No. 647,427. Patented Apr. 10, 1900.

H. D. W. SAWYER.

COOKING AND HEATING STOVE.

(Application filed May 24, 1897.)

(No Model.)

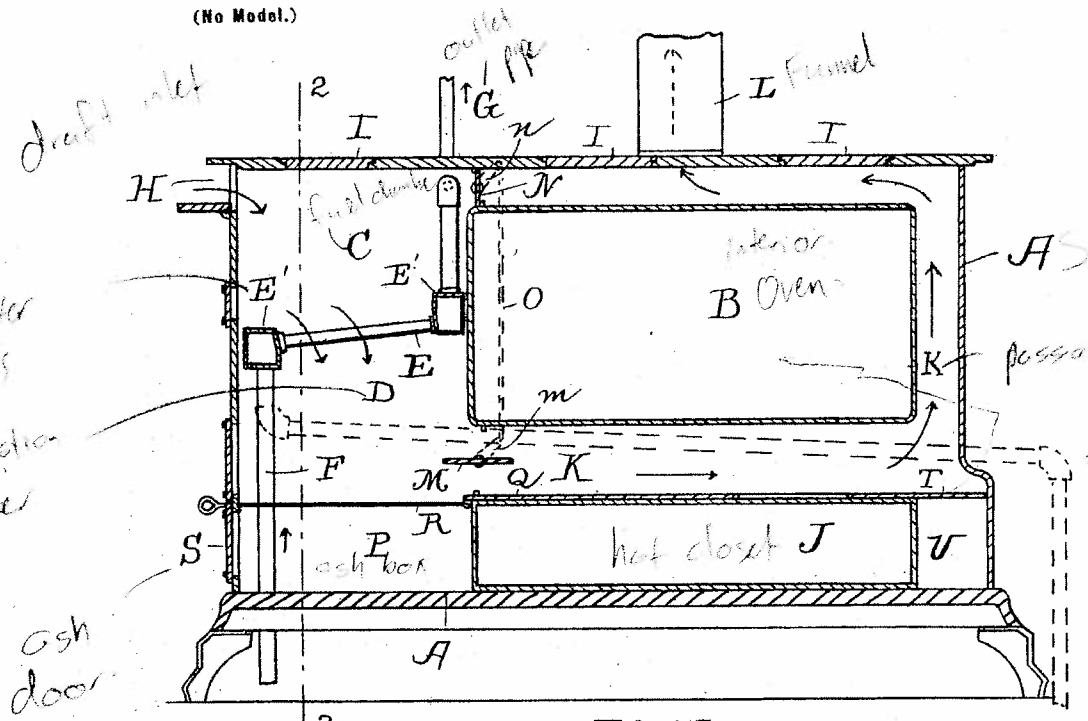

Fig. 1.

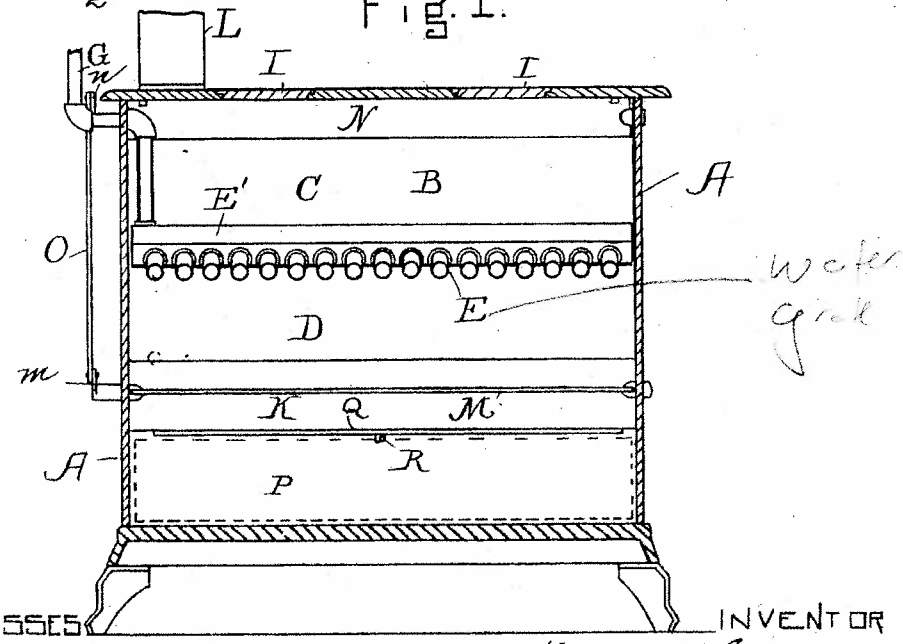

Fig. 2.

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UNITED STATES PATENT OFFICE.

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COOKING AND HEATING STOVE.

SPECIFICATION forming part of Letters Patent No. 647,427, dated April 10, 1900.

Application filed May 24, 1897. Serial No. 637,841. (No model.)

To all whom it may concern:

Be it known that I, HOWARD D. W. SAWYER, of Revere, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Cooking and Heating Stoves, of which the following, taken in connection with the accompanying drawings, is a specification.

The object of this invention is to provide a most simple and efficient downward-draft cooking and house-heating stove in which complete combustion of the fuel is attained and water circulating through the hollow grate-bars and connecting-tubes is effectually heated. In my present invention I have especially sought to simplify the apparatus, and hence to reduce cost and liability to get out of order, without impairing its efficiency. I have therefore omitted water walls or tables and now use as a grate a succession of parallel water-tubes connected at their ends with larger tubes or water-boxes, with which the inlet or supply pipe and the outlet or circulation pipe respectively communicate. The draft-inlet is through the body of the stove above the grate, either through a griddle-hole or the broiler-opening, and hence the fumes of cooking and the gases generated from the fuel, with all the volatile products of combustion, are normally carried downward through the fire and consumed, the caloric-current passing between the water-containing grate-bars and thence beneath, beyond, and over the oven to the funnel. A high degree of heat attends the complete combustion of the fuel thus attained, a "baking-oven" is always available, and water exposed in the pipes to the intense current within the stove is utilized for the sink or bath-room and for heating other rooms by hot-water circulation. Return-pipes from the radiators may traverse the caloric-passage beneath the oven and the combustion-chamber below the grate for effective exposure to the heat therein. My invention also provides for converting this most effective winter heater into a summer stove when a limited amount of heat is desired and hot-water circulation to the radiators is not required. This I accomplish by closing the caloric-passage beneath the oven at will and opening one above the oven, at the same time closing the draft-inlet above the grate and opening one below it, thereby reversing the draft-current through the grate and fire-pot and producing a convertible downdraft and updraft cooking-stove.

The deflectors, slides, or dampers by which the caloric-passages are opened and closed are preferably connected for simultaneous operation, so that one will always be closed when the other is open; but they may be operated independently by the attendant.

Another feature of my present invention is a sliding cover for the ash-pit, by which when ashes are to be removed the downward draft is not interfered with and ash-dust is prevented from drawing into the caloric-passage. A similar slide covers and uncovers a soot-box or dust-box within the rear part of the stove, said slides resting at other times on top of the hot closet in the base of the stove and being operated when desired by protruding rods with terminal knobs.

In the drawings, Figure 1 is a vertical longitudinal section through the stove-body, and Fig. 2 a transverse section on line 2 2 of Fig. 1.

A represents the stove-body, which may be of any ordinary pattern having the interior oven B.

C is the fuel-chamber, and D the combustion-chamber, together forming the fire-pot occupying the front end of the stove.

E is the water-grate, arranged obliquely between the chambers C and D and formed of a succession of parallel tubes entering larger pipes or water-boxes E' and provided with a supply-pipe F and an outlet-pipe G for a continuous water-current through the grate and connecting-pipes. The water circulation thus insured supplies the sink, radiators, and bath-room with abundance of hot water and at the same time prevents burning out or melting the grate-bars. The supply-pipe or return-pipe may traverse the caloric-passage, as indicated in dotted lines, Fig. 1.

H is the broiler-opening, serving as a draft-inlet through the stove-body above the grate, and I I are covers for the griddle-holes in the stove-top. Partial removal of one of these covers over the grate provides a suitable inlet, or lateral openings controlled by slides will be provided. In either case the draft is

normally downward between the tubular grate-bars E, on which the fuel rests, which insures not only that the gases and light combustible matter shall pass downwardly into the fire to be consumed therein instead of contaminating the external air, but also that the draft-current shall be an intensely-hot instead of a cold blast against the grate-bars and shall tend to free the upper surface of such bars from ashes, and thereby keep the lower part of the fire very much hotter than usual.

J is a hot closet in the base of the stove under the oven. Between the two is the caloric-passage K, leading horizontally from the combustion-chamber D, and such passage is continued upwardly beyond the oven and horizontally above its top to the funnel L, so that the caloric-current completely encircles the oven and in its normal course passes over the hot closet and the oven. I, however, provide for deflecting the current out of this course when a small fire only is required—as, for instance, during much of the summer season. At such times the deflector or damper M at the inlet to the caloric-passage is closed, and a like device N is opened at the top of the fuel-chamber, so that the caloric-current is quite direct to the funnel and not downwardly between the grate-bars. These deflectors are represented as pivoted dampers, and they may be separately operated; but I prefer to connect the crank-arms *m n* on their axes by a rod O, which will open one when the other is closed. This convertible feature is very advantageous, giving as it does to a single stove the varying heating capabilities of two distinct heaters. The draft will ordinarily be admitted below the grate rather than above it when the limited fire is desired.

The ash-box P at the base of the fire-box is provided with a sliding cover Q, which normally rests on top of the hot closet J, but may be drawn forward by a rod R when the ashes are to be removed. By this device the downward draft is not interfered with in opening the ash-door S to take up the ashes, since the ash-pit is at that time cut off from the combustion-chamber by said slide. A similar slide may be provided at the other end of the hot closet to open and close the top of a dust-box U.

I claim as my invention—

1. The improved cooking and house-heating stove described consisting of the stove-body proper, the fire-box within such body and comprising the fuel-chamber above and the combustion-chamber below the grating, the tubular grate therein with connecting-pipes for continuous water circulation through such grate, a draft-inlet through the stove-body above the grate and an ash-door below it, in combination with the oven, the hot closet beneath it, and the caloric-passage from the grate downwardly, thence between the oven and hot closet, and upwardly beyond and over the oven, substantially as set forth.

2. The described convertible downward and upward draft stove, consisting of the stove-body proper, the fire-box within such body and comprising the fuel-chamber above and the gas-combustion chamber below the grate, the draft-inlet and ash-door similarly disposed, the tubular, water-containing grate between said chambers and provided with water-circulation pipes, in combination with the oven inclosed within the stove-body, the caloric-passage from said chambers entirely encircling the oven, and with the deflecting-dampers adapted to control said passage and reverse the draft through the grate, substantially as set forth.

3. In a downdraft cooking and heating stove the stove-body proper having within it the oven and the fire-box at substantially the same height, the water-circulation pipes with tubular grate dividing the fire-box into two chambers, the draft-inlet opening into the upper and the ash-door into the lower chamber, and the caloric-passage leading from the lower chamber beneath beyond and over the oven, in combination with a movable slide or cover adapted to be interposed between the combustion-chamber and the ash-space when desired, and at other times to form part of the bottom wall of the caloric-passage, substantially as set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

HOWARD D. W. SAWYER.

Witnesses:
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D. W. WORMWOOD.

United States Patent [19]

Syme

[11] **Patent Number: 4,466,419**

[45] **Date of Patent: Aug. 21, 1984**

[54] **COOKING METHOD AND APPARATUS FOR USE WITH WOOD-BURNING STOVE**

[75] Inventor: **Duncan C. Syme**, Chelsea, Vt.

[73] Assignee: **Vermont Castings, Inc.**, Randolph, Vt.

