any one claims 10 to 12, wherein the temperature in the interspace between the first and the second chamber is in the range of 200° to 1000 °C.

14. Use of the apparatus according to any claim 10 to 13, wherein the rotation rate of the second chamber (5) is in the range of 1 to 20 rpm.

15. Use of the apparatus according to any claim 10 to 14, wherein the flow of the solid material to be treated is in the range of 50 to 5000 Kg/h, its permanence time is in the range of 10 to 180 min and its dimension is in the range of 0,1 to 50 mm.

Patentansprüche

1. Energierückgewinnungsvorrichtung (1) zur Wärmebehandlung von Fluiden oder Feststoffen, umfassend:

- Mittel zum Einströmen des ersten Fluids;

- eine erste Enthaltekammer (2) zum Enthalten eines ersten Fluids, versehen mit einem Abweiser (2'), der sich im Innenraum der Kammer im Wesentlichen entlang deren gesamten Länge entwickelt und dieser die Form eines ersten Hohlrads (2") verleiht;
- Wärmetauschmittel für den Wärmetausch (3) zwischen dem ersten Fluid und einem zweiten Fluid oder einem Feststoff, umfassend eine zweite Kammer (5) für den Feststoff oder für das zweite Fluid, ein zweites Hohlrad, das außenseitig oder innenseitig im Kontakt mit der Enthaltekammer (2) des ersten Fluids positioniert ist, aufweisend eine parallele Längssymmetrieachse, die vorzugsweise mit der Längssymmetrieachse der Enthaltekammer (2) übereinstimmt, wobei das zweite Hohlrad beim Wärmetausch zwischen dem ersten Fluid und dem zweiten Fluid geeignet ist, um Leitungen zu enthalten, die sich über mindestens eine der außenseitigen Wände der Enthaltekammer (2) in Schraubenform oder in linearer Form mit der Längssymmetrieachse parallel zur Längssymmetrieachse der Enthaltekammer (2) erstrecken, die geeignet sind, um zu bewirken, dass das zweite Fluid zwischen dem Eintritt und dem Austritt gleichläufig, gegenläufig oder in einer gleichläufigen und gegenläufigen Abfolge mit der/zur Zirkulationsrichtung des ersten Fluids strömt, wobei es sich beim zweiten Fluid um ein diathermisches Öl handelt und wobei die zweite Kammer (5), die für die Zirkulation von Feststoffen im Innenraum geeignet ist, im Wesentlichen zylindrisch und außerhalb der ersten Enthaltekammer (2) positioniert ist, geeignet ist, um sich rund um ihre Längssymmetrieachse vorzugsweise parallel zur oder übereinstimmend mit der Längsachse der ersten Enthaltekammer (2) zu drehen, und formend einen Zwischenraum (6) mit der außenseitigen Wand der ersten Enthaltekammer (2), wobei die zu behandelnden Feststoffe durch den Kontakt mit der innenseitigen Wand der rotierenden zweiten Kammer (5) bewegt werden;
- Mittel zum Ausströmen des ersten Fluids;
- mögliche Mittel zur Behandlung von ausgegebenen Fluiden oder Feststoffen,

wobei die Mittel zum Einströmen des ersten Fluids geeignet sind, um gleichläufig oder gegenläufig mit der/zur Zirkulationsrichtung des zweiten Fluids oder des Feststoffs zuzuführen, wobei die Mittel zum Einströmen und Ausströmen des ersten Fluids Verbindungen umfassen, und wobei die Enthaltekammer (2) und die Wärmetauschmittel aus Metallmaterial gefertigt sind, das gegen hohe Temperaturen beständig ist, und wobei die erste Kammer und die zweite Kammer aus Materialien bestehen, die beständig gegen Temperaturen im Bereich 200-1000 °C sind.

2. Vorrichtung (1) nach Anspruch 1, wobei die Kammer (2), die für die Zirkulation von Fluiden in ihrem Innenraum geeignet ist, im Wesentlichen zylindrisch oder prismatisch ist und eine Längsachse aufweist, die möglichst zu der horizontalen Achse einfallend ist.

3. Vorrichtung nach Anspruch 2, wobei das zweite Hohlrad kreisförmig oder vieleckig ist und vorzugsweise die außenseitige Wand der Enthaltekammer (2) formt.

4. Vorrichtung nach Anspruch 1, wobei die Mittel zur Behandlung der Fluidausgabe mindestens einen Filter oder einen Entstauber oder einen Fliehkraftabscheider einschließen.

5. Vorrichtung (1) nach Anspruch 1, zudem umfassend:

- Mittel für den Einlass (4) von zu behandelnden Feststoffen und
- Mittel für die Ausgabe (7) von behandeltem Feststoffmaterial.

