



(11) **EP 1 860 380 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
28.11.2007 Bulletin 2007/48

(51) Int Cl.:
F23G 5/027^(2006.01) F23G 7/14^(2006.01)

(21) Application number: **06114532.2**

(22) Date of filing: **24.05.2006**

(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 LV MC NL PL PT RO SE SI
SK TR**
Designated Extension States:
AL BA HR MK YU

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Remarks:

A request for correction of the originally filed italian description has been filed pursuant to Rule 88 EPC. A decision on the request will be taken during the proceedings before the Examining Division (Guidelines for Examination in the EPO, A-V, 3.).

(54) **Device for pyrolyse**

(57) The invention relates to a pyrolysing device for the pyrolysing of materials, the device comprising
- an oven with a pyrolysis chamber (1) with an inner chamber for heating and pyrolysing the material to be pyrolysed, wherein the pyrolysis chamber (1) comprises an inlet (10) for supplying the material to be pyrolysed, an outlet (11) for discharging remainders of the pyrolysed material and an exhaust (13) for discharging gasses from the pyrolysis,
- a heating unit (23, 24) for heating the pyrolysis chamber and
- displacement means for moving the material to be py-

rolysed through the pyrolysis chamber (1).

The displacement means comprise at least one transport belt (5) for moving the material and a driving unit (25) for driving the displacement of the transport belt in longitudinal direction of the pyrolysis chamber (1) and for transporting the material from the inlet (10) to the outlet (11) and in that the heating unit is provided for heating at least a part of the pyrolysis chamber to a temperature which is sufficient to involve at least a partial pyrolysis of the material.

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Description

[0001] The present invention relates to a pyrolysing device for the pyrolysing of materials, the device comprising

- an oven with a pyrolysis chamber with an inner chamber for heating and pyrolysing the material to be pyrolysed, wherein the pyrolysis chamber comprises an inlet for supplying the material to be pyrolysed, an outlet for discharging remainders of the pyrolysed material and an exhaust for discharging gasses from the pyrolysis,
- a heating unit for heating the pyrolysis chamber and
- displacement means for moving the material to be pyrolysed through the pyrolysis chamber

according to the preamble of the first claim.

Description of the prior art.

[0002] From US-A-5.454.164 a pyrolysis oven is known which comprises a rotating tube oven, which is placed in a closed, air tight housing. The oven comprises an inlet connected to a supply unit for the material to be pyrolysed and an outlet connected to a discharge unit for the pyrolysed material. The oven slants with respect to a horizontal plane from the inlet towards the outlet to facilitate the displacement of the material to be pyrolysed through the oven. In the vicinity of the outlet a burning unit is provided which comprises a conventional air burner with a blower for heating the fuel gasses for heating the oven. Combustion gasses which originate from the pyrolysis leave the oven through an exhaust chimney positioned in the vicinity of the inlet of the oven.

[0003] Known devices for the thermal cleaning of contaminated soil mostly include a rotating tube oven, the inner wall of which is provided with a plurality of blades. The blades ensure that upon rotation of the oven, the soil falls downward like a curtain. In the vicinity of the exit of the oven a burner is mounted for heating the soil, by direct contact between the soil and the flame of the burner. The soil to be cleaned is heated to a temperature of about 400-500°C. At this temperature the impurities present in and on the soil are evaporated and decomposed. Although in this type of oven a good heat transfer to the soil is provided, the contact between the soil curtain and the burner involves formation of a significant amount of dust. This is unwanted as the gasses leaving the pyrolysis oven need to be cleaned from the dust.

[0004] In the course of time, attempts have been made to optimize existing rotating tube ovens. The optimization however concentrated to increasing the capacity of the oven and the cleaning of the gasses produced during the pyrolysis, but was not intended to solve the dust problem. As a consequence, there is a need to a pyrolysis device with which dust production may be reduced, even with materials which in the course of pyrolysis give rise to dust

formation.

Brief description of the invention.

5 **[0005]** The present invention therefore has the object of providing a pyrolysis device with which less dust is produced when treating solid, powdery or granular materials or materials which in the dry state easily give rise to dust formation.

10 **[0006]** This is achieved according to the present invention with the technical features of the characterizing part of the first claim.

[0007] Thereto, the pyrolysis device of the present invention is characterized in that the displacement means comprise at least one transport belt for moving the material and a driving unit for driving the displacement of the transport belt in longitudinal direction of the pyrolysis chamber and for transporting the material from the inlet to the outlet and in that the heating unit is provided for heating at least a part of the pyrolysis chamber to a temperature which is sufficient to involve at least a partial pyrolysis of the material.

[0008] According to the present invention, the material is moved in longitudinal direction of the oven because it is entrained with the transport belt. The use of a transport belt for displacing the material to be pyrolysed through the pyrolysis chamber makes it possible to move the material while lying. By using the transport belt it is possible to avoid entraining of the material with the wall of the pyrolysis chamber and twirling of the material throughout the space of the whole chamber and to significantly reduce dust formation. The use of the transport belt also makes it possible to avoid formation of a "curtain" of falling material at the exit of the pyrolysis chamber. As a consequence, dust formation is limited to a minimum and the pyrolysis device of this invention is particularly suitable for treating materials which show a strong tendency to dust formation.

[0009] Although the person skilled in the art would expect that the device of the present invention would provide an insignificant heating of the material to be pyrolysed because no direct contact with the flame of the heating is provided and the material is not subjected to a treatment which brings it in a finely divided state, the inventor has found that this is not the case. Because the material is moved by the transport belt, intense contact and good heat transfer from the transport belt to the material to be pyrolysed, is provided. The transport belt is driven to move continuously through the pyrolysis chamber from the inlet to the outlet, and is thus heated. The additional heating needed to evaporate and to pyrolyse volatile components present in the material to be pyrolysed and to accomplish pyrolysis is provided by heating the pyrolysis chamber, the inner room of the pyrolysis chamber and the gasses present therein.

[0010] In a practical embodiment of the invention the pyrolysis chamber comprises a floor on top of which the material to be pyrolysed is present and over which the

material to be pyrolysed is to be displaced from the inlet to the outlet. The transport belt is preferably an endless conveyor belt provided with holes for receiving the material and which is positioned in height direction of the pyrolysis chamber at such a distance from the floor that at least part, but preferably the whole amount of material to be pyrolysed is entrained with the displacement of the conveyor belt from the inlet towards the outlet of the pyrolysis chamber. As both the transport belt, the walls of the pyrolysis chamber and the gasses present in the pyrolysis chamber are heated, a good heat transfer to the material to be pyrolysed may be guaranteed.

