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TITLE: FIREPLACE INSERT

ABSTRACT

A fireplace insert comprising a trapezoidal firebox (1) with slanted walls (24) and a smoke chamber (2) placed above the firebox (1), has a grate (13), a firebox mantle (4) providing the outside border of the firebox (1), and a noncombustible lining (5) providing inside covering of the firebox (1). Further it has a screen opening with a glass door (6) in its front part, an adjustable primary air intake (7) in the ash-dump (11) below the grate (13) and above the door (6), an adjustable secondary air intake (8) channelled to the upper part of the door (6). In the side walls (24) and/or the back wall (23) of the firebox (1), the fireplace insert has tertiary air intakes (18) disposed preferably in equi-partition approximately halfway up the walls (23, 24), as well as air intakes for afterburning (19) disposed preferably in equi-partition at approximately the upper third of the height of the walls (23, 24). The smoke chamber (2) comprises a tortuous smoke outlet (22) formed by the back wall (23), a flame deflector (20) and a parallel higher mounted smoke damper (21).
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FIREPLACE INSERT

The invention relates to a fireplace insert, which can be applied to form fireboxes for heating in fireplaces, respectively cockle stoves or fireplaces built in walls.

There are various solutions according to prior art for forming firebox of fireplaces. The December, 1998 issue of the magazine called Kachelofen & Kamin (Verlag Gustav Kopf GmbH, Waiblingen, DE) makes known the most common methods of building fireplaces, fireplace inserts. According to this article certain main types of fireplace fireboxes are of rectangular or square form of parallel side walls respectively of parallel side walls with arched back or with entirely arched, half-arched inner wall forms. Further a fireplace insert is made known in the article, which has a firebox of trapezoidal area formed with slanted side walls. This is significantly more advantageous from the point of view of direct heat radiation due to its slanted side walls, than fireboxes of parallel side walls, as it better radiates heat forward. Beside convection heat transfer of the fireplace the slanted walls provide more advantageous heat output values, better efficiency from the point of view of heat radiation. The solutions made known in the article do not include instructions regarding improvement of the quality of combustion.

The Austrian patent description AT 403 318 makes known a solution relating to forming of firebox of stoves, especially fireplaces. In case of the solution made known here, the side walls are extending towards the front wall, back wall and fireclay sheets are applied to these to serve as the boundary surface of the firebox. The secondary air intake takes place at the upper part of the firebox door so, that the secondary air forms an air partition protecting the inner surface of the firebox door. The solution is characterized by that, that the combustion area is divided into an upper part forming the flue, and a lower part, forming the firebox by an insert of nearly parallel surface with the covering plate put into the combustion area.
The disadvantage of the solution is, that dividing the combustion area into two parts makes the fireplace more complicated and at the same time it is disadvantageous from the point of view of deflecting smoke. Due to the division into two parts deflecting of the smoke takes place above the firebox door, at the intake of the secondary air, the disadvantage of which is, that the smoke may mix with the secondary air, and at opening of the firebox door, smoke may come out.

Working out the solution of the invention our aim is to provide a fireplace insert, which has improved combustion and heat radiation characteristics, its smoke emission is of minimum carbon monoxide content, which beside providing advantageous heating, ensures reduction respectively elimination of pollution caused by volatile matters penetrating into the air of the living area through the firebox door during heating as well.

We realized, when we produced the solution according to the invention, that in case we make tertiary air intakes in equipartition to the side walls and the back wall of the firebox at roughly the half of the height of the firebox of slanted side walls of the fireplace insert of trapezoidal shape, and further in the upper third of the height of the back wall of the firebox air intakes for afterburning are made, and there is a smoke chamber consisting of flame-deflectors and smoke dampers, approximately parallel with each other lapping each other, from which the opening between the lower flame-deflector and the back wall of the firebox provides a smoke outlet for the firebox, then the set aim can be achieved.

The invention is a fireplace insert to be used for fireplace respectively cockle stove or fireplace built into wall, which fireplace insert consists of a trapezoidal firebox with slanted side walls and a smoke chamber placed above the firebox, the fireplace insert has a grate in the bottom of the firebox providing primary air intake, a firebox mantel providing outside border of the firebox, and a noncombustible lining providing inside covering of the firebox, further it has a screen opening with glass firebox door in the front part of the firebox, as well as there is an adjustable primary air intake in the ash-dump below the grate, and
above the firebox door there is an adjustable secondary air intake channeled to the upper part of the firebox door.

