(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 331 439 A1

# (12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
**30.07.2003 Bulletin 2003/31**

(51) Int Cl.[7]: **F23B 1/00**, F23L 1/02

(21) Application number: **03396006.3**

(22) Date of filing: **23.01.2003**

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PT SE SI SK TR**
Designated Extension States:
**AL LT LV MK RO**

(30) Priority: **25.01.2002 FI 20020145**

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## (54) Fireplace

(57) The invention relates to a fireplace comprising a firebox (1) and a trough-shaped grate (3) including an upper end (4) and a lower end (5) and a wall construction (6 to 9), which comprises walls (6, 7) / wall portions at an acute angle ($\alpha$) in relation to one another, the walls/wall portions being provided with elongated apertures (10) for supplying combustion air through the grate, the main direction of the apertures being at a 40 degree angle at the most in respect of an imaginary line (L) on the wall (6, 7) /wall portion, in which the apertures are formed, said line extending at a right angle in relation to a level defined by the upper end (4, 4') of the grate. In order for the grate to improve fine combustion and to enable low-emission combustion throughout almost the entire combustion process, the apertures (10) examined together form in the portion of the walls (6, 7) /wall portions, in which they are formed and which is closer to the lower end (5) of the grate, a larger surface area than in the portion of the walls/wall portions, which is closer to the upper end (4) of the grate. The invention also relates to a grate.

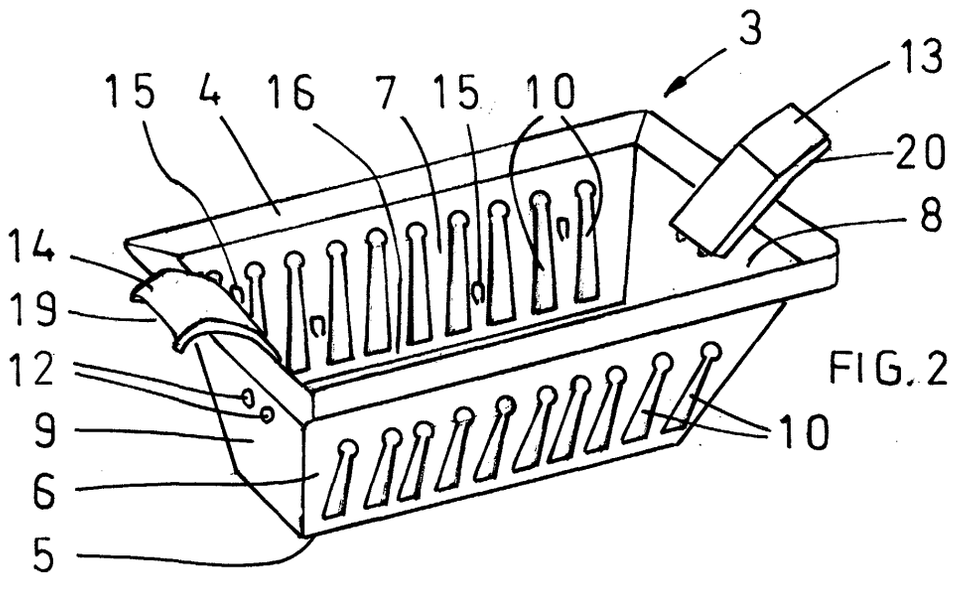



FIG. 2

EP 1 331 439 A1

## Description

### BACKGROUND OF THE INVENTION

**[0001]** The invention relates to a fireplace comprising a firebox and a trough-shaped grate including an upper end and a lower end and a wall construction, which comprises walls or wall portions at an acute angle in relation to one another, the walls/wall portions being provided with elongated apertures for supplying combustion air through the grate, the main direction of the apertures being at a 40 degree angle at the most in respect of an imaginary line on the wall /wall portion, in which the apertures are formed, said line extending at a right angle in relation to a level defined by the upper end of the grate.

**[0002]** The invention also relates to a trough-shaped grate of a fireplace comprising an upper end and a lower end and a wall construction including walls or wall portions at an acute angle in relation to one another, the walls or wall portions being provided with elongated apertures for supplying combustion air through the grate, the main direction of the apertures being at a 40 degree angle at the most in respect of an imaginary line on the wall/wall portion, in which the apertures are formed, said line extending at a right angle in relation to a level defined by the upper end of the grate.

**[0003]** Patent application FI 823745 discloses a heating device comprising a trough-shaped grate. This prior art grate comprises a set of slots arranged at the lower end of the grate and a set of apertures arranged at the upper end for supplying combustion air towards the solid combustible matter on the grate. Primarily owing to the shape of the apertures, but partly also to the location thereof, the grate does not allow efficient fine combustion to be carried out. Fine combustion refers to such a combustion process in which the solid combustible matter, for instance coal cinders, on the grate is burnt in such a manner that the ashes remain very fine. If no efficient fine combustion exists, the grate practically chokes, although the walls thereof are inclined. If the solid combustible matter were to burn to fine ashes, the inclined walls would be able to direct the fine ashes away from the grate through the bottom of the grate. Another problem with the prior art grate is that when firewood is being burnt, the wood has to be vertically placed owing to the shape and size of the grate.

**[0004]** US patent publication 5522327 discloses a trough-shaped grate comprising a set of slots arranged at the lower end of the grate and a set of apertures arranged on the sidewall of the grate for supplying combustion air into the trough-shaped space of the grate. Owing to the shape and location of the apertures, the grate does not allow efficient fine combustion to be carried out.

**[0005]** US patent publication 2145261 discloses a trough-shaped grate provided with elongated apertures with constant width. The apertures are placed at the bottom level of the grate and on the inclined sidewalls of the grate. Considered together, the apertures on the sidewalls form an equally large surface area in the portions of the sidewalls closest to the lower end of the grate as the apertures form in the portions of the sidewalls closer to the upper end of the grate. Owing to the shape and location of the apertures, the grate does not allow efficient fine combustion to be carried out.

### BRIEF DESCRIPTION OF THE INVENTION

**[0006]** It is an object of the invention to avoid the above drawbacks. In order to achieve this, the fireplace and grate according to the invention are characterized in that the apertures considered together form in the portion of the walls /wall portions, where they are formed, and which is closer to the lower end of the grate, a larger surface area than in the portion of the walls/wall portions, which is closer to the upper end of the grate.

**[0007]** Such apertures provide efficient combustion, while the gravity causes the firewood to automatically fall onto the bottom of the grate during the combustion process, constantly maintaining an adequate degree of heat in the grate and thus creating a basis for clean combustion.