[0011] Thereby, the transport belt is preferably executed as a band comprising a plurality of chains which extend in cross direction of the belt and of the pyrolysis chamber and which are connected to each other in longitudinal direction to form a continuous belt by means of longitudinally extending chains. The direct contact between the floor and the chain on the one hand which are continuously exposed to the temperature remaining in the pyrolysis chamber and on the other hand at least a part of the material to be pyrolysed, guarantees an optimum heat transport to the material to be pyrolysed. Thereby, in case the material to be pyrolysed is powder shaped or granular such as for example soil, the material is at least partly turned over when moving the chain, this minimizing dust formation. The entraining and turning over as well as heat transfer proceed in an optimum manner when the chain is loose, i.e. not tensioned in longitudinal direction of the pyrolysis room and at least partly drags over this floor.

[0012] When carrying out the pyrolysis it is important that in the pyrolysis chamber an atmosphere is created and maintained which is as inert as possible. In the known devices this was mostly realized by placing the pyrolysis chamber in a closed housing and by avoiding direct contact between the pyrolysis chamber and the outside air. In the device of this invention, an inert atmosphere in the pyrolysis chamber is provided in that the pyrolysis chamber comprises an air tight circumferential wall with a front wall. The inlet for the material to be pyrolysed is positioned in the front wall and comprises an opening which extends in cross direction of the pyrolysis chamber. Along at least part of an upper edge of the opening, means are provided for stopping and/or neutralizing oxygen containing gasses which are moving through the inlet, often together with the material to be pyrolysed. A suitable example of such means is a line burner which burns in downward direction, for burning the oxygen containing gasses moving through the inlet. Similar means, for example a line burner, are preferably also provided in the back wall of the pyrolysis chamber, along the upper edge of the outlet for discharging possible remainders of the pyrolysed material. Due to the presence of the downwardly burning line burners, oxygen containing gasses trying to intrude the pyrolysis chamber through the inlet and/or outlet possibly with the material to be pyrolysed are burnt in the inlet or outlet opening and an inert at-

mosphere is maintained in the pyrolysis chamber. The line burners simultaneously involve a first heating of the material and are thus energetically favorable.

[0013] An optimum heating of the inner chamber of the pyrolysis chamber is provided by providing in the vicinity of the inlet, an exhaust for discharging the gasses formed during the pyrolysis, whereby the exhaust is provided with a suction unit for a forced exhaust of gasses from the inner chamber of the pyrolysis chamber. In that way gasses originating from the back, warm part or the pyrolysis chamber or heating chamber are sucked to the front, colder part or the drying chamber and ensure heating of the front part of the pyrolysis chamber. This is energetically favorable.

Detailed description of the invention.

[0014] The invention is further elucidated in the appending figures and description of the figures.

Figure 1 shows a view to the pyrolysis device of this invention.

Figure 2 shows a longitudinal section of the pyrolysis device of this invention.

Figure 3 shows a view to the chain transport belt used in the pyrolysis device of this invention.

Figure 4 shows a view to the top side of the transport belt and to the size reducing devices mounted thereto.

Figure 5 shows a view to the front wall of the pyrolysis chamber.

[0015] As is shown in figure 1, the pyrolysis device of this invention comprises a pyrolysis chamber 1, with a longitudinal wall 8, the front side of which is closed off by a front wall 9 and the back side of which is closed off by the back wall 19. The walls enclose an inner chamber 2. The inner chamber is provided for receiving the material to be pyrolysed and functions as an oven or a space in which pyrolysis takes place. The pyrolysis chamber comprises a first part which extends from the front wall 9 and which has a temperature that is mostly lower than in the remainder of the pyrolysis chamber. This first part is also called drying chamber 32, because the temperature remaining therein is sufficient for evaporation of the volatile compounds present in the material to be pyrolysed. The second, remaining part of the pyrolysis chamber 33 is situated between the drying chamber 32 and the back wall 19 and is also called the heating chamber 33. This part mostly has a much higher temperature, which is such that pyrolysis of the material to be removed takes place.

[0016] The front wall 9 comprises an inlet 10 for supplying the material to be pyrolysed to the inner chamber 2. The back wall 19 comprises an outlet opening 11 for discharging remainders of the material remaining after pyrolysis from the inner chamber 2. The longitudinal front wall 8, front and back wall 9, 19 as well as the connections between these walls are hermetically sealed, i.e. gas

tight. This is needed to prevent penetration of oxygen containing gasses through the walls or through the connections into the inner chamber 2 of the pyrolysis chamber, since pyrolysis is mainly carried out in the absence of oxygen and oxygen containing gasses. The material of which the walls of the pyrolysis chamber 1 are made is not critical to this invention and can be any material considered suitable by the person skilled in the art and which resists the usual pyrolysis temperatures. The inner wall of the pyrolysis chamber may for example be made of an insulation material which is resistant to high temperatures of for example up to 800°C or more. The wall may however also be made of ceramic material, in steel or stainless steel and is mostly chosen taking into account the envisaged application field. In the longitudinal wall, also hermetically closeable doors may be provided to provide access to the pyrolysis chamber.

[0017] The inlet opening 10 for supplying the material to be pyrolysed to the inner chamber 2 of the pyrolysis chamber preferably extends in cross direction of the pyrolysis chamber 1. The inlet opening 10 is preferably oblong and more preferably has the shape of a slit with a height sufficient to permit passing of the material to be pyrolysed to the pyrolysis chamber. In case it is the intention to use the device for the pyrolysing of soil, the opening may have a relatively small height. In case it is the intention of using the device for the pyrolysing of seriously varying materials and materials of strongly varying dimensions, the inlet opening may be made in such a way the height and width are adjustable. In the inlet opening 10 preferably a device is provided for neutralizing and/or stopping oxygen containing gasses which try to intrude the pyrolysis chamber. An analogous device is preferably also provided in the material outlet 11.

