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(54) **Fireplace**

(57) Fireplace (10, 100), at least comprising:
a housing enclosing a combustion chamber (9) having a height, a width and a depth;
wherein said housing at least comprises:
a bottom wall;
a front wall;
side walls;
wherein the front wall or at least one of the side walls is/are at least partially construed as door (4) through which said combustion chamber (9) may be supplied with combustible;
a top wall;
a rear wall;
at least one outlet for smoke gas (5) that is formed when operating the fireplace (10, 100) when burning a combustible in said combustion chamber (9), preferably wherein said outlet (5) is located in the top wall and/or rear wall of the housing;
an ash grate (3) being arranged in the combustion chamber (9) above the bottom wall;
wherein
the height of the combustion chamber (9) is greater than the width and the depth, respectively;
said combustion chamber (9) comprises at least one first means for aerating (1) through which combustion air may flow into the combustion chamber (9) in order to support the burning of combustible, and at least one second means for aerating (2) through which combustion air may flow into the combustion chamber (9) in order to support the burning of combustible;
the first means for aerating (1) is arranged above the ash grate (3) and the second means for aerating (2) is arranged above the first means for aerating (1).

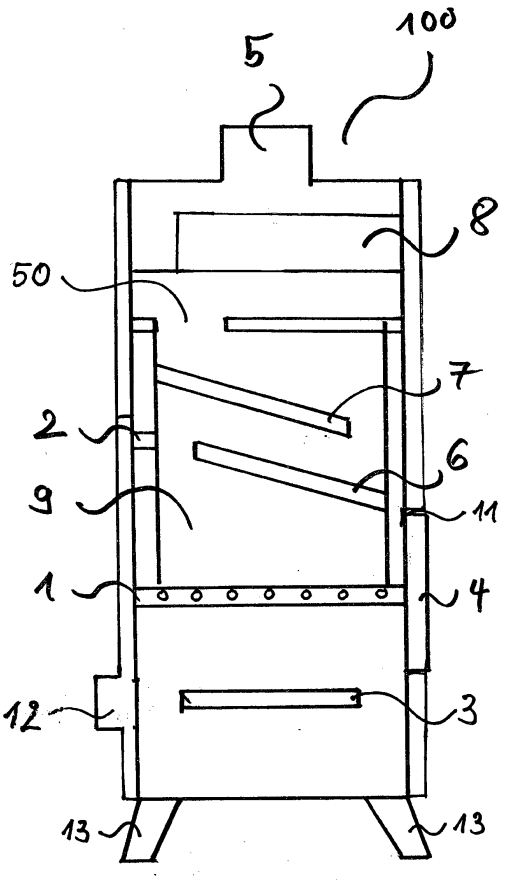

Fig. 3

EP 2 905 540 A1

Description

[0001] The present invention relates to a fireplace providing for low emission of carbon monoxide and particulate matter.

[0002] Fireplaces such as small heating systems, also termed as small combustion systems, heating systems for single rooms such as wood-burning stoves, tile stoves, cookers and opened fireplaces which are operated with solid fuel such as wood or wood pellets may often be found in private households. Typical emissions of such fireplaces may amount up to approximately 60 mg/Nm^3 for particulate matter and approximately up to 1,500 mg /Nm^3 for carbon monoxide. However, governmental regulations may require reduced emissions. E.g., respective regulations of the Federal Republic of Germany specify for heating systems for single rooms an emission of carbon monoxide in the range of from 40 - 350 mg/Nm^3 and for particulate matter in the range of from 30 - 75 mg/Nm^3 (1. BImSchV).

[0003] One object to be solved by the present invention is the provision of a fireplace allowing for reduced emission of carbon monoxide and particulate matter. Preferably, said fireplace should be usable in a private household, however also for industrial and professional use.

[0004] This problem is solved with a fireplace as defined in claim 1. Preferred embodiments are specified in claims depending thereon.

[0005] In one embodiment, the invention relates to a fireplace, at least comprising:

> a housing enclosing a combustion chamber, the combustion chamber having a height, a width and a depth; wherein said housing at least comprises:
> a bottom wall;
> a front wall;
> one or more side walls;
> wherein the front wall and / or at least one of the side walls is / are at least partially construed as door through which said combustion chamber may be supplied with combustible;
> a top wall;
> a rear wall;
> at least one outlet for smoke gas that is formed when operating the fireplace while burning a combustible in said combustion chamber, preferably wherein said outlet is located in the top wall or the rear wall or the top wall and the rear wall of the housing;
> an ash grate being arranged in the combustion chamber above the bottom wall;

wherein
the height of the combustion chamber is greater than the width and the depth, respectively;
said combustion chamber comprises at least a first means for aerating through which combustion air may flow into the combustion chamber in order to support the burning of combustible and/or the burning of smoke gas formed in the burning of combustible, and at least one second means for aerating through which combustion air may flow into the combustion chamber in order to support the burning of combustible and/or the burning of smoke gas formed in the burning of combustible;
the first means for aerating is arranged above the ash grate and the second means for aerating is arranged above the first means for aerating.

[0006] The fireplace according to the invention allows reducing the emission of carbon monoxide and particulate matter to values below 300 mg/Nm^3 carbon monoxide and 30 mg/Nm^3 particulate matter, more preferred down to 270 mg/Nm^3 carbon monoxide and 25 mg/Nm^3 particulate matter.

[0007] The invention is explained in more detail in the following: The terms in quotation marks are defined in the meaning of the invention.

[0008] The term *"Nm^3"* encompasses the term *"dry standard cubic meter",* which term is synonymously used to the terms *"normal cubic meter"* or *"standard cubic meter".*

[0009] The term *"particulate matter"* is synonymously used to the term *"dust"* or *"fine dust".* This particulate matter is generated when combustible in a fireplace is not completely combusted to gaseous products.

[0010] The term *"fireplace"* encompasses an architectural structure designed to contain fire when in operation. In the broadest meaning, the term encompasses any heating system which may be operated by means of burning a combustible. Accordingly, the term *"fire-place"* encompasses terms such as *"oven", "furnace"* or *"stove".* In a preferred embodiment, said fireplace encompasses a heating system that is used in a private household, preferably a small heating system. In a preferred embodiment, said heating system provides for a power of from 5 to 15 kW, preferably of from 5 to 10 kW, more preferably 6 to 8 kW.

[0011] In a further embodiment, the term *"fireplace"* encompasses a heating system that provides for a power of more than 2 kW, preferably up to 49 kW.

[0012] The term *"housing"* encompasses a hard or stable casing or mantle which encloses a combustion chamber.