[21] Appl. No.: **213,952**

[22] Filed: **Dec. 8, 1980**

[51] **Int. Cl.**³ **F24C 1/14**

[52] **U.S. Cl.** ..... **126/4**; 126/2; 126/9 R; 126/26; 126/218

[58] **Field of Search** ..... 126/4, 6, 9 R, 137, 126/136, 135, 2, 3, 29, 211, 218, 147, 157, 148, 28, 27

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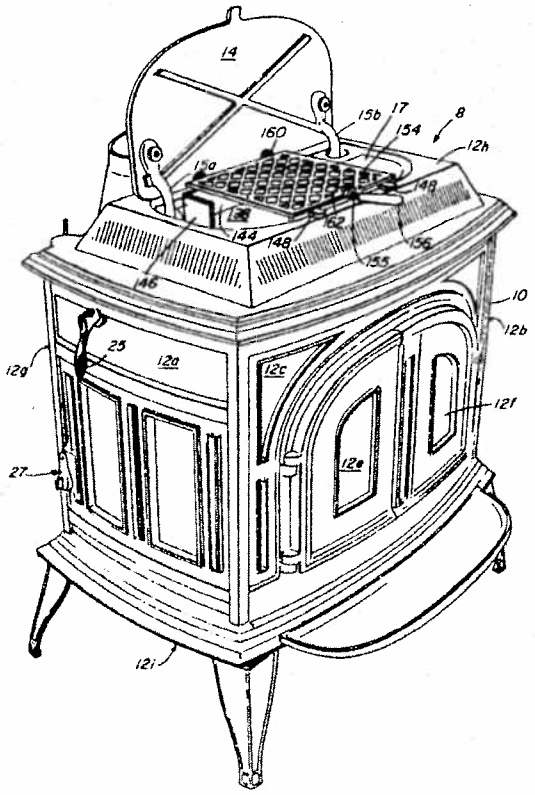
Primary Examiner—James C. Yeung

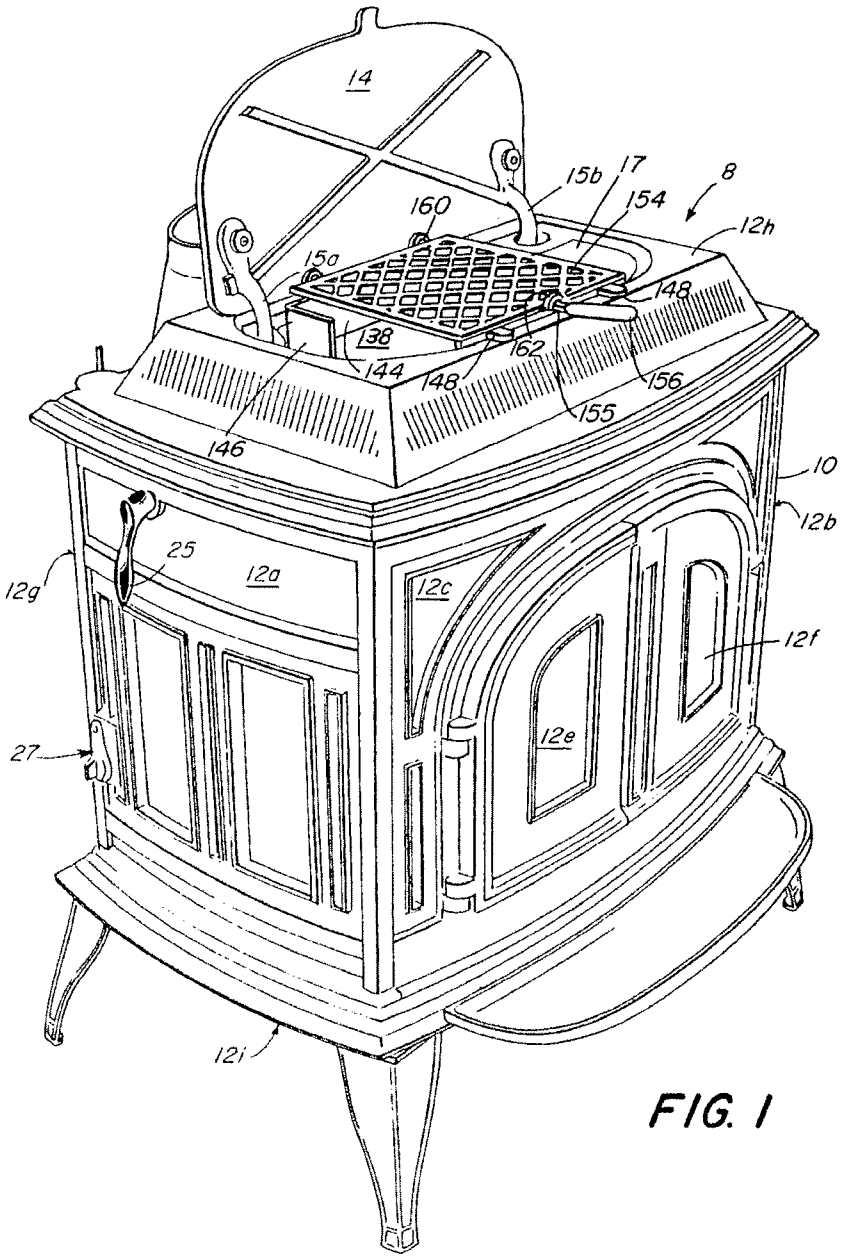
Attorney, Agent, or Firm—Kenway & Jenney

[57] **ABSTRACT**

A solid fuel burning heating apparatus, used as a parlor stove, is also used for cooking. The stove is provided with a self-clearing top smoke chamber having a top cover over an aperture. A cooking tray is supported in the aperture when the stove is operating. The tray has a surface for holding coals and an opening communicating between the aperture and the interior of the stove. A perforate cooking surface is supported above the tray.

26 Claims, 12 Drawing Figures

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15b
17
8
160
154
12h
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148
138
162
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10
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12g
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12c
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27
12i