**[0008]** The apertures are preferably formed to taper in a wedge-shaped manner so that they provide a substantially logarithmic airflow. The air intake spaces formed by the apertures are thus formed according to the principle of logarithmic division. Such a solution provides a most efficient airflow through the grate, even if it were filled with kindling (at the beginning of the combustion process) or with smouldering fixed matter, whereby the final combustion becomes environmentally friendly.

**[0009]** Preferably, a nozzle opening is formed at the upper end of the apertures, the diameter of the nozzle opening being greater than the width of the apertures immediately beneath the nozzle opening. Such a nozzle opening is able to supply air to the particular point on the grate and combustible matter where air is greatly required. Air jets provided from the nozzle openings extend approximately to a third of the width of the upper end of the grate on both sides. Such a structure improves burning but does not cool down the grate box excessively, and therefore the combustion of coke is cleaner. The ashes fall into an ash bin through an elongated opening that opens towards the bottom.

**[0010]** The grate is preferably provided with at least one ignition nozzle, the nozzle opening of which is located above the level defined by the upper end of the grate. The ignition nozzles maintain clean combustion by supplying air to the periphery of the grate above the hot ember, whereby the pyrolysis gases ignite at the periphery of the grate. The ignition nozzles are able to push combustion air above the grate even in such a situation that the air intake through the grate via the apertures is limited owing to the large amount of ashes on the grate.

Preferably, the upper end of the grate is formed substantially as a rectangle and comprises four walls, whereby two oppositely placed walls, which are substantially placed at a right angle to the walls provided with elongated apertures, are both provided with guiding means for directing air into at least one ignition nozzle.

**[0011]** The inner surface of the walls of the grate is preferably provided with support/turbulence means at a distance from the lower end of the grate to support the firewood to be horizontally placed and to provide the flowing air with turbulence. The support/turbulence means prevent the firewood from falling to the space in the immediate vicinity of the lower end of the grate, and therefore the space can be used as an ignition space, into which birch bark or some other suitable kindling material is placed at the initial stage of ignition. The support/turbulence means, which preferably are projections, thresholds or the like, cause discontinuity points to the inner surface of the walls of the grate, which provide the air with a turbulent flow so that it is appropriately mixed with the pyrolysis gases. The turbulent flow nicely "surrounds" the combustible fixed matter on the grate, thus improving/intensifying the combustion process.

**[0012]** The preferred embodiments of the fireplace are disclosed in the accompanying dependent claims.

**[0013]** The most significant advantages of the fireplace according to the invention are to improve fine combustion, enable efficient and low-emission combustion of firewood during almost the entire combustion process, i.e. during the initial stage, "normal stage" and final stage of the combustion. The portion of combustible material that remains incombustible is considerably smaller than in prior art fire grates. The emission created during combustion owing to efficient combustion remains low so that not only carbon monoxide remains at a lower level, but also nitric oxide emission is at the same time kept low. The firewood can be vertically placed onto the grate, but also horizontally, as the grate is preferably provided with the support/turbulence means. Particularly if the fireplace comprises a firebox described below comprising walls provided with apertures, a very efficient combustion can be achieved. The same charge weight results in twice as clean combustion results compared with those of the prior art systems.

**[0014]** The most significant advantages of the grate according to the invention, when the grate is mounted into the fireplace, are the same as the ones described above.

**[0015]** The preferred embodiments of the grate are explained in the appended claims.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0016]** In the following, the invention will be described in greater detail by means of the preferred embodiments with reference to the accompanying drawing, in which

Figure 1 is a general view showing a fireplace according to the invention,
Figure 2 shows in perspective a grate according to the invention and a part of the fireplace shown in Figure 1,
Figure 3 shows a frame intended for the grate shown in Figure 2,
Figure 4 shows a detail of the grate shown in Figure 2,
Figure 5 shows an alternative implementation for Figure 4,
Figure 6 is an end view illustrating the grate shown in Figure 2,
Figure 7 is a side view close to the end illustrating the grate shown in Figure 2,
Figure 8 illustrates a firebox with grates of the fireplace according to the invention,
Figure 9 is a top view illustrating air jets achieved with a wall construction of the firebox shown in Figure 8,
Figure 10 is a front view illustrating mixing layers achieved with the wall construction of the firebox shown in Figure 8, and
Figures 11 and 12 are top views from the view angle of Figure 9 illustrating gas rotations achieved with the wall solution of the firebox shown in Figure 8.

## DETAILED DESCRIPTION OF THE INVENTION

**[0017]** Figure 1 shows a fireplace comprising a firebox indicated using reference numeral 1. A wall construction of the firebox is indicated using reference numeral 2 and a through-shaped grate at the bottom of the firebox is indicated using reference numeral 3.

**[0018]** The structure of the grate 3 shown in Figure 1 is illustrated in Figures 2, 4, 6 and 7.

**[0019]** The grate 3 comprises a rectangular upper end 4, a lower end 5 and a wall construction including two longer substantially rectangular walls 6 and 7 and two shorter walls 8 and 9 resembling a parallelogram.

**[0020]** The opposite walls 6, 7 are provided with an array of elongated apertures 10. The number of apertures 10 in each wall 6, 7 is recommended to be 10 to 30, whereby the wall construction of the grate includes approximately 20 to 60 apertures. If the number of apertures 10 is smaller, the grate will not operate appropriately, even if the apertures were large.

**[0021]** The surface area of the apertures 10 close to the lower end 5 of the grate is larger than the surface area thereof close to the upper end 4 of the grate.

**[0022]** Figure 4 shows that the main direction of the apertures 10 is the same as that of an imaginary line L on the wall 6 extending perpendicularly in relation to the level defined by the upper end 4 of the grate. The main direction of the apertures 10 may vary from what is shown in that it is placed at an acute angle below 40 degrees in relation to the line L. Preferably the angle is below 30 degrees. If the angle exceeds 40 degrees, the apertures 10 are not operating appropriately consider-

ing the object of the invention.

**[0023]** Figure 4 also shows the recommendable wedge-shaped form of the apertures 10. The apertures 10 taper from the bottom to the top so that they provide the grate 3 with logarithmic air flow.

**[0024]** The upper end of the apertures 10 comprise a nozzle opening 11 having a diameter that exceeds the width of the apertures immediately below the nozzle opening. The diameter of the nozzle opening 11 preferably ranges between 5 and 15 mm.

**[0025]** Figure 5 shows an alternative way for implementing apertures 10a', 10b' of the grate 3. The apertures 10a', 10b' are similar to the apertures 10 shown in Figure 4, since they are elongated and the total surface area thereof close to the lower end 5' of the grate is larger than the surface area thereof close to the upper end 4' of the grate. This is because the apertures 10b' do not extend to the upper end of the grate, but are entirely placed in the bottom half of the wall 6'. Figures 4 and 5 show that an opening pair 10a', 10b' in Figure 5 corresponds with the opening 10 in Figure 4. In view of the above, the number of opening pairs 10a', 10b' on each opposite wall 6' is recommended to be between 10 and 30. If the number of opening pairs on the wall 6' remains below 10, the grate will not operate appropriately.