The fireplace insert is characterized by that, at approximately the half of the height of the firebox, in the side walls and/or in the back wall of the firebox preferably in equipartition there are tertiary air intakes, at approximately the upper third of the height of the firebox, in the side walls and/or in the back wall of the firebox preferably in equipartition there are air intakes for afterburning. Further above the firebox there is a smoke chamber comprising of a flame deflector placed below, and a smoke damper placed above it, roughly parallel with each other lapping each other so that the opening between the flame deflector and the back wall of the firebox provides a smoke outlet of the firebox.

In one preferred embodiment of the fireplace insert according to the invention there are deflecting flaps on the firebox mantel on the outside of the firebox directing tertiary air respectively afterburning air. There are preferably fifteen pieces tertiary air intakes of size 1,5x15 mm and preferably five pieces of afterburning air intakes of size 2x15 mm led through the firebox mantel and firebox lining. There are heat dissipation ribs on the exterior wall of the firebox mantel, density of which is preferably 10...30 mm, advantageously 25 mm.

In another preferred embodiment of the fireplace insert according to the invention there is a heat shield behind the firebox dividing the flow of convection air into outer air channel and inner air channel. There are air deflectors and ember-holder placed preferably in 45° angle in the firebox and at the bottom of the firebox door deflecting secondary air. The material of the firebox lining, flame-deflector, smoke damper is fireclay or Vermiculite, the material of the firebox mantel is a steel sheet of 3 mm thickness with noncombustible paint finish.

The solution according to the invention is presented with the help of the enclosed figures:

Fig. 1 is a lateral section of a preferred embodiment of a fireplace built with a fireplace insert according to the invention.
Fig. 2 shows the cross section of a firebox of a fireplace built with the fireplace insert according to the invention.

Fig. 3 shows the front elevation of a fireplace built with the fireplace insert according to the invention.

5 Figure 1 shows the lateral section of a preferred embodiment of a fireplace built with the fireplace insert according to the invention. The firebox 1 of the fireplace insert comprises of an outside firebox mantel 4 and inside firebox linings 5 and a firebox door 6 preferably with transparent heat resistant glass on the front side. In the bottom of the firebox 1 there is preferably a cast-iron grate 13, and in the upper side the firebox 1 is bordered by a flame-deflector 20 made of flame-proof and heat-proof material extending from the firebox door 6 backward to the back wall 23 of the firebox 1. The smoke outlet 22 of the firebox 1 is between the flame-deflector 20 and the firebox lining 5 serving as the back wall 23 of the firebox 1. Within the smoke chamber 2 arranged above the firebox 1, an alike flame-proof and heat-proof smoke damper 21 is placed above the smoke outlet 22 of the firebox 1. As an extension of the smoke chamber 2 a smoke distributor 25 with convection tubes 29 is located according to this preferred embodiment of the fireplace, the outlet of which is a chimney junction 3 of the fireplace built with the fireplace insert according to the invention.

In the bottom of the firebox 1 under the grate 13 in the ash-dump 11 is an ash-pan 12. The ash-pan 12 is closed towards outside by an ashes door 34 supplied with an adjustable primary air intake 7. There is an air-deflector 28 at the upper edge of the firebox door 6 deflecting secondary air to the inner surface of the firebox door 6 for which air is supplied by an adjustable secondary air intake 8 above the firebox door 6. An ember-holder 27 consisting of preferably slanted plates of 45° is placed in front of the firebox door 6 in the bottom of the firebox 1, which acts as deflector for the secondary air besides protecting firebox door 6. At approximately half height of the firebox, in the side walls 24 and the back wall 23 of the firebox 1 there are tertiary air intakes 18 shaped in one line preferably in equipartition as openings of the firebox mantel 4 and heat-proof firebox lining 5. In the upper third of the
height of the firebox 1 in the back wall 23 of the firebox 1 also as openings of the firebox mantel 4 and heat-proof firebox lining 5 in one line preferably in equipartition air intakes for afterburning 19 are formed. Air flowing directly upwards beside the firebox mantel 4 is deflected to tertiary air intakes 18 and air intakes for afterburning 19 with the help of deflecting flaps 17, which are between heat dissipation ribs 30 placed on the outer surface of the firebox mantel 4.

The convection air channel behind the firebox 1 is divided into two parts by a heat shield 14. The space between the firebox mantel 4 and the heat shield 14 serves as an inner air channel 15 and the space between the heat shield 14 and in given case the back wall 32 of the fireplace serves as an outer air channel 16. Air for tertiary air intakes 18 behind firebox 1 and for air intakes for afterburning 19 is led from the inner air channel 15. In given case there is an additional heat shield 31 below the ash-dump 11 serving as protection against downward heat radiation.