6. Vorrichtung nach Anspruch 5, wobei die Mittel für den Feststoffmaterialeinlass aus der Gruppe ausgewählt sind, umfassend: Schraubenförderer, Bandförderer, pneumatische Injektoren.

7. Vorrichtung nach Anspruch 5, wobei die Längssymmetrieachse der zweiten Kammer (5) vorzugsweise einfallend zu einer horizontalen Achse mit einem Winkel zwischen 0 und 2,5° ist.

8. Vorrichtung nach Anspruch 5, wobei diese Mittel für den Feststoffmaterialienauslass mindestens ein Schwerkraftsystem einschließen.

9. Multimodulare Energierückgewinnungsvorrichtung für die Wärmebehandlung von Fluiden oder Feststoffen mit in Reihe oder parallel geschalteten Modulen, **dadurch gekennzeichnet, dass** ein jedes Modul aus einer Vorrichtung nach Anspruch 1 bis 8 besteht.

10. Verwendung der Vorrichtung nach einem der vorhergehenden Ansprüche 1 bis 9 für die Energierückgewinnung, assoziiert mit der Wärmebehandlung von Fluiden oder Feststoffen, wobei die Abkühlungsrate des ersten Fluids im Bereich von 250 °C/s bis 3000 °C/s liegt und vorzugsweise höher als 300 °C/s ist.

11. Verwendung der Vorrichtung nach Anspruch 10, wo-

bei das erste Fluid, das Abgase aus der Nachverbrennungskammer oder aus der Verbrennung herkömmlicher Brennstoffe einschließt, bei einer linearen Strömungsgeschwindigkeit im Bereich von 15 m/s bis 50 m/s, vorzugsweise 35-45 m/s, einströmt und bei einer Temperatur von weniger als 250 °C ausströmt.

12. Verwendung der Vorrichtung nach Anspruch 10 oder 11, wobei die Feststoffmaterialien, die verunreinigt oder nicht verunreinigt der Wärmebehandlung unterzogen werden, Industrie- oder Siedlungsschlämme, Industriefeststoffe, Gesteine, Mischungen von Sand und Materialien, aufweisend eine organische Matrix wie Papier, Kunststoff, Schmutzwasser, einschließen.

13. Verwendung der Vorrichtung nach einem der Ansprüche 10 bis 12, wobei die Temperatur im Zwischenraum zwischen der ersten und der zweiten Kammer im Bereich von 200° bis 1000 °C liegt.

14. Verwendung der Vorrichtung nach einem der Ansprüche 10 bis 13, wobei die Drehzahl der zweiten Kammer (5) im Bereich von 1 bis 20 U/min liegt.

15. Verwendung der Vorrichtung nach einem der Ansprüche 10 bis 14, wobei die Durchflussmenge des zu behandelnden Feststoffmaterials im Bereich von 50 bis 5000 kg/h liegt, dessen Verweildauer im Bereich von 10 bis 180 min liegt und dessen Größe im Bereich von 0,1 bis 50 mm liegt.

Revendications

1. Appareil de récupération d'énergie (1) adapté au traitement thermique de fluides ou de solides, comprenant :

- des moyens pour l'arrivée du premier fluide ;
- une première chambre de contenance (2), servant à contenir un premier fluide, pourvue d'un déflecteur (2') se développant lui-même dans l'intérieur de la chambre substantiellement le long de toute sa longueur en lui donnant la forme d'un premier espace annulaire creux (2") ;
- des moyens d'échange de chaleur pour l'échange de chaleur (3) entre le premier fluide et un second fluide ou un solide, comprenant une seconde chambre (5) pour le solide ou pour le second fluide, un second espace annulaire creux placé en contact, extérieurement ou intérieurement, avec ladite chambre de contenance (2) du premier fluide et ayant un axe de symétrie longitudinal parallèle coïncidant de préférence avec l'axe de symétrie longitudinal de ladite chambre de contenance (2), dans lequel dans l'échange de chaleur entre le premier fluide et le second fluide, ledit second espace annulaire creux est adapté pour contenir des conduits, qui se prolongent sur au moins une des cloisons externes de la chambre de contenance (2), de forme hélicoïdale ou de forme linéaire, avec l'axe de symétrie longitudinal parallèle à l'axe de symétrie longitudinal de ladite chambre de contenance (2), étant adaptés pour permettre au second fluide de s'écouler, entre l'entrée et la sortie, à co-courant, à contre-courant ou en séquence à co-courant et à contre-courant avec la direction de circulation du premier fluide, dans lequel le second fluide est une huile diathermique et dans lequel la seconde chambre (5), adaptée pour la circulation de solides en son sein, substantiellement cylindrique, positionnée extérieurement à ladite première chambre de contenance (2), est adaptée pour tourner autour de son axe de symétrie longitudinal de préférence parallèle ou coïncidant avec l'axe longitudinal de la première chambre de contenance (2) et formant un interstice (6) avec la cloison externe de la première chambre de contenance (2), les solides à traiter étant déplacés au moyen du contact avec la cloison interne de la seconde chambre en rotation (5) ;
- des moyens pour l'écoulement du premier fluide ;
- des moyens éventuels destinés au traitement des fluides ou des solides émis ;