**[0026]** The alignment of the apertures 10a', 10b' complies with what is explained in connection with the apertures 10.

**[0027]** As Figure 6 shows, the grate has a shape resembling the letter V. The walls 6 and 7 of the grate are placed at an angle $\alpha$ = approximately 70 degrees in respect of one another. The angle $\alpha$ is preferably within a range from 50 to 90 degrees and more preferably within a range from 60 to 80 degrees. If the angle $\alpha$ is too large, the walls 6, 7 will not efficiently direct the partly but also completely burnt material on the grate downward towards the lower end of the grate. If the angle $\alpha$ is too small, the volume of the grate 3 and the surface area in the horizontal direction of the upper end 4 remain very small, if the grate is not made very deep or very large. A deep and/or large grate is inappropriate in view of the size of the fireplace and therefore impossible to implement in practice. The width of the lower end 5 of the grate ranges between 10 and 30 mm, and the width of the upper end 4 between 100 and 200 mm. The ratio between the surface areas of the lower end 5 and the upper end 4 is preferably 0.005 to 0.3 and more preferably 0.1 to 0.25. If the lower end of the grate is too wide, the size of the grate increases excessively. In addition, the apertures 10 are not able to efficiently remove the ashes, if the lower end of the grate is too wide.

**[0028]** In Figures 2, 4 and 5, reference numerals 15 and 15' indicate projections formed on the inner surfaces of the walls. The number of projections 15 is at least two on both opposite walls 6, 7. In the example shown in the Figures, the number of projections 15 is eight; four of the projections being placed at the first level and four other projections at the second level, which is located somewhat (approximately 10 to 40 mm) below the first level. The projections 15, 15' are arranged approximately in the middle of the upper and lower end of the grate. The number of projections 15, 15' as well as the exact location thereof may vary. The projections 15, 15' operate as supports, which prevent the firewood placed horizontally on the grate from falling to a grate space 16 (cf. Figure 2) beneath the projections, referred to as an ignition space, into which the ignition material is placed before ignition. The projections 15, 15' also operate as turbulence means causing turbulence to the combustion air. The turbulence allows the air to be appropriately mixed with the pyrolysis gases, which in turn improves the combustion process considering the purity of the combustion. Instead of projections, thresholds or the like can also be employed. A combined term used here for projections, thresholds or the like functioning as support means and turbulence means is support/turbulence means.

**[0029]** Figure 6 also shows that the shorter walls 8, 9 of the grate are provided with apertures 12. The object of the apertures 12, the number of which may be one or more, is to direct combustion air above the upper end 4 of the grate. The apertures 12 direct combustion air to the inner surface of the upper half of the grate wall 9, on which a trough-like guiding means 14 is formed, cf. also Figure 7. The guiding means 14 ends at a nozzle opening 19, located above the grate at a distance ranging from 10 to 50 mm, preferably from 20 to 30 mm, from the level defined by the upper end 4 of the grate. The nozzle opening 19 forms an ignition nozzle, which ignites the combustion gases on the upper surface of the grate. If the nozzle opening 19 is placed too high above the upper end of the grate, air is not directed close enough to the combustion gases, which will therefore not ignite. If the nozzle opening 19 is placed too close to the upper surface 4 of the grate, the nozzle opening is not capable of directing air above the combustion gases, if the grate is filled with material. The opposite wall 8 of the grate 3 comprises similar apertures and guiding means 13.

**[0030]** The grate 3 according to Figure 2 is typically made of cast iron. The grate 3 is placed into a frame 17 according to Figure 3, typically also made of cast iron. An air control apparatus 30 (cf. Figure 1) is placed beneath the frame 17. The air control apparatus is used to direct air partly through the grate 3 and partly through arrays of openings or apertures 100, 200, 300 in the wall construction of the firebox, the arrays of apertures being placed significantly above the upper end of the grate, cf. Figure 8. The first-mentioned air is referred to as primary air and the last-mentioned as secondary air. During the initial stage of ignition the ratio between the primary air amount and the secondary air amount is larger than in a situation, in which the fireplace is heated. An ash bin 18 is placed beneath the air control apparatus 30, cf. Figure 1.

**[0031]** The above-described grate 3 is particularly

suitable to be used with the wall construction 2 of the firebox shown in Figure 8, since the emission created during combustion is particularly low. In view of the above, the wall construction 2 of the firebox will also be described below.

**[0032]** Figure 8 illustrates in more detail how the arrays of apertures in the wall construction of the firebox are achieved. The Figure shows that the walls of the firebox comprise perforated plates 110b, 110c and 110a respectively. The sidewalls also comprise plates 110d and 110e without apertures. The plates 110d and 110e could alternatively be provided with apertures. The plate 110a is a rear plate, the plates 110b and 110c are corner plates, and the plates 110d and 110e are side plates. The plates 110a, 110e are made of fire-resistant metal or ceramic material.

**[0033]** The plates 110a, 110b and 110c comprise a first array of apertures 100, a second array of apertures 200 and a third array of apertures 300. The arrays of apertures 100, 200, 300 are substantially horizontal and comprise a plurality of apertures 100b, 100a, 100c, 200b, 200a, 200c, and 300b, 300a, 300c respectively. In the firebox, the lowest arrays of apertures 100, 200 are placed below the fireplace throat 220 and the highest array of apertures 300 is placed at the lower end of the fireplace throat. It is possible that the throat comprises an array of apertures 400, 600 placed above the array of apertures 300. It is also possible that one or more arrays of apertures are placed above the throat 220.

**[0034]** The arrays of apertures 100, 200 and 300 are arranged to supply air substantially in the horizontal level to places in the firebox, which are located considerably above the upper end 4 of the grate and in such a manner that the air jets starting from the corner plates 110b and 110c converge with the air jets starting from the rear plate 110a. The air jets from the corner plates 110b, 110c are at an angle y, which is recommended to range between 30 and 80 degrees, in relation to the jets from the rear plate 110a, cf. Figure 9.

**[0035]** An additional array of apertures 201, 202 is formed on the rear plate 110a below and above the array of apertures 200. The additional arrays of apertures 201 and 202 strengthen the airflow from the rear plate 110a. Consequently, the rear plate 110a is provided with more apertures than the corner plate 110b or 110c and the total surface area of the apertures in the rear plate is larger than the total surface area of the apertures in the corner plate 110b or 110c. Alternatively, the required amount of air supplied from the rear plate 110a can be obtained by providing the rear plate with larger apertures than the corner plates 110b, 110c.