[0013] Said housing of the fireplace according to the invention comprises at least
a bottom wall;
a front wall, which may be at least partially construed as door through which said combustion chamber may be supplied with combustible and / or which is at least partially construed of glass ceramics;
one or more side walls which may be at least partially construed as door through which said combustion chamber may be supplied with combustible;
a top wall; and
a rear wall.

[0014] In one embodiment, the term *"one or more side wall/walls"* encompasses all parts of the housing which are different from the bottom wall and the top wall, or

from the bottom wall and the top wall, the front wall and the rear wall.

[0015] In a preferred embodiment, said front wall, said rear wall, said one or more side walls, said top wall and said bottom wall form the combustion chamber, respectively said combustion chamber is comprised by said front wall, said rear wall, said one or more side walls, said top wall and said bottom wall.

[0016] The term *"combustion chamber"* encompasses the location in which the combustible is combusted or burnt.

[0017] The combustion chamber has a height, a width and a depth. According to the invention, the height of the combustion chamber is greater than the width and the depth, respectively. Accordingly, the combustion chamber extends vertically. This vertical extension in combination with the location of the first and second means for aerating in said combustion chamber is a prerequisite for the excellent properties of the fireplace. Said excellent properties may be further improved if the combustion chamber comprises further means for aerating such as third and/or fourth means for aerating or still further means for aerating, which are explained in more detail below.

[0018] In one embodiment, the width and/or depth of the combustion chamber are independently selected in a range of from 200 to 1200 mm. The height of the combustion chamber may range from 600 mm to 2000 mm. The width and/or depth and height of the combustion chamber refer to the shortest distances measured from side wall to side wall, front wall to rear wall and bottom wall to the top wall.

[0019] In one embodiment, the bottom wall is designed in a rectangular manner. In this embodiment, the combustion chamber preferably comprises a top wall, a bottom wall, a front wall, a rear wall and two side walls.

[0020] In another embodiment, it is also possible to construe the bottom wall in any conceivable form such as a triangle, a pentagon, a circle or as an oval. Preferably, the number of the side walls, the front wall and the rear wall preferably are adapted to the shape of the bottom wall. E.g., if the bottom wall is a circle or an oval, then the front wall, the side walls and the rear wall may form a cylinder or are cylindrically shaped.

[0021] Preferably, said walls forming the combustion chamber are made from cast iron or from steel.

[0022] In a further preferred embodiment, the walls of said combustion chamber are at least partially additionally provided with refractory material, preferably chamotte, cast iron or vermiculite.

[0023] The term *"door"* in connection with the fireplace according to the invention encompasses the term *"furnace door"* or *"fireplace door"*.

[0024] Said door of said front wall or side wall may also consist of or may comprise cast iron or steel.

[0025] In a preferred embodiment, said door of said front wall or the front wall is at least partially construed from glass ceramics such that the combustion of said combustible may be monitored.

[0026] In a further preferred embodiment, said door comprises one or two layers of glass ceramics. Preferably, said two layers are spaced apart such that air from the environment may circulate between said layers due to convection when operating said fireplace.

[0027] The term *"combustible"* encompasses any solid fuel such as wood, wood pellets, or carbon such as coal or brown coal. In a preferred embodiment, the combustible is a solid fuel comprising wood or is wood such as wood billets or wood pellets.

[0028] The fireplace according to the invention also comprises at least one outlet for smoke gas which is generated when combustible is combusted in the combustion chamber. The term "*outlet*" encompasses the portion of the fireplace through which said smoke gas may exit said fireplace when in operation. Preferably, said outlet is connected via a smoke gas pipe to a chimney when operating the fireplace.

[0029] Preferably, said outlet is positioned in the top wall or rear wall of said housing.

[0030] The term *"smoke gas"* is synonymously used to terms such as *"flue"* or *"exhaust"* or *"exhaust gas"*.

[0031] The fireplace according to the invention further comprises an ash grate. The term "ash grate" encompasses any conceivable means which supports the combustible. Preferably, said ash grate is in the form of a grid or comprises a grid. Said ash grate allows ashes formed in the combustion of combustible to fall down into an ash pan.

[0032] In a preferred embodiment, said ash grate comprises not only one grid but at least two grids. Preferably, said grids are arranged one above the other.

[0033] The inventors of the invention have discovered that an ash grate which comprises at least two grids which are arranged one above the other may further support the low emission when burning combustible in the fireplace according to the invention.

[0034] The fireplace according to the invention comprises at least two different means for aerating, i.e. first means for aerating and second means for aerating. However, in further preferred embodiments, the fireplace according to the invention may comprise further means for aerating.

[0035] The term *"means for aerating"* encompasses any conceivable means or device or equipment by means of which the combustion chamber may be aerated in order to support the combusting of the combustible and/or the burning of smoke gas formed in the burning of combustible and/or the burning of condensed smoke gas or soot. By means of said means for aerating, air is fed into or flows into the combustion chamber. Said air may also be termed *"combustion air"*.

[0036] In a preferred embodiment, the fireplace according to the invention comprises at least three different means for aerating, i.e. said first means for aerating and said second means for aerating in combination with a third means for aerating.

[0037] In a further preferred embodiment, the fireplace according to the invention comprises at least four different means for aerating, i.e. said first means for aerating and said second means for aerating in combination with a third means and a fourth means for aerating.

[0038] In one embodiment, said third means for aerating is construed such to feed air to said door of the front wall or to said glass ceramics of the front wall. Without being bound by theory, it is believed that this hinders the soiling of the glass ceramics by residue of smoke gas which is formed at the inner side of the door of the front wall and / or the side wall or the glass ceramics of the front wall due to condensation, e.g. formed due to condensed smoke gas or formed due to soot formation. Additionally, the third means for aerating also supplies combustion air to the fire from the front when operating the fireplace.

[0039] Preferably, said third means for aerating is arranged below the second means for aerating and further preferably above the first means for aerating.

[0040] In a further preferred embodiment, fourth means for aerating are arranged below the first means for aerating, further preferably below the ash grate in order to support the burning of the combustible.

[0041] Such fourth means for aerating means may be further valuable when igniting the combustible, i.e. said fourth means for aerating may facilitate the ignition of the combustible due to the flow of combustion air through said combustible.

[0042] In a preferred embodiment, the first means for aerating or the second means for aerating or the first means for aerating and the second means for aerating are construed as pipe / pipes having a multitude of openings through which combustion air may flow into the combustion chamber in order to support the burning of combustible.

[0043] The term "pipe" encompasses a pipe having a circular cross section, an oval cross section, a rectangular cross section or a triangular cross section. In one embodiment, the cross section may have any conceivable shape.

[0044] In a preferred embodiment, said pipes forming the first means for aerating and the second means for aerating extend in parallel to the bottom wall and / or the ash grate.