Due to its application as fireplace it can be seen in Fig. 1 that convection air intake 9 under the ash-dump 11 is shaped as a room for logs 10 and there is a heating shelf 26 above the smoke chamber 2. Primary air intake 7 is supplied with a draft control 36 which in given case is switchable, secondary air intake 8 is supplied with a draft control 35 which has in given case a slide.

During use of the fireplace insert according to the invention fuel, for example firewood is placed on the grate 13 of the firebox 1 and lighting takes place through the open firebox door 6. Primary air which is combustion air is led into the bottom of the firebox 1 from the primary air intake 7 through the ash-dump 11 and the gaps of grate 13 into the bottom of the firebox 1 and there ensures proper combustion. Secondary air flows from the adjustable secondary air intake 8 through inside of the firebox door 6 led by an air-deflector 28, flushing out its inner surface. This ensures continuous cooling and by this provides heat-protection for the firebox door 6. An ember-holder 27 consisting of slanted sheets located at the bottom of the firebox also helps deflect secondary air to the bottom of the fireplace.
Intake of tertiary air according to the invention at half of the height of side walls and back wall of firebox 1 serves improving combustion process taking place in firebox, as additional air intake at this point increases efficiency of combustion. Efficiency of combustion is further increased by air intake for afterburning in upper third of height of firebox 1, which ensures air for afterburning of smoke of high temperature including still combustible gases. Smoke gas from firebox 1 goes to smoke chamber 2 through smoke outlet 22, and from there through smoke distributor 25 and chimney junction 3 to chimney.

After lighting fire temperature of firebox mantel 4 starts rising, which sets flowing of convection air. Convection air enters fireplace through room for logs 10 under ash-dump 11 and flows upward along sides and back of firebox 1, then leaves on top of the fireplace through openings preferably made for this purpose. Tertiary air and air for afterburning are deflected from this upward air flow to the firebox 1 with help of deflecting flaps 17.

In order to decrease downward radiation there are heat shields 31 placed in upper part of room for logs 10 under ash-dump 11 serving decrease of overheating of room for logs 10. Room for logs 10 is a place for intake of convection air 9 as well which continuously cools this space. This way downward radiation heat is not wasted, as it preheats convection air and convection air supplies this heat as well.

Figure 2 shows the cross section of the firebox of the fireplace built with the fireplace insert according to the invention. The firebox of trapezoidal shape with slanted side walls 24, which is sectioned at height of tertiary air intake 18 can be well seen in the Figure. Tertiary air intakes 18 are openings in firebox lining 5 and firebox mantel 4 shaped in equipartition in given case at same height, at which on the outer surface of firebox mantel 4 deflecting flaps 17 are shaped.

In case of a preferred embodiment of the fireplace shown in figure the fireplace is bordered from sides by side walls 33 and from back by back wall 32. Convection air channel starting from room for logs 10 and leading upwards is located between firebox mantel 4 and side wall
33 and back wall 32 of fireplace. Heat dissipation ribs 30 can be well seen on side of firebox mantel 4 serving improvement of heat transfer for convection air. In order to decrease undesirable backward heat radiation a heat shield 14 is placed in given case between back wall 23 of fireplace insert and back wall 32 of fireplace. Firebox 1 is closed from front by firebox door 6 made of transparent material, which can be turned on a vertical hinge 38, can be closed by a handle 37. In the bottom of the firebox 1 grate 13 with openings of gap shape is placed.

Heating of the fireplace insert according to the invention is based on double effect. One heat transfer mode is convection with help of convection air flowing beside and behind the firebox 1. Convection air providing convection heat transfer flows upward beside and behind firebox 1. It enters in the bottom in room for logs 10 and leaves on top of the fireplace through openings preferably shaped for this purpose. There are heat dissipation ribs 30 on outer side of 4 firebox mantel to increase area of heat transfer of firebox mantel 4, so they increase heating efficiency of convection air flowing along side and back of firebox 1.

Other heat transfer method is direct and indirect heat radiation. Through transparent firebox door 6 fuel, for example firewood burning on grate 13 radiates heat partly directly to the room. Efficiency of direct heat radiation is increased by trapezoidal shape of firebox 1 as heat radiated backward is partly reflected by slanted side walls 24 and is radiated through transparent firebox door 6 to outer space. At the same time there is a considerable direct heat radiation from the point of view of heat transfer as well, which comes from heating of side wall 33 of fireplace and its heat radiation. It is also important from the point of view of heating efficiency.