**[0036]** The diameter of the apertures in the arrays of apertures 100, 200, 201, 202, 300 is recommended to be 10 to 12 mm. If the diameter is too small, the strength of the air jets remains too low. The apertures may comprise a wall, on which a thread is formed in order to achieve a rotational motion for the air supplied from the hole.

**[0037]** The mutual distance N between the arrays of apertures 100 and 200 preferably ranges between 30 and 150 mm, and more preferably between 30 and 100 mm, cf. Figure 10. Most preferably, the distance N ranges between 30 and 50 mm.

**[0038]** The apertures in the arrays of apertures 100, 200, 201, 202 and 300 are arranged to supply secondary air into the firebox in a point-like manner, cf. the arrows in Figure 9. The arrows of different lengths in Figure 9 illustrate that the rear plate 110 is arranged to supply more air into the firebox 1 than the corner plates 110b and 110c (and side plates 110d, 110e, if they were provided with apertures). This is important in order to achieve the desired low-emission combustion process in the firebox.

**[0039]** The air jets supplied from the described arrays of apertures 100, 200, 201, 202 and 300 provide three thin plate-like layers I, II and III placed at a distance from one another in the vertical direction, also referred to as fraction layers, in which air and combustion gases are mixed, cf. Figure 10. The thickness of each layer I, II and III preferably ranges between 10 and 30 mm.

**[0040]** Mixing of secondary air and combustion gases occurs in fraction layers I, II and III so that the gases rotate as illustrated in Figures 11 and 12. In Figure 11, the arrows illustrate the rotation of the gases when the firewood to be burnt is placed horizontally on the grate 3. In Figure 12, the arrows illustrate the rotation of the gases when firewood 180 is placed on the grate 3 vertically. A dashed line indicates the firewood 180 in the Figures.

**[0041]** In Figure 11, the starting end (i.e. the wide end) of the arrows is placed at the edges of the grate. The starting ends of the wide arrows indicate the air supplied from the ignition nozzles as well as the ignited gases. The mixture of air and gases flows obliquely upward towards the corresponding corner plates 110b, 110c, and the air supplied therefrom is mixed with the above-mentioned gases, also illustrated by the wide arrows. The gases continue substantially in the horizontal direction towards the rear wall 110a, but turn substantially in the horizontal plane towards the grate owing to the air jets arriving from the back (narrow arrows), as the wide arrows indicate. The narrow end of the wide arrows comprises all the above-mentioned gases.

**[0042]** In Figure 12, mixing occurs in front of the firewood, i.e. in the space between the firewood 180 and the fireplace door. For the sake of simplicity, Figure 12 only shows two arrows that illustrate the flow of gases in the horizontal direction. In addition to the air jets supplied from the rear plate 110a the arrows include air jets supplied from the corner plates 110b, 110c and naturally the combustion gases.

**[0043]** The rotation chamber provides such a special feature that horizontal turbulence layers are formed in the rear part of the box irrespective of whether the firewood is placed vertically or horizontally. The achieved rotational gas flows allow the gases to remain consider-

ably longer in the firebox, and the proportional delay time of the combustion gases increases in comparison with a conventional firebox. The temperature in the rotation chamber does not increase to a noxiously high level regarding the nitrogen emission, and the combustion outcome is therefore better than in prior art fireboxes. In conventional fireboxes, the temperature easily and uncontrollably becomes so high that large amounts of nitric oxides are formed. In the rotation chamber, hydrocarbon and nitrogen emission are both simultaneously kept at a fairly low level.

**[0044]** In the fireplace shown in Figures 1 and 8, air and gas are mixed in the horizontal steps rotating in layers within each other. The required air impulse for the apertures in the arrays of apertures 100, 200, 201, 202, 300 and from there to the firebox 1 is obtained using buffering spaces 152, 153, cf. Figure 9. The buffering spaces 152, 153 are placed between the corner plates 110b and 110c and the corners of the stone structure in the firebox. The air pressure in the buffering spaces 152, 153 exceeds the air pressure on the grate side surfaces of the rear and corner plates. The air control apparatus 30 directs air via the apertures 10 travelling through the grate 3 and also passed the grate through passages/gaps 151, 154 and the buffering spaces 152, 153 into the firebox through the openings in the arrays of apertures 100, 200, 201, 202, 300. Alternatively, the required overpressure and air impulse can be achieved using a fan. The last-mentioned solution is much more complicated and expensive to implement.

**[0045]** Figure 8 also shows such a significant feature of the firebox, according to which grooved surfaces 500a, 500b, 500c are found between the wall construction and the grate. The grooves on the grooved surfaces 500a, 500b, and 500c enable to supply air more efficiently from the grate 3 towards the plates 110a to 110e.

**[0046]** The number of arrays of apertures in the wall construction 2 of the firebox may deviate from what is shown in the Figures, like the number, size and location of the apertures. The shape of the wall construction 2 may also be different.

**[0047]** It should be noted that the details of the invention may be implemented in various ways within the scope of the appended claims and differently than shown in the Figures. Thus, for instance, the form of the grate may be different, although the shape shown is to be recommended in view of the combustion result and how the firewood is placed; the precise location of the apertures on the grate may deviate from what is shown; the shape of the ignition nozzles may deviate; ignition nozzles are not necessarily required, even though they significantly improve the operation of the grate.

## Claims

1. A fireplace comprising a firebox (1) and a trough-shaped grate (3) including an upper end (4, 4') and a lower end (5, 5') and a wall construction (6 to 9), which comprises walls (6, 7) or wall portions at an acute angle ($\alpha$) in relation to one another, the walls/wall portions being provided with elongated apertures (10, 10a', 10b') for supplying combustion air through the grate, the main direction of the apertures being at a 40 degree angle at the most in respect of an imaginary line (L) on the wall (6, 7) /wall portion, in which the apertures are formed, said line extending at a right angle in relation to a level defined by the upper end (4, 4') of the grate, **characterized in that** the apertures (10, 10a', 10b') considered together form in the portion of the walls (6, 7) /wall portions, in which they are formed and which is closer to the lower end (5, 5') of the grate, a larger surface area than in the portion of the walls/wall portions, which is closer to the upper end (4, 4') of the grate.

2. A fireplace as claimed in claim 1, **characterized in that** the apertures (10) are formed to taper in a wedge-shaped manner when moving from the lower end (5) of the grate towards the upper end (4) of the grate.

3. A fireplace as claimed in claim 2, **characterized in that** the shape of the apertures (10) resembles a wedge so that the apertures provide a substantially logarithmic airflow.

4. A fireplace as claimed in claim 1, **characterized in that** the upper end of the apertures (10, 10a', 10b') is provided with a nozzle opening (15, 15'), the diameter of which is greater than the width of the apertures immediately below the nozzle opening.