[0045] Preferably, said pipes are adapted to the shape of the respective wall, where they are attached to or where they are close to. In case of a plane wall, said pipes are preferably shaped in a straight manner in order to conform to the shape of the plane wall. In case of a curved wall, said pipes are also curved in order to conform to the shape of the curved wall.

[0046] In a preferred embodiment, the third means for aerating is also construed as a pipe having a multitude of openings through which combustion air may be fed to the inner side of said door or doors or to said class ceramics.

[0047] Said third means for aerating may be mounted at the rear wall such that it guides combustion air to the inner surface of said door in the front wall.

[0048] In an alternative embodiment, said third means is construed as an opening in the front wall through which combustion air may flow into the combustion chamber. Preferably, said opening, preferably in the form of a slit, is arranged above the door.

[0049] Preferably, a baffle plate is arranged at the inner side of the combustion chamber such that it may direct combustion air to the inner surface of the door or the glass ceramics, i.e. the surface which comes into contact with combustible, respectively products formed when burning combustible. This arrangement helps preventing the deposition of particulate matter or ashes or soot onto the furnace door.

[0050] Preferably, the fourth means for aerating is also construed as a pipe having a multitude of openings through which combustion air may penetrate the combustible and flow through said combustible when burning same in the combustion chamber.

[0051] In a preferred embodiment, said means for aerating comprise a multitude of opening, respectively.

[0052] The term *"multitude"* encompasses at least two or three or four or five or six or seven or eight or nine or ten or more openings. Said openings may be arranged randomly or may be arranged in a regular manner on or in said first means for aerating or said second means for aerating or said third means for aerating or said fourth means for aerating.

[0053] The term "*opening*" encompasses a hole such as a bore hole. Said opening may also have the form of a slit or any other conceivable form which allows combustion air to exit said opening in order to enter the combustion chamber.

[0054] According to the invention, the first means for aerating is arranged above the ash grate and the second means for aerating is arranged above the first means for aerating.

[0055] In one embodiment, both the first means for aerating and the second means and preferably also the third means for aerating are arranged at the rear wall, preferably mounted, or are arranged close to the rear wall of the fireplace according to the invention.

[0056] In another embodiment, it is possible to arrange the first means for aerating at the rear wall or close to the rear wall and to arrange the second means for aerating at one of the side walls or close to one of the side walls, or the front wall or close to the front wall or vice versa.

[0057] In another embodiment, it is possible to arrange the first means for aerating and the second means for aerating and the third and fourth means of aerating at any position of one of the side walls, the front wall or the rear wall, or close to said walls, provided the first means for aerating is arranged above the ash grate and the second and third means for aerating is arranged above the first means for aerating, wherein the third means for aerating is arranged below the second means for aerating,

and the fourth means for aerating is arranged below the first means for aerating, preferably below the ash grate.

[0058] In a preferred embodiment, said first means for aerating is spaced apart from the ash grate in a distance such that said first means for aerating is not covered by combustible when burning combustible.

[0059] In a preferred embodiment, said first means is spaced apart from the ash grate in a distance which is at least a third of the width and/or the depth of the combustion chamber.

[0060] In a further preferred embodiment, the distance of the second means for aerating from the first means for aerating is greater than the distance of the first means for aerating from the ash grate.

[0061] The term *"distance"* defines the shortest connecting line between the ash grate and the first means for aerating, respectively the shortest connecting line between the first means for aerating and the second means for aerating.

[0062] Preferably, the ratio of the distance of the second means for aerating from the first means for aerating to the distance of the first means for aerating from the ash grate is in the range of from 1.1 to 4.0, preferably from 1.5 to 3, more preferred from 1.8 to 2.5.

[0063] Such ratios have proved to be particularly efficient to burn combustible such to produce particulate matter and/or carbon dioxide in an amount as low as possible.

[0064] It is further possible to optimize the above distances, respectively ratio of distances. In a preferred embodiment, said distances, respectively ratio of said distances is/are selected such that the color of the flame that is generated when burning combustible turns from yellow to blue. The person skilled in the art is capable of evaluating said distances/ratio of distances in a few experiments.

[0065] In a further preferred embodiment,
the height of the combustion chamber is in the range of from 600 to 2000 mm;
the width is in the range of from 200 to 1200 mm;
the depth is in the range of from 200 to 1200 mm;
the distance of the second means for aerating from the first means for aerating is in the range of from 300 to 500 mm; preferably 300 to 450 mm;
the distance of the first means for aerating from the ash grate is in the range of from 150 mm to 300 mm, preferably 150 to 250 mm

[0066] In another preferred embodiment,
the height of the combustion chamber is in the range of from 800 to 1800 mm;
the width is in the range of from 250 to 500 mm;
the depth is in the range of from 250 to 500 mm;
the distance of the second means for aerating from the first means for aerating is in the range of from 350 to 450 mm; preferably 400 mm;
the distance of the first means for aerating from the ash grate is in the range of from 180 mm to 280 mm; preferably 220 mm.

[0067] The term *"distance"* with respect to the height defines the shortest distance between the bottom wall and the top wall, with respect to the width, the shortest distance between two side walls facing each other, with respect to the depth, the shortest distance between the front wall and the rear wall.

[0068] Further preferably, said housing further comprises at least one opening in the housing through which combustion air may be fed to the first means and / or the second means and/or third means and / or fourth means or any further means for aerating, such as fifth means for aerating.

[0069] Such fifth means or any further means for aerating may be arranged at any conceivable position in the combustion chamber.

[0070] Preferably, said opening and said first means for aerating and / or said second, third or fourth or fifth means for aerating are connected to one another via a pipe or pipes or other form of aerating channel.

[0071] In a preferred embodiment, said pipe or pipes for supplying the first and second means, third or fourth or fifth means for aerating with combustion air are arranged at least partially in the combustion chamber such that combustion air which may flow through said pipes is heated when burning combustible. Accordingly, said air exits the first means and/or the second means and/or, third or fourth or fifth means for aerating in order to enter the combustion chamber.

[0072] In a further embodiment, the fireplace according to the invention further comprises means for controlling the flow of combustion air to the first means for aerating and/or the second means for aerating and/or third or fourth or fifth means for aerating. By means of said means for controlling, which may preferably be provided in the form of a valve, a gate valve or a butterfly valve, the flow of combustion air may be controlled and adjusted.

[0073] In a preferred embodiment, the combustion chamber comprises at least one means for directing smoke gas that is formed in the combustion chamber when burning combustible to the smoke gas outlet.

[0074] The term *"means for directing smoke gas that is formed in the combustion chamber when burning combustible"* encompasses any means whose shape and arrangement in the combustion chamber is suitable for performing the intended use.

[0075] Preferably, the means for directing smoke gas is construed as one or more baffle plates for directing formed smoke gas.

