

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11)

EP 1 669 709 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:

14.06.2006 Bulletin 2006/24

(51) Int Cl.:

F27B 1/24 (2006.01)

F23M 5/00 (2006.01)

F27D 1/10 (2006.01)

(21) Application number: **04425914.1**

(22) Date of filing: **13.12.2004**

(84) Designated Contracting States:

**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IS IT LI LT LU MC NL PL PT RO SE SI SK TR**

Designated Extension States:

AL BA HR LV MK YU

(71) Applicant: **Terruzzi Fercalx S.p.A.**

20121 Milano (IT)

(72) Inventors:

• **Terruzzi, Daniele Maria**
24050 Spirano (Bergamo) (IT)

• **Humfeldt, Udo**
24050 Spirano (Bergamo) (IT)

(74) Representative: **Siniscalco, Fabio et al**

Jacobacci & Partners S.p.A.

Via Senato, 8

20121 Milano (IT)

(54) Beams for kilns processing lumpy materials

(57) The invention is referred to support/protection elements (26) that can be used in kilns (1) for the calcination and sintering of materials in lumps such as limestone, dolomite and likely. In particular the invention is related to a support/protection beam and/or a burner beam and/or a beam for combustion gases discharge and/or combustion air suction beam, said beam being cooled by means of diathermic oil.

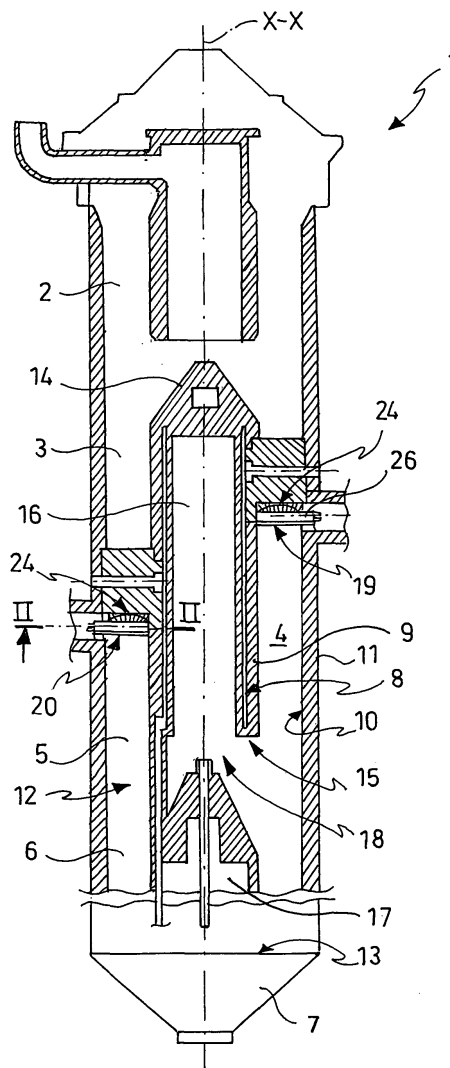


FIG.1

EP 1 669 709 A1

Description

[0001] The present invention is directed to elements to support/protect the bridges of combustion chambers in kilns for the processing of lumpy materials. With the terms material in lumps, it is intended any coarse material, of different sizes made of stone with high content of calcium carbonate, magnesium calcium carbonate or dolomite. In particular, the invention is directed to supporting/protecting devices that can be used in kilns for the calcination (burning) of lumpy materials such as limestone, dolomite or likely.

[0002] The treatment of the above materials in lumps for the production for example of quicklime, or generally, for the dissociation of volatile elements present in a solid substance, is known that is made in calcination kilns where the material is treated by heat.

[0003] In particular, the materials in lumps like limestone, dolomite or likely can be charged from the top of a kiln for example, ring shaft type, which is substantially a vertical axis. The materials are passed in succession from top to bottom, through a pre-heating zone, a calcining zone where two or three combustion chambers, preferably in counter-current, where in its lower part the first level of combustion chambers equipped with burners are foreseen against the circumferential wall of the kiln, a second calcining zone, preferably in counter-current where in its lower part the second level of combustion chambers equipped with burners are foreseen against the circumferential wall of the kiln, an eventual third combustion zone, a homogeneization zone in co-current where the recycling gas moves down, by the effect of the injectors, in the same moving direction of the materials coming down from the calcining zone, a cooling zone in counter-current and a discharging zone for the calcined material.

[0004] The calcination zone is therefore extended longitudinally on the vertical axis of the kiln and is equipped with several combustion chambers installed radially in series and on more levels. In particular, the combustion chambers are made out by a circular part external to the shaft and by a part internal to the shaft having a substantially pyramidal shape with the upper part usually made of refractory bricks, and the supporting part made by a bridge structure, that defines the calcination zone. When the lime kiln is charged with the material to be burnt, and therefore almost the complete shaft is filled with the material, the lumps are standing around the bridges, between the top and the lower part, and while the calcination is performed, flow down to the further level of the calcinations zone. The function of the bridges of the combustion chambers is that to support the load of the material to be treated, usually very high, in addition to its own load of the upper part.

[0005] Furthermore, the bridges are usually made with three overlapped arches of refractory material, of which one is delimits the vault of the combustion chamber and is therefore at direct contact with the hot combustion gas-

es.

[0006] The arch that forms the vault of the bridge is therefore constantly subjected to very high temperatures. After a certain period of time that can be of variable extent, and even of only few months, it must be replaced because of the severe wear. Infact such wear of the arches shall have the consequence of the falling down of the complete bridge because of the lack of supporting to the bridge itself. It is evident that the result of the falling down of the bridges with damages to the kiln has the consequence to avoid completely the operation of the kiln itself.

[0007] The technical problem which is the ground for the present invention is exactly the necessity to find a system to avoid the said heavy inconvenient.

[0008] Such problem is solved by the use of elements to support/protect the bridges of the combustion chambers in kilns for the treatment of materials such as limestone or dolomite that should be particularly resistant to the wear due to the exposure to high temperatures.

[0009] A first object of the present invention is therefore that to provide a device suitable to support/protect as listed in the attached claims.

[0010] A second object of the present invention is that to provide a kiln for the treatment of limestone, dolomite and likely having a supporting/protecting device as above described.

[0011] Further characteristics and the advantages of the present invention shall become more evident from the following description related to an embodiment that is given as typical example without any limitation with reference to the figures listed hereafter;

- the figure 1 represents a side view in sections of a kiln for the treatment of lumpy materials incorporating supporting/protecting elements according to the invention;
- the figure 2 represents a view of a particular of a section along the line II-II of the kiln of figure 1;
- the figure 3 represents a section along the line III-III of figure 2;
- the figure 4 represents a section view along the line IV-IV of figure 2;
- the figure 5A represents a transversal section perspective view of a detail section of a supporting/protecting device according to the invention;
- the figure 5B represents a transversal section perspective view of a detail section of part of the device represented at the figure 5A;
- the figure 5C represents transversal section view a prospective of the device represented at the figure 5B;
- the figure 5D represents a longitudinal section view of the device as represented in the figure 5B, complete of the cooling fluid circulation;
- the figure 6A represents a transversal section view of a supporting/protecting device according to a first variant of the invention;
- the figure 6B represents a longitudinal section side

- view of the device represented at the figure 6A;
- the figure 7A represents a transversal section view a supporting/protecting device according to a second variant of the invention;
- the figure 7B represents a longitudinal section view representing the device of figure 7A;
- the figure 7C represents a plan section view from the bottom representing the device of figure 7B;
- the figure 8 represents a scheme of the cooling circuit of the supporting/protection devices of the invention.
- the figure 9 represents a transversal section view of a device in accordance with a third variant of the invention.

[0012] With reference to the figure 1, a kiln for the calcination of lumpy material like limestone or dolomitic is represented as a general example. The kiln is preferably of the annular shaft type, but can be also a shaft kiln with circular, square or rectangular section, or a double shaft kiln or a regenerative kiln.

[0013] The kiln 1, well-known in the art, extends along a vertical axis X-X and comprises, from the top to the bottom, a preheating zone 2 where the material to be calcined is fed to the kiln through conventional devices (not shown), a calcining zone in counter - current, where two levels of, upper 3 and lower 4, combustion chambers with burners are arranged against the circumferential wall of the kiln, a homogenisation zone 5 in co-current where the recycling gas moves down, by the effect of the injectors (not shown), in the same moving direction of the materials coming down from the calcining zone, a cooling zone 6 in counter current and a discharging zone 7 for the calcined materials. A kiln of this type is described for example in the German Patent DE 3140582 here mentioned as reference.