[0018] In a possible embodiment, the neutralization device comprises an incineration device, which extends along at least part, and preferably along almost the whole length of the upper edge of the inlet opening 11 and which is provided to burn in the direction of the bottom edge 12 of the material inlet opening. The incineration device is preferably a line burner 4. However, every other neutralization or incineration device considered suitable by the person skilled in the art may be used as well. This line burner is intended to burn oxygen containing gasses which try to enter the pyrolysis chamber through the inlet 10, possibly together with the material to be pyrolysed. Therefore the line burner 4 is provided such that the flames touch the upper surface of the supplied material to be pyrolysed. The contact with the material to be pyrolysed is energetically favorable as this causes a first heating of the material already at the entrance of the pyrolysis chamber and a first evaporation of the volatile compounds present in the material. Preferably a similar outlet opening 11 is provided in the back wall 19 of the pyrolysis chamber, for discharging of the material which remains after pyrolysis. The presence of line burners in the inlet and outlet opening 10, 11 guarantees that an inert atmosphere may be maintained in the inner cham-

ber 2 of the pyrolysis chamber. It is important that the line burners 4, 14 burn in downward direction because this provides a better shielding of the inlet and outlet 10, 11. The line burner used in the present invention can be any line burner known to the person skilled in the art. Instead of a line burner also another burning or oxidation device can be used, which sufficiently guarantees that possible incoming oxygen containing gasses are oxidized as completely as possible. In case the materials to be pyrolysed have very large dimensions and the inlet and outlet opening 10, 11 need to be seriously enlarged, the person skilled in the art may consider providing a line burner or another oxygen neutralizing device along the bottom edge of the inlet and outlet opening 10, 11. Due to the presence of the neutralization device or line burners 4, 14 it is not necessary to position the pyrolysis chamber in a closed space wherein an inert atmosphere is to be maintained as is mostly the case with pyrolysis devices which make use of rotating tube ovens. This simplifies the construction seriously and improves the mobility of the pyrolysis device of this invention.

[0019] The material to be pyrolysed is moved from the inlet opening 10 to the outlet 11 by means of a transport device 5 present in the pyrolysis chamber, which transport device is moveable throughout the inner chamber 2 in longitudinal direction. The transport device may for example be a transport belt 5 on which the material to be pyrolysed is located. The transport belt may for example be heated, on the other hand the transport belt is also heated by the high temperature remaining in the pyrolysis chamber. In the present invention however, preferably use is made of a pyrolysis chamber 1 in which at a bottom side a floor 5 is present which preferably is made of a heat resistant material and which extends in longitudinal direction of the pyrolysis chamber. The floor and bottom wall of the pyrolysis chamber 1 can be positioned at a distance from each other or may be made as one part. The material to be pyrolysed is brought onto the floor through inlet opening 10 and moved over the floor by means of the transport belt 5. The transport belt 5 is positioned above the floor 18. The distance between the transport belt 5 and the floor 18 is selected such that the transport belt is in contact with the material to be pyrolysed and such that it entrains the material to be pyrolysed when moving from the inlet 10 to the outlet 11. In case it is the intention of using this device for the purification of soil, the transport belt preferably lays on the floor. In that case the transport belt preferably comprises a plurality of holes for receiving at least a part of the material and for entraining the material from the inlet 10 to the outlet 11. Thereby it is possible to drag the transport belt at least partly or fully over the floor in the course of its displacement, so that the material is entrained by the transport belt.

[0020] In such a device, the floor 18 is heated by the heat present in the inner chamber 2 of the pyrolysis chamber 1. Because the material is moved over the floor 18, a good heating of the material is ensured and an optimum

heat transfer from the floor to the material to be pyrolysed, without thereby necessitating a direct contact between the material and the flame of the burner, which would constitute a source of dust formation.

[0021] In a practical embodiment the transport belt 18 is formed as a continuous belt, forming a loop and which contains a plurality of chains 6 which extend in cross direction of the belt and of the pyrolysis chamber 1. The cross chains 6 are preferably connected to each other in longitudinal direction by means of at least two longitudinal chains 16 mounted on opposite longitudinal sides of the transport belt. If so desired an additional chain may be provided which extends centrally of the transport belt. To guarantee optimum entraining of the material, whereby simultaneously some turning over of the material in thickness direction of the material layer takes place, the chain drags at least partly over the floor. In the device of this invention the material to be pyrolysed is moved through the pyrolysis chamber by dragging it over the floor together with the chain. Falling down of the material from the top wall of the pyrolysis chamber in downward direction is thereby avoided, thus permitting to minimize dust formation.

[0022] If so desired means may be provided which involve turning over of the material to provide a better heating and optimum pyrolysis. Such means may for example be provided in the chain - transport belt by mounting the cross chains in a rotatable manner with respect to the longitudinal chains. Other turning over means may for example comprise baffles or trays which take the material from the transport belt and throw it down again.

[0023] The device also comprises a driving for driving the displacement of the transport belt and the revolving of the transport belt 5. By using a driving 15 which permits varying the revolving speed of the transport belt, the speed with which the material to be pyrolysed is moved through the pyrolysis chamber 1, may be controlled and thus the temperature of the material may be controlled during its displacement through the pyrolysis chamber 1. This renders the device suitable for the pyrolysing of material of widely varying origin, thus materials which have to be heated to a higher or lower temperature and which show a slower or faster heating.

[0024] To provide a uniform heating of the material to be pyrolysed throughout the whole thickness of the material, it may be necessary to reduce the material. Thereto the device of this invention comprises at least one material reducer 7. The material reducer 7 is preferably formed as a reducer containing a rotation axis 3 which extends in cross direction of the pyrolysis chamber 1. To guarantee optimum functioning, the transport belt 5 and material reducer 7 are rotatable in opposite directions. If so desired, the rotation direction of one or both may be invertible. To the axis 3 of the material reducer 7 preferably a plurality of pins is provided which extend towards the transport device, i.e. the chain. The material reducer 7 is preferably mounted at such a distance of the transport belt 5 in height direction of the pyrolysis chamber, that

the pins are capable of at least partly penetrating the material and preferably also between the shackles of the cross chains, to reduce the material. The material reducer 7 may for example be hingedly mounted with respect to a frame extending in longitudinal direction of the pyrolysis chamber 1. In that case the connection between the material reducer and the frame will slant in height direction and in the displacement direction of the transport belt 5. The number of material reducers present in the pyrolysis chamber is not critical to this invention and may be adapted by the person skilled in the art taking into account the nature of the material to be treated. Within the framework of this invention any material reducer considered suitable by the person skilled in the art may be used.

[0025] The transport belt and chain may be made of any material considered suitable by the person skilled in the art. Suitable materials include amongst others materials capable of resisting the high temperatures prevailing during pyrolysis, for example steel, metal, ceramic materials. The displacement of the transport belt and the chain is preferably controlled by guidings mounted into the floor.