[0076] Preferably, the baffle plates are made from steel or cast iron or from ceramics, preferably chamotte or vermiculite.

[0077] Preferably, the combustion chamber comprises at least two baffle plates.

[0078] Preferably, said means for directing, preferably in the form of baffle plates, respectively, are arranged in the combustion chamber in an inclined manner.

[0079] In a preferred embodiment, a first inclined baffle plate is arranged in the combustion chamber such that

it may direct smoke gas, which has been aerated by the first means for aerating, to the second means for aerating.

[0080] In a further preferred embodiment, a is second inclined baffle plate is arranged in the combustion chamber such that it may direct smoke gas, which has passed the second means for aerating, to the outlet for smoke gas when burning combustible.

[0081] In a further preferred embodiment, the first baffle plate and the second baffle plate extend in the same direction. Preferably, the first and the second baffle plate are in parallel.

[0082] In a further preferred embodiment, said baffle plates may be arranged in a pyramidic shape.

[0083] In a further preferred embodiment of the invention, the combustion chamber of the fireplace according to the invention comprises at least one cleaning device for smoke gas.

[0084] The term *"cleaning device"* encompasses any conceivable device which is suitable for at least partially reducing the amount of carbon monoxide or particulate matter in the smoke gas formed when combusting combustible in the combustion chamber.

[0085] In case of solid emissions such as particulate matter, said cleaning device may be construed such to act as a filter, and / or such to act as a catalyst in order to catalytically convert same.

[0086] In case of gaseous emissions, said cleaning device may be construed such to absorb or adsorb said gaseous emissions, and / or to catalytically convert same.

[0087] Preferably, said cleaning device is arranged in or above the combustion chamber such that formed smoke gas at least partially flows through said cleaning device before said smoke gas at least partially exits the combustion chamber or the fireplace via an outlet, preferably in form of a smoke gas pipe that connects said fireplace to a chimney.

[0088] In a preferred embodiment, said cleaning device may be arranged in said smoke gas pipe.

[0089] Preferably, said cleaning device is selected from the group consisting of: a filter device or a catalytic device. Preferably, the catalytic device at least partially may oxidize generated carbon monoxide to carbon dioxide when operating said fireplace according to the invention.

[0090] A suitable catalytic device is e.g. described in EP 2 418 425 B1.

[0091] Accordingly, said catalytic device comprises a catalytically active material, wherein the catalytically active material is a ceramic by means of which an oxidation of exhaust compounds is catalyzable and wherein the catalytic device comprises a plurality of apertures through which smoke gas may flow. Preferably, the catalytic device further comprises a supporting device for supporting the catalytic device, wherein the catalytic device comprises a fixed bed, wherein the supporting device comprises a frame and an upper and lower grid-like plate, wherein said catalytic device comprising said fixed bed is arranged between the grid-like plates and the frame. Thus, said catalytic device may be provided in the form of a cassette which accommodates said catalytically active material preferably in the form of a fixed bed.

[0092] In one embodiment, said fixed bed comprises said catalytically active material, or said fixed bed comprises said catalytically active material, wherein the solid particles of the fixed bed have one or more predetermined external shapes, which are preferably selected from the group of shapes comprising or consisting of: rings, cylinders, cones, saddles, spheres, ellipsoids, cuboids, cubes, polyeders, plates, rods, or other shapes or cuts, or combinations of these shapes.

[0093] In a further embodiment said ceramic is a technical ceramic and comprises one or more of the following: titanium oxide(s), tungsten oxide(s), molybdenum oxide(s), cordierite, corundum, in particular TiO_2, WO_3, MoO_3, ZrO_2, CeO_2, and/or Al_2O_3.

[0094] In still a further embodiment, said catalytically active material comprises platinum and palladium, or platinum or palladium; or the catalytically active material comprises TiO_2 and V_2O_5; or that the catalytically active material comprises TiO_2 and V_2O_5, wherein the catalytically active material comprises a disordered anatase where less than 3.2 % or less than 2 % Ti^{4+} is replaced by V^{5+}; or the catalytically active material comprises gold. Cleaning devices preferably in the form of cassettes which accommodate materials such as chamotte, volcanic ash, pumice stone, clinker, expanded clay or a mixture thereof may also be used. Suitable materials are e.g. described in EP 2 306 087.

[0095] In one embodiment, one filter device is used for cleaning generated smoke gas.

[0096] In another embodiment, more than one filter devices are combined for cleaning generated smoke gas. Preferably, said filter devices bear different filter materials.

[0097] In one embodiment, one catalytic device is used for cleaning generated smoke gas.

[0098] In another embodiment, more than one catalytic devices are combined for cleaning generated smoke gas. Preferably, said catalytic devices bear different catalytically active materials.

[0099] In another embodiment, one filter device or several filter devices is / are used in combination with one catalytic device or several catalytic devices for cleaning generated smoke gas.

[0100] In a preferred embodiment, the invention relates to a fireplace according to the invention, wherein the combustion chamber comprises a cleaning device for smoke gas, wherein said cleaning device is arranged in the combustion chamber such that formed smoke gas at least partially flows through said cleaning device before said smoke gas at least partially exits the combustion chamber through said outlet; wherein said cleaning device is selected from the group consisting of:
a filter device or a catalytic device or a filter device and a catalytic device, preferably wherein the catalytic device at least partially may oxidize formed smoke gas when

operating said fireplace.

[0101] In one embodiment, the cleaning device may also be arranged on the top of the housing of the fireplace according to the invention such that formed smoke gas exits the fireplace through a smoke gas outlet and enters said cleaning device.

[0102] In one embodiment, the catalytic device or the fitter device or the catalytic device and the filter device may be arranged in a smoke gas pipe that connects the outlet for the smoke gas to a chimney when operating the fireplace according to the invention.

[0103] The combination of said first and second means for aerating, preferably in combination with said third means for aerating and said fourth means for aerating, and further preferably in combination with a cleaning device, preferably said means for aerating in combination with a catalytic device, is particularly effective for reducing emission of carbon monoxide and particulate matter formed in the combustion chamber of the fireplace according to the invention.

[0104] In another preferred embodiment, the width and the breadth and the distance of the ash grate from the bottom wall define a first compartment containing embers when operating the fireplace according to the invention.

[0105] Herein, the width and the breadth and the distance of the first means for aerating from the ash grate define a second compartment in which combustible is burnt when operating the fireplace according to the invention.

[0106] Herein, the width and the breadth and the distance of the second means for aerating from the first means for aerating define a third compartment in which smoke gas is burnt when operating the fireplace according to the invention.

[0107] Herein, the width and the breadth and the distance of the top wall from the second means for aerating define a fourth compartment in which smoke gas is exposed to a cleaning device when operating the fireplace according to the invention.