FIG. 1

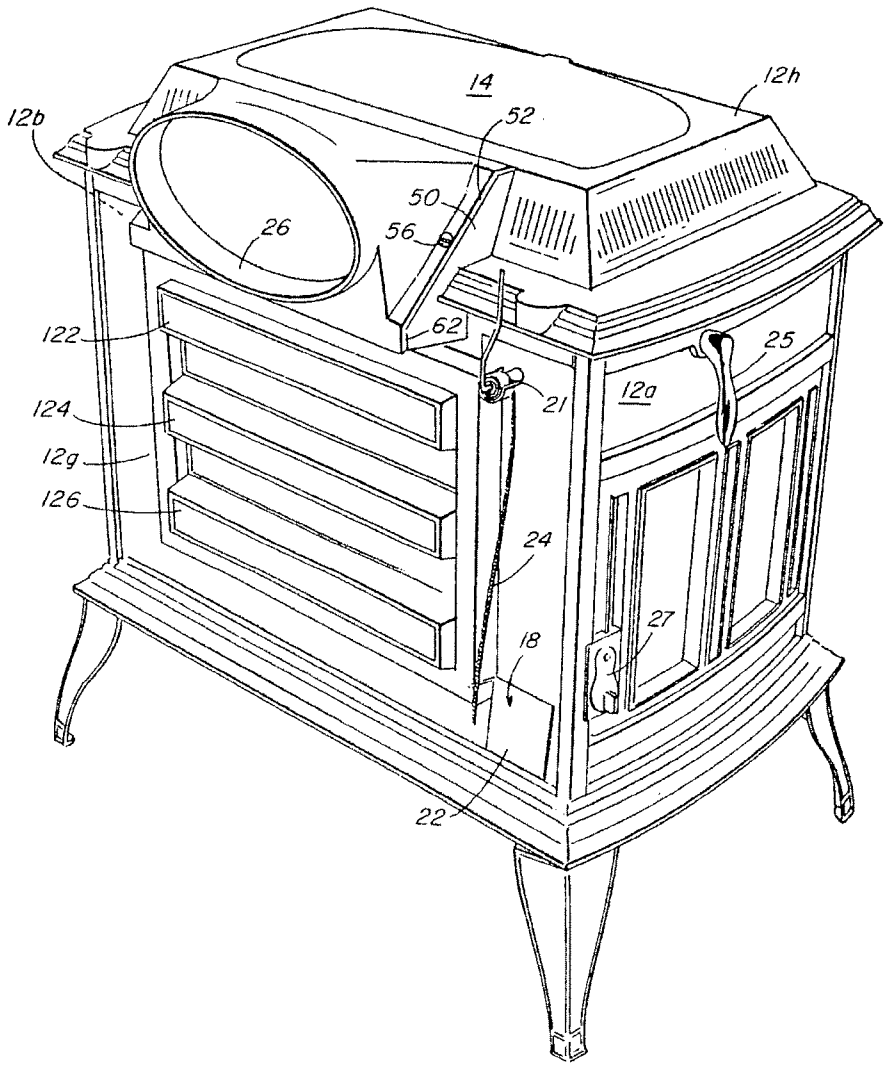

FIG. 2

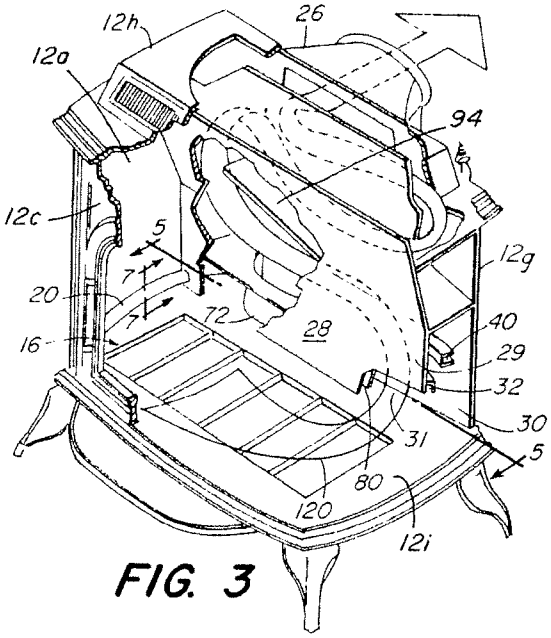

FIG. 3

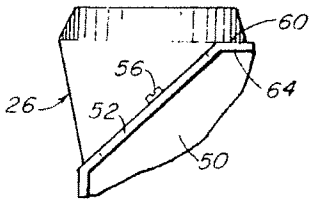

FIG. 4B

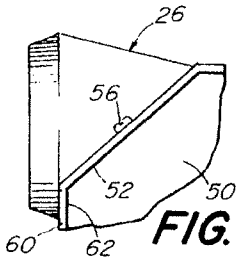

FIG. 4A

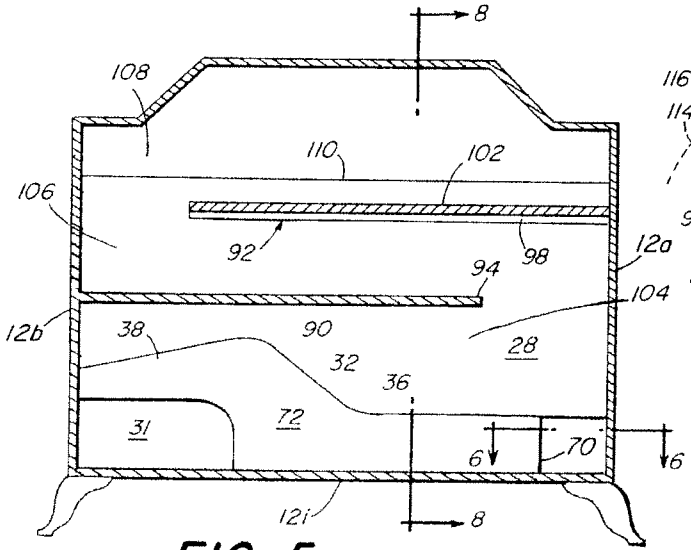

FIG. 5

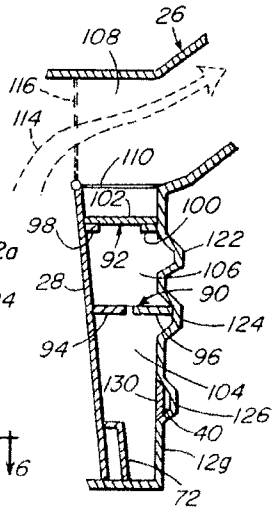

FIG. 8

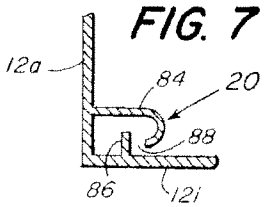

FIG. 7

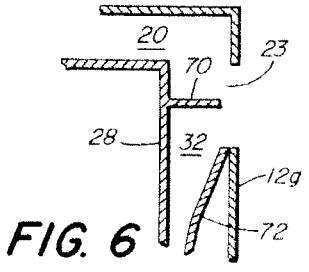

FIG. 6

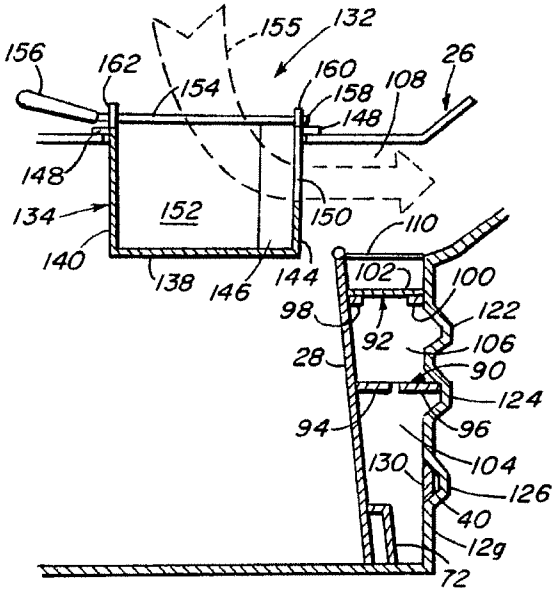

FIG. 9

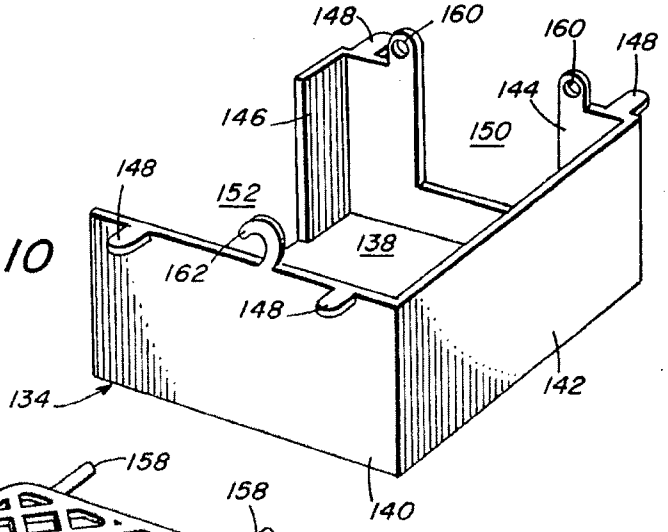

FIG. 10

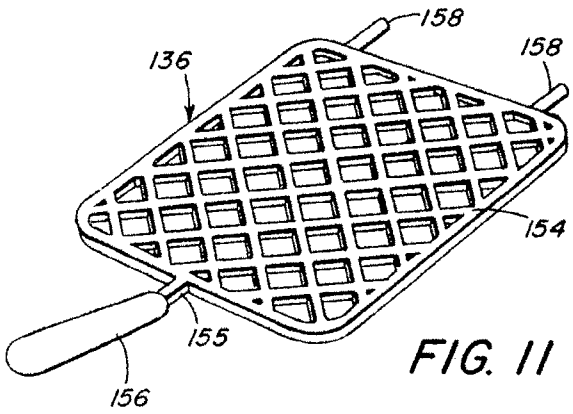

FIG. 11

COOKING METHOD AND APPARATUS FOR USE WITH WOOD-BURNING STOVE

BACKGROUND OF THE INVENTION

The invention relates generally to heating apparatus and in particular to cooking adapted to a wood-burning heating apparatus.

Heat from burning fuel is, of course, a traditional medium for cooking food, and cooking over an open fire is undoubtedly the earliest method of cooking. Although ovens and broilers are used for certain kinds of cooking, much cooking is still done atop open sources of heat such as gas or electric ranges.

Open cooking produces a certain amount of cooking odor and gaseous and solid by-products, that can rise to an annoying and uncomfortable level. Many gas and electric stoves are accompanied by overhead hoods for drawing up and exhausting such products. Some are equipped with passages built into the surface of the stove, with fans for drawing cooking by-products down into the stove openings and exhausting them.

The enclosed fire in a wood burning stove transmits enough heat to the frame of the stove so that a stove surface, usually the top, can also be used as a source of heat for cooking. Cooking on top of a wood stove, however, also produces the cooking odors and other gaseous and solid cooking by-products mentioned above.

A principal object of the invention is to provide a method and apparatus for cooking in conjunction with solid fuel burning stoves like the one described hereinafter, namely, one with a top loading capability which requires that a downdraft through the top loading aperture be maintained if wood is loaded while the fire is lit.

Further objects of the invention are to provide an apparatus and a method for using a wood burning stove for cooking while maintaining the room free of cooking odors and, in the case of the apparatus, which is easy to use and inexpensive to manufacture.

SUMMARY OF THE INVENTION

The apparatus of the invention features, in wood-burning apparatus having a fuel-containing member enclosing a combustion chamber, in which the frame member has a panel with a coverable aperture, and the frame member has, in addition, a combustion products exit aperture positioned in relation to the panel aperture so that air is drawn in through the panel aperture while wood is burning and the aperture is uncovered, a food cooking assembly supported in operative relation to the panel aperture for drawing cooking by-products through the panel aperture into the frame member. The food cooking assembly comprises a food cooker adapted for insertion at least partially into the aperture and support for the food cooker so placed.

The invention also features use of the top panel of the stove, as the apertured panel and a cooking assembly including a coal-holding tray having bottom and side walls adapted to be inserted into the aperture. The tray walls define an opening communicating between the panel aperture and the exit aperture, and also a coal aperture for reintroducing coals in the tray back into the combustion chamber. A cooking surface made up of a perforate planar cast iron member is supported above the tray.

The method of the invention uses a wood-burning heating apparatus having a frame enclosing a combustion chamber and a frame aperture in communication with the combustion chamber, a downdraft flowing through the uncovered aperture when wood is burning in the combustion chamber. The method includes the steps of uncovering the frame aperture, placing a cooking surface on which food can be cooked in an operative relation to the frame aperture, providing a heat source in operative relation to the cooking surface, and providing an unimpeded communication between the cooking surface and the combination chamber so that cooking byproducts will be carried by the downdraft through the frame aperture in the combustion chamber. The method also features providing a coals support surface assembly beneath the cooking surface, and providing a passageway in the coals support surface for reintroducing the coals to the combustion chamber.

DESCRIPTION OF THE DRAWINGS

Other features, objects, and advantages of the invention will appear from the following description of a preferred embodiment taken together with the drawings, in which:

FIG. 1 is a front perspective view of a wood-burning stove;

FIG. 2 is a rear perspective view of the stove of FIG. 1;

FIG. 3 is a cut-away front perspective view of the stove;

FIG. 4A is a cross-sectional schematic view of a rotatable flue collar of the stove in the rear exit position;

FIG. 4B is a cross-sectional schematic view of the rotatable flue collar in the top exit position;

FIG. 5 is a cross-sectional view facing the back of the fireback baffle along lines 5—5 of FIG. 3;

FIG. 6 is a cross-sectional view taken along lines 6—6 of FIG. 5;

FIG. 7 is a cross-sectional view taken along lines 7—7 of FIG. 3;

FIG. 8 is a cross-sectional view taken along lines 8—8 of FIG. 5.

FIG. 9 is a view like that of FIG. 8, showing a cooking assembly according to the invention inserted into the aperture at the top of the stove described in the other Figures;

FIG. 10 is a perspective view of a tray of the cooking assembly according to the invention; and

FIG. 11 is a perspective view of a grill of the cooking assembly.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring to FIG. 1, the wood-burning heating apparatus 8 has an exterior frame member 10 preferably comprised of a heavy-duty cast iron. The sides 12*a*, 12*b*, front 12*c* with doors 12*e*, 12*f*, back 12*g*, top 12*h*, and bottom 12*i* of the frame member are joined to form an integral air tight unit. The front pivoting doors 12*e*, 12*f*, allow the heating apparatus to be opened from the front for both loading of wood and for viewing the fire when the heating apparatus is used as a fireplace. A top cover 14 of the apparatus has hinges 15*a*, 15*b* which allow it to pivot to an upward position, whereby wood may be loaded into a primary combustion chamber 16 (FIG. 3) through a smokeless loading aperture 17. The aperture size is designed to sweep the opening clear of smoke when the top cover is pivoted to an open condition. Preferably the ratio of aperture cross-sectional area to

the flue gas output exit cross-sectional area is about three to one. Thus, even when the stove is in operation, firewood may be reloaded merely by dropping wood into the primary combustion chamber. An seal around aperture **17** provides an air tight fit between cover **14** and the frame member.

Referring to FIGS. **2** and **3**, air is fed to the primary combustion chamber **16** through a primary inlet port **18** and a primary air supply flow path **20** (FIG. **3**). Inlet port **18** is thermostatically controlled by a thermostat **21** which operates a damper **22** (FIG. **2**) covering an aperture **23** (FIG. **6**) in the back frame member **12***g*. Thermostat **21** is for example a 5" coil of bimetallic material connected to a damper **22** by a flexible chain **24**. Heating apparatus **8** is also provided with a damper control lever **25**, a rotatable flue member **26**, and a manually controlled night air inlet port **27** in side member **12***a*.

Referring to FIG. **3**, primary air travels through primary air supply path **20** after entering aperture **23** (see FIG. **6** for the relation between aperture **23** and air supply path **20**) and is heated by the fire which surrounds the tubes. Thus, the primary air is preheated and helps to keep a hotter fire going with less air and wood consumed. The primary combustion chamber is bounded by the substantially vertically oriented downwardly extending fireback baffle **28**, the side walls **12***a* and **12***b* of the frame member, the front doors **12***e*, **12***f* and front wall **12***c* of the frame member, and the top **12***h* and bottom **12***i* frame member panels (FIGS. **1**, **2** and **3**).

A right-hand portion **29** of baffle **28** further provides a partial separation between the primary combustion chamber **16** and a secondary combustion chamber **30**. The secondary combustion chamber is connected to and is in gaseous communication with the primary combustion chamber through an opening **31** in baffle **28**. A secondary air supply flow path **32** is provided for the secondary combustion chamber from thermostatically controlled inlet port **18**, and comprises an imperforate section **36** (FIG. **5**) which extends from the inlet port **18** to substantially the beginning of the secondary combustion chamber and a perforate or apertured conduit **38** which extends within the secondary combustion chamber along a bottom section of baffle **29** around opening **31**. The nature of the secondary air supply is described in more detail below.

There is further provided a third air supply path **40** which may be used to provide air from manually controlled inlet **27** (FIGS. **1** and **2**) to the secondary combustion chamber during night or other selected periods of low heat output operation. Air supply path **40** further provides additional oxygen for secondary combustion in the secondary combustion chamber.

Behind the fireback baffle **28** are a plurality of connecting smoke passages **104**, **106**, **108** (FIGS. **3** and **5**). These passages direct the spent flue gases from the secondary combustion chamber to the left end of the apparatus (looking from the front), then into an upper channel or passage **106** and back toward the right portion of the stove, and then further up into an uppermost passage **108** and back toward the left portion of the stove, where they finally exit through the flue collar **26**. The secondary combustion chamber, taken together with the smoke passages, make up the flame path. Since the heat of the flue gas is considerable, and is transferred to the surfaces of the stove as the flue gases traverse the passages, a significant amount of heat is given off to the room rather than being lost up the chimney. In addition, since the passages are adjacent to the primary combustion chamber, higher temperatures are maintained within the fire mass itself, which aids in burning the volatile gaseous products from the burning wood.

Referring to FIGS. **4A** and **4B**, flue collar **26** is preferably rotatable to allow operation of the apparatus with either a horizontal exit (FIG. **4A**) or a vertical exit (FIG. **4B**) position. The flue collar is attached to an inclined back portion **50** which is securely positioned on the back and top frame portions of the apparatus. The flue collar is secured to the inclined surface **52** of the back portion by two flue collar bolts **56** (only one of which is shown in the figures). The two bolts are secured on opposed sides of the flue collar.

Referring to FIG. **4A**, an extended portion **60** of the flue collar contacts vertically oriented section **62** of the back portion **50** for additional orientation and alignment support. By removing the flue collar bolts (located on opposite sides of the flue), and rotating the flue collar 180°, the orientation shown in FIG. **4B** may be obtained. This orientation provides the top exiting stove and is maintained by replacing the bolts **56**. The extended portion **60** of the flue collar **26** is now positioned against the horizontally oriented section **64** of portion **50**.

Thermostatically controlled inlet port **18** (seen in FIG. **2** preferably supplies air for both the primary and secondary air flow paths. As shown in FIGS. **5** and **6**, air enters through aperture **23** in frame back wall **12***g* and is almost immediately divided between the primary and secondary flow paths by a dividing plate member **70**. That portion of the incoming air which passes into the secondary flow path **32** is directed along the fireback baffle **28** and is constrained to follow a path adjacent to the fireback baffle by an enclosing member **72**. Enclosing member **72** not only directs the secondary air flow toward opening **31** in baffle **28**, but, in order to provide a substantially uniform flow of air into opening **31**, the cross-sectional area of the supply path defined by enclosing member **72** in combination with baffle **28** increases substantially as the path approaches the opening, as shown in FIG. **5**. This provides the necessary volume distribution of the flow to promote substantially uniform air flow in the opening. At the opening **31**, the enclosing member **72** ends in a substantially spaced apart parallel alignment with the baffle **28**, for example, at **80** (FIG. **3**) so that the flow of secondary air is substantially unimpeded into the secondary chamber at opening **31**. The secondary air supplied at opening **31** is also preheated due to its proximity with baffle **28** so that the efficiency of the secondary combustion chamber is increased.

That portion of the ambient air passing through aperture **23** which follows primary flow path **20** passes through the baffle **28** near the lower base of the baffle (FIG. **3**) and is supplied to the primary combustion chamber along an open ended slotted conduit **20** which extends from baffle **28**, along side wall **12***a*, and for approximately one-fifth the distance along the bottom of front wall **12***c*. The slotted conduit has a cross-sectional area which is substantially constant (FIG. **7**). The conduit comprises a horizontally extending J-shaped element **84** and a vertically upwardly extending cast member **86** which together define the elongated slot **88**. Primary air is thus provided to promote a uniform flow of combustion supporting oxygen across the entire depth of the combustion chamber.