[0026] The supply of the material to be pyrolysed to the inlet opening 10 and transport belt 5 may be provided by any supply device considered suitable by the person skilled in the art. This may for example be a transport belt 20 which is fed by a silo or container. The supply speed from the silo is preferably variable, so that the layer thickness of the material to be pyrolysed on the supply transport belt 20 may be controlled. Preferably the revolving speed of the supply transport belt 20 may be adapted to the revolving speed of the transport belt 5 in the pyrolysis chamber. Both transport belts 5 and 20 may have a same or a different revolving speed in use, but preferably have the same revolving speed.

[0027] The pyrolysis chamber 1 preferably comprises also means for heating the inner chamber 2. Heating preferably occurs in a direct manner and thus in an optimum manner by means of devices mounted in a front and a back part in the inner chamber and which heat the gasses present in the inner chamber. To heat the inner chamber, use can be made of any heating device known to the person skilled in the art. Heating may for example be carried out electrically and be mounted into the wall of the pyrolysis chamber, heating can also be accomplished by means of a pipe system provided in the wall, a heated liquid flowing through the pipes or by means of pipes present in the pyrolysis chamber which are directly heated for example electrically or using gas. To heat the pyrolysis chamber also use can be made of at least one burner 24 which is present in the back wall 19 of the pyrolysis chamber and which burns in the direction of the inner chamber 2 and is directed towards the inlet 10 for the material to be pyrolysed. In that way optimum spreading of the heat throughout the inner chamber 2 is provided. Thereto the usual burners may be used. Optimum heating of the inner chamber is provided in case also in

the front wall 9 of the pyrolysis chamber at least one burner 23 is provided which preferably burns in the direction of the inner chamber 2 and is directed towards the outlet 11 for the material to be pyrolysed. The front heating is provided to heat the material to be pyrolysed to a temperature which is sufficient to evaporate the water present and other possibly present volatile compounds. This part of the pyrolysis chamber occupies usually about 1/3 to 1/4th of the length of the pyrolysis chamber and is usually called drying chamber and mostly has a temperature of maximum 150-250°C. When necessary this length may be larger or smaller, as well as the temperature so that optimum drying of the material is achieved. The back heating is provided to heat the material to be pyrolysed to a temperature which is sufficient to cause pyrolysis. This part of the pyrolysis chamber usually occupies 2/3 to 3/4th of the length of the pyrolysis chamber and is called heating chamber and mostly has a temperature which may amount to 400°C or 700 to 800°C or more, depending on the nature of the material to be treated. When necessary, the length of the heating chamber may be smaller or larger, as well as the temperature. The device of this invention presents the advantage that the drying chamber in which pyrolysis is carried out, form one part and transfer into each other in a seamless way. This is energetically favorable since the heat leaving the pyrolysis section is also used in the drying section.

[0028] The number of burners may simply be adapted by the person skilled in the art taking into account the dimensions of the pyrolysis chamber and the envisaged temperature. If so desired, also in the top wall or side walls of the pyrolysis chamber one or more heating devices may be provided. The heating in the back wall 19 will usually be a more powerful heating as compared to the heating in the front wall 9.

[0029] The energy management of the device of this invention may be further optimized by using a controlled discharge of the gasses that escape in the course of the pyrolysis. Thereto the device of this invention comprises a gas exhaust 13, which preferably sucks the gasses from the inner chamber 2 and which is situated in the vicinity of the inlet 10 for the material supply. With such a construction, hot gasses are sucked from the heating chamber 33 to the drying chamber 32 and the drying chamber 32 is heated. This is energetically favorable. The exhaust 13 is preferably positioned at a position in longitudinal direction of the pyrolysis chamber 1, which corresponds to the point where mostly all volatile components of the material to be pyrolysed are evaporated and may be exhausted. The exhaust 13 may for example be located at a distance from the inlet 10 which corresponds to 1/4th of the length of the pyrolysis chamber and at a distance from the outlet 11 which corresponds to 3/4th of the length of the pyrolysis chamber. However any other arrangement is possible if the material to be pyrolysed so requires.

[0030] The device of this invention may further contain the usual additional parts. In that way, gasses discharged

along the exhaust 3 may for example be subjected to purification in an after burner 30, be thereafter conducted through a heat exchanger 31, to a quenching device 26, where they are contacted with water and to a gas washing device 27. At the outlet 11 for discharging material which possible remains after pyrolysis also a transport belt 28 may be provided, which preferably has a variable revolving speed. If so desired the cooling 29 may be provided for cooling the material leaving the pyrolysis chamber.

[0031] The pyrolysis chamber may be made as one part or in several parts which are connectible to each other in an air-tight manner if it is the intention of providing a mobile pyrolysis device. Because the pyrolysis chamber takes the form of a stationary chamber and the material is moved throughout the pyrolysis chamber using a transport belt, and because use is made of a direct heating of the inner chamber 2, an improved mobility is provided as compared to the known pyrolysis devices which make use of a rotating tube oven which is to be placed in a sealed room.

[0032] The above-described device is suitable for treating materials of widely varying dimensions and types. This device is for example suitable for the purification of soil or sludge contaminated with organic pollutants or similar materials as well as very light materials, whereby at least part of the (volatile) contaminations is removed by removal and the remaining contaminations are removed using pyrolysis, at minimum dust production. The device is also suitable to remove stresses from parts for example parts made in steel or metal, containing parts that are sealed to each other. Thereby stress may be removed by exposing the part during a pre-determined period of time to a high temperature, for example about 600°C and to let it cool down thereafter. Such parts may often not be treated in a rotating tube oven.

[0033] The device of this invention is also suitable for purifying material or soil contaminated with mercury. In that case the material of which the pyrolysis chamber is made and all other parts through which mercury is to be transported or which may contact the mercury, are made in a material which is inert as possible and with which the risk to reaction with mercury is minimal. In case the device is intended for removing mercury, the walls and all parts which risk contacting mercury are preferably made in stainless steel. The temperature, to which the pyrolysis chamber is heated, depends on the other contaminations present in the material to be pyrolysed and may vary from a few hundred degrees in case only mercury has to be removed to 600 or 700°C or more in case also other contaminations have to be removed. Mercury is removed from the pyrolysis chamber together with the other gasses leaving the material to be pyrolysed and sucked off through exhaust 13, the inner wall of which is preferably also made of stainless steel. The temperature of the cool 34 and quenching device 26 is chosen so low that optimum condensation of the mercury is obtained, and that for example a cooling of the vapors to 10-20°C is achieved. In this application further care needs to be

taken that all connections between the parts are sealed to prevent escaping of mercury. Also care needs to be taken that the risk to the intrusion of air and other oxygen containing gasses is absolutely minimal, to guarantee within the pyrolysis chamber an atmosphere which is as inert as possible.