Figure 3 shows the front elevation of a fireplace built with the fireplace insert according to the invention. It shows room for logs 10 shaped in the bottom, which is also convection air intake 9. Ash-dump 11 closed by ashes door 34 is above this. Ashes door 34 with hinge 39 can be found on ash-dump 11. In given case two switchable draft controls 36 can be placed on the ashes door 34 to regulate primary air. Closing of
ashes door 34 takes place by a switchable closing knob 40. At opening ash-pan 12 in ash-dump 11 can be reached and removed, then after emptying and placing back ashes door 34 can be closed back by turning closing knob 40.

5 Above ashes door 34 there is firebox door 6 made of transparent material, for example heat-proof glass or transparent heat-proof ceramic, which can be opened and closed to the side by handle 37 and hinge 38 of vertical axis. Inner shape of firebox 1, locations and shapes of tertiary air intakes 18 and air intakes for afterburning 19 can be seen well on Figure. Tertiary air intakes 18 are placed preferably at half of height of firebox 1, air intakes for afterburning 19 are at upper third of height of firebox 1 preferably at joinings of pieces of firebox lining 5 providing inner heat insulation of firebox 1 consisting of several pieces. An air-deflector 28 directing secondary air intake can be seen as well at upper part of transparent firebox door 6. Above firebox door 6 there are secondary air intakes 8 in given case provided with draft control 35 with slide. Above it heating shelf 26 can be seen. We show stud of chimney junction 3 on top of fireplace.

In case of a preferable embodiment of the solution according to the invention the material of the firebox lining 5 further flame-deflector 20 and smoke damper 21 is Vermiculite of good heat reflecting property, which ensures combustion of better efficiency than conventional fireclay. In case of a preferred embodiment flame-deflector 20 is made in one piece, smoke-deflector 21 is made in two pieces. Firebox lining 5 is made of several pieces and is divided at height of tertiary air intake 18 respectively at height of air intake for afterburning 19. Tertiary air intakes 18 of fifteen pieces and air intakes for afterburning 19 of five pieces are preferably at the joinings of firebox lining 5.

Secondary air is deflected by an air-deflector 28 at upper edge of firebox door 6 toward heat-proof glass of firebox door 6. On the outer side of firebox 1 on the firebox mantel 4 there are deflecting flaps 17 placed at 45° angle serving as deflectors of tertiary respectively afterburning air, deflecting upward flowing warm convection air into
firebox 1, by this improving efficiency and ensuring evenness of combustion.

On exterior wall of firebox mantel 4 there are heat dissipation ribs 30 density of which is preferably 10...30 mm, advantageously 25 mm, increasing surface of dissipation of heat to more than the double. Behind the back of the firebox 1 convection air is divided in given case into inner air channel 15 between the firebox mantel 4 and heat shield 14 and outer air channel 16 behind heat shield 14. As the case may be there can be a heat shield 14 on the side or can not be. Further heat protection is provided by additional heat shield 31 placed under ash-dump 11.

There are ember-holders 27 placed at 45° at the front of the firebox 1 deflecting secondary air into the bottom of the firebox 1 besides protecting the bottom of the firebox door 6 from direct heat radiation. Chimney junction 3 of the fireplace can be located to the top or back of the fireplace, this is provided by a smoke distributor 25 where opening not in use should be covered by a closing plate.

Operation of fireplaces produced with fireplace insert according to the invention is based mainly on convection heat transfer. Cold air is heated between the side wall of the firebox 1 and the mantel of the fireplace and flows between 29 convection tubes, when a steady flow of air movement is ensured during combustion. At the same time heat of fire is transferred by heat radiation to the surrounding area through the glass of the heat-proof firebox door 6 as well. The mantle of the fireplace and the ceramic or lard stone lining of good heat-storing character transfers heat to the surrounding area by long-wave heat radiation.

The ideal material for heating is air-dry logs up to 33 cm length and lignite briquettes. Logs of long flame need a lot of oxygen in the upper part of the firebox 1 as well. This demand is met by steady deflection of tertiary respectively afterburning air into the firebox 1. Primary air deflected through grate 13 is complemented by secondary, flushing air promoting cleaning of heat-proof glass and flow of smoke gases and
burning of materials, and tertiary air deflected in equipartition through the back and side walls of the firebox, which lights still combustible gases, ensuring more efficient combustion.

The solution according to the invention offers the advantage of corresponding with the new DIN Standard, demanding higher requirements from combustion products. It conforms with higher level standard prescriptions with its higher efficiency and with more favorable flue gas emission. Deflection of smoke gases through the back prevents occurring of usual coming out of smoke when opening the firebox door.