Thus, the air provided by primary flow path **20** enters the primary combustion chamber along the bottom

left-hand side of the chamber (looking from the front), and traverses the chamber toward the right-hand side providing combustion along the entire bottom of the wood supply. Upon reaching the right-hand portion of the apparatus, the air flow is directed toward and through opening **31** and exits through the circuitous flow path provided by the baffle arrangement extending between baffle **28** and rear wall **12***g*.

Referring to FIGS. **5** and **8**, the baffle arrangement for directing the flue gases along the circuitous path through the space between baffle **28** and back wall **12***g* comprises a lower baffle **90** and an upper baffle **92**. Lower baffle **90** comprises two cast plate members **94** and **96** which meet along their length to form baffle **90** when the fireback baffle **28** is put into position. Baffle **90** extends substantially from side wall **12***b* to a position near side wall **12***a*. Baffle **92** extends above baffle **90** and comprises a pair of tabular cast supported members **98**, **100** which support a baffle plate **102** extending substantially from side wall **12***a* to a position near side wall **12***b*. The flue gases thereby are directed from a first horizontally directed passage **104** to a second horizontally directed passage **106** and then to a third horizontally directed passage **108** from which they exist through the flue collar **26**.

The heating apparatus is also provided with a damper **110** which enables the apparatus to be used both as a parlor stove and as a fireplace. In the position shown in FIG. **8**, the open position, the apparatus can be used as a fireplace with the flue gases exiting from the primary combustion chamber along a path generally indicated by arrow **114**. This provides updraft combustion. When the damper is closed, that is, placed in a position indicated by a dotted line **116**, the heating apparatus operates as a stove and the flue gases exit substantially as shown by the arrow **120** (FIG. **3**). (When fuel is loaded into the apparatus through aperture **17** the damper must be in the open position or otherwise smoke will pour out of the aperture **17** in the top panel **12***h*.)

Referring to FIGS. **2** and **8**, back wall member **12***g* has a series of corrugations **122**, **124**, **126**, which protrude outwardly from the plane of back wall member **12***g*. These corrugations provide additional heat radiation surfaces for the heating apparatus for increasing the heat delivery to the surrounding air. In addition, the corrugations provide convenient means for channeling "night air" from the manually controlled inlet port **27** to the secondary combustion chamber through night air flow path **40**. Thus, the lowermost corrugation **126** is blocked off by a plate **130** and is used to channel the night air into or at least towards the secondary combustion chamber.

In the preferred embodiment of the invention, the opening **31** (FIGS. **3** and **5**) has a height of between 3 and 4¼ inches and is preferably 4 inches high. It has been found for the particular apparatus depicted in FIG. **3** that the height of opening **31** is important and a height substantially greater than 4 inches increases the heat output of the apparatus and also its conversion efficiency.

Referring to FIGS. **9**, **10** and **11**, there is shown a food cooking assembly **132** that can be used with the heating apparatus **8** described above. The cooking assembly **132** has two components, a tray **134** (see FIG. **10**) and a grill **136** (see FIG. **11**).

The tray **134** is configured generally to fit through the shape of the aperture **17** in the top panel, wall, **12***h* of the stove frame. It is made of a non-combustible, preferably metal, material, and in the preferred embodiment is made of stamped tin. As seen in FIG. **10**, the tray **134** has a flat, horizontal bottom **138**, and vertical walls at the front **140**, right side **142**, rear **144**, and left side **146**. Horizontal tabs **148** extending from the top of the front and rear walls **140**, **144** engage the stove top and support the tray **134** therefrom in the stove aperture **17**.

The rear wall **144** of the tray defines a substantial rear opening **150**, and the illustrated left side wall **146** of the tray is in fact short, leaving a substantial side opening **152** in the tray. In effect, communication between the aperture **17** in the stove top **12***h* and the interior of the stove **8**, and, eventually the flue collar **26**, is maintained despite the presence of the tray **134** inserted into the aperture. The downdraft **155** that occurs when the cover **14** is lifted from the aperture **17** while the stove is in operation (and the damper **110** is in the appropriate position, namely, horizontal) to allow leading the stove with wood, is thus uninterrupted by insertion of the tray **134**.

The grill **136** is cast iron in the preferred embodiment and provides an open cooking surface **154** made of a perforate planar member an and a shank **155** on which a handle **156** is mounted. The cooking surface, like the tray **134**, is preferably made from metal, and includes a pair of rearward projections **158** which are insertable into vertical tabs **160** extending from the top of the tray rear wall **144** for support. A hook-like projection **162** extends upwardly from the front wall **140** of the tray to capture the handle **156** of the grill **136**. After it has been inserted in the rear tabs **160**.

To insert the cooking assembly **132** into its operative position, it is only necessary to open the cover **14** on top of the stove **8** and drop in the tray **134**. The horizontal tabs **148** will support the tray **134** on the rim of the aperture **17**, and the openings **150**, **152** in the tray walls **144**, **146**, respectively, will continue to allow the downdraft that passes through aperture **17** when the damper **110** is in the horizontal position and the wood in the stove is burning.

After the tray **134** is in place, coals from burning wood are placed in the tray on the bottom **138**. The grill **136** may then be placed appropriately by inserting the rear projections **158** into the tray vertical tabs **160** and capturing the grill handle **156** under the front tray hook **162**. The grill **136** provides an open cooking surface **154** then, for food to be cooked over the hot coals in the tray **134** below. The cooking is inherently adjustable because more or less coals can be placed in the tray **134** until the desired heat level is reached. Gaseous and solid by-products of the cooking process will not escape into the air above the stove, but instead will be carried by the downdraft **155** into the interior combustion chamber of the stove (through the openings **150**, **152** in the tray) and eventually out the exhaust flue **26** of the stove. After the food on the grill **136** is cooked and there is no longer any need for the coals in the tray **134**, the coals can be pushed out tray opening **152** to rejoin the fire below.

The method of cooking just described takes advantage of the built-in downdraft natural devised for the stove **8** so that it could be loaded with wood fuel from the top **12***h* through aperture **17**. It has long been known that it is desirable to exhaust, from the vicinity of cooked food, the gaseous and solid by-products of the cooking process. Cooking apparatus have been devised which mechanically draw air down below a cooking

surface and discharge it elsewhere. Cooking on the hot surface of a wood-burning stove is, of course, an old custom. The invention, however, provides a method and apparatus for cooking in which the built-in downdraft of a top-loading stove is used to advantage. The particular form of the stove, or of the components of the cooking assembly may, of course, be varied without departing from the spirit of the invention.

Other embodiments of the invention, including additions, subtractions, deletions, and other modifications of the preferred embodiment of the invention will be obvious to one skilled in the art and are within the scope of the following claims.

I claim:

1. A solid fuel burning heating and cooking apparatus comprising:

a fuel-containing frame member enclosing a combustion chamber,

said frame member having an apertured panel for defining a panel aperture in said frame member, and means for covering said aperture,

said frame member further having means for defining a combustion products exit aperture, said exit aperture and said panel aperture having a positioned interrelationship with a ratio of the cross-sectional area of said panel aperture to the cross-sectional area of said combustion products exit aperture being sufficient to draw air by naturla draft through said panel aperture into said frame member while solid fuel is burning in said combustion chamber and said panel aperture is uncovered, and

coverless apertured grill means for cooking food substantially unimpeded over a secondary fuel source, and means for supporting said grill means and said secondary fuel source in said frame member in the path of said natural draft through said panel aperture, said supporting means including a base for supporting said secondary fuel source and side portions connected to said base for supporting said grill means, said side portions defining an aperture through said supporting means, said apparatus utilizing said fuel-containing frame member's means for naturally drawing air through said panel aperture in order to draw cooking by-products through said panel aperture and into said frame member.

2. The apparatus of claim 1 wherein said apertured panel is a top panel of said frame member.

3. The apparatus of claim 1 wherein said cooking means comprises

tray means including bottom and side walls adapted to be inserted into said frame member through said panel aperture,

said tray means walls defining an opening communicating between said panel aperture and said exit aperture, said opening preventing impedance of the downdraft built into said frame member, and

said tray means including a support member for engaging said apertured panel for supporting said tray means in said frame member.

4. The apparatus of claim 3 wherein said cooking means further comprises

means for defining a cooking surface,

said tray means further has means for supporting said cooking surface means above said tray means bottom, and

said tray bottom being adpated to support hot coals in an operative relation to said cooking surface.

5. The apparatus of claim 4 wherein said means defining said cooking surface comprises a perforate planar member defining said cooking surface.

6. A solid fuel burning heating and cooking apparatus comprising:

a fuel-containing frame member enclosing a combustion chamber,

said frame member having an apertured panel for defining a panel aperture in said frame member, and means for covering said aperture, said aperture panel being a top panel of said frame member,

said frame member further having means for defining a combustion products exit apertue, said exit aperture and said panel aperture having a positioned interrelationship with a ratio of the cross-sectional area of said panel aperture to the cross-sectional area of said combustion products exit aperture being sufficient to draw air by natural draft through said panel aperture into said frame member while solid fuel is burning in said combustion chamber and said panel aperture is uncovered, and

means for cooking food supported in the path of said natural draft through said panel aperture, said apparatus utilizing said fuel-containing frame member's means for naturally drawing air through said panel aperture and into said frame member in order to draw cooking by-products through said panel aperture,

said cooking means including,

tray means including bottom and side walls adapted to be inserted into said frame member through said panel aperture,

said tray means walls defining an opening communicating between said panel aperture and said exit aperture,

said opening preventing impedence of the downdraft built into said frame member, and

said tray means including a support member for engaging said apertured panel for supporting said tray means in said frame member.

7. The apparatus of claim 6 wherein said cooking means further comprises

means for defining a cooking surface,

said tray means further has means for supporting said cooking surface means above said tray means bottom, and

said tray bottom being adapted to support a secondary solid fuel source in an operative relation to said cooking surface.

8. The apparatus of claim 7 wherein said means defining said cooking surface comprises a perforate planar member defining said cooking surface.

9. For use with a solid fuel burning heating apparatus having a top aperture in the combustion chamber enclosing frame of said apparatus and a combustion products exit aperture, and through which a natural downdraft flows when a primary solid fuel source is burning said combustion chamber and said top aperture is uncovered,

a food cooking assembly comprising

coverless apertured grill means for cooking food substantially unimpeded over a secondary fuel source, said grill means being adapted for insertion at least partially into said top aperture, including

means positioned adjacent said top aperture for supporting said grill means and said secondary fuel source in the path of said natural draft through said top aperture said supporting means including a base

for supporting said secondary fuel source and side portions connected to said base for supporting said grill means, said side portions defining an aperture through said supporting means, whereby by-products generated during said cooking are drawn into said combustion chamber.

10. The food cooking assembly of claim 9 wherein said cooking means comprises

tray means including bottom and side walls adapted to be inserted into said frame member through said top aperture,

said tray means walls defining an opening communicating between said top aperture and the interior of said heating apparatus, and

said tray means including a support member for engaging said top panel for supporting said tray means in said frame member.

11. The apparatus of claim 10 wherein said cooking means further comprises

means for defining a cooking surface,

said tray means further has means for supporting said cooking surface means above said tray means bottom, and

said tray bottom being adapted to support hot coals in an operative relation to said cooking surface.

12. The apparatus of claim 11 wherein said means defining said cooking surface comprises a perforate planar member pattern defining said cooking surface.

13. The apparatus of claim 10 wherein at least one of said tray side walls defines a coal aperture having a bottom boundry defined by said tray bottom.

14. The apparatus of claim 10 wherein at least one of said tray side walls facing said combustion products exit aperture defines a flowthrough aperture forming a communication passage between said top aperture and said exit aperture.

15. The apparatus of claim 10 wherein said tray side walls extend substantially from said tray bottom wall to said top aperture to close off said top aperture, except that

at least one of said tray side walls defines a coal aperture having a bottom boundary defined by said tray bottom, and

at least one of said tray side walls facing said combustion products exit aperture defines a flowthrough aperture forming a communication passage between said top aperture and said exit aperture.

16. For use with a solid fuel burning heating apparatus having a top aperture in the combustion chamber enclosing frame of said apparatus and a combustion products exit aperture, and through which a natural downdraft flows when solid fuel is burning in said combustion chamber and said top aperture is uncovered.

a food cooking assembly comprising

means for cooking food adapted for insertion at least partially into said top aperture, said cooking means including,

tray means including bottom and side walls adapted to be inserted into said frame member through said top aperture,

said tray means walls defining an opening communicting between said top aperture and the interior of said heating apparatus, and

said tray means including a support member for engaging said top panel for supporting said tray means in said frame member in operative relation to said aperture whereby by-products generated during said cooking are drawn into said combustion chamber.