[0108] The mentioned distances in each case represent the respective shortest distances, i.e. the shortest distance in form of a connecting line between bottom wall and ash grate, the shortest distance between ash grate and first means for aerating, the shortest distance between second means for aerating and first means for aerating, and the shortest distance between top wall and second means for aerating.

[0109] Preferably, the distance of the ash grate from the bottom wall is in a range of from 2 to 14 %;
the first means for aerating from the ash grate is in the range of from 10 to 30 %;
the second means for aerating from the first means for aerating is in the range of from 25 to 45 %;
the top wall from the second means for aerating is in the range of from 25 to 45 %; based on the total distance of the bottom wall from the top wall, which amounts to 100 %, respectively.

[0110] More preferably, the distance of
the ash grate from the bottom wall is in a range of from 4 to 12 %;
the first means for aerating from the ash grate is in the range of from 14 to 25 %;
the second means for aerating from the first means for aerating is in the range of from 30 to 40 %;
the top wall from the second means for aerating is in the range of from 30 to 40 %; based on the total distance of the bottom wall from the top wall, which amounts to 100 %, respectively.

[0111] Still more preferably, the distance of
the ash grate from the bottom wall is in a range of from 6 to 10 %;
the first means for aerating from the ash grate is in the range of from 16 to 20 %;
the second means for aerating from the first means for aerating is in the range of from 32 to 38 %;
the top wall from the second means for aerating is in the range of from 32 to 38 %; based on the total distance of the bottom wall from the top wall, which amounts to 100 %, respectively.

[0112] Still more preferably, the distance of
the ash grate from the bottom wall is in a range of from 7 to 9 %;
the first means for aerating from the ash grate is in the range of from 17 to 19 %;
the second means for aerating from the first means for aerating is in the range of from 34 to 36 %;
the top wall from the second means for aerating is in the range of from 34 to 36 %; based on the total distance of the bottom wall from the top wall, which amounts to 100 %, respectively.

[0113] If the bottom wall is covered by a fire retardant layer, the respective distance is the shortest distance in form of a connecting line between said layer and the ash grate.

[0114] If the top wall is at the inner side thereof with a fire retardant layer, the respective distance is the shortest distance in form of a connecting line between said layer and the second means for aerating.

[0115] In the figures show

Fig. 1 a schematic front view of a preferred fireplace according to the invention;

Fig. 2 a schematic side view of a fireplace according to the invention, preferably the fireplace according to **Fig.1.**

Fig. 2a an alternative arrangement of the means for directing smoke gas of **Fig. 1.**

Fig. 3 a schematic side view of a further preferred fireplace according to the invention.

Fig. 4 a schematic side view of a further preferred fireplace according to the invention.

[0116] **Fig. 1** shows a schematic front view of a preferred fireplace 10 according to the invention. Fireplace 10 has a rectangular bottom wall, side walls and top wall. The opened door 4 allows a view into the combustion chamber 9 of fireplace 10. Fireplace 10 comprises first means for aerating 1 having a multitude of openings (indicated by the circles) and second means for aerating 2 having a multitude of openings (indicated by the circles). Said means 1 and 2 are construed as pipes, respectively. An ash grate 3 is arranged below the first means for aerating 1. The upper region of the combustion chamber 9, respectively of the fireplace 10, includes an outlet 50 through which smoked gas reaches cleaning device 8. Cleaned smoke gas exits the fireplace 10 via an outlet 5 in the form of a smoke pipe which connects fireplace 10 to a chimney when in operation. Fourth means for aerating 40 (not shown) may be arranged below ash grate 3 in order to facilitate the ignition of combustible or to further facilitate the burning of combustible. Third means for aerating 30 between (not shown) which are arranged above first means for aerating 1 and below second means for aerating 2 may be provided such to feed combustion air to the inner surface of door 4. The fireplace may be provided with fourth means for aerating 40 which support the burning of combustible.

[0117] **Fig. 2** shows a schematic side view of the fireplace according to **Fig.1.** The first means for aerating 1 and the second means for aerating 2 are mounted at the rear wall of fireplace 10, respectively are arranged close to the rear wall. Combustion chamber 9 includes inclined means 6 in the form of a baffle plate for directing smoke gas that has been aerated by means for aerating 1 to the second means for aerating 2. Fireplace 10 further includes inclined means 7 in the form of a baffle plate for directing smoke gas that has been aerated by means for aerating 2 via an outlet 50 to cleaning device 8. Fireplace 10 further includes an opening (third means for aerating 30; slit) in combination with a baffle plate 11 for directing combustion air to the inner surface of door 4.

[0118] In the fireplace according to **Fig. 2,** means for directing smoke gas 6 and 7 are arranged in parallel or substantially in parallel. In an alternative, said means may be arranged such that they form a pyramid. **Fig. 2a** shows a respective arrangement with means for directing smoke gas 6 and 7'.

[0119] **Fig. 3** shows a schematic side view of a further preferred fireplace 100. Fireplace 100 has a rectangular bottom wall, side walls and top wall. It is further provided with leveling feet 13. The first means for aerating 1 (in the form of a pipe having a multitude of openings) is mounted to a side wall or is arranged close to a side wall, whereas the second means for aerating 2 (in the form of a pipe having a multitude of openings) is mounted at the rear wall of fireplace 100, respectively is arranged close to the rear wall. Combustion air is fed via inlet 12 to means 1 and 2. Combustion chamber 9 includes inclined means 6 in the form of a baffle plate for directing smoke gas that has been aerated by first means for aerating 1 to the second means for aerating 2. Combustion chamber 9 has a width of approx. 40 cm, a depth of approx. 40 cm and a height of approx. 100 cm. Fireplace 100 further includes inclined means 7 in the form of a baffle plate for directing smoke gas that has been aerated by second means for aerating 2 via an outlet 50 to cleaning device 8. Fireplace 100 further includes an opening (third means for aerating 30; slit) in combination with a baffle plate 11 for directing combustion air to the inner surface of door 4. Door 4 comprises two layers of glass ceramics which are spaced apart from one another such that air from the environment may circulate between said two layers due to convection. Cleaned smoke gas may exit fireplace 100 via outlet 5 in the form of a smoke pipe which connects fireplace 10 to a chimney when in operation.