[0014] A piece of shaft, named 8, is inserted inside the kiln in the way which is known, for example in the German Patent DE 3140582. An annular shaft 12 where the material to be calcined flows through the kiln from top to the bottom is made between the external wall 9 of the piece of the shaft named 8 and the internal surface 10 of the external wall of the kiln 11. The piece of shaft named 8 is then closed to its bottom end by a wall 13 and to its upper end by a cover 14, having for example a conical shape. Furthermore, the piece of shaft named 8 is divided through a transversal wall 15, in an upper inner cylinder 16 and in a lower cylinder 17. In particular the upper section 16 separates the above mentioned burning zones, while the lower section 17 is connected to the annular shaft 12 through the openings 18 for the cooling air (in the figure 1 only one is represented).

[0015] Furthermore, to each one of the burning zones, first 3 and second 4 a corresponding first 19 and second 20 combustion chamber is associated. In particular. These combustion chambers are positioned at the bottom of each of the burning zone and in a manner that the combustion gases that are produced in the chamber flows at the side and upstream in the burning zones, in

a conventional way.

[0016] As better represented in the figures 2-5 the combustion chambers first 19 and second 20 are delimited and separated by the corresponding burning zones through a pyramidal structure 22.

[0017] In particular, the pyramidal structural 22 includes an upper part 23 and a vault part 24 (figure 5).

[0018] A particular advantageous according to the present invention is that the vault part 24 has a series of arches 25 that, instead to be beard on the side on supports of the internal wall of the kiln according to the well-known method, are bearing on supporting/protection devices 26.

[0019] Each of the combustion chambers first 19 and a second 20 is normally equipped with burners (not shown in the Figure 1-5) of conventional type, preferably fed with gaseous fuels, liquid fuels and/or pulverized solid fuels, installed on the external surface of the kiln 1 at the inlet 27 of the combustion chambers or on their sides.

[0020] The supporting/protection devices 26 are preferably beams that are extended lengthwise along one axis Y-Y, as better represented in the figure 5B. The beams 26 are installed radially, two for each bridge, with their axis Y-Y substantially perpendicular to the axis X-X of the kiln itself, as represented in the figure 2. Furthermore, the beams are inserted in the combustion chambers in a way to bear with the distal end 28 on a housing 29 made in the internal refractory wall of the kiln 1, and with the proximal end 30 on a floor 31, horizontal to the external wall of the kiln, made nearby the inlet 27 of the combustion chambers (figure 3).

[0021] As represented in the figure 5A, the beams 26 have a transversal T section with a head 32 and a body 33. Both the head and the body are equipped with jackets 34 to allow the flowing of a cooling fluid. The cooling fluid could flow in the jacket following any type of path, preferred or chosen according to the particular necessities, such as, for example that one represented by the arrows in the figures 5C and 5D.

The central part of the body 33 of the beams 26 can advantageously house burners, preferably burner lances 35 as better shown in the figure 5B, in tailored hollows 36 having the function to house a variable quantity of burners. The hollows 36 can be more than one and, as better represented in the figure 5A, each one is separated by a longitudinal vertical baffle 37. The burner lances 35 include burner pipes 38 that are extending inside the beams 26 parallelly, preferably one over the other one. The pipes 38 can be preferably embodied by hollows 39 having the function to allow the flow of the combustion air for each individual burner lance or set of burner lances in order to obtain a better control of the air distribution in addition to the possibility to measure constantly and regulate the flow. In particular, the combustion air is forced inside the beams through openings (not shown) positioned preferably on the bottom side towards the kiln 1 and follow a path similar to that one that is described after with reference to the figures 7A and 7B. Alternatively the

openings can be used for the recycling of combustion gases.

[0022] The burner lances 35 or the hollows 39 are bearing both to the baffle 37 through spacers and to the bottom part of the same hollow 39 through a set of wheels 60 (represented in the figure 5B) that allow the advantage to insert and extract the set of lances 35 and hollows 39. Furthermore, the pipes can be equipped in side the hollows with spacers 41 in order to avoid the contact between the pipes and walls of the hollows.

[0023] As represented in the figure 5B, the burner lances 35 have one end 42 opened that are positioned where there are corresponding openings 43 to the external wall of the beams 26; these openings 43 are located in different positions along the beams in order to allow the fuel to exit from the beam itself in several points and penetrate inside the kiln in prefixed points. In this way, the mixing air/fuel can be uniformly distributed along the beam.

[0024] The beams 26 are successfully realized with high temperature resistant steel, or steel that can resist to the operating temperature of the kiln 1. In reality that type of steel can resist to temperatures between 200°C and 300°C because the cooling system, hereafter described, permits to keep constant this temperature of the beams. In any case such steel are well-known in the field as quality unalloyed steel, special unalloyed steel and special alloyed steel. All these types of steel are suitable to resist to the above temperatures and to bear remarkable loads so that show a mechanical strength suitable to the use such as beams in a kiln as that one above described.

[0025] In particular, steel that can satisfy the above necessities are for example that one identified with the code P275N (No. 1.0486), P275NH (No. 1.0487), P275NL1 (No. 1.0488) o P275NL2 (No. 1.1104).

[0026] As above described, the beams 26 are advantageously cooled with a cooling fluid through a circulation system. Preferably, the fluid is a diathermic one such as water, mineral, vegetal or synthetic (MONSANTO) oils, biphenyl and derivate, tetra-aril silicate, mixing of melted salts, liquid products such as glycerin, silicone, derivate from the naphthalene, more preferably diathermic mineral oil. Among the oils, those that are particularly preferred are the mineral diathermic oils used for the cooling of boilers, heat exchangers or similar. Examples of these oils are that one available on the market with the commercial brands ESSOTHERM 300 (ESSO), TEXATHER 46 (TEXACO) e SHELL THERMIA OIL B.

[0027] The cooling fluid circulates under pressure in the above mentioned jackets 34 of the beams 26 in order to keep a beam temperature not above 300°C. The fluid has therefore the function to remove the heat produced by the combustion and consequently keep the beams under the best preservation and operating conditions.

[0028] An example of circulation of the fluid in the jackets 34 of the beams 26 is represented by the arrows in the figure 5C and 5D.

[0029] In particular, an example of the circuit to feed

the oil to the beams and its recycling is represented in the figure 8. The circuit is made with a first heat exchanger 44' for example a tube type, finned or not equipped with a fan 45', with heat recovery (as shown by the inlet/outlet arrows to the heat exchanger 44') and of a second heat exchanger 44, for example finned type heat exchanger with fans 45 for waste air (or recovering). Both the heat exchangers allow to draw the heat removed from the above mentioned beam in a conventional way.

[0030] Then the oil passes through a filter, which is not shown but it is a conventional type, that keep the oil free from impurities.

[0031] Downstream the filter a small decanter, not shown, can be foreseen in order to eliminate the possible last residual present in the oil, and create a turbulence free zone to facilitate the operation of the oil circulation pumps.

[0032] Downstream the decanter the pumping group 46 is foreseen made with two centrifugal pumps, each one equipped with electric motor and an additional pump with diesel motor (all the three pumps are installed in parallel with respect to the inlet, in order to assure the same pressure and flow to the outlet collector). The system is normally into operation with only one of the two electric pumps working (the other one is in stand-by and is switched on in case the pressure or flow of the oil is reduced). The diesel pump is switched on in case of electric black-out with consequent stop of the electric pumps: in this way the life of the beams is preserved, keeping the oil circulation to the beams, supporting their cooling and therefore assuring the integrity.

[0033] From the delivery side of one of the pumps a pipe 48 feeds the inlet collector 49 from where the primary piping 50 starts to reach one of the beams 26 for each couple. The fluid is circulated through secondary piping 51 to a beam positioned on a different level. After, a third piping 52 takes back the fluid to the second pump of the first couple at the outlet of this second beam, the fluid is taken with fourth piping 53 to the second beam of the different level. Finally, a fifth piping 54 brings the fluid into a outlet collector 55 and through a return piping 56 to an heat exchanger 44'.

[0034] It is to be underlined that this particular circuit allows to keep advantageously a reduced flow of the cooling fluid, and in particular the diathermic oil, with the consequent saving in the total amount of fluid circulating and efficiency of the complete system.