17. The apparatus of claim 16 wherein said cooking means further comprises

means for defining a cooking surface,

said tray means further has means for supporting said cooking surface means above said tray means bottom, and

said tray bottom being adapted to support hot coals in an operative relation to said cooking surface.

18. The apparatus of claim 17 wherein said means defining said cooking surface comprises a perforate planar member pattern defining said cooking surface.

19. The apparatus of claim 16 wherein at least one of said tray side walls defines a coal aperture having a bottom boundary defined by said tray bottom.

20. The apparatus of claim 16 wherein at least one of said tray side walls facing said combustion products exit aperture defines a flowthrough aperture forming a communication passage between said top aperture and said exit aperture.

21. The apparatus of claim 16 wherein said tray side walls extend substantially from said tray bottom wall to said top aperture to close off said top aperture, except that

at least one of said tray side walls defines a coal aperture having a bottom boundary defined by said tray bottom, and

at least one of said tray side walls facing said combustion products exit aperture defines a flowthrough aperture forming a communication passge between said top aperture and said exit aperture.

22. A method of cooking food using a solid fuel burning heating apparatus having a frame enclosing a combustion chamber and a frame aperture in communication with said combustion chamber and having an inward flow through said aperture when a primary solid fuel source is burning in said combustion chamber and said aperture is uncovered, comprising the steps of

uncovering said frame aperture,

placing an apertured cooking surface, on which food can be cooked substantially unimpeded over a secondary fuel source, in an operative relation to said open frame aperture,

providing said secondary fuel source in operative relation to said cooking surface, and

providing an unimpeded communication between said surface and said combustion chamber whereby cooking by-products will be carried by said downdraft through said frame aperture into said chamber.

23. The method of claim 22 wherein said heat producing step comprises the step of

providing a coals support surface assembly beneath said cooking surface, said coal support surface including means to prevent the impedance of said downdraft between said surface and said combustion chamber, and

placing coals from said burning wood on said coals support surface.

24. The method of claim 23 further including the step of providing a passgeway in said coals support surface assembly to said combustion chamber for reintroducing the coals to the combustion chamber.

25. A method of cooking food using a solid fuel burning heating apparatus having a frame enclosing a combustion chamber and a frame aperture in communication with said combustion chamber and having an in-

ward flow through said aperture when a primary solid fuel source is burning in said combustion chamber and said aperture is uncovered, comprising the steps of

uncovering said frame aperture,

placing an apertured cooking surface on which food can be cooked in an operative relation to said open frame aperture,

providing a secondary solids fuel support surface assembly beneath said cooking surface, said secondary solid fuel support surface including means to prevent the impedance of said downdraft between said surface and said combustion chamber, and

placing secondary solid fuel from said primary solid fuel source on said solid fuel support surface, and

providing an unimpeded communication between said cooking surface and said combustion chamber whereby cooking by-products will be carried by said downdraft through said frame aperture into said chamber.

26. The method of claim **25** further including the step of providing a passageway in said secondary solid fuel support surface assembly to said combustion chamber for reintroducing the secondary solid fuel to the combustion chamber.

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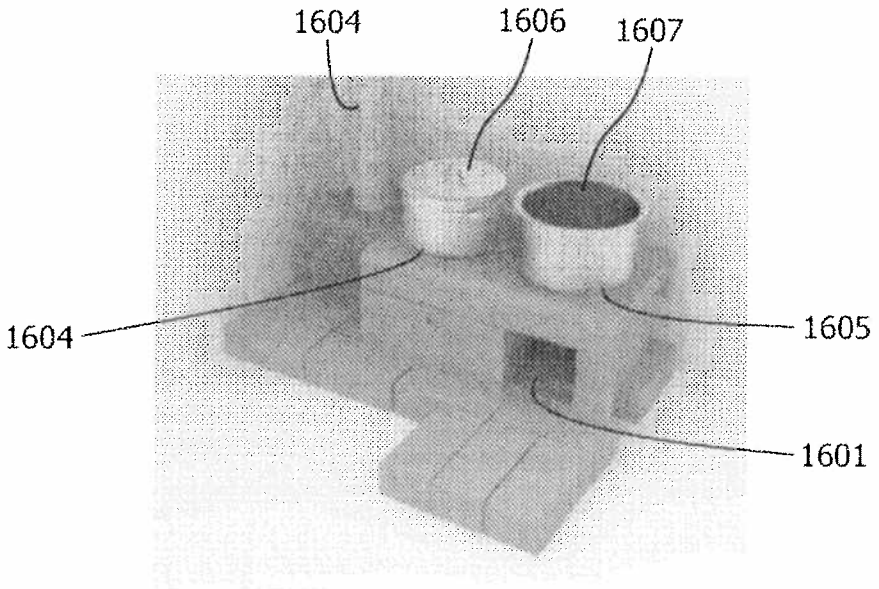

FIG. 16

(57) Abstract: PH009323 18 ABSTRACT: A cooking stove comprises a cavity for solid fuel, a chimney for the removal of exhaust gases created by the burning of the solid fuel and a channel arranged to connect the cavity and the chimney. The channel comprises a first opening to receive and support a first cooking receptacle. The first cooking receptacle is a cooking plate or a cooking pot. 5

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Cooking Stove

FIELD OF THE INVENTION

The invention relates to a cooking stove for use in a domestic environment.

BACKGROUND OF THE INVENTION

Existing cooking stoves used in many homes, and shown in figure 1, consist of a small, hollowed out space 101 in a shelf 102, the space proportioned so that a cooking pot or other cooking receptacle 103 is supported by the edges of the shelf 102 so that it is suspended over the space 101. Sometimes a further cooking plate 104 is placed over the pot. Solid fuel 105 is placed in the space 101 and lit to provide heat for cooking or heating the contents of the pot 103 and/or plate 104. Unfortunately, the burning of solid fuel creates exhaust gases, particularly carbon monoxide and also causes the release of smoke particles, and these can linger in the room around the stove. Exposure to the exhaust gases plus smoke particles creates risk of respiratory infections and carbon monoxide poisoning and is associated with an increased risk of miscarriage, blindness and tuberculosis.

It is an object of the invention to provide a cooking stove which allows food to be cooked efficiently by an individual without the concomitant exposure of the individual to dangerous amounts of exhaust gases and smoke, and in particular to carbon monoxide.

BRIEF SUMMARY OF THE INVENTION

This is achieved according to the invention whereby the cooking stove comprises a cavity for solid fuel; a chimney for the removal of exhaust gases created by the burning of the solid fuel; a channel arranged to connect the cavity and the chimney; the channel comprising a first opening to receive and support a first cooking receptacle. Biomass, which is used as the solid fuel, emits a lot of soot and smoke which creates

indoor air pollution, the main cause for respiratory diseases. The stove is fitted with the chimney to reduce the air pollution. When the solid fuel in the cavity is lit, heat is generated which starts to rise and causes movement of air standing in the chimney. As the air in the chimney start to rise up under the influence of the heated gases coming from the cavity, suction is created in the chimney and more gases are gradually pulled through the channel. Thus user of the stove will not be exposed to the smoke that can be dangerous to his/her health. The cavity for the solid fuel has a gap through which the solid fuel can be inserted and the increasing suction of gases into the chimney pulls more air into the cavity through this gap to provide oxygen for the fire. The movement of increasingly heated exhaust gases through the channel from the cavity to the chimney allows heating and cooking of food inside the cooking receptacle thereby increasing the efficiency of the stove.

According to an embodiment of the invention, the channel comprises a protuberance arranged directly underneath the first opening arranged to receive and support the first cooking receptacle when the stove is in operation, wherein the protuberance is configured to deflect flow of exhaust gases to the underside of the first cooking receptacle. This protuberance blocks the path of the hot gases to create a small turbulence under the first opening. This helps better transfer of heat to the cooking receptacle. The hot exhaust gases from the solid fuel burning in the cavity are transported along the channel which comprises the protuberance arranged to deflect flow of exhaust gases to the underside of the first cooking receptacle placed on the first opening. The protuberance deflects the hot gases and causes them to momentarily pause under the first cooking receptacle placed on the first opening before moving further to the chimney under the pressure of further exhaust gases coming from the cavity. The momentary pausing of the gases under the first cooking receptacle is possible because the exhaust gases are compressible, and this momentary pausing of hot gas as it is transported along the channel improves heating of the first cooking receptacle. Without the protuberance, the hot gases pass through the channel at a high speed and does not transfer good amount of heat to the first cooking receptacle.

According a still further embodiment of the invention, the protuberance is a ridge arranged to span the diameter of the duct transversely to the direction of the

channel. The height of the protuberance in relation to the diameter of the channel is substantially 90% of the diameter of the channel. This is the ideal height, because if it takes up any more of area of the cross section of the channel, the latter becomes sufficiently obstructed and causes exhaust gases to issue backwards out of the cavity into the room. If the protuberance takes up any less of the cross sectional area of the channel there is insufficient pausing of the exhaust gases under the cooking receptacle to cause the advantageous heating allowed.

According to another embodiment of the invention, wherein the first cooking receptacle is a cooking plate. The cooking plate is particularly advantageous for cooking of chapattis. The first opening is suitably arranged to receive and support the cooking plate. In other words, the first opening is wide enough to support the cooking plate while leaving a wide enough opening to allow heating of substantial area of the cooking plate surface. If the edge of the opening is further chamfered to allow the cooking plate to nestle in the opening supported by the edges of the cooking plate then conduction of heat from the walls of the channel provides further heating to the edge of the cooking plate.

According to yet another embodiment of the invention, the first cooking receptacle is a cooking pot, wherein the first opening is proportioned to allow an insertion of the cooking pot into the channel and the channel is arranged to maintain the flow of exhaust gases in the channel around the inserted cooking pot. In this embodiment the flow of hot exhaust gases around the cooking pot allows heating and cooking of the contents of the pot. It is important that the channel is arranged to maintain the flow of exhaust gases around the inserted cooking pot and therefore it is important that the insertion of the cooking pot does not cause narrowing of the channel. Narrowing of the channel around a large pot can constrict the easy flow of hot exhaust gases and smoke to the chimney. This may cause the exhaust gases and smoke to reissue backwards out of the cavity into the surrounding room.

According to a still further embodiment of the invention, the first opening is arranged in the upper side of the channel when the cooking stove is in operation.

According to a preferred embodiment of the invention, the cavity for the solid fuel comprises a second opening for receiving a second cooking receptacle. It is

further advantageous if the cavity for the solid fuel comprises a second opening for receiving a second cooking receptacle as both the cooking receptacles can be used simultaneously thus reducing the cooking time. The cavity is arranged to receive the solid fuel while smoke and exhaust gases are transported into the channel and carried away via the chimney. The second opening is proportioned to allow placement of the second cooking receptacle on top of the second opening and this allows conventional cooking directly over the heat produced by the burning of the solid fuel. The second opening allows a second pot to be used in addition to the first cooking plate that is heated by the flow of exhaust gases along the channel.

According to an embodiment of the invention, a by-pass tunnel is provided between the first opening in the channel and the second opening in the cavity. Turbulence is needed in the first and second openings so that there is a better heat transfer to the cooking receptacles. The by-pass tunnel splits the hot gases (fire) in the second opening. This helps the hot gases to linger under the second cooking receptacle for a longer time. This bypass connects the second opening with the first opening where the hot gases from the by-pass tunnel mix with the hot gases passing through the channel. The gases from the channel and by-pass tunnel collide with a high speed and create small turbulence in the first opening. This increases the temperature in the first opening substantially.

According to a further embodiment of the invention, a barrier is provided on top of the second opening, and wherein the barrier is arranged to increase volume of the cavity yet keeping the second opening of the cavity small. This stops the smoke coming out of the cavity in spite of turbulence inside the cavity.

According to a preferred embodiment of the invention, the chimney has a modular construction to allow assembly of the chimney by the abutment of a first set of respective elements together to form a pipe and the placement of a second set of respective sleeve-like elements over the joints formed between the first elements. Long chimney pipes of 8+ ft are needed to efficiently remove the smoke. These chimneys need to be carried for installation of the stove. These are too fragile to be carried on rural roads in locally available transport and can lead to transit damages. Sometimes people carry them on their heads and it is very difficult to carry as they weigh a lot and need to be balanced carefully. The modular construction of the chimney proves to be very

advantageous while transporting on a bike or local carts. Further, the modular construction of the chimney enables easy cleaning.