[0120] **Fig. 4** shows a schematic side view of a further preferred fireplace according to the invention. Fireplace 10, 100 may be divided into four compartments 200, 300, 400 and 500. The width and the breadth and the distance of the ash grate 3 from the bottom wall 60 define a first compartment 200 containing embers when operating the fireplace according to the invention, the width and the breadth and the distance of the first means for aerating 1 from the ash grate 3 define a second compartment 300 in which combustible is burnt when operating the fireplace according to the invention, the width and the breadth and the distance of the second means for aerating 2 from the first means for aerating 1 define a third compartment 400 in which smoke gas is burnt when operating the fireplace according to the invention, and the width and the breadth and the distance of the top wall 70 from the second means for aerating 2 define a fourth compartment 500 in which smoke gas may be exposed to a cleaning device(8), if desired. The dashed lines symbolize the position of ash grate 3 and first and second means for aerating 2. The relative position of ash grate 3 and first means for aerating 1 and second means for aerating 2 is crucial for the efficacy of the fireplace according to the invention. This efficacy may be further improved by means of third means for aerating 30 and fourth means 40 for aerating (also indicated be dashed lines). Herein, the third means for aerating 30 is arranged such to feed combustion air to furnace door 4. Fourth means for aerating 40 is arranged below ash grate 3 in order to further support the burning of combustible when operating the fireplace according to the invention.

Reference numerals

[0121]

10, 100	fireplace
1	first means for aerating
2	second means for aerating
3	ash grate
4	furnace door
5	smoke gas outlet / smoke gas pipe
6	first means for directing smoke gas / baffle

	plate
7, 7'	second means for directing smoke gas / baffle plate
8	cleaning device
9	combustion chamber
11	opening (e.g. slit; fourth means for aerating) in combination with a baffle plate for directing combustion air to the inner surface of door 4
12	inlet for combustion air
13	leveling feet
50	smoke gas outlet
30	third means for aerating
40	fourth means for aerating
60	bottom wall
70	top wall
200	compartment formed by the width, breadth and distance of ash grate 3 from bottom wall 60
300	compartment formed by the width, breadth and distance of first means for aerating 1 from ash grate 3
400	compartment formed by the width, breadth and distance of second means for aerating 2 from first means for aerating 1
500	compartment formed by the width, breadth and distance of top wall 70 from second means for aerating 2

Claims

1. Fireplace (10, 100), at least comprising:

a housing enclosing a combustion chamber (9) having a height, a width and a depth;
wherein said housing at least comprises:

a bottom wall (60);
a front wall;
side walls;
wherein the front wall and / or at least one of the side walls is / are at least partially construed as door (4) through which said combustion chamber (9) may be supplied with combustible;
a top wall (70);
a rear wall;
at least one outlet for smoke gas (5) that is formed when operating the fireplace (10, 100) when burning a combustible in said combustion chamber (9), preferably wherein said outlet (5) is located in the top wall (70) and/or rear wall of the housing;
an ash grate (3) being arranged in the combustion chamber (9) above the bottom wall;
wherein
the height of the combustion chamber (9) is greater than the width and the depth, respectively;
said combustion chamber (9) comprises at least one first means for aerating (1) through which combustion air may flow into the combustion chamber (9) in order to support the burning of combustible, and at least one second means for aerating (2) through which combustion air may flow into the combustion chamber (9) in order to support the burning of combustible;
the first means for aerating (1) is arranged above the ash grate (3) and the second means for aerating (2) is arranged above the first means for aerating (1).

2. Fireplace (10, 100) according to claim 1, wherein said front wall is at least partially construed as door (4) through which said combustion chamber (9) may be supplied with combustible and / or which is at least partially construed of glass ceramics.

3. Fireplace (10, 100) according to claim 1 or 2, wherein said first means for aerating (1) is spaced apart from the ash grate (3) in a distance such that said first means for aerating (1) is not covered by combustible when burning combustible.

4. Fireplace (10, 100) according to any one of the preceding claims, wherein said first means for aerating (1) is spaced apart from the ash grate (3) in a distance which is at least a third of the width and depth of the combustion chamber (9).

5. Fireplace (10, 100) according to any one of the preceding claims, wherein the distance of the second means for aerating (2) from the first means for aerating (1) is greater than the distance of the first means for aerating (1) from the ash grate (3).

6. Fireplace (10, 100) according to any one of the preceding claims, wherein
the height of of the combustion chamber (9) is in the range of from 600 to 2000 mm; the width is in the range of from 200 to 1200 mm;
the depth is in the range of from 200 to 1200 mm;
the distance of the second means for aerating (2) from the first means for aerating (1) is in the range of from 300 to 500 mm;
the distance of the first means for aerating (1) from the ash grate (3) is in the range of from 150 mm to 300 mm.

7. Fireplace (10, 100) according to any one of the preceding claims, wherein
the height of the combustion chamber (9) is in the range of from 800 to 1800 mm; the width is in the

range of from 250 to 500 mm;
the depth is in the range of from 250 to 500 mm;
the distance of the second means for aerating (2) from the first means for aerating (1) is in the range of from 350 to 450 mm;
the distance of the first means for aerating (1) from the ash grate (3) is in the range of from 180 mm to 280 mm.

8. Fireplace (10, 100) according to any one of the preceding claims, comprising third means for aerating (30), wherein said third means for aerating (30) is arranged below the second means for aerating (2) and above the first means for aerating (1), wherein said third means for aerating (30) is arranged such that combustion air exiting said third means for aerating (30) is directed to said door (4) and / or to said glass ceramics of the front wall.

9. Fireplace (10, 100) according to any one of the preceding claims, wherein a fourth means for aerating (40) is arranged below the ash grate (3) in order support the burning of combustible being on the ash grate (3) when operating the fireplace (10, 100).

10. Fireplace (10, 100) according to any one of the preceding claims, wherein the first means for aerating (1) or the second means for aerating (2) or the first means for aerating (1) and the second means for aerating (2) are construed as pipe/pipes having a multitude of openings through which combustion air may flow into the combustion chamber (9) in order to support the burning of combustible or smoke gas formed when burning combustible.

11. Fireplace (10, 100) according to claim 10, wherein the first pipe and the second pipe run in parallel to the ash grate (3) and/or the bottom wall.

12. Fireplace (10, 100) according to any one of the preceding claims, wherein said ash grate (3) comprises a double grid.

13. Fireplace (10, 100) according to any one of the preceding claims, wherein a first means for directing smoke gas (6), preferably an inclined baffle plate, is arranged above the first means for aerating (1) in the combustion chamber (9) such that it may direct smoke gas to the second means for aerating (2) when burning combustible, and wherein a second means for directing smoke gas (7, 7'), preferably an inclined baffle plate, is arranged in the combustion chamber (9) such that it may direct smoke gas that has passed the second means for aerating (2) to the outlet for smoke gas (50) or (5) when burning combustible.