[0035] An expansion tank 47 of the oil is installed at the top of the kiln in order to keep a constant head on the pumping group and furthermore allows to compensate the slight volumetric expansions of the oil that are due to the temperature difference from the ambient one, to the operating temperature of about 200°C.

[0036] Finally a storage tank 48' installed at the ground level assures a continuous oil reserve for the circuit and furthermore allows, in case of stop of the kiln for maintenance (for example replacement of the beams, etc.), to have a collecting tank for the oil contained in the circuit.

[0037] It is necessary to keep into consideration that the above described cooling circuit is subject to modifications because of necessities and preferences. For example, the piping branches can foresee first piping that reach one beam of a couple of the same level, second piping that bring the fluid to the other beam of the same couple of the same level, third piping that brings the fluid to a first beam of a couple of different level and fifth piping that bring the fluid to the outlet collector.

[0038] The above first heat exchanger 44' can also be eliminated in case that it is not intended or it is not necessary to recover the heat that could be recycled into the kiln in accordance with conventional systems.

[0039] Further modifications to the oil circuit are in any case available to engineers of this field.

[0040] The complete system is normally operating in automatic mode with conventional PLC.

[0041] Different configurations for the realization of the beam 26 above described are represented by the figure 6A and figure 6B.

[0042] In particular, the beams 126 correspond, from the construction point of view, substantially to half of to the beams 26, or to one of the two sections separated by the longitudinal vertical baffle 37; for this reason these beams are not described hereafter into details, and the identical reference numbers to that one indicated in the figure 5A-5D represents identical pieces or portions.

[0043] The advantage deriving from the use of the beams 126 consists in the fact that with this particular structure the combustion gases can be produced from one side of the beam only, and in particular from the side towards the external of the combustion chamber. Consequently, for particular applications where it is sufficient to have burner lances on one side of the beam only, this allows to simplify advantageously the realization of the complete plant and to reduce the size of the beams, increasing the surface treatment and reduction of the consumptions.

[0044] Furthermore, a type of beam similar to that one above described, can be also used in kiln having circular, square or rectangular section, and not annular, where the immersed beams that across the kiln section and that are near to the walls of the kiln, can avoid the installation of useless burner lances against the wall and foresee only those towards the center of the kiln. The necessity to have external and/or peripheral burners than penetrate inside the limestone bed is also eliminated.

[0045] In accordance with a further embodiment of the invention, a beam 226 similar to the beam 26 of the figure 5C, but without the head 32, the baffle 37 and the burners 3, is represented in the figure 7A and 7B.

[0046] In particular, the beam 226 has a section which is almost rectangular, with a jacket system 234 substantially identical to that one described before. Furthermore, the central part has an hollow 261 suitable to allow the circulation of hot air and/or exhaust gases in order to create a suitable recycling system. Infact, the beam 226 can be equipped with openings 262 put on the side to-

wards the bottom of the kiln, through whom hot air is forced with conventional method (suitable fans) that flows through the hollow 261 up to the two ends of the beam to reach the burners and obtain the best combustion.

[0047] The combustion gases can be alternatively sucked also internally to the beam and follow the same circuit route just mentioned before, but being fed to a conventional recovery system.

[0048] Furthermore, the beam 226 can be realized without the openings 262 and simply operating as supporting/protection device to the vault of the combustion chambers, cooled with the above mentioned cooling system.

[0049] A further function of the beam 226 can be that one to be suction beam, also cooled as previously described, and that can be installed at the limit of the post-combustion zone also in the type of shaft kilns where the beams are extended across their full cross section and are immersed in the material to be treated.

[0050] The beams object of this invention can be preferably lined with insulating and refractory materials, for example bricks and/or castable materials, in order to eliminate the contact between the limestone, in the calcination zone, and the beam surface which is relatively cold. Infact, a similar contact in the operative conditions of the kiln could bring the limestone in contact with the beams and suffer a principle of cooling and in any case of different operative conditions compared to that one where the limestone is not in contact with the said beams.

[0051] The beams can be installed in different quantities and with two ways of distribution: on the same vertical axis for each level of the combustion chamber, or staggered with respect to the vertical axis for each of the two levels. Infact the solution with the beams installed on the same vertical axis allows that the very hot combustion gases produced by the combustion of the lower level of calcination come into contact, in counter-current, with the quicklime already completely calcined in the upper calcination level, allowing in this way a thickening of the crystal structure, that is linked to the reduction of the specific surface, obtaining in this way a reduced reactivity of the lime.

[0052] It is also necessary to keep into consideration that the flow rate of the fuel, whichever is the type - gaseous, liquid and pulverized solid - is advantageously controlled and measured in automatic mode for each set of burner lances, and automatic or manually for each individual burner lance. In case of gaseous fuel it is a system with regulating valves that are controlled by a PLC, as previously indicated. In particular, the PLC system regulates the fuel gas flow rate opening and closing the valves according to the set points. This system operates by means of sensors that transmit a signal to the control system that will constantly compare the signal received with the set points and will operate with the emission of a regulating signal that will drive a suitable device for the opening or closing of the valves. In case of liquid fuel dosing pumps shall be used, while in case of pulverized

solid fuels shall be used dynamic dosing system and static system for the repartition; both of conventional type such as rotary valves, screw conveyors or splitters, and operating and regulated under the PLC. Also the combustion air flow rate is regulated by means of regulating valves and measured with suitable instrumentation. These systems, all operated and regulated by the PLC system allow to regulate the fuel and air quantity for each burner in order to obtain a different distribution in the kiln of both the calories and the excess air. This is the condition, together with the different degrees of negative and/or positive pressure that can be obtained inside the kiln, in order to produce high reactivity material, up to the sinterized material and therefore all the intermediate qualities.

[0053] As before described, the beams in accordance with the present invention can be advantageously cooled with different types of fluids, according to the preference and particular necessities.

[0054] Infact, in a ring shaft kiln as described before, it is possible to use any type of fluid, preferably demineralized water, more preferably diathermic oil (mineral type), as that specified before. For shaft kilns with immersed beams the use of mineral diathermic oil is for sure the best solution.

[0055] Infact, water cooling system implies the use of pipes and valves having a much bigger size compared to that one used in a oil system, and the necessity to use demineralized water to avoid inconvenient and calcium carbonate deposits. This implies that the equipment require larger sizes and higher operating costs.

[0056] On the other hands, the smaller dimensions of the diathermic oil allows to simplify the plant with piping and valves of smaller sizes because of compacts components and equipment. Furthermore, the operating costs of the complete plant are dramatically reduced because the diathermic oil is replaced after years of operation.

[0057] In addition to this, the use of diathermic oil allows the heat recovery through heat exchangers to pre-heat the combustion air, increasing consequently the kiln efficiency.

[0058] In any case, the surprising advantage that is obtained having selected beams with diathermic oil, is that is possible to obtain important reduction in the oil jacket of the beams. Consequently, the treatment of the lumpy material is, from the point of view of the process, much more efficient since the reduced size of the beam inside any type of kiln for the burning of lumpy materials increases the working surface and the kiln capacity or, in any case, implies a benefit the descending of the material inside the kiln. In particular, it has been detected that the flow rate of the cooling fluid and the section of the jackets for the cooling fluid can be reduced by 30% compared to conventional fluids.

[0059] Of course, the skilled man in the art can apply to the supporting/protection devices according to the present invention, further modifications and embodi-

ments in order to satisfy peculiar and specific necessities, but all within the protection of the present invention, as defined in the enclosed claims.

[0060] For example, the shape, dimensions and thickness of the beams could be subject to modifications according to specific structural conditions, but in any case able to operate according to what above described. In particular, the dimensions and the thickness could be increased in case that the arches of the bridges that support the upper part of the combustion chambers will be completely eliminated or be present in a variable quantity according to the particular necessities and /or conditions.

[0061] The number, the position and the type of the burners inside the beams, in particular the burner lances, could be subjected to modifications according to some special exigencies. For example, it can be foreseen burner lances whose outlet hole of the fired fuel is positioned on the beams body at level of the parallel side respect to the beams head. In this case, it is possible also to use a pulverized fuel according to conventional methods. Furthermore, as explained previously, the beams in subject can be adapted by the technician to kilns of different type such as for example the shaft kilns annular, circular, square or rectangular type and the type in which the beams are immersed in the bed of material to be treated, without the support function above described.

[0062] In addition, the beams can be positioned inside the kiln according to the schemes above specified or in a different way. For example the beams can be positioned radially on one or two levels corresponding to one or two combustion chambers according to the type of kiln and/or to the kind of treatment to be carried out. Of course, in this case the beams can be modified dimension wise and shape wise as above indicated.