5. A fireplace as claimed in claim 1, **characterized in that** the number of the apertures (10, 10a', 10b') on the walls (6, 7) ranges between 20 and 60.

6. A fireplace as claimed in claim 1, **characterized in that** the main direction of the apertures (10, 10a', 10b') is at a 30-degree angle at the most in respect of the line (L).

7. A fireplace as claimed in claim 1, **characterized in that** the angle ($\alpha$) between the walls (6, 7, 6') /wall portions ranges between 50 and 90 degrees.

8. A fireplace as claimed in claim 7, **characterized in that** the angle ($\alpha$) between the walls (6, 7, 6') /wall portions ranges between 60 and 80 degrees.

9. A fireplace as claimed in claim 1, **characterized in that** the grate (3) is provided with at least one ignition nozzle, whose nozzle opening (19, 20) is placed above the level defined by the upper end (4) of the grate.

**10.** A fireplace as claimed in claim 9, **characterized in that** the upper end (4) of the grate (3) is substantially formed as a rectangle and that the grate comprises four walls (6 to 9), whereby the two oppositely placed walls (8 and 9) are at a substantially right angle with respect to the two adjacent walls (6 and 7) comprising the elongated apertures (10, 10a', 10b') and are both provided with guiding means (13, 14) for directing air into at least one ignition nozzle (19, 20).

**11.** A fireplace as claimed in claim 9 or 10, **characterized in that** the nozzle opening (19, 20) of the ignition nozzle is placed at a distance from 10 to 50 mm above the upper end (4) of the grate.

**12.** A trough-shaped grate of a fireplace comprising an upper end (4, 4') and a lower end (5, 5') and a wall construction (6 to 9) including walls (6, 7) or wall portions at an acute angle ($\alpha$) in relation to one another, the walls or wall portions being provided with elongated apertures (10, 10a', 10b') for supplying combustion air through the grate, the main direction of the apertures being at a 40 degree angle at the most in respect of an imaginary line (L) on the wall (6, 7) /wall portion, in which the apertures are formed, said line extending at a right angle in relation to a level defined by the upper end (4, 4') of the grate, **characterized in that** the apertures (10, 10a', 10b') considered together form in the portion of the walls (6, 7) /wall portions, in which they are formed and which is closer to the lower end (5, 5') of the grate, a larger surface area than in the portion of the walls/wall portions, which is closer to the upper end (4, 4') of the grate.

**13.** A grate as claimed in claim 12, **characterized in that** the apertures (10, 10a', 10b') are formed to taper in a wedge-shaped manner when moving from the lower end (5) of the grate towards the upper end (4) of the grate.

**14.** A grate as claimed in claim 13, **characterized in that** the shape of the apertures (10) resembles a wedge so that the apertures provide a substantially logarithmic airflow.

**15.** A grate as claimed in claim 11, **characterized in that** the grate (3) is provided with at least one ignition nozzle, whose nozzle opening (19, 20) is placed above the level defined by the upper end (4) of the grate.

**16.** A grate as claimed in claim 15, **characterized in that** the upper end (4) of the grate (3) is substantially formed as a rectangle and that the grate comprises four walls (6 to 9), whereby the two oppositely placed walls (8 and 9) at a substantially right angle with the two adjacent walls (6 and 7) comprising the elongated apertures (10, 10a', 10b') are both provided with guiding means (13, 14) for directing air into at least one ignition nozzle (19, 20).

**17.** A grate as claimed in any one of the preceding claims 11 to 16, **characterized in that** the inner surface of the walls (6, 7) /wall portions are provided at a distance from the lower end of the grate with support/turbulence means (15) for supporting the firewood to be horizontally placed and for achieving turbulence in the flowing air.