14. Fireplace (10, 100) according to any one of the preceding claims, wherein the combustion chamber (9) comprises a cleaning device for smoke gas (8), wherein said cleaning device (8) is arranged in the combustion chamber (9) such that formed smoke gas at least partially may flow through said cleaning device (8) before said smoke gas at least partially exits the combustion chamber (9) through said outlet (5); wherein said cleaning device (8) is selected from the group consisting of:

a filter device or a catalytic device or a filter device and a catalytic device, preferably wherein the catalytic device at least partially may oxidize formed smoke gas when operating said fireplace.

15. Fireplace (10, 100) according to any one of the preceding claims, wherein the width and the breadth and the distance by means of which ash grate (3) is spaced apart from the bottom wall (60) define a first compartment (200) containing embers when operating the fireplace (10, 100);
the width and the breadth and the distance by means of which first means for aerating (1) is spaced apart from the ash grate (3) define a second compartment (300) in which combustible is burnt when operating the fireplace (10, 100);
the width and the breadth and the distance by means of which second means for aerating (2) is spaced apart from the first means for aerating (1) define a third compartment (400) in which smoke gas is burnt when operating the fireplace (10, 100); the width and the breadth and the distance by means of which top wall (70) is spaced apart from the second means for aerating (2) define a fourth compartment (500) in which smoke gas may exposed to a cleaning device (8) when operating the fireplace;
wherein the distance of
the ash grate (3) from the bottom wall (60) is in a range of from 2 to 14 %;
the first means for aerating (1) from the ash grate (3) is in the range of from 10 to 30 %;
the second means for aerating (2) from the first means for aerating (1) is in the range of from 25 to 45 %;
the top wall (70) from the second means for aerating (2) is in the range of from 25 to 45 %;
respectively based on the total distance of the bottom wall (60) from the top wall (70), which amounts to 100 %.