[0063] In accordance with a further embodiment of the invention, in Figure 9 a beam 326, concerning shape and section basically identical to the beam 226 in Figure 7A, comprises a cavity 361 in which a series of burner lances 335 are housed. Preferably, the burner lances 335 are surrounded by chambers 339 identical to the ones described in Figure 5A. In particular the burner lances 335 show their open end 342 positioned in correspondence to the holes 343 obtained in the external wall of the beams in correspondence to the side towards the kiln bottom. This particular position is used in case pulverised fuel is utilized. In addition the series of burner lances 335 lay and slide inside the cavity 361 thanks to wheels 360 identical to one described in Figure 5B.

[0064] Notice the advantage that the beam 326 can be double, which means it can house 2 series of burner lances 335 in the cavity 361 separated by a baffle identical to the one described in Figure 5A.

[0065] The advantage of this further variant is that the combustion capacity can be doubled especially when pulverised fuel is used.

[0066] From the above description it comes clear that the beams shape, the presence or not of burners and their position inside the mentioned beams, can be mod-

ified according to specific exigencies that the skilled man in the art can easily carry out.

[0067] For example, the wheels 60, 360 can slide on a insertion plan inside the cavity 39,339 of the beams 26, 326 which ends with a descending ramp to indicate the reaching of the correct working position of the burner lances as well as to avoid their accidental outlet from this correct position. Alternatively, the wheels can slide on a proper rail lifted above the bottom of the cavity where the burner lances are housed.

Claims

1. Beam (26;126;226;326) of a kiln (1) for the burning of materials in lumps to be positioned at level of the treatment zones (2,3,4,5,6) of the kiln, **characterized in that** it comprises an oil cooling circuit.
2. Beam (26;126;226;326) according to the claim 1, in which the oil cooling circuit comprises jackets (34) obtained along the peripheral zone of the beam that allow the passage of cooling oil so to remove heat from all the beam surface and maintain constant the optimal operation temperature of the beam.
3. Beam (26;126;226;326) according to the claim 1 o 2, in which the beam has been chosen among a supporting/protection beam, a burner beam, an exhaust gases discharge beam, a combustion air suction beam and a beam resulting from any combination of the previous beams.
4. Beam (26;126;226;326) according to any of the claims from 1 to 3, in which the beam elongates lengthwise along an axis (Y-Y) and comprises at least one cavity (36;261;361) suitable to permit the passage of combustion air and/or of exhaust gases and/or to house burners (35;335).
5. Beam (26) according to the claim 4, comprising two cavities (36) separated by a vertical longitudinal baffle (37), where in both of them at least a burner is housed (35).
6. Beam (26) according to the claim 4, in which at least one burner (35) is singularly or in group surrounded by a chamber (39) that allow the passage of combustion air.
7. Beam (26) according to the claim 6, in which the chamber (39) is connected to the baffle (37) by means of spacers (40).
8. Beam (26) according to any claim from 6 to 7, comprising spacers (41) between the burners (35) and the chambers walls (39).
9. Beam (26;326) according to any claim from 5 to 8, comprising wheels (60;360) that allow the insertion and the extraction of the burners (35;335) in the beam.
10. Beam (26;126;226;326) according to any claim from 4 to 9, in which the burners (35;335) have the shape of lances which elongate on the beam longitudinal axis (Y-Y) and finish at different distances along this axis.
11. Beam (26;326) according to the claim 10, in which the lances (35;335) comprise piping (38) with open ends (42;342) in correspondence of holes (43;343) obtained in the beams walls in different positions along their longitudinal axis.
12. Beam (26) according to any claim from 4 to 11, in which the crossing section has substantially a T shape with a head (32) and a body (33).
13. Beam (26) according to claim 12, in which the head (32) of the beam houses jackets (34) connected with jackets (34) housed in the body.
14. Beam (26) according to the claim 13, in with the body (33) of the beam comprises at least a cavity (36) surrounded by the jackets (34).
15. Beam (26;126;226) according to any claim from 4 to 14, comprising crossing holes (62;262) suitable to allow the passage of combustion air or exhaust gases from outside to inside of the beam.
16. Beam (126) according to any claim from 4 to 14 and 15, in which its crossing section substantially has a half T shape comprising a cavity (36) suitable to house burners (35) whose ends (42) are open only on one side of the half T.
17. Beam (226) according to any claim from 4 to 14 and 15, in which its crossing section substantially has a rectangular shape with a cavity (261) for the passage of combustion air or exhaust gases delimited by jackets (34) for the cooling oil passage.
18. Beam (26;126;226) according to any claim from 1 to 17, with the characteristic to be manufactured with unalloyed quality steel, unalloyed special steel or special alloyed steel.
19. Beam (26;126;226) according to the claim 18, in which the above mentioned steel is chosen among steel P275N, P275NH, P275NL1 o P275NL2.
20. Beam (26;126;226) according to any claim from 1 to 19, in which the cooling oil is a diathermic oil used for the cooling of boilers, heat exchangers and sim-

ilar ones.

21. Beam (26;126;226) according to the claim 20, in which the above mentioned oil is chosen between vegetal oils, mineral oils and synthetic oils. 5
22. Beam (26;126;226) according to the claim 21, in which the oil is a diathermic mineral oil chosen among the oils sold with the commercial name ES-SOTHERM 300, TEXATHER 46 e SHELL THERMIA OIL B. 10
23. Beam (26;126;226) according to any claim from 1 to 22, comprising an external lining composed of insulating material, preferably of refractory type. 15
24. Beam (26;126;226) according to any claim from 1 to 23, comprising moreover a fuel flow rate regulation system comprising regulating valves and dosing pumps. 20
25. Beam (26;126;226) according to any claim from 1 to 23, including moreover a fuel flow rate regulation system with a dosing dynamic system and a distribution static system. 25
26. Beam (26;126;226) according to the claim 24 or 25, comprising moreover combustion air flow rate regulation valves controlled by a proper device. 30
27. Beam (26;126;226) according to the claim 26, comprising a combustion air measurement device. 35
28. Kiln (1) for the burning of the material in lumps including at least a burning zone (3,4) to which is joined at least a combustion chamber (19,20) provided with a vault structure (24), **characterised in that** the vault part is supported/protected by a beam according to any one of claims from 1 to 27. 40
29. Kiln according to the claim 29, in which the kiln is a shaft kiln with annular, circular, square or rectangular section, a double shaft kiln or a regenerative kiln. 45
30. Kiln for the burning of lumpy material such as limestone or dolomite, of the shaft type with circular, square or rectangular section elongating on a vertical longitudinal axis, comprising from the upper part towards the bottom a pre-heating zone, at least a burning zone, a cooling zone and a discharge zone, **characterised in that** these zones include at least a beam (26;126;226;326) according to any one of claims from 1 to 27, which crosses completely the cross section of the kiln so to be immersed in the material to be treated. 50
31. Kiln (1) according to the claims 28, 29 or 30, in which the beam (26;126;226;326) is placed radially in cou-

ples of two by two at one or more levels along the longitudinal vertical axis (X-X) of said kiln so that their longitudinal axis (Y-Y) substantially is perpendicular respect to this axis (X-X) of the kiln.

32. Kiln according to the claims 28, 29 or 30, in which the beam is placed single or radially in couple of two by two at one or more levels along its longitudinal vertical axis staggered respect to the axis.
33. Kiln (1) for the burning of lumpy material such as limestone or dolomite of the annular section shaft type, elongating on the longitudinal vertical axis (X-X), comprising from the upper part towards the bottom a pre-heating zone (2), an upper calcination level (3) downstream of which is positioned a first combustion chamber (19), a lower calcination level (4) downstream of which is positioned a second combustion chamber (20), a cooling zone (6) and a discharge zone (7), **characterised in that** the first (19) and second (20) combustion chambers are provided with vault parts (24) supported and protected by beams (26;126;226;326) made of high temperatures resistant steel and cooled by means of diathermic fluid chosen among water preferably distilled, biphenyl and derivates, tetra-aril-silicate, melted salts mixings, various liquids like glycerine, silicones, naphthalene derivates.