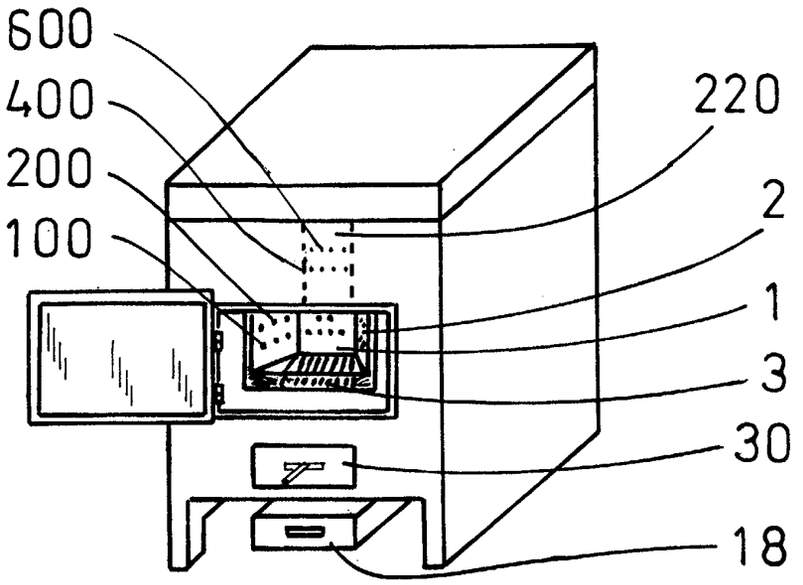



FIG. 1

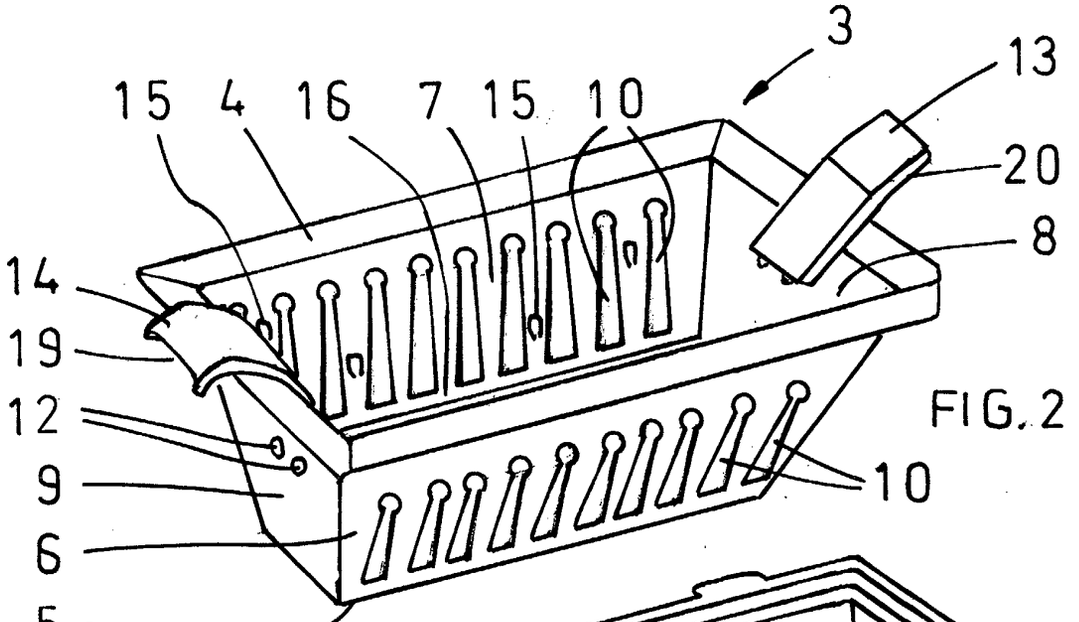



FIG. 2

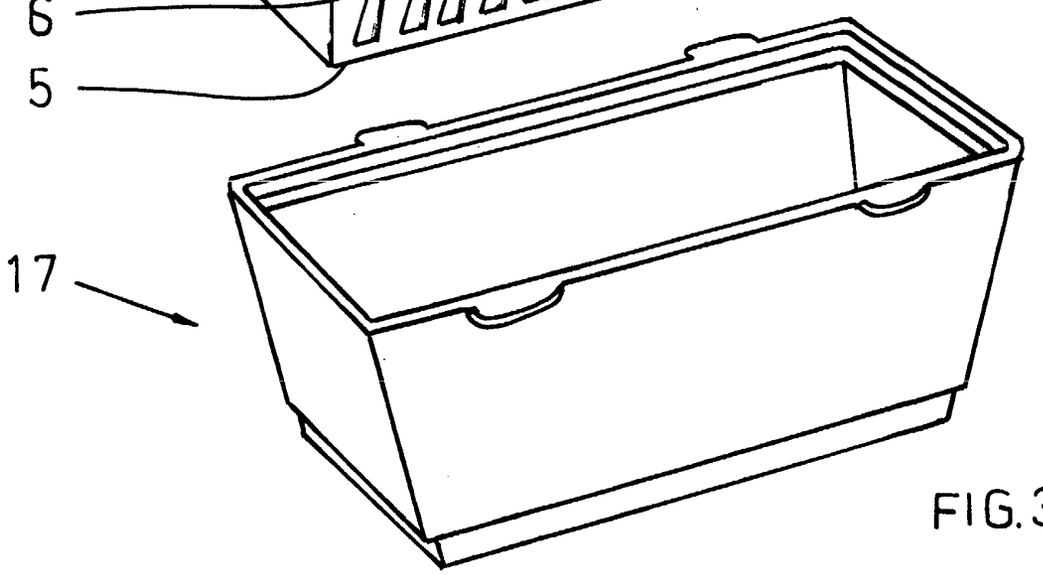



FIG. 3

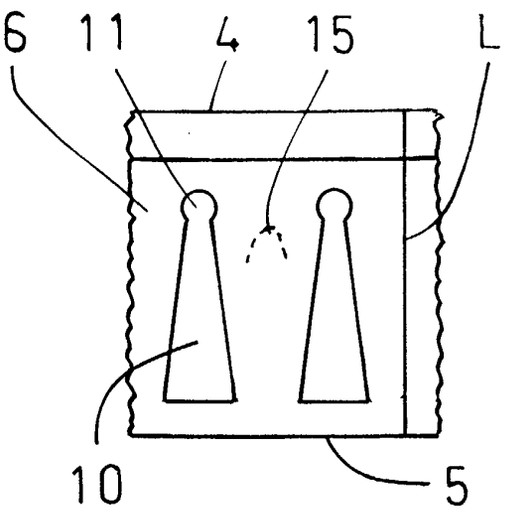



FIG.4

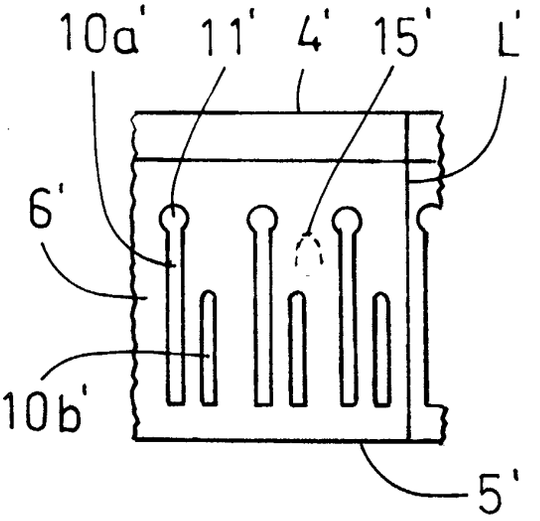



FIG.5

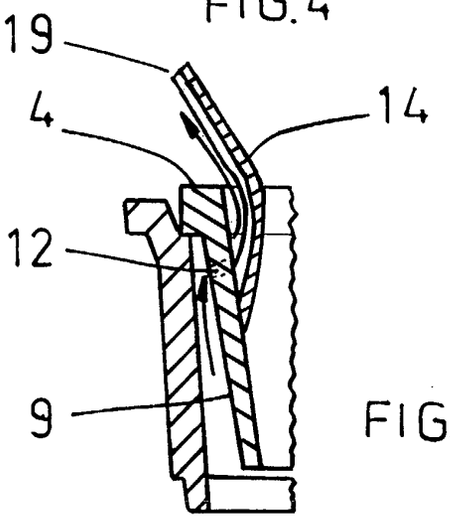



FIG. 7

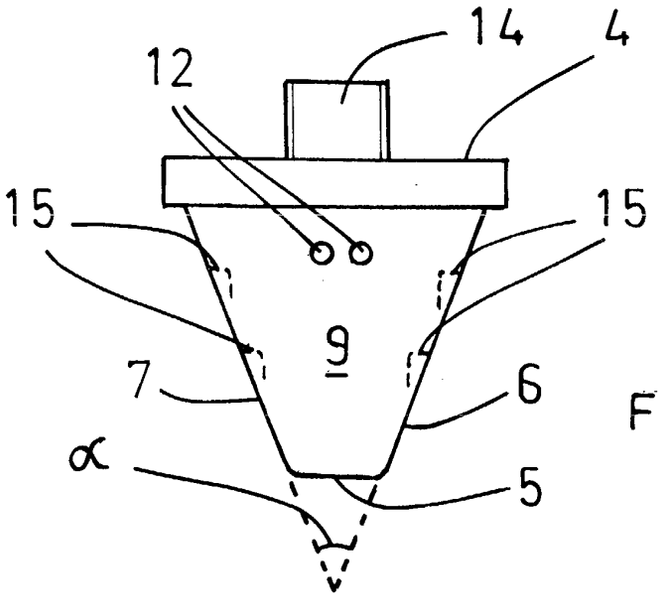
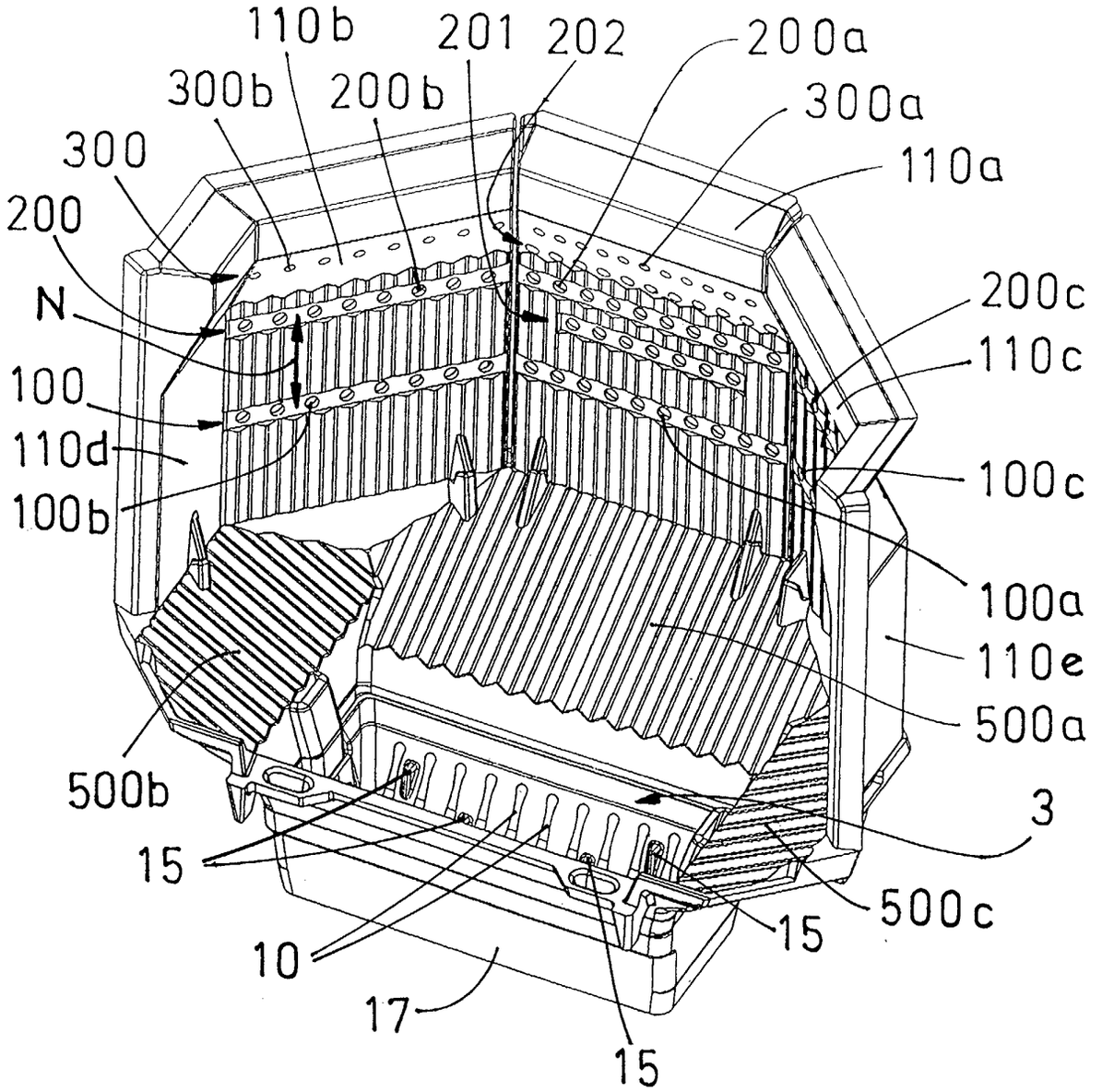