Efficiency is increased by the smoke chamber above the combustion area and dense ribs of firebox mantel. These technical solutions can ensure almost perfect combustion, high efficiency and environment friendly operation in the fireplace. Actual efficiency of firewood or coal is more than 75%, carbon monoxide content of smoke emitted is less, than 0.12%. According to demand, the fireplace insert according to the invention can be built in cockle stove or fireplace built in wall as well. Conditions of proper operation should be created according to the code of building fireplaces.
List of references:

1 - firebox
2 - smoke chamber
3 - chimney junction
4 - firebox mantel
5 - firebox lining
6 - firebox door
7 - primary air intake
8 - secondary air intake
9 - convection air intake
10 - room for logs
11 - ash-dump
12 - ash-pan
13 - grate
14 - heat shield
15 - inner air channel
16 - outer air channel
17 - deflecting flap
18 - tertiary air intake
19 - air intake for afterburning
20 - flame-deflector
21 - smoke damper
22 - smoke outlet
23 - back wall
24 - side wall
25 - smoke distributor
26 - heating shelf
27 - ember-holder
28 - air-deflector
29 - convection tube
30 - heat dissipation rib
31 - heat shield
32 - back wall
33 - side wall
34 - ashes door
35 - draft control
36 - draft control
37 - handle
38 - hinge
39 - hinge
40 - closing knob
CLAIMS:

1. Fireplace insert to be used for fireplace respectively cockle stove or fireplace built into wall, which fireplace insert consists of a trapezoidal firebox with slanted side walls and a smoke chamber placed above the firebox, the fireplace insert has a grate in the bottom of the firebox providing primary air intake, a firebox mantel providing outside border of the firebox, and a noncombustible lining providing inside covering of the firebox, further it has a screen opening with glass firebox door in the front part of the firebox, as well as there is an adjustable primary air intake in the ash-dump below the grate, and above the firebox door there is an adjustable secondary air intake channeled to the upper part of the firebox door,

characterized by that,

at approximately the half of the height of the firebox (1), in the side walls (24) and/or in the back wall (23) of the firebox (1) preferably in equipartition there are tertiary air intakes (18), at approximately the upper third of the height of the firebox (1), in the side walls (24) and/or in the back wall (23) of the firebox (1) preferably in equipartition there are air intakes for afterburning (19),

further above the firebox (1) there is a smoke chamber (2) comprising of a flame deflector (20) placed below, and a smoke damper (21) placed above it, roughly parallel with each other lapping each other so that the opening between the flame deflector (20) and the back wall (23) of the firebox (1) provides a smoke outlet (22) of the firebox (1).

2. Fireplace insert as in claim 1 characterized by that, there are deflecting flaps (17) on the firebox mantel (4) on the outside of the firebox (1) directing tertiary air respectively afterburning air.

3. Fireplace insert as in claims 1 or 2 characterized by that, there are preferably fifteen pieces tertiary air intakes (18) of size 1,5x15 mm and preferably five pieces of afterburning air intakes of size 2x15 mm led through the firebox mantel (4) and firebox lining (5).
4. Fireplace insert as in any of the claims 1 to 3 characterized by that there are heat dissipation ribs (30) on the exterior wall of the firebox mantle (4), density of which is preferably 10...30 mm, advantageously 25 mm.

5. Fireplace insert as in any of the claims 1 to 4 characterized by that there is a heat shield (14) behind the firebox (1) dividing the flow of convection air into outer air channel (16) and inner air channel (15).

6. Fireplace insert as in any of the claims 1 to 5 characterized by that there are air deflectors and ember-holder (27) placed preferably in 45° angle in the firebox (1) and at the bottom of the firebox door (6) deflecting secondary air.

7. Fireplace insert as in any of the claims 1 to 6 characterized by that the material of the firebox lining (5), flame-deflector (20), smoke damper (21) is fireclay or Vermiculite, the material of the firebox mantle (4) is a steel sheet of 3 mm thickness with noncombustible paint finish.
Fig. 2
### INTERNATIONAL SEARCH REPORT

**A. CLASSIFICATION OF SUBJECT MATTER**
- IPC 7 F24B5/02

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**
- Minimum documentation searched (classification system followed by classification symbols)
  - IPC 7 F24B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

**Electronic data base consulted during the international search (name of data base and, where practical, search terms used)**
- EPO-Internal, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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<td>DE 88 03 468 U (INGFRIED WODTKE) 11 May 1988 (1988-05-11) claim 1; figure 1</td>
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