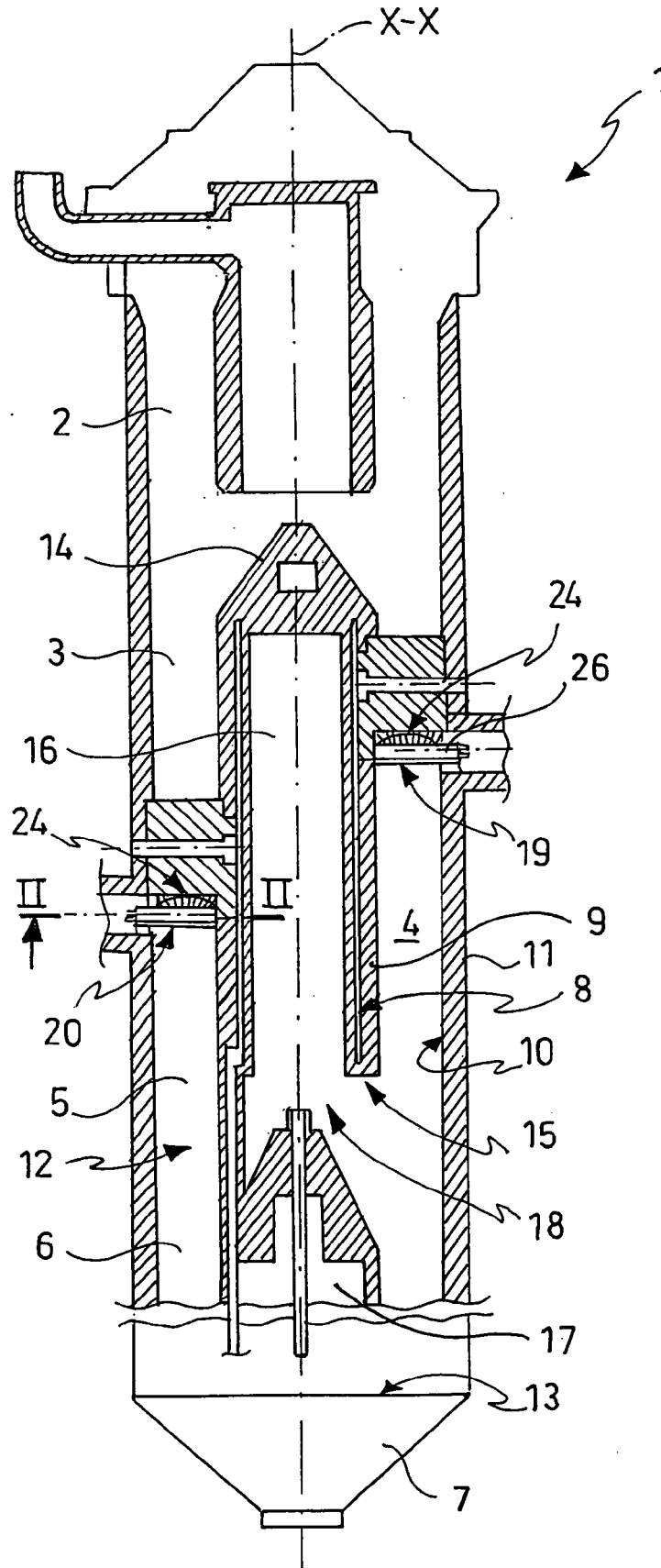


FIG.1

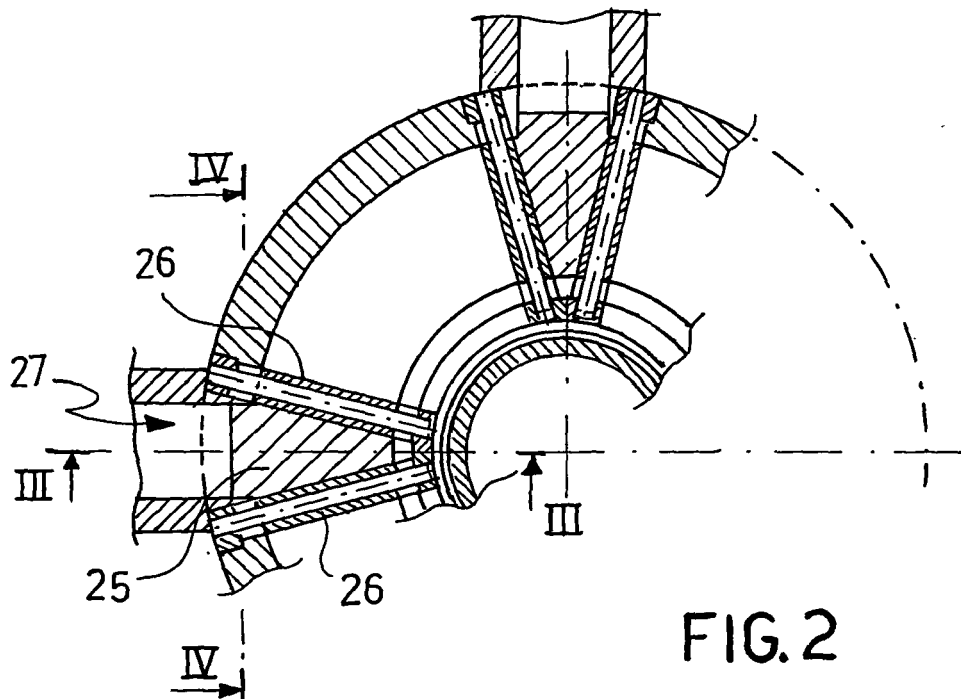


FIG. 2

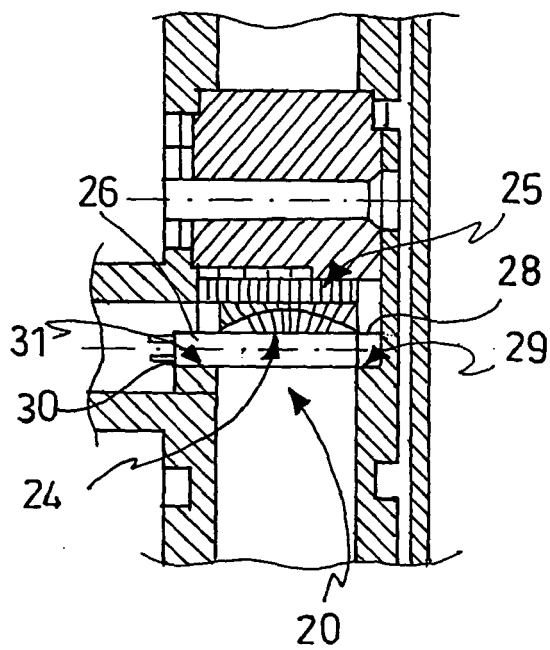


FIG. 3

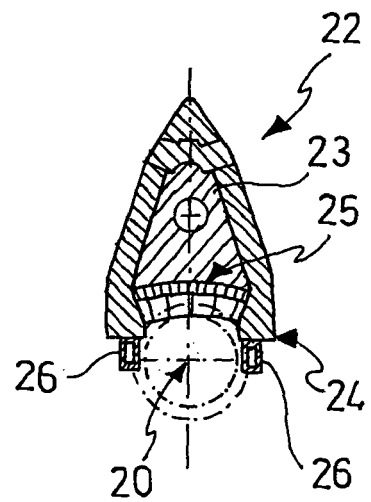