According to an embodiment of the invention, the chimney has internal diameter of between 75mm and 125mm, but preferably between 90 mm and 110 mm, but preferably between 95 mm and 105 mm. The channel has substantially the same internal diameter as the chimney. If the channel has a substantially wider diameter than the chimney there is a risk that the exhaust gases and smoke cannot flow freely into the chimney and a proportion of them will flow backwards into the room

According to a further embodiment of the invention, a soot collector is provided at bottom of the chimney. Chimneys get clogged very frequently as the biomass, solid fuels, that people in rural India use for cooking, have a lot of resins and substances like silica that do not burn completely. These un-burnt particles travel with the fire and settle on any rough and cooler surface. As the fire cools the soot condenses and settles. It builds quickly and clogs the chimney. The soot collector provided in the chimney reduces clogging of the chimneys. The soot collector is placed at an accessible point before it enters the chimney so that the chimney is not chocked easily.

According to yet another embodiment, the stove is constructed from a moldable material and has a modular construction to allow assembly of the cooking stove by the abutment of respective elements alongside each other in situ. The moldable material is concrete or clay. It is particularly advantageous if the stove is constructed from a moldable material and has a modular construction to allow assembly of the cooking stove by the abutment of respective elements alongside each other in situ. Further, it has been found to be advantageous if the stove constructed from concrete, but the stove can also be constructed from clay or other material suitable for molding. Following abutment of the modular units together to form the cavity, channel and opening, the whole stove can be covered in cement or clay or other non-flammable sealing material to seal the gaps between the modular units and improve successful transfer of the exhaust gases and smoke from the cavity to the chimney.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a cooking stove of the prior art;

Figure 2 shows a cooking stove according to the invention;

Figure 3 shows an embodiment of the cooking stove of the invention;

Figure 4 shows another embodiment of the cooking stove of the invention;

Figure 5 shows a cooking stove containing two openings to receive two cooking receptacles;

Figure 6 shows a top view of a cooking stove with a by-pass channel;

Figure 7 shows a side view sectional of a cooking stove with a barrier;

Figures 8a and 8b show the construction of a chimney attached to a cooking stove of the invention; and

Figure 9 shows a chimney provided with a chimney cleaning bracket;

Figure 10 shows a prototype of chimney being assembled;

Figure 11 shows an adjustable chimney to suit any available roof height;

Figure 12 shows perforated plates without and with a soot collector in a chimney;

Figure 13 shows stackable soot collector tablets;

Figure 14 shows the modular construction of the cooking stove in an advantageous embodiment;

Figure 15 shows a Saral stove; and

Figure 16 shows a Sampooran stove.

DETAILED DESCRIPTION OF THE INVENTION

The present invention will be described with respect to particular embodiments and with reference to certain drawings but the invention is not limited thereto. Any reference signs in the claims shall not be construed as limiting the scope. The drawings described are only schematic and are non-limiting. In the drawings, the size of some of the elements may be exaggerated and not drawn on scale for illustrative purposes. Where the term "comprising" is used in the present description and claims, it does not exclude other elements or steps. Where an indefinite or definite article is used when referring to a singular noun e.g. "a" or "an", "the", this includes a plural of that noun unless something else is specifically stated.

Furthermore, the terms first, second, third and the like in the description

and in the claims, are used for distinguishing between similar elements and not necessarily for describing a sequential or chronological order. It is to be understood that the terms so used are interchangeable under appropriate circumstances and that the embodiments of the invention described herein are capable of operation in other sequences than described or illustrated herein.

Moreover, the terms top, bottom, over, under and the like in the description and the claims are used for descriptive purposes and not necessarily for describing relative positions. It is to be understood that the terms so used are interchangeable under appropriate circumstances and that the embodiments of the invention described herein are capable of operation in other orientations than described or illustrated herein.

As shown in figure 2, the cooking stove comprises a cavity for solid fuel 201, a chimney 202 for the removal of exhaust gases created by the burning of the solid fuel 205, a channel 203 arranged to connect the cavity and the chimney and to ensure exhaust gases are conducted from the cavity to the chimney. Further, the channel comprises an opening 204 to receive and support a cooking receptacle, arranged so that the flow of exhaust gases through the channel heats the cooking receptacle. When the solid fuel 205 in the cavity 201 is lit, heat is generated which starts to rise and causes movement of the air and gases standing in the chimney. As the air and gases in the chimney start to rise up under the influence of the heated gases coming from the cavity, suction is created in the chimney and more gases are gradually pulled through the channel 203.

The cavity 201 for the solid fuel 205 has a gap at through which the solid fuel can be inserted and the gradually increasing suction of gases into the chimney pulls more air into the cavity through this gap to provide oxygen for the fire.

The movement of increasingly heated exhaust gases through the channel 203 from the cavity 201 to the chimney 202 allows heating and cooking of food inside a cooking receptacle placed on an opening 204 for that purpose.

The result of this arrangement is the heating and cooking of food contained in the cooking receptacle while in addition, exhaust gases and smoke are pulled

out of the cavity 201, along the channel 203 and into the chimney 202 from where they rise to be removed from the room in which the cooking stove is placed.

There are two main embodiments allowing use of the channel to provide cooking. In the first, shown in figures 3a (side view) and 3b (top view), hot exhaust gases from the solid fuel 305 burning in the cavity 301 are transported along the channel 303 which comprises a protuberance 306 arranged to deflect flow of exhaust gases to the underside of the cooking receptacle placed on the opening 304. The protuberance deflects the hot gases and causes them to momentarily pause under the cooking receptacle placed on the opening 304, before moving further to the chimney 302 under the pressure of further exhaust gases coming from the cavity 301. The momentary pausing of the gases under the cooking receptacle is possible because the exhaust gases are compressible, and this momentary pausing of hot gas as it is transported along the channel 303 improves heating of the cooking receptacle. This is a particularly advantageous embodiment.

Preferably, the protuberance 306 is arranged directly underneath the opening 304, as shown in figure 3b in which the opening 304 is shown by the dotted line. It has been found that the most advantageous design for the protuberance is a ridge arranged to span the diameter of the duct transversely to the direction of the channel. This protuberance blocks the path of the fire to create a small turbulence under the opening 304. This helps better transfer of heat to the cooking receptacle. It has also been found that the best height for the protuberance in relation to the diameter of the channel is substantially 90% of the diameter of the channel. In practice, the height of the protuberance can vary between 70% and about 90% of the height of the channel 303, so within the tolerances of manufacture it might in fact be 88%, 89%, 91% or 92% of the height of the channel 303. It has in fact been found that about 90% is the ideal height, because if it takes up any more of area of the cross section of the channel 303 the latter becomes sufficiently obstructed to cause exhaust gases to issue backwards out of the cavity 301 into the room. If the protuberance takes up any less of the cross sectional area of the channel there is insufficient pausing of the exhaust gases under the cooking receptacle to cause the advantageous heating allowed by this embodiment.

This first embodiment is particularly advantageous when the cooking receptacle is a cooking plate, for example for the cooking of chapatis. In order to achieve

this, the opening 304 is suitably arranged to receive and support a cooking plate. In other words, the opening 304 is wide enough to support a cooking plate while leaving a wide enough opening 304 to allow heating of substantially enough of the cooking plate surface. If the edge of the opening 304 is further chamfered to allow the cooking plate to nestle in the opening supported by the edges of the cooking plate then conduction of heat from the walls of the channel provides further heating to the edge of the cooking plate.

In the second embodiment, shown in figures 4a (side view) and 4b (top view), hot exhaust gases from the solid fuel 405 burning in the cavity 401 are transported along the channel 403 which contains an opening 404 which is proportioned to allow the insertion of a cooking pot 406 into the channel. In this embodiment the flow of hot exhaust gases around the cooking pot 406 allows heating and cooking of the contents of the pot. It is important that the channel is arranged to maintain the flow of exhaust gases around the inserted cooking pot 406 and therefore it is important that the insertion of the cooking pot 406 does not cause narrowing of the channel 403. Narrowing of the channel around a large pot 406 can constrict the easy flow of hot exhaust gases and smoke to the chimney and cause instead the exhaust gases and smoke to reissue backwards out of the cavity 401 into the surrounding room. Therefore, in this embodiment, the channel 403 is further widened in the vicinity 407 of the pot. It is particularly advantageous if the pot 406 is supplied with the cooking stove because in this case the size of the supplied pot 406 and size of the associated widening 407 can be matched so that no reduction in cross sectional area of the channel 403 for gas and smoke transport occurs when the pot 406 is in place.

As can be seen by consideration of figures 3 and 4, the opening is arranged in the upper side of the channel when the cooking stove is in operation. It can therefore also be noted that the channel should be arranged to be substantially horizontal.

It is further advantageous if the cavity for solid fuel comprises a second opening for receiving a second cooking receptacle. This is shown in figure 5, in which the cavity 501 now has a second opening 505. The cavity 501 is arranged to receive solid fuel 504 and smoke and exhaust gases are transported, as before, into the channel 502 and carried away in the chimney. However, in this further embodiment, the opening 505 is proportioned to allow placement of a further pot 503 on top of the opening 505 and this

allows conventional cooking directly over the heat produced by the burning of the solid fuel 504. The addition of this further opening 505 allows a further pot to be used in addition to the pot or cooking plate heated by the flow of exhaust gases along the channel.

The heat transfer in the second opening 605 is increased by creating turbulence as shown in figure 6. A by-pass channel 610 splits hot gases (fire) in the second opening 605 hole. This helps fire to linger under the second cooking receptacle (not shown) for a longer time. Experiments showed that the boiling point was reached within 10min 30 sec as compared to 13+ minutes required when the by-pass channel 610 was not present in the second opening 605.The by-pass channel 610 connects with the channel 603 in the first opening 604. The hot gases from the by-pass channel 610 collide with the hot gases in the channel 603 with a high speed and create small turbulence in the first opening 604. It was noted that the test sample in the first opening reached maximum of 76 + deg C as compared to 65degree C in the cooking stove without the by-pass channel.

Another way of increasing turbulence in the second opening 705 is shown in figure 7. A barrier 710 is placed on top of the second opening 705. The barrier helps increasing volume of the cavity 701 yet keeping the second opening 705 small. This stops the smoke coming out of the second opening 705 in spite of turbulence inside.

Advantageously, the chimney has a modular construction to allow assembly of the chimney by the abutment of a first set of respective elements together to form a pipe and the placement of a second set of respective sleeve-like elements over the joints formed between the first elements. Chimney pipes are heavy and need to be transported carefully. Due to lack of transport and good roads there is a lot of transit damage. They are too heavy to be carried by people. The modular construction of the chimney is shown in figure 8, in which the modular elements 801 are placed one on top of each other to form a chimney of a suitable height to transport smoke away from the room in which cooking is undertaken, and further sleeve elements 802, each with a handle 803, are slid over the length of pipe formed by the elements 801 to close the gaps 804 between the elements 801. The sleeve like elements 802 should be closely fitting enough to maintain the integrity of the resulting pipe, in other words to allow the pipe to

transport exhaust gases and smoke out of the room without leakage through the gaps 804 back into the room. The sleeve like elements 802 can be held in place by a metal peg (not shown) inserted vertically between each sleeve like element 802 and one or other of the elements 801 next to it, which peg holds the sleeve like element 802 in place by use of friction.

In use, the chimney is built up from elements 801 and sleeve like elements 802 until the top of the chimney is tall enough to issue out from the roof of the room in which the cooking stove is positioned. In this way, exhaust gases and smoke are removed completely from the room. A chimney cap (not shown) can be placed over the top of the chimney.

It has been found that the ideal internal diameter for the chimney is between 75mm and 125mm, but preferably between 90 mm and 110 mm, but preferably between 95 mm and 105 mm. It has also been found that the channel must have substantially the same internal diameter as the chimney if the operation of the chimney and channel together are to successfully remove exhaust gases and smoke by the action of suction. If the channel has a substantially wider diameter than the chimney there is a risk that the exhaust gases and smoke cannot flow freely into the chimney and a proportion of them will flow backwards into the room.

The chimneys can easily be cleaned by having a break in the chimney inside the house at a level easily accessible by a person as shown in figure 9. This solution also helps easy fixing of chimney on the wall. Wall bracket 902 is fixed on the wall helps holding the pipes 901 in place and it has a hanging detail that allows easy fixing of chimney cleaning cover 903. The chimney pipe 901 is divided into two parts, one attached to the chimney chamber (not shown) and other attached to the roof. The actual assembly depends on the height of the roof and the pipe connected to the roof is sized to fix it to the roof. Figures 10 and 11 show how the chimney gets fixed inside a kitchen.

Chimneys get clogged very frequently as the biomass, solid fuels, that people in rural India use for cooking, have a lot of resins and substances like silica that do not burn completely. These un-burnt particles travel with the fire and settle on any rough and cooler surface. As the fire cools the soot condenses and settles. It builds quickly and

clogs the chimney. This makes it necessary to clean the chimneys very frequently. Chimney maintenance is problematic as one has to climb the roof to clean it. A bag of sand is dropped from top end – that scrapes the soot as it falls due to gravity.