[0034] When treating contaminated materials, for example contaminated soil, the soil is supplied using the supply transport belt, and from there through inlet opening 10 brought onto the transport belt 5 which transports the soil through the drying chamber 32 and heating chamber 33. When passing the inlet 10 the air incoming with the material is burned by means of the line burner 4 burning from the top. This involves a first heating of the soil. In the drying chamber 32 the soil is heated to a relatively low temperature, mostly between 50 and 150 to 250 °C, to remove the first volatile components. These are sucked away through exhaust 13. During further transport through the heating chamber 33 the soil is further heated to pyrolyse the less volatile components. The temperature of the heating chamber is adjustable and may be controlled by adjusting the heating 23 and 24 provided in the front and back wall, or by adjusting any other heating present in the device. Reminders of the pyrolysed soil leave the pyrolysis chamber through outlet 11. Intrusion of oxygen containing gasses is prevented by the line burner 14 mounted along the upper edge of the outlet, which burns in downward direction. Gaseous reaction products of the pyrolysis are also exhausted through exhaust 13. The drying chamber 32 is partly heated because gasses are sucked from the heating chamber 33 towards the drying chamber. If so desired the material leaving the device may be cooled. The gasses sucked away through the exhaust may further be subjected to one or more gas purification steps. Because the soil is not turned over by rotation of the oven and because the soil needs not to tumble down from the upper wall of the pyrolysis chamber in downward direction, dust formation is minimized.

[0035] The device of this invention presents the advantage that the residence time of the material in the pyrolysis chamber may be varied within wide ranges and is adjustable in a simple manner from a few minutes to a few hours or more, by adjusting the revolving speed of the transport belt.

Claims

1. A pyrolysing device for the pyrolysing of materials, the device comprising
 - an oven with a pyrolysis chamber (1) with an inner chamber for heating and pyrolysing the material to be pyrolysed, wherein the pyrolysis chamber (1) comprises an inlet (10) for supplying the material to be pyrolysed, an outlet (11) for discharging remainders of the pyrolysed ma-

terial and an exhaust (13) for discharging gasses from the pyrolysis,

- a heating unit (23, 24) for heating the pyrolysis chamber and

- displacement means for moving the material to be pyrolysed through the pyrolysis chamber (1),

characterized in that the displacement means comprise at least one transport belt (5) for moving the material and a driving unit (25) for driving the displacement of the transport belt in longitudinal direction of the pyrolysis chamber (1) and for transporting the material from the inlet (10) to the outlet (11) and **in that** the heating unit is provided for heating at least a part of the pyrolysis chamber to a temperature which is sufficient to involve at least a partial pyrolysis of the material.

2. A pyrolysis device as claimed in claim 1, **characterized in that** the pyrolysis chamber comprises a floor (18) onto which the material to be pyrolysed is positioned and over which the material to be pyrolysed is displaced, **in that** the transport belt (5) consists of an endless conveyor belt provided with holes, which is positioned in height direction of the pyrolysis chamber at such a distance from the floor (18) of the pyrolysis chamber that the material to be pyrolysed is at least partly entrained with the conveyor belt and displaced over the floor (18) from the inlet (10) towards the outlet (11).
3. A pyrolysis device as claimed in claim 2, **characterized in that** the conveyor belt (5) comprises a plurality of chains (6) which extend in cross direction of the belt and of the pyrolysis chamber and which are connected to each other in longitudinal direction to form a continuous belt by means of longitudinally extending chains (16).
4. A pyrolysis device as claimed in claim 3, **characterized in that** the cross chains (6) are connected in longitudinal direction by means of at least two longitudinal chains (16) mounted on opposite longitudinal sides of the conveyor belt.
5. A pyrolysis device as claimed in claim 3 or 4, **characterized in that** the belt is not tensioned in longitudinal direction of the pyrolysis chamber and drags at least partly over the floor (18).
6. A pyrolysis device as claimed in any one of claims 1-5, **characterized in that** the conveyor belt (5) is rotated through the pyrolysis chamber (1) with an adjustable rotation speed.
7. A pyrolysis device as claimed in any one of claims 1-6, **characterized in that** in longitudinal direction

of the pyrolysis chamber (1) a plurality of material reducing devices (7) is arranged for reducing the size of the material to be pyrolysed.

8. A pyrolysing device as claimed in claim 7, **characterized in that** each material reducing device comprises a rotation axis (3) which extends in cross direction of the chamber, wherein every material reducing device is provided with a multiplicity of downwardly extending pins, wherein the material reducing devices (3) are located at such a distance of the conveyor belt (5) at a position shifted in height direction of the chamber that the pins are capable of eat least partly penetrating the holes in the conveyor belt and the material to be pyrolysed and of down sizing the material. 5
9. A pyrolysis device as claimed in any one of claims 1-8, **characterized in that** the pyrolysis chamber comprises a sealed circumferential wall with a front wall (9), wherein the inlet (10) for the material to be pyrolysed is located in the front wall and comprises an opening which extends in cross direction of the pyrolysis chamber, wherein in the opening means are provided for stopping and/or neutralizing of oxygen containing gasses which are displaced through the inlet. 10
10. A pyrolysis device as claimed in claim 9, **characterized in that** the means for neutralizing the oxygen containing gasses comprise a line burner (4) which extends along at least part of an upper edge of the inlet opening (10) and which is provided to burn in downward direction for burning the oxygen containing gasses which are displaced through the inlet (10). 15
11. A pyrolysis device as claimed in any one of claims 1-10, **characterized in that** the pyrolysis chamber (1) comprises a sealed circumferential wall with a back wall (19) comprising the outlet (11) for discharging remainders of the pyrolysed material and an opening which extends in cross direction of the pyrolysis chamber, wherein in the opening means are provided for stopping and/or neutralizing oxygen containing gasses which are displaced through the outlet towards the inner chamber (2) of the pyrolysis chamber. 20
12. A pyrolysis device as claimed in claim 11, **characterized in that** the means for neutralizing the oxygen containing gasses comprise a line burner (4) which extends along at least part of an upper edge of the opening and which burns in downward direction for burning the oxygen containing gasses which are displaced through the outlet. 25
13. A pyrolysis device as claimed in any one of claims 1-12, **characterized in that** in the front wall (9) of 30

the pyrolysis chamber at least one front heating unit (23) is provided for heating a front part of the inner chamber of the pyrolysis chamber.