FIG. 4

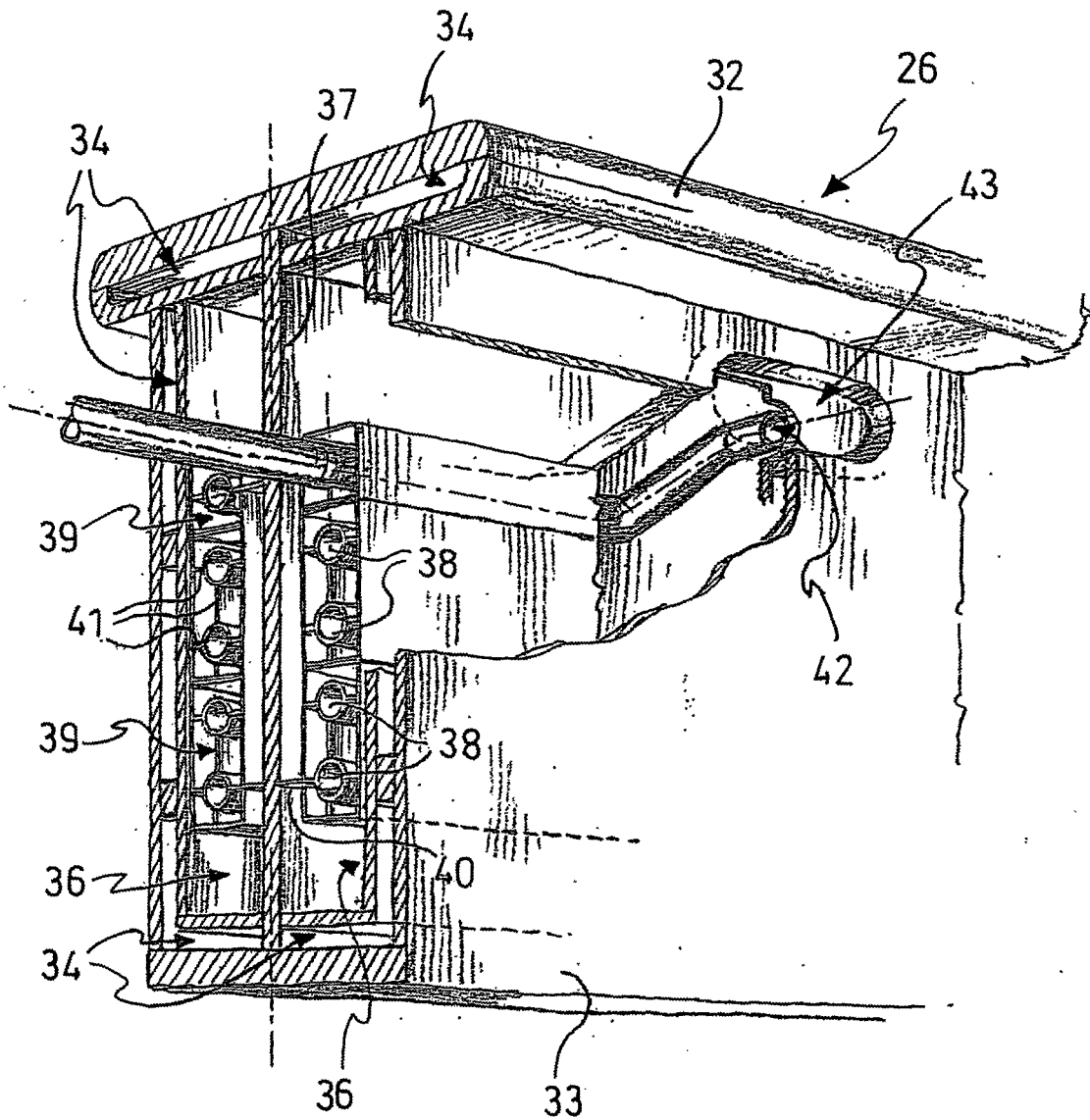


FIG.5A

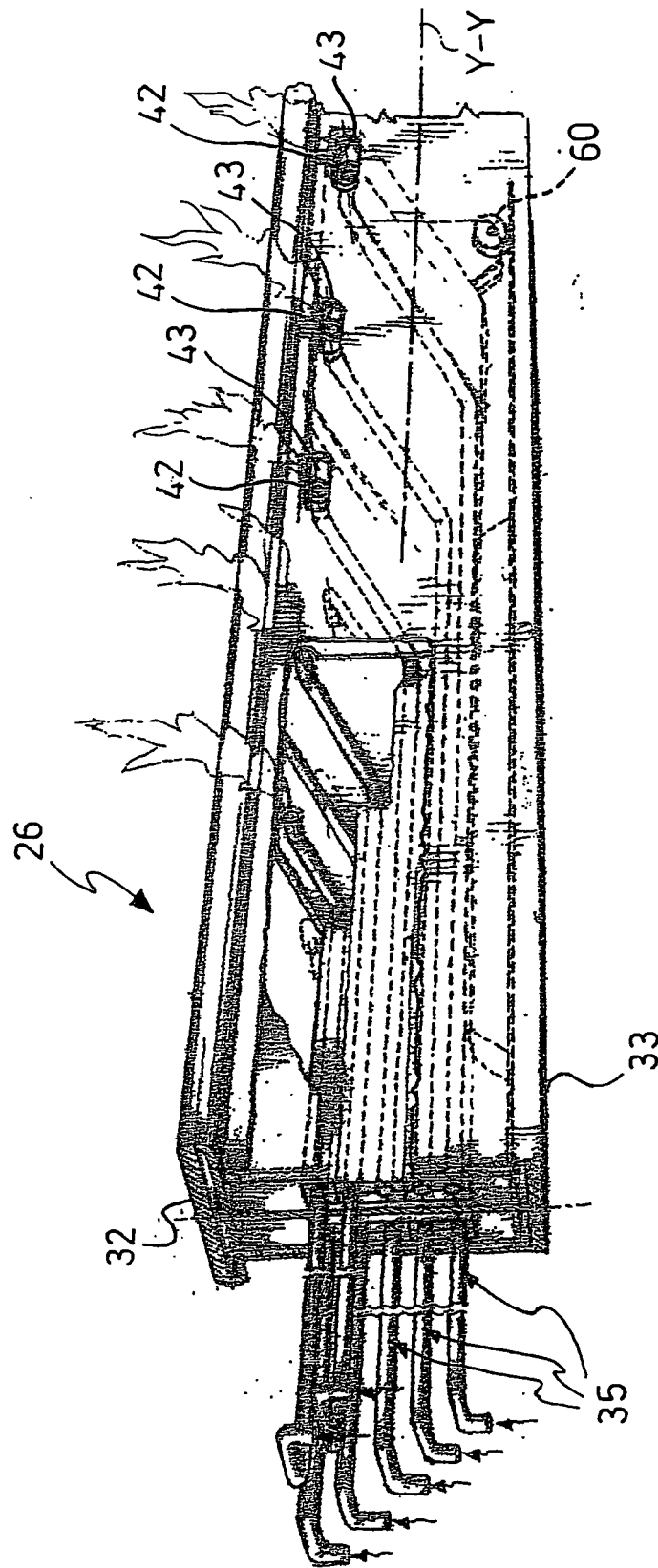


FIG. 5B

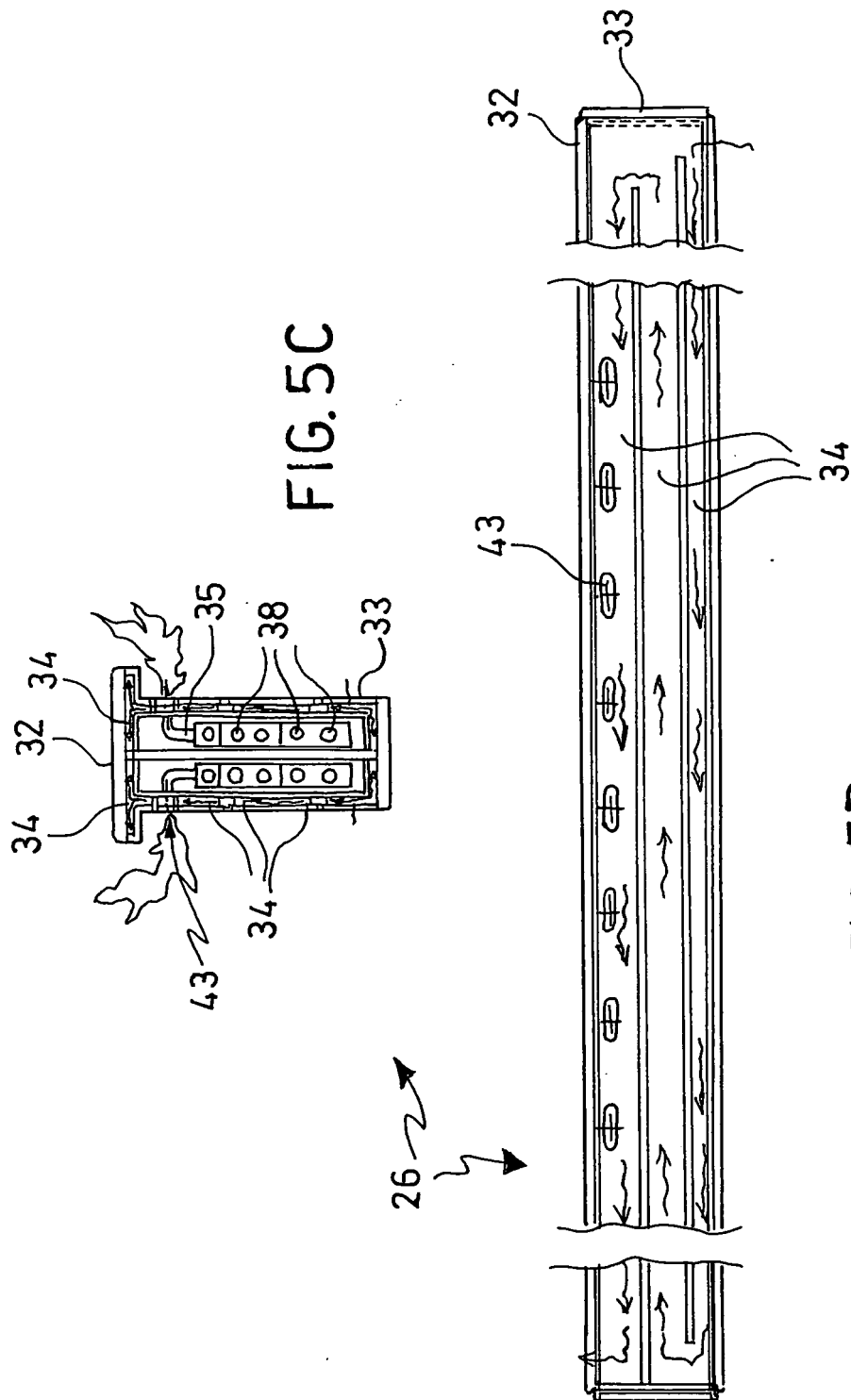