Figure 12 shows two perforated plates 1201 and 1202. These perforated plates are placed in the chimney for 30 minutes. The perforated plate 1201 is placed inside the chimney without a soot collector and the perforated plate 1202 is placed inside the chimney with a soot collector. It is very obvious from figure 12 that the perforated plate 1201 collected lot of soot compared to the perforated plate 1202. This indicates that the presence of soot collector improves the chimney maintenance.

Figure 13 shows a set of soot collector tablets 1301 placed in the chimney chamber1303 at an accessible point before it enters the chimney 1302 so that the chimney 1302 is not chocked easily. It is found out that if the soot is collected earlier on at the stove level it makes it easier to clean and maintain the chimney 1302. The chimney chamber 1303 connects stove with the chimney 1302. This is the last part where the flue gases pass through. The set of clay tablets 1301 let the smoke pass through in a zig-zag way, thus increasing length of travel of the flue gases and cooling them down in the process. These tablets 1301 collect soot in the process. These tablets 1301 can be removed, scrubbed and washed easily. This reduces collection of soot inside the chimney 1302.

It is particularly advantageous if the stove is constructed from a moldable material and has a modular construction to allow assembly of the cooking stove by the abutment of respective elements alongside each other in situ. Further, it has been found to be advantageous if the stove constructed from concrete, but the stove can also be constructed from clay or other material suitable for molding.

Figure 14 is a diagrammatic, expanded view of the second embodiment of the stove in modular form. The first module 1401 comprises the cavity 1403 and part of the channel 1404. The second module 1402 comprises the main part of the channel 1404 plus the space into which the cooking pot will be lowered. A further part of the channel 1407 is arranged to connect with a third modular unit 1406 which comprises the space 1408 into which the lowest element of the chimney is inserted. A further modular unit 1409 is placed over units 1401 and 1402 and comprises the openings 1410 and 1411

which are arranged respectively over the cavity 1403 and the space 1405 for the pot. The modular units are abutted together to form the overall cooking stove. An equivalent arrangement allows construction of the first embodiment, in which modular unit 1402 is replaced with modular unit 1412 comprising the channel 1404 plus the protuberance 1413. Because space is not required for insertion of the cooking pot (as in 1402) there is space underneath the channel 1404 of 1412 for a warming area to be constructed 1414 (shown in dotted line). Alternatively, 1412 can be constructed in two sections, one flat lower section comprising the warming area 1414 and a second section comprising the channel 1404 plus protuberance 1413 and arranged to be placed on top of the lower section. The warming area 1414 is designed merely to keep food warm and does so using conduction of heat from the cavity 1403 and the channel 1404 through the solid modules 1401 and 1412. A door plus plate, of for example metal, can be provided to close off warming area 1414 while also allowing plates of food to be slid in and out.

Construction of the stove is from concrete mixed with grid, i.e. broken stones, and the mixture is pored into a greased mould. It has been found that engine oil is a suitable grease which is cheap to obtain and easy to find. The mixture remains in the mould for one hour, covered under wet cloths. The mixture begins to dry and shrinks sufficiently for it to taken out of the mould after 1 hour. This allows the mould to be re-used and increases the number of cooking stoves that can be made from one mould. The dried and now shaped mixture must further dry for another 7 to 10 days in open air, covered by wet cloths again to make sure it does not dry to fast and burst.

The moulds are made of iron and an epoxy composite material, re-enforced with fiber glass pieces. This adds strength to the mould which can therefore take any form.

The modularity allows ease of construction and transport. Concrete is a heavy material and by splitting the overall stove structure up into sections it becomes easier to manufacture without the use of heavy lifting gear, and also easy to transport into the home and set up.

A further modular unit comprising a shelf (not shown) can be supplied and placed at the back of the stove. This shelf can be used to place cooking implements at a ready height for easy access and further keeps them away from the floor of the home.

Following abutment of the modular units together to form the cavity, channel and opening, the whole stove can be covered in cement or clay or other non-flammable sealing material to seal the gaps between the modular units and improve successful transfer of the exhaust gases and smoke from the cavity to the chimney.

The invention allows construction of a low stove, positioned on the ground or on bricks, which allows successful and efficient cooking while ensuring the removal of exhaust gases and smoke from the room.

All of the above-mentioned features are incorporated in two designs of stoves called Saral Stove and Sampoorna Stove as shown in figures 15 and 16. The Sampoorna stove shown in figure 16 has a dedicated steamer 1606 included in the second opening 1605. The steamer 1606 is inserted inside the second opening 1605.The steamer 1606 sits 4 cm inside the second opening 1605 and obstructs the fire path. This helps water inside the steamer 1606 to boil.

CLAIMS:

1. A cooking stove, comprising:

a cavity for solid fuel;

a chimney for the removal of exhaust gases created by the burning of the solid fuel; and

a channel arranged to connect the cavity and the chimney; the channel comprising a first opening to receive and support a first cooking receptacle.

2. The cooking stove as claimed in claim 1, wherein the channel comprises a protuberance arranged directly underneath the first opening arranged to receive and support the first cooking receptacle when the stove is in operation, wherein the protuberance is configured to deflect flow of exhaust gases to the underside of the first cooking receptacle.

3. The cooking stove as claimed in claim 2, wherein the protuberance is a ridge arranged to span the diameter of the duct transversely to the direction of the channel.

4. The cooking stove as claimed in claim 3, wherein the height of the protuberance in relation to the diameter of the channel is substantially 90% of the diameter of the channel.

5. The cooking stove as claimed in claims 2, 3, 4 wherein the first cooking receptacle is a cooking plate.

6. The cooking stove as claimed in claim 1, wherein the first cooking receptacle is a cooking pot, wherein the first opening is proportioned to allow an insertion of the cooking pot into the channel and the channel is arranged to maintain the flow of exhaust gases in the channel around the inserted cooking pot.

7. The cooking stove according to any previous claim, wherein the first opening is arranged in the upper side of the channel when the cooking stove is in operation.

8. The cooking stove as claimed in claim 1, wherein the cavity for solid fuel comprises a second opening for receiving a second cooking receptacle.

9. The cooking stove as claimed in claim 8, wherein a by-pass tunnel is provided between the first opening in the channel and the second opening in the cavity.

10. The cooking stove as claimed in claim 8, wherein a barrier is provided on top of the second opening, and wherein the barrier is arranged to increase volume of the cavity.

11. The cooking stove according to any previous claim, wherein, chimney has a modular construction to allow assembly of the chimney by the abutment of a first set of respective elements together to form a pipe and the placement of a second set of respective sleeve-like elements over the joins formed between the first elements.

12. The cooking stove according to any previous claim, wherein, chimney has internal diameter of between 75mm and 125mm, but preferably between 90 mm and 110 mm, but preferably between 95 mm and 105 mm.

13. The cooking stove according to claim 11, wherein, the channel has substantially the same internal diameter as the chimney.

14. The cooking stove according to claim 1, wherein a soot collector is provided at bottom of the chimney.

15. The cooking stove according to any previous claim, wherein, the stove is constructed from a moldable material and has a modular construction to allow assembly of the cooking stove by the abutment of respective elements alongside each other in situ.

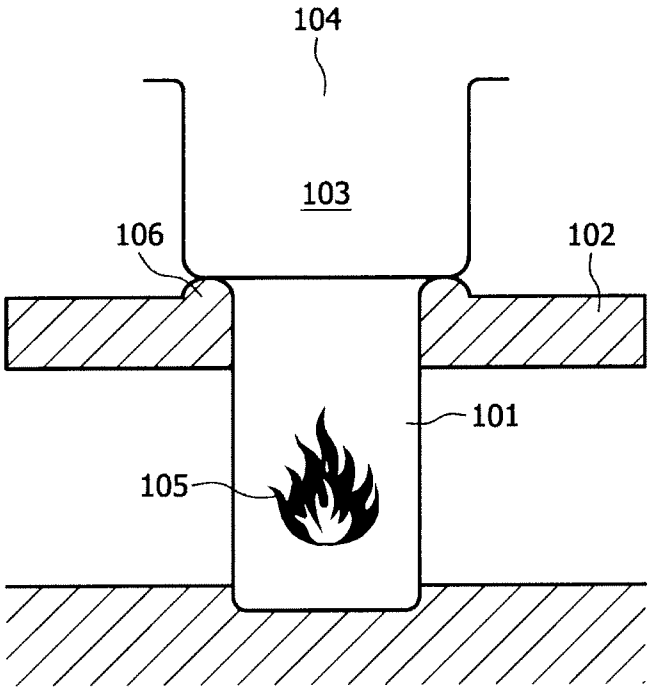

FIG. 1 (Prior Art)