FIG. 6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202
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300b
200b
300a
300
110a
200
200c
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110d
100c
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110e
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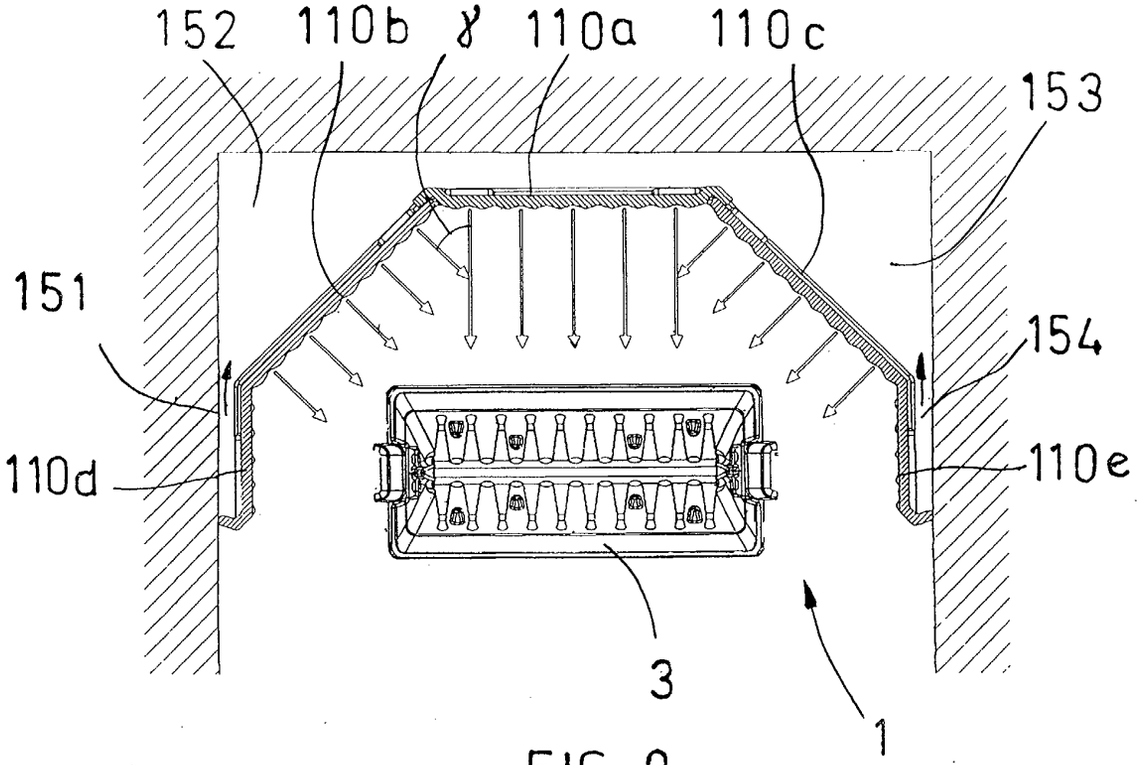
500b
3
15
500c
15
10
17
15