FIG. 5D

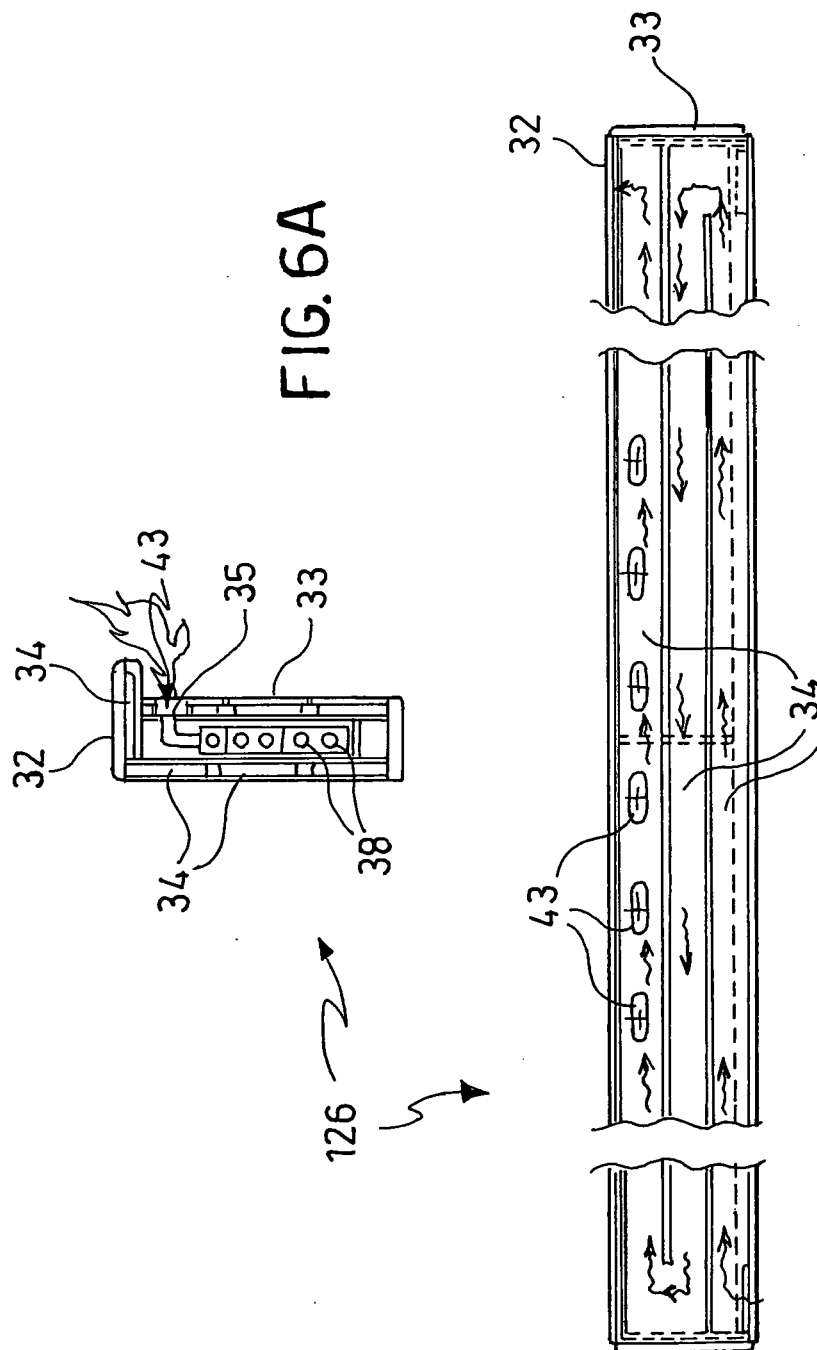
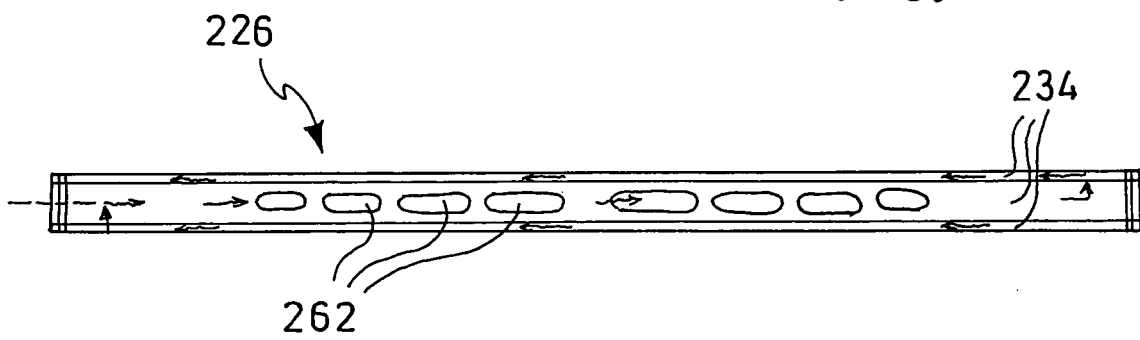
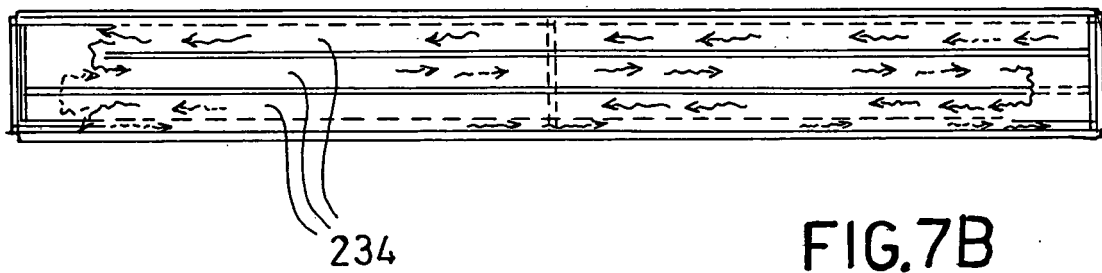
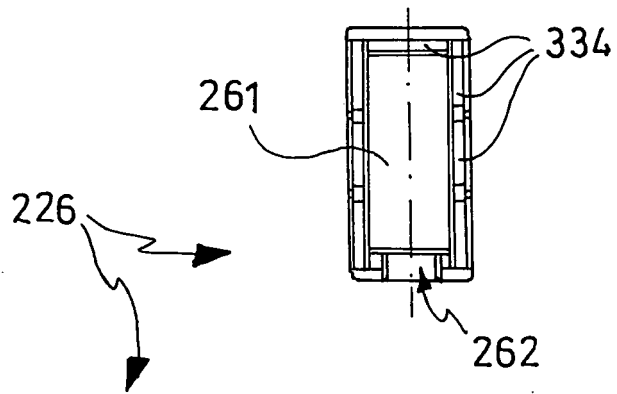