les moyens pour l'arrivée du premier fluide étant adaptés pour l'envoi à co-courant ou à contre-courant avec la direction de circulation du second fluide ou du solide, lesdits moyens pour l'arrivée et l'écoulement du premier fluide comprenant des raccordements, et la chambre de contenance (2) et les moyens d'échange de chaleur étant réalisés dans un matériau métallique résistant aux températures élevées, les première et seconde chambres étant constituées de matériaux résistants à des températures comprises entre 200 et 1 000°C.

2. Appareil (1) selon la revendication 1, dans lequel ladite chambre (2), adaptée pour la circulation des fluides en son sein, est substantiellement cylindrique ou prismatique et avec un axe longitudinal éventuellement incident avec un axe horizontal.

3. Appareil selon la revendication 2, dans lequel ledit second espace annulaire creux est circulaire ou polygonal et, de préférence, forme la cloison externe de la chambre de contenance (2).

4. Appareil selon la revendication 1, dans lequel lesdits moyens destinés au traitement de l'émission de fluides incluent au moins un filtre ou un dépoussiéreur

ou un cyclone.

5. Appareil (1) selon la revendication 1, comprenant également :

- des moyens pour l'entrée (4) de solides à traiter ; et
- des moyens pour l'émission (7) de matériau solide traité.

6. Appareil selon la revendication 5, dans lequel lesdits moyens pour l'entrée des matériaux solides sont sélectionnés dans le groupe comprenant : un convoyeur à vis, une bande transporteuse, des injecteurs pneumatiques.

7. Appareil selon la revendication 5, dans lequel l'axe de symétrie longitudinal de la seconde chambre (5) est de préférence incident par rapport à un axe horizontal avec un angle compris entre 0 et 2,5°.

8. Appareil selon la revendication 5, dans lequel lesdits moyens pour la sortie des matériaux solides incluent au moins un système à gravitation.

9. Appareil multi-modulaire de récupération d'énergie, adapté au traitement thermique de fluides ou de solides, doté de modules en série ou en parallèle, **caractérisé en ce que** chaque module est constitué par un appareil selon les revendications de 1 à 8.

10. Utilisation de l'appareil selon l'une quelconque des revendications précédentes de 1 à 9, destinée à la récupération d'énergie associée au traitement thermique de fluides ou de solides, dans laquelle la vitesse de refroidissement du premier fluide est comprise entre 250°C/s et 3 000°C/s, de préférence supérieure à 300°C/s.

11. Utilisation de l'appareil selon la revendication 10, dans laquelle le premier fluide, incluant des fumées provenant de la chambre post-combustion ou de la combustion de combustibles traditionnels, entre à un débit linéaire compris entre 15 m/s et 50 m/s, de préférence 35-45 m/s, et ressort à une température inférieure à 250°C.

12. Utilisation de l'appareil selon les revendications 10 ou 11, dans laquelle les matériaux solides, soumis au traitement thermique, pollués ou non pollués, incluent des boues industrielles ou civiles, des matières solides industrielles, des pierres, des mélanges de sable et de matériaux comportant une matrice organique telle que le papier, les plastiques, les eaux usées.

13. Utilisation de l'appareil selon l'une quelconque des revendications de 10 à 12, dans laquelle la température dans l'interstice entre la première et la seconde chambre est comprise entre 200° et 1 000°C.

14. Utilisation de l'appareil selon l'une quelconque des revendications de 10 à 13, dans laquelle le taux de rotation de la seconde chambre (5) est comprise entre 1 et 20 tour/min.

15. Utilisation de l'appareil selon l'une quelconque des revendications de 10 à 14, dans laquelle le débit de matériaux solides à traiter est compris entre 50 et 5 000 Kg/h, son temps de permanence est compris entre 10 et 180 minutes et ses dimensions comprises entre 0,1 et 50 mm.