FIG.8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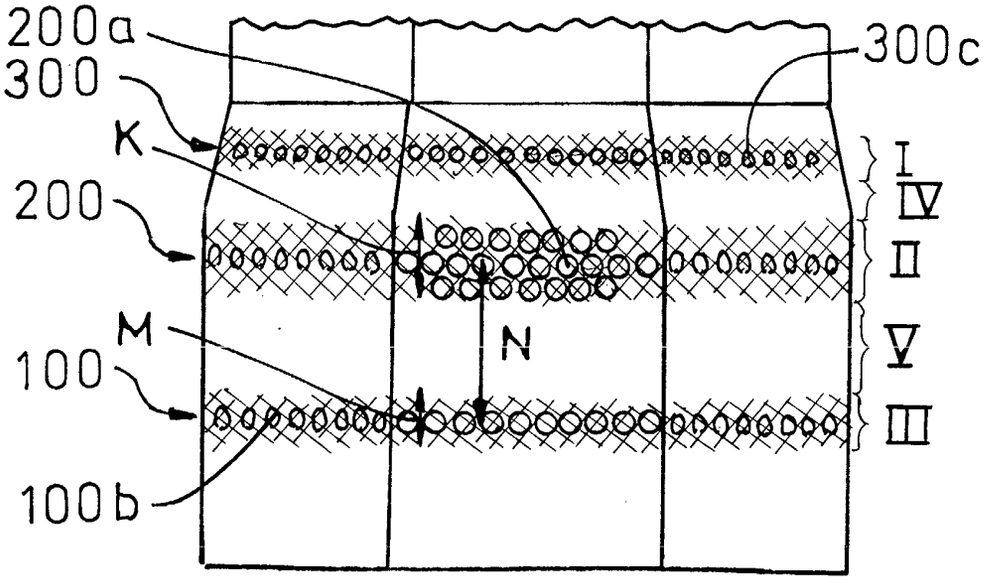
110c
153
151
154
110d
110e
3
1

FIG. 9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300c
K
200
M
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100
100b
I
IV
II
V
III

FIG. 10

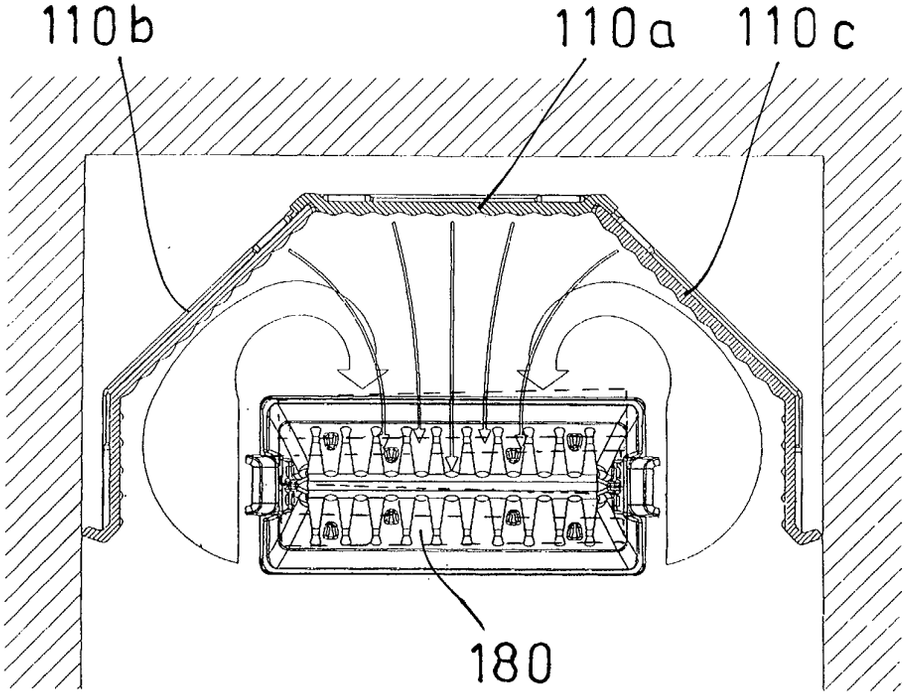


FIG.11

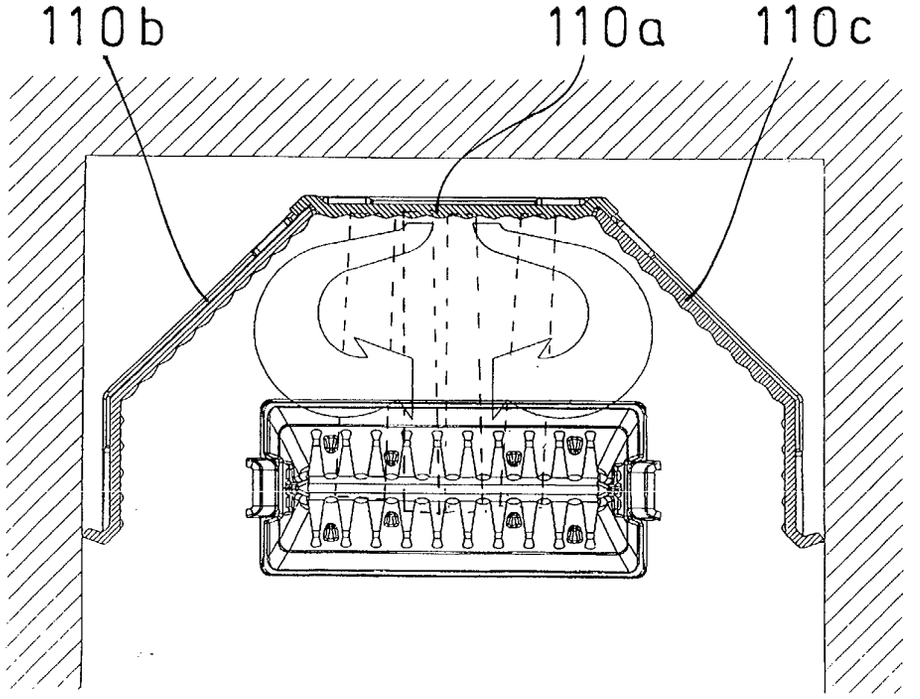


FIG.12

European Patent Office

# EUROPEAN SEARCH REPORT

Application Number
EP 03 39 6006

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F23B
F23L
B23B
F23G

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| MUNICH | 30 April 2003 | Theis, G |

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