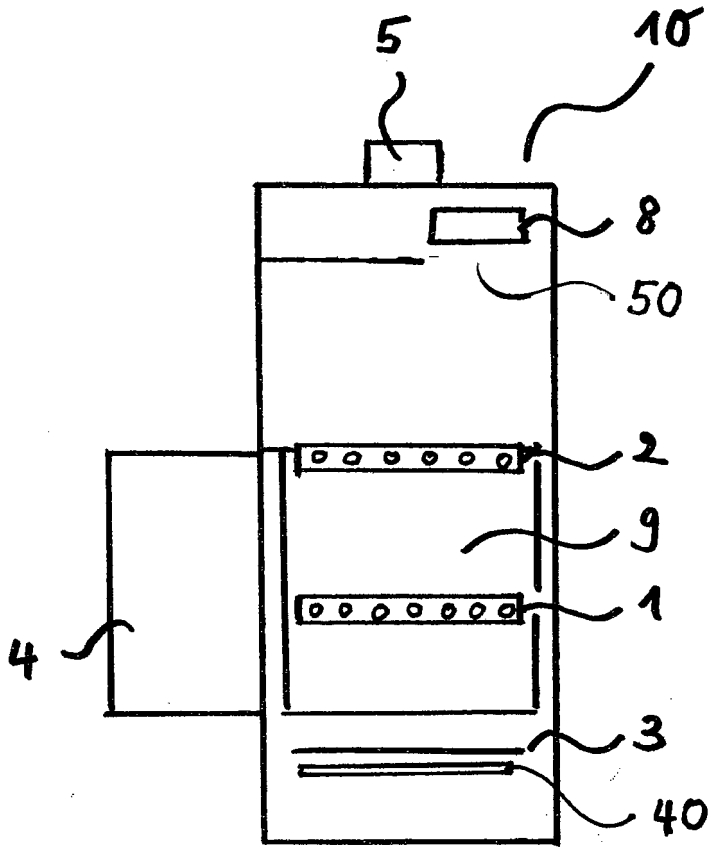

Fig. 1

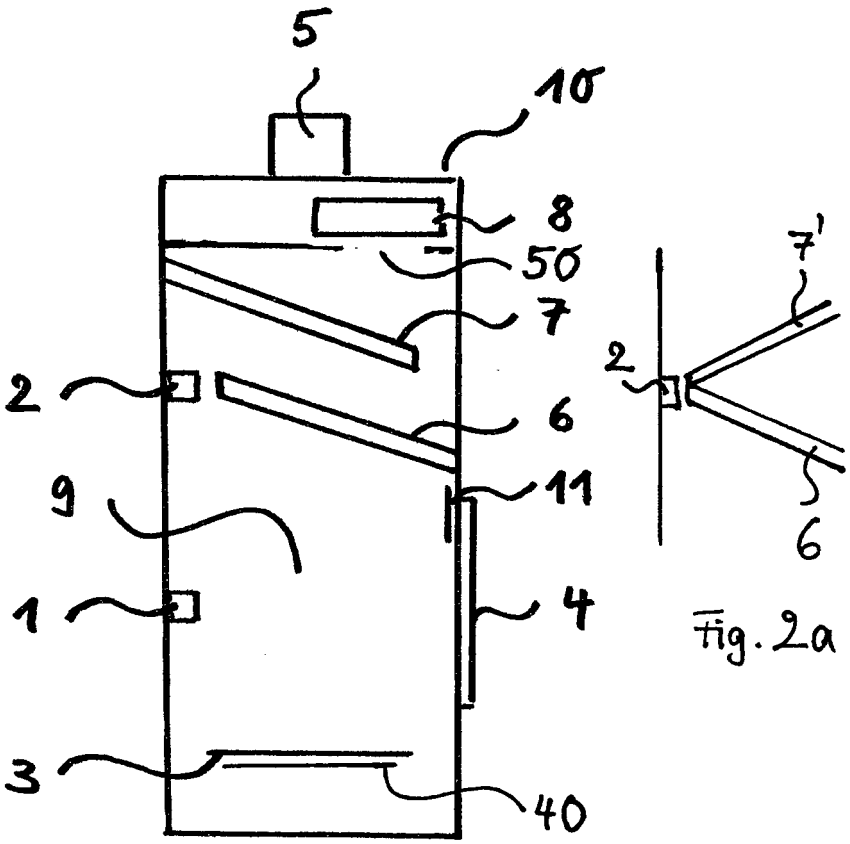

Fig. 2a

Fig. 2

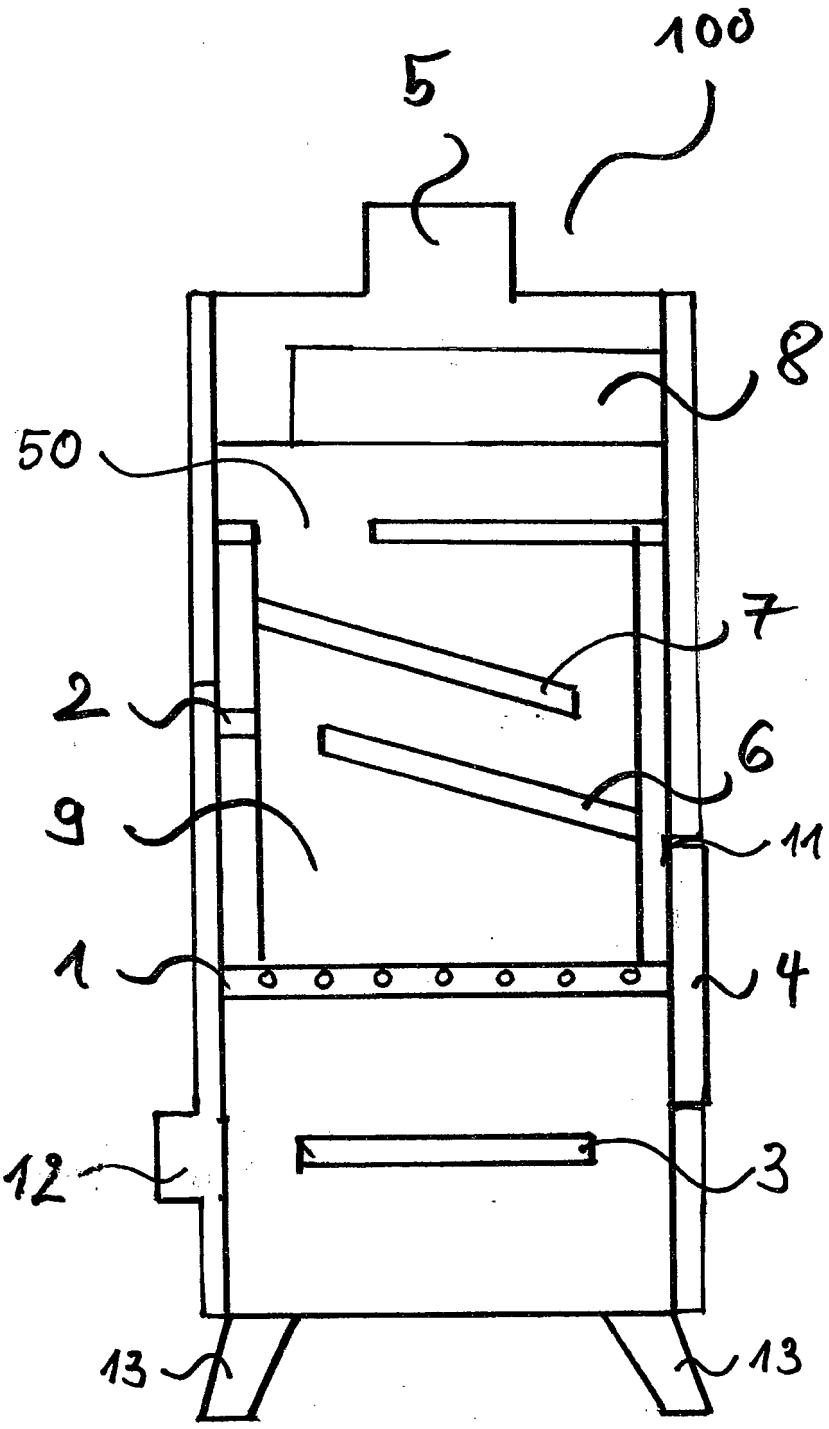

Fig. 3

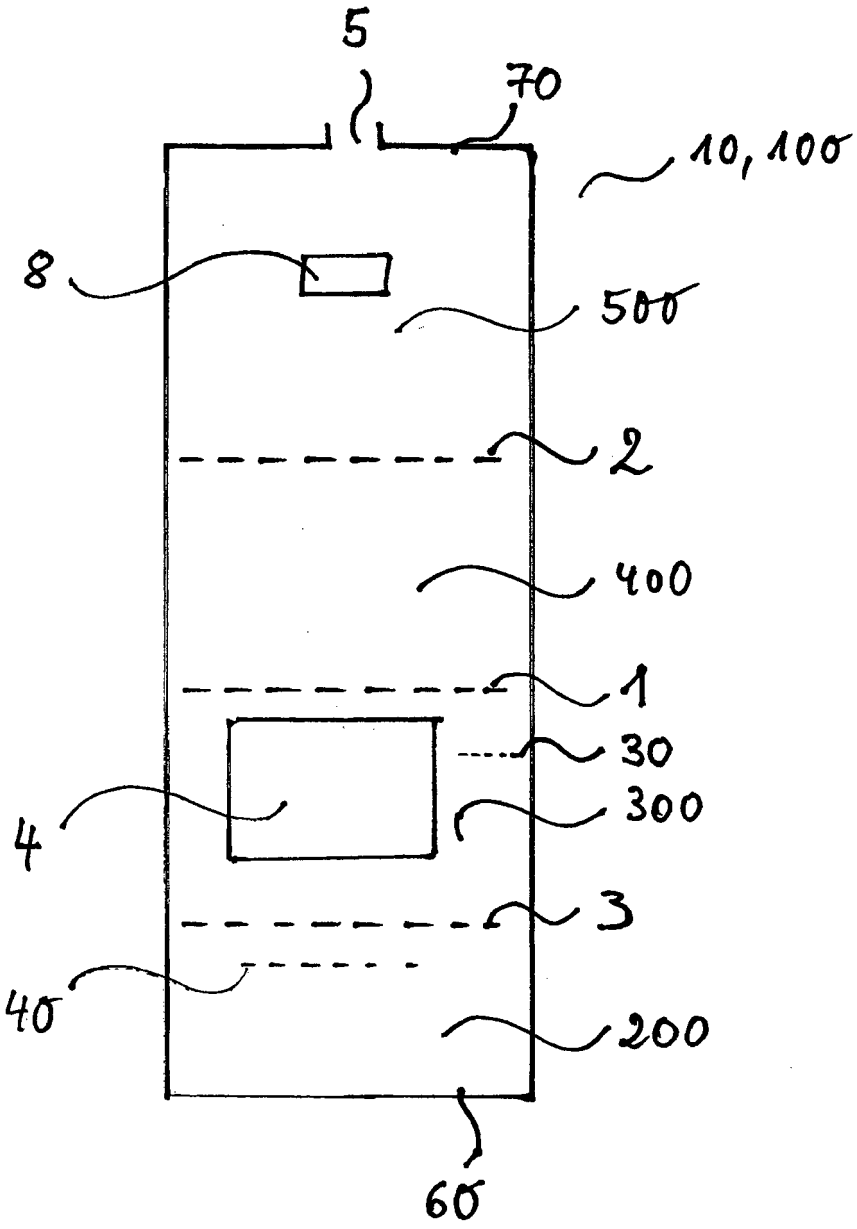

Fig. 4

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Application Number
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