FIG. 6A

FIG. 6B



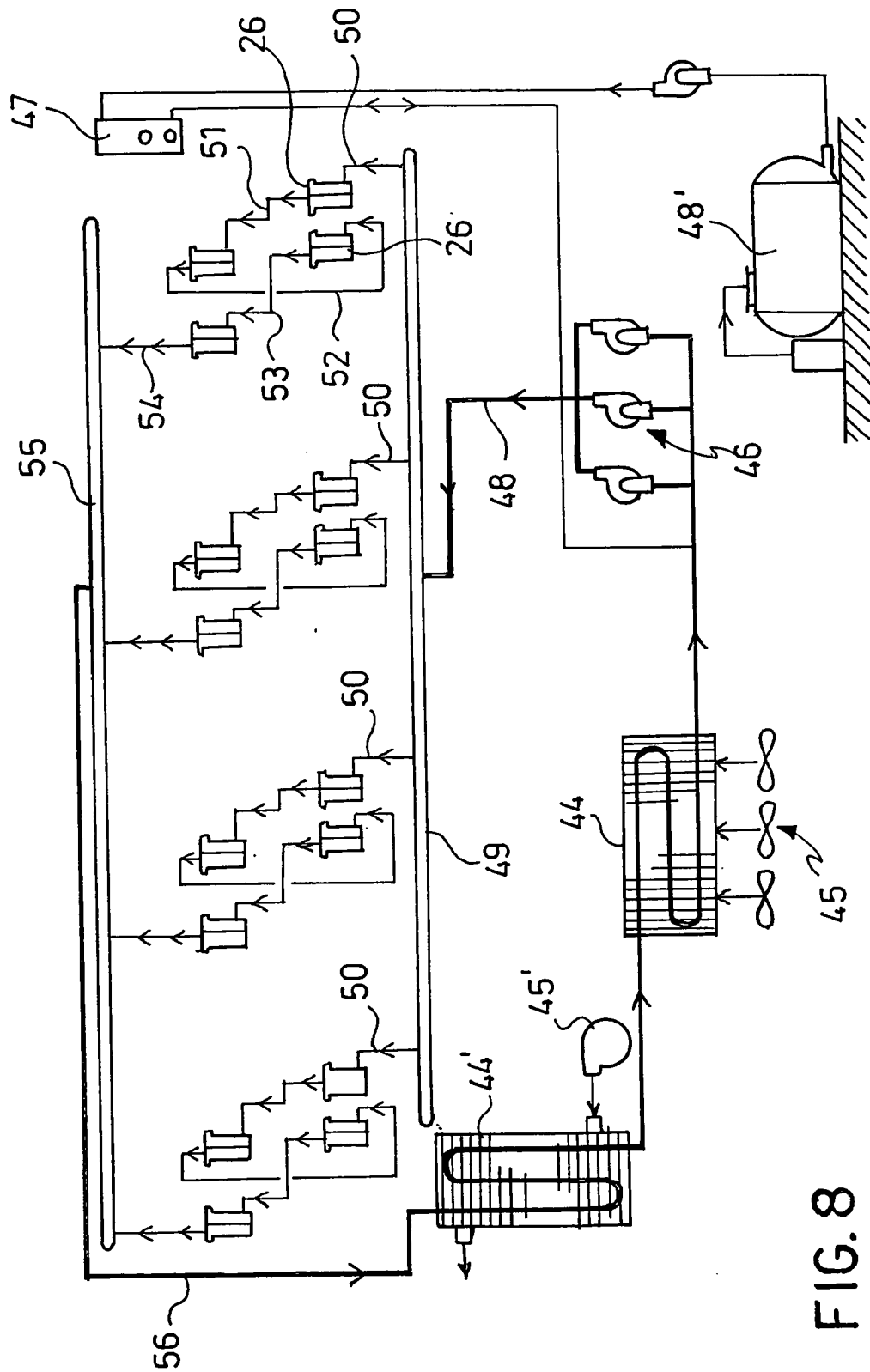


FIG. 8

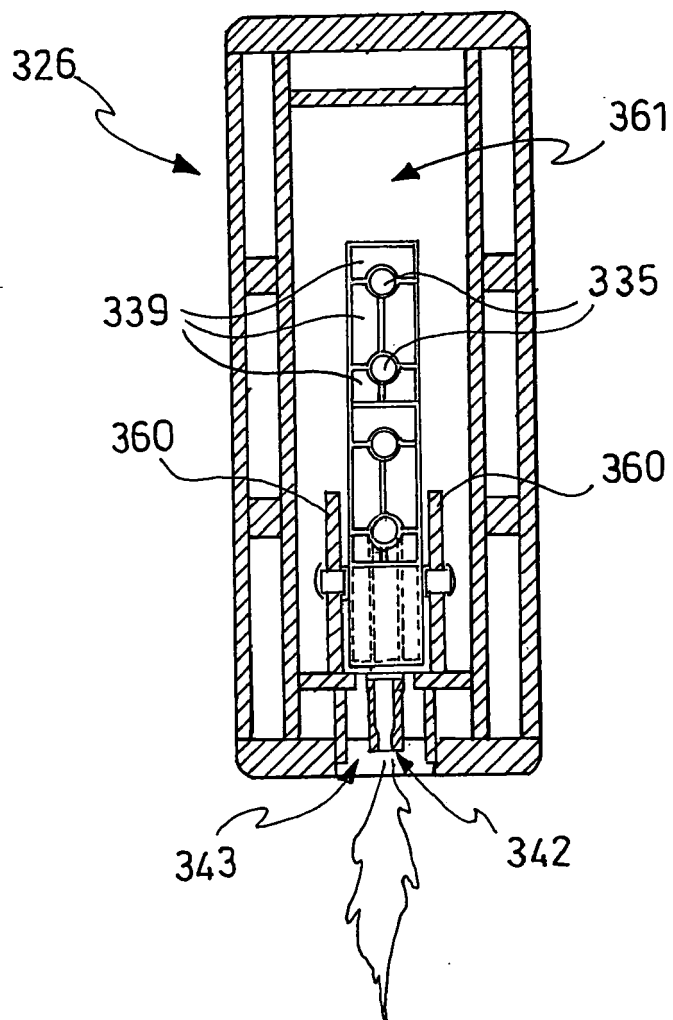


FIG. 9



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 42 5914

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 4 141 154 A (BUCHNER ET AL) 27 February 1979 (1979-02-27)	1,3,4, 10,18, 20,21	F27B1/24 F23M5/00 F27D1/10
Y	* column 1, line 57 - line 66 * * column 3, line 24 - line 39; claims 1,6,7; figure *	2,5,6, 11-15, 17, 23-27, 30,32	
Y	US 3 356 351 A (ROBERTS JAMES E ET AL) 5 December 1967 (1967-12-05) * the whole document *	2,5,6, 11-15, 17,23, 30,32	
Y	US 4 414 186 A (SCHMIDT ET AL) 8 November 1983 (1983-11-08) * the whole document *	24-27	
A,D	DE 31 40 582 A1 (BECKENBACH,ULRICH,DIPL.-ING; BECKENBACH, ULRICH, DIPL.-ING., 4005 MEER) 28 April 1983 (1983-04-28) * the whole document *	1-33	TECHNICAL FIELDS SEARCHED (Int.Cl.7) F27B F23M F27D C04B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 7 June 2005	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			

1

EPO FORM 1503 03.82 (P04C01)

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

EP 04 42 5914

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

07-06-2005

Patent document cited in search report		Publication date		Patent family member(s)	Publication date
US 4141154	A	27-02-1979	DE	2657238 A1	22-06-1978
			BR	7708298 A	25-07-1978
			ES	464840 A1	01-08-1978
			FR	2374605 A1	13-07-1978
			PL	202700 A1	19-06-1978

US 3356351	A	05-12-1967	BE	788273 A7	18-12-1972
			GB	1111746 A	01-05-1968
			NO	117758 B	22-09-1969

US 4414186	A	08-11-1983	DE	3116986 A1	25-11-1982
			ES	8204977 A1	01-09-1982
			IT	1189264 B	04-02-1988
			ZA	8202928 A	30-03-1983

DE 3140582	A1	28-04-1983	AT	379131 A ,B	25-11-1985
			AT	534781 A	15-04-1985
			CA	1167256 A1	15-05-1984
			CH	657843 A5	30-09-1986
			FR	2514341 A1	15-04-1983
			JP	1475814 C	18-01-1989
			JP	58064482 A	16-04-1983
			JP	63016033 B	07-04-1988
			US	4431407 A	14-02-1984
			ZA	8108748 A	24-11-1982