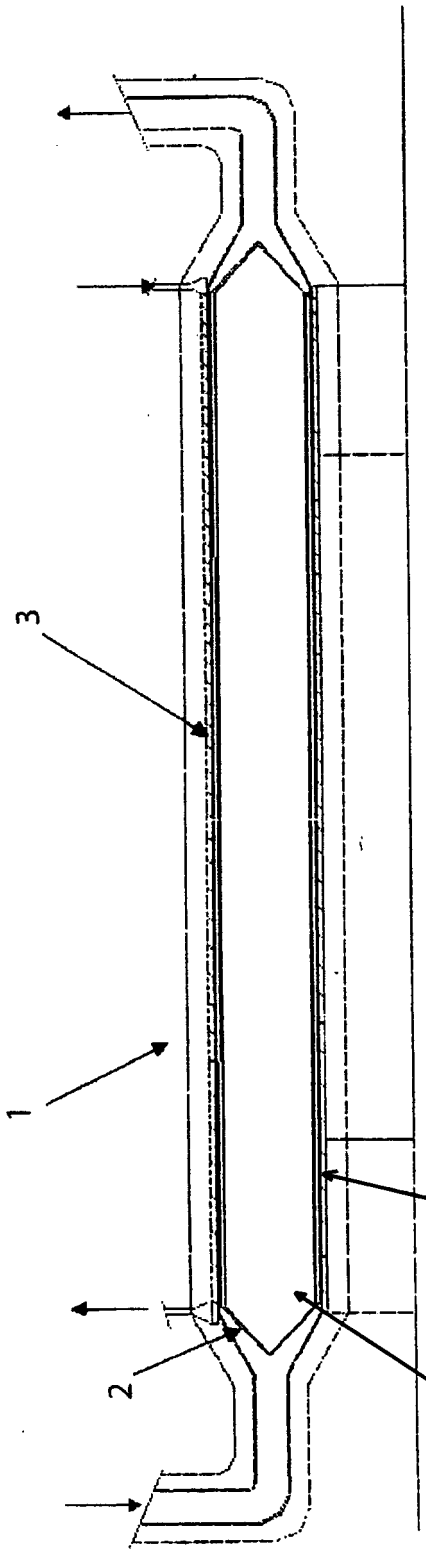

Fig. 1

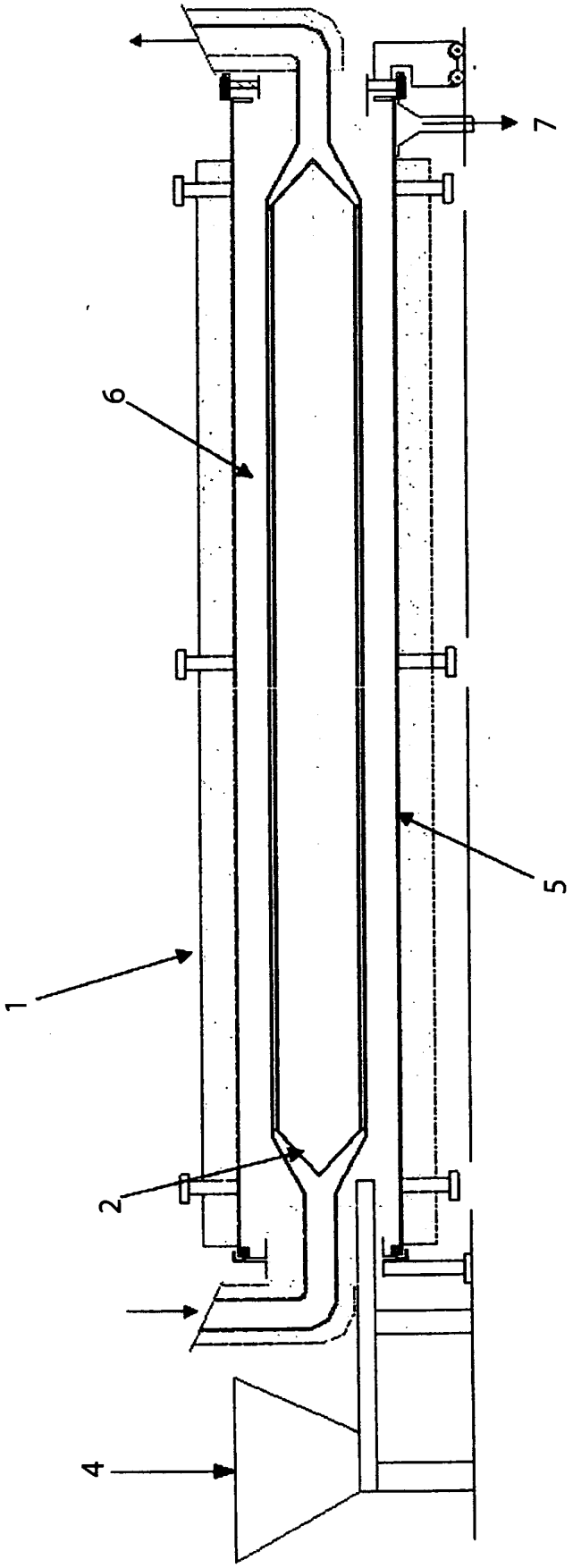

Fig. 2