14. A pyrolysis device as claimed in any one of claims 1-13, **characterized in that** in the back wall (19) of the pyrolysis chamber at least one back heating unit (24) is provided for heating a back part of the inner chamber of the pyrolysis chamber. 35
15. A pyrolysis device as claimed in any claim 13 or 14, **characterized in that** the at least one front heating unit (23) comprises a burner which is provided to burn in the direction of the outlet (11) and **in that** the at least one back heating unit (24) comprises a burner which is provided to burn in the direction of the inlet (10). 40
16. A pyrolysis device as claimed in claims 13-15, **characterized in that** the pyrolysis chamber (1) comprises an exhaust unit (13) in the vicinity of the inlet (10) for exhausting gasses originating from the pyrolysis, wherein the exhaust is preferably provided with a suction unit to provide a forced exhaust of the gasses from the inner chamber (2) of the pyrolysis chamber. 45
17. A pyrolysis device as claimed in claim 16, **characterized in that** the exhaust is mounted at a position where the temperature of the pyrolysis chamber is equal to or higher than the temperature required for evaporating volatile components present in the material. 50

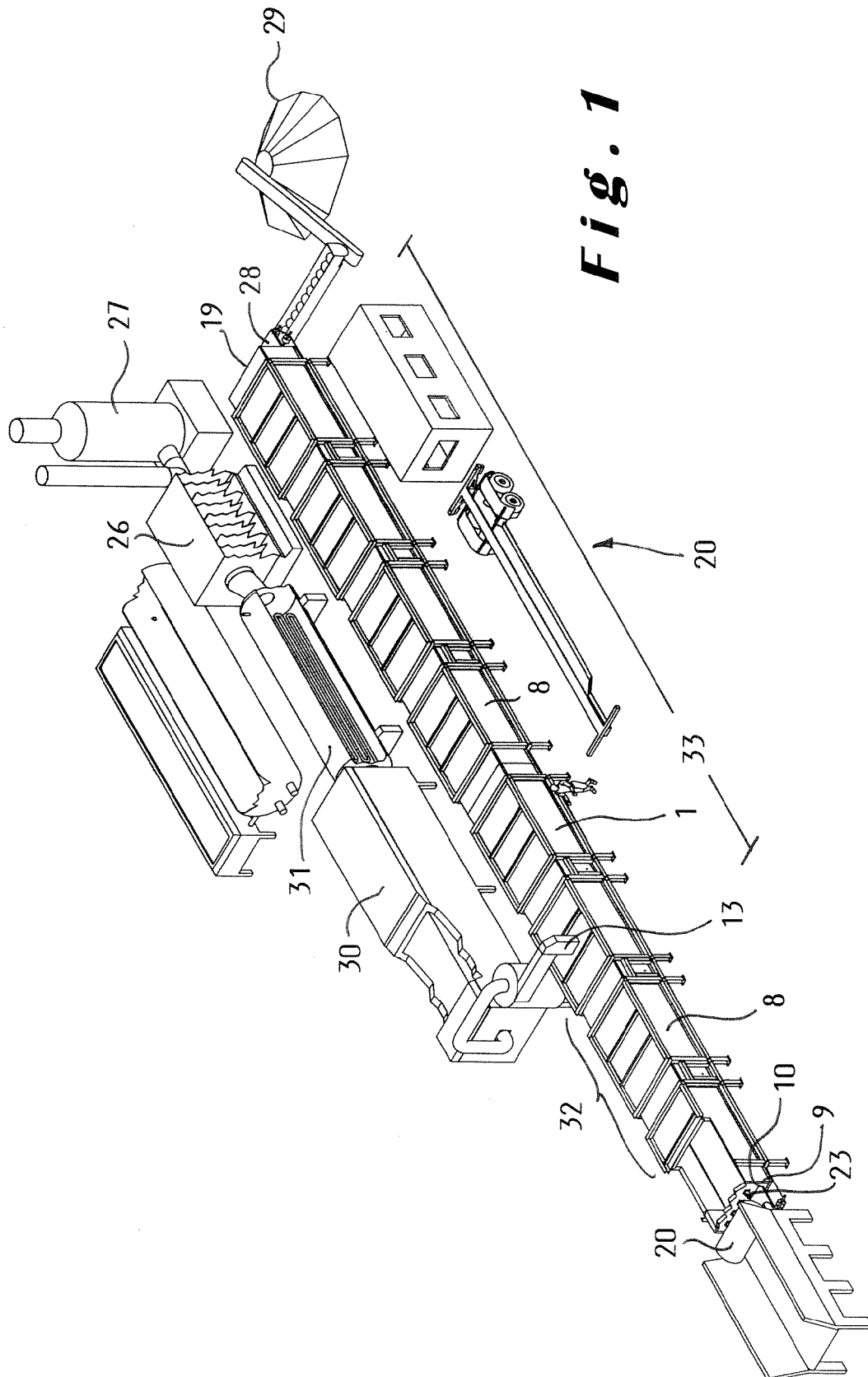


Fig. 1

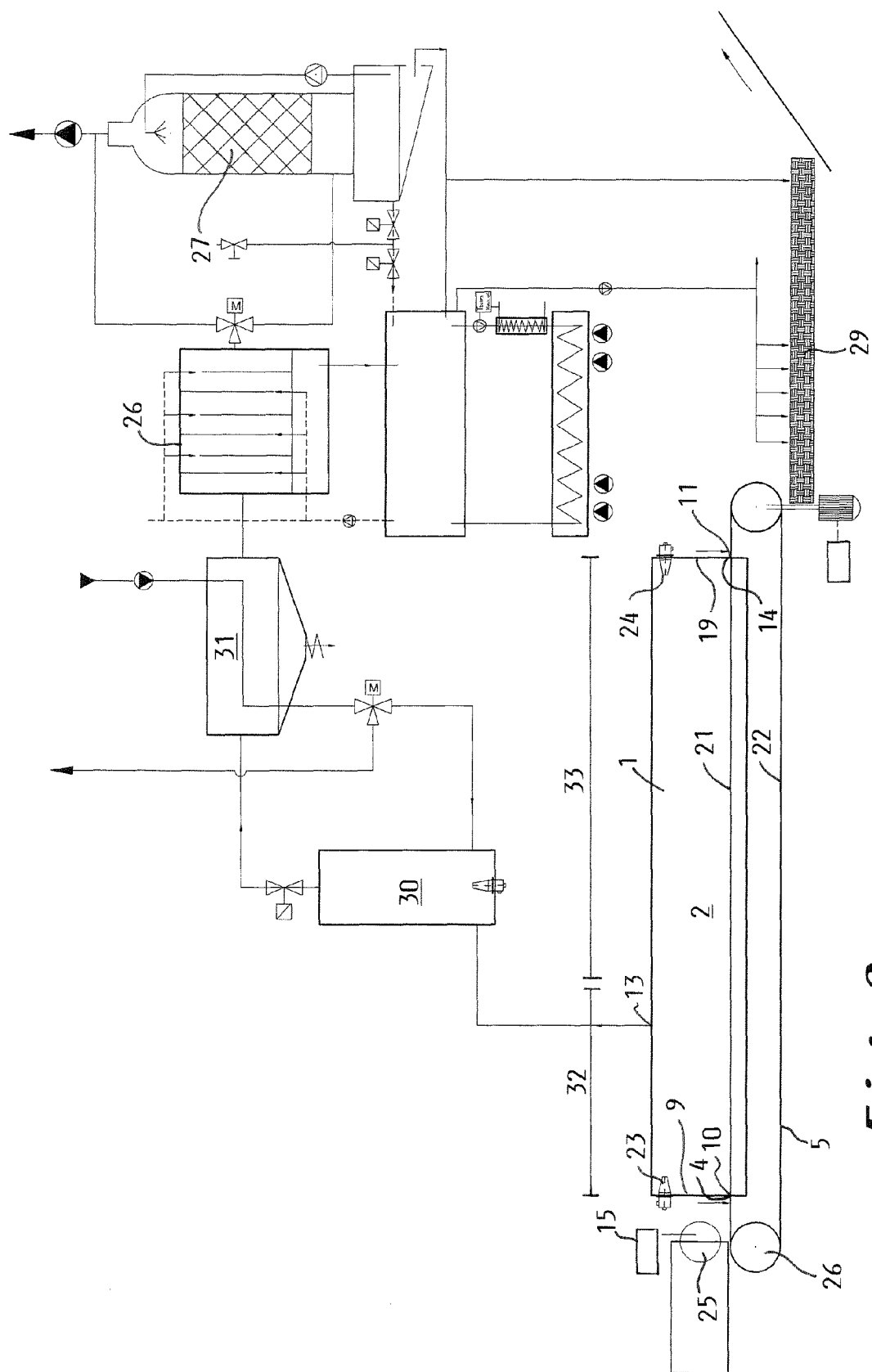


Fig. 2

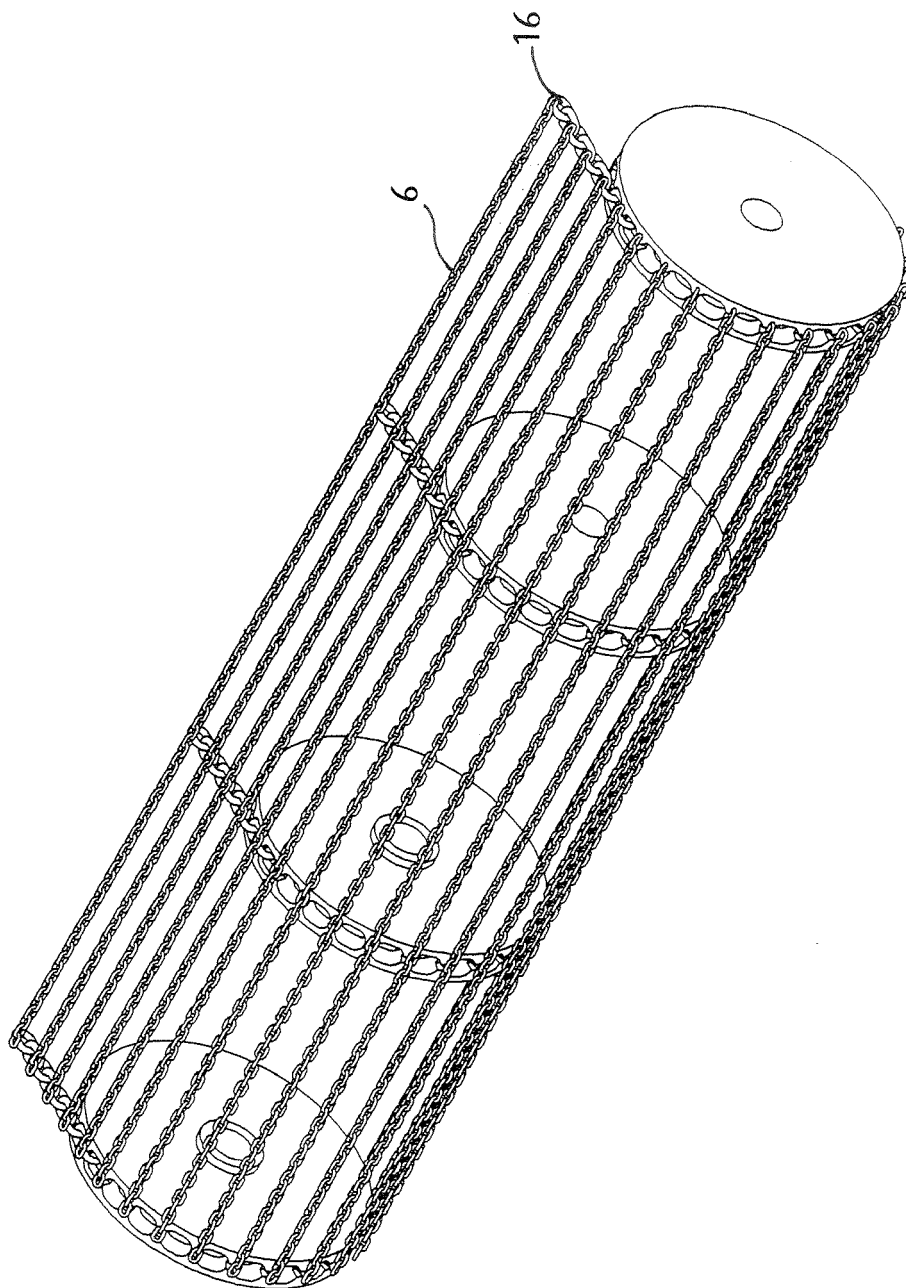


Fig. 3

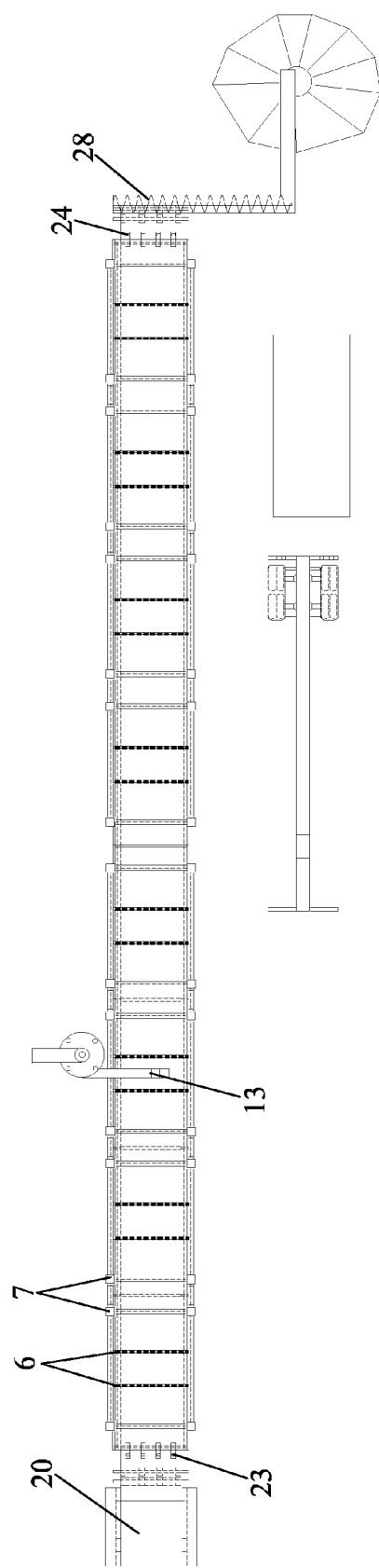


Fig. 4

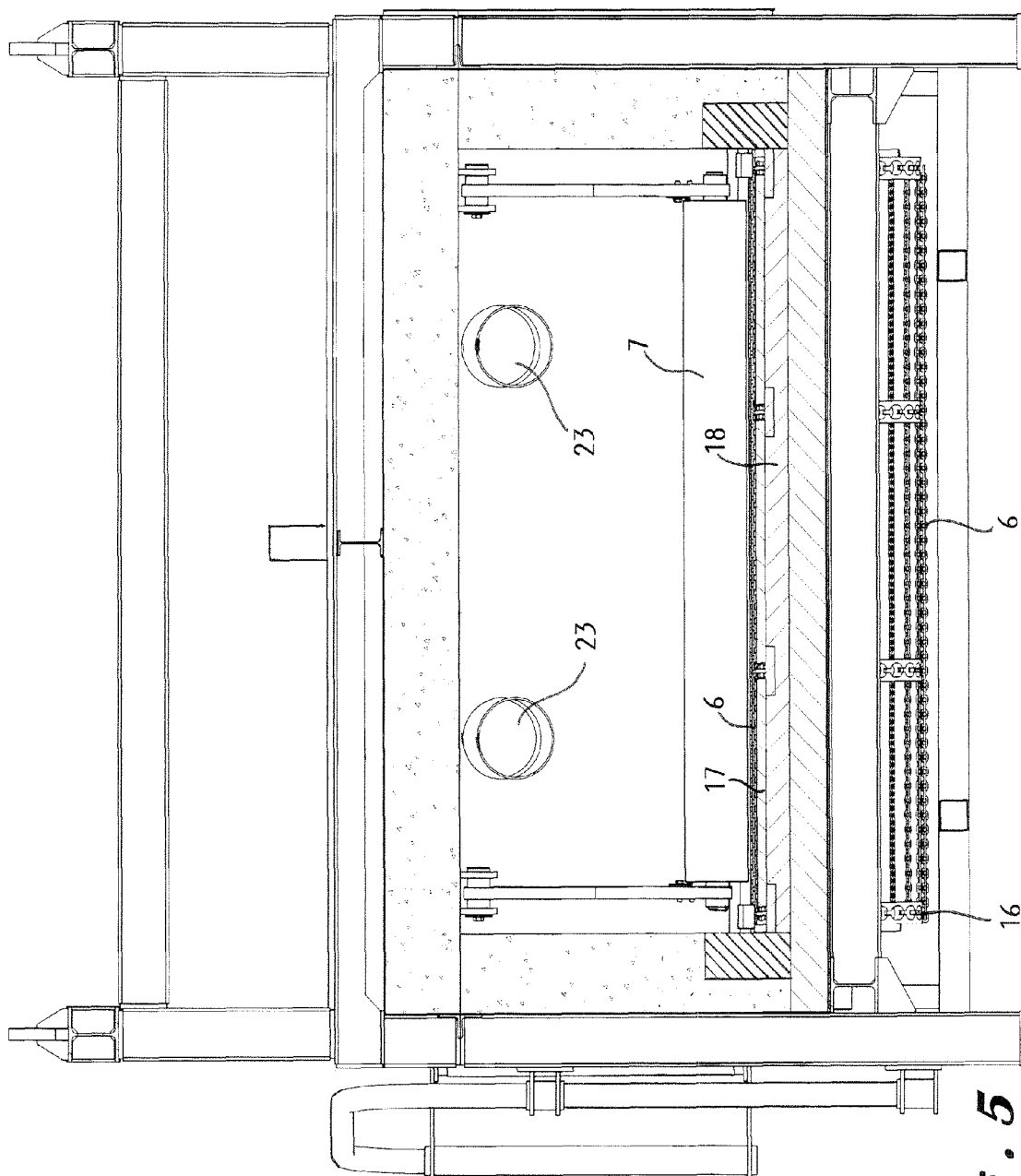


Fig. 5



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EUROPEAN SEARCH REPORT

Application Number
EP 06 11 4532

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Place of search Munich		Date of completion of the search 3 November 2006	Examiner Coquau, Stéphane
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