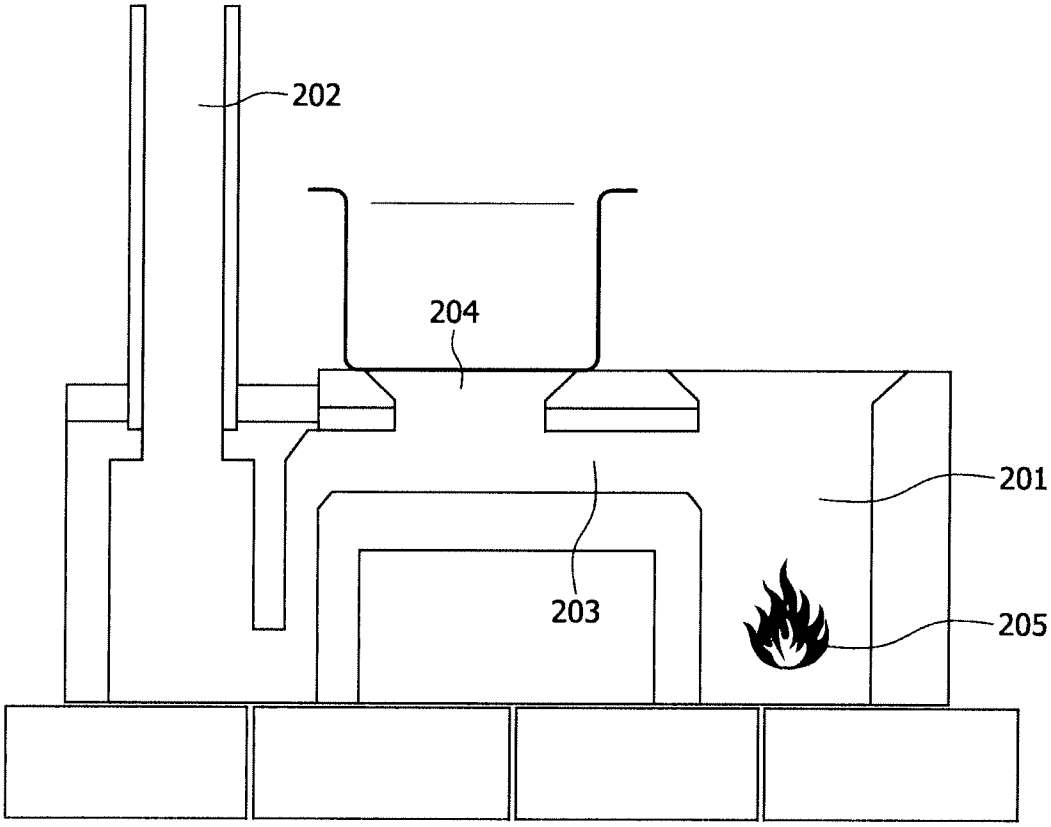

FIG. 2

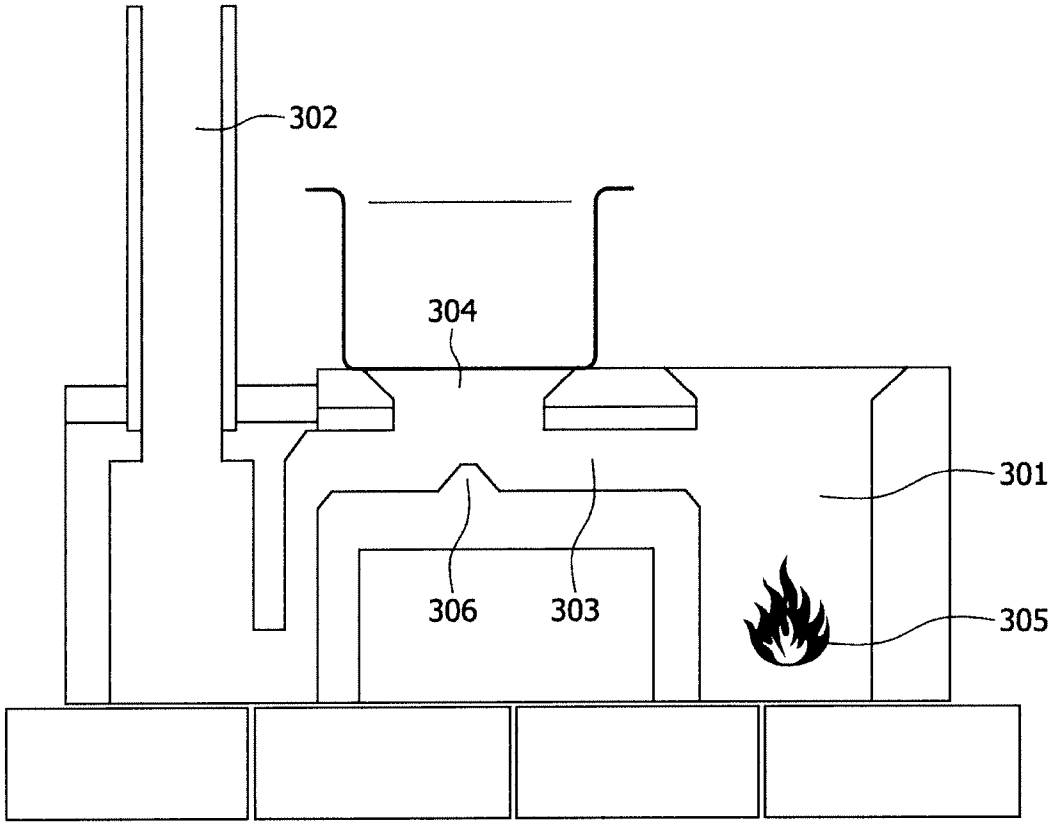

FIG. 3a

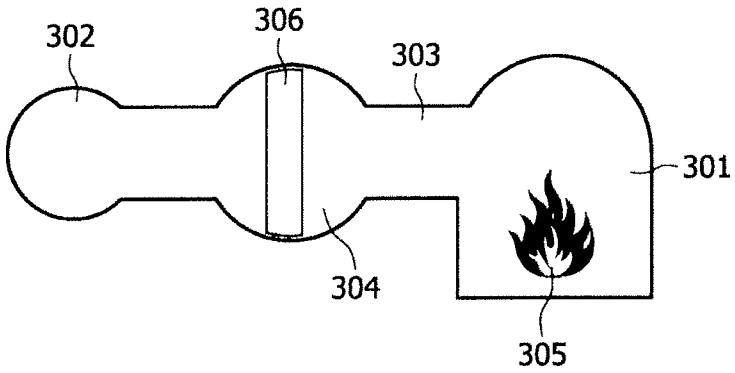

FIG. 3b

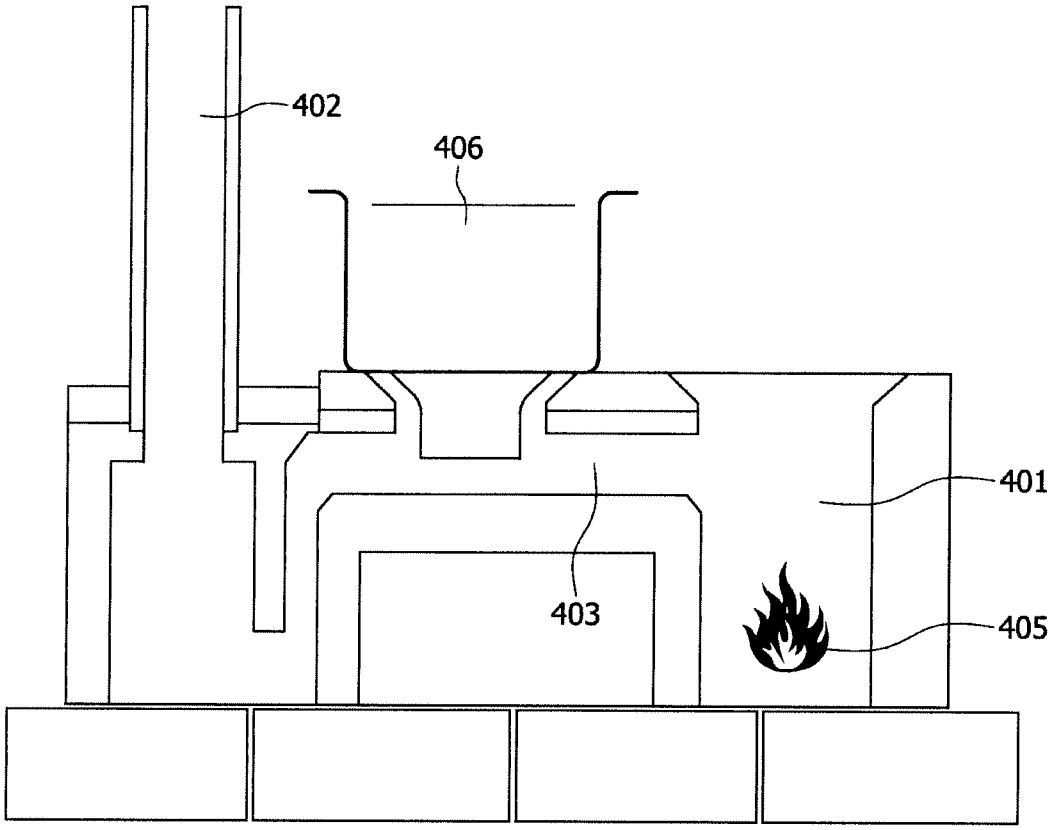

FIG. 4a

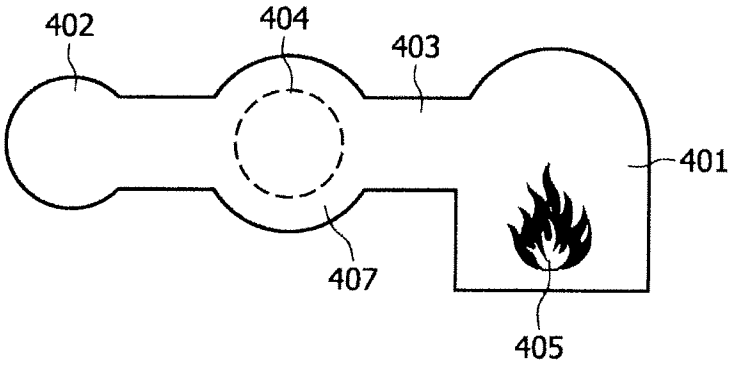

FIG. 4b

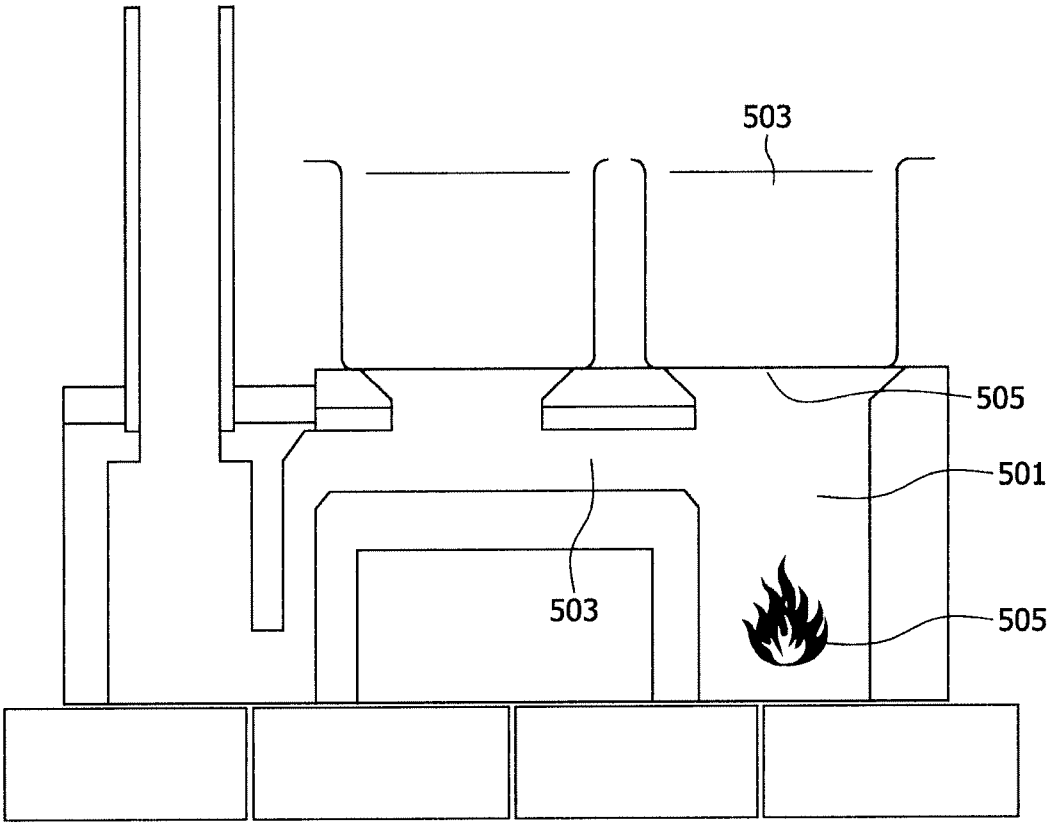

FIG. 5

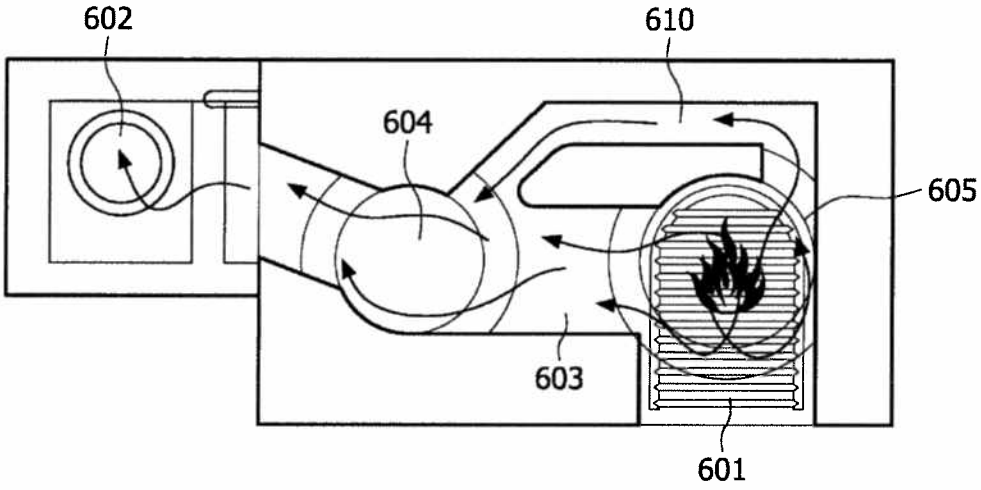

FIG. 6

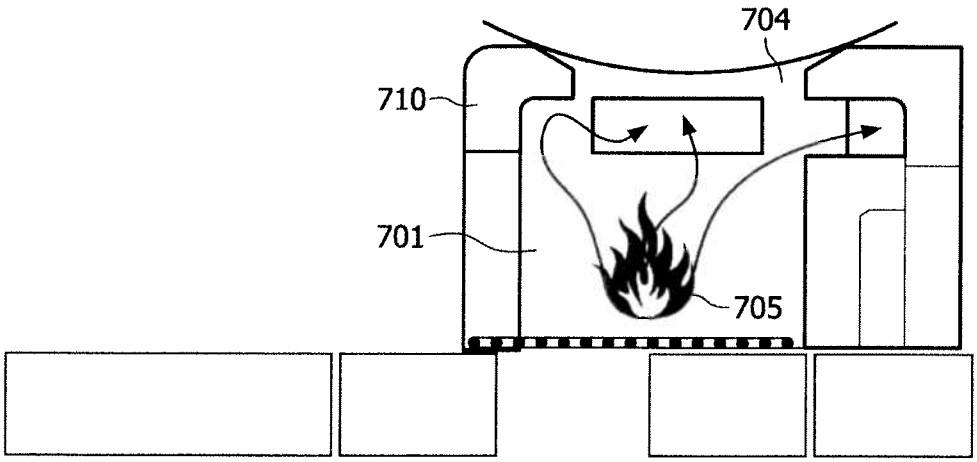

FIG. 7

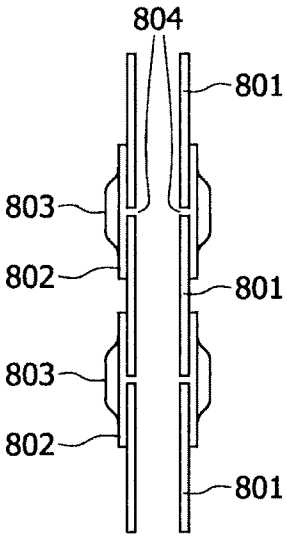

FIG. 8a

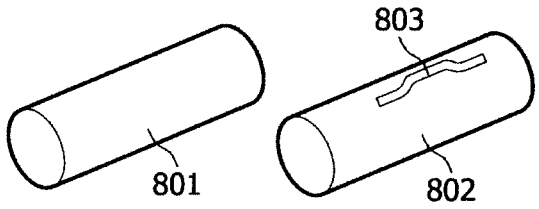

FIG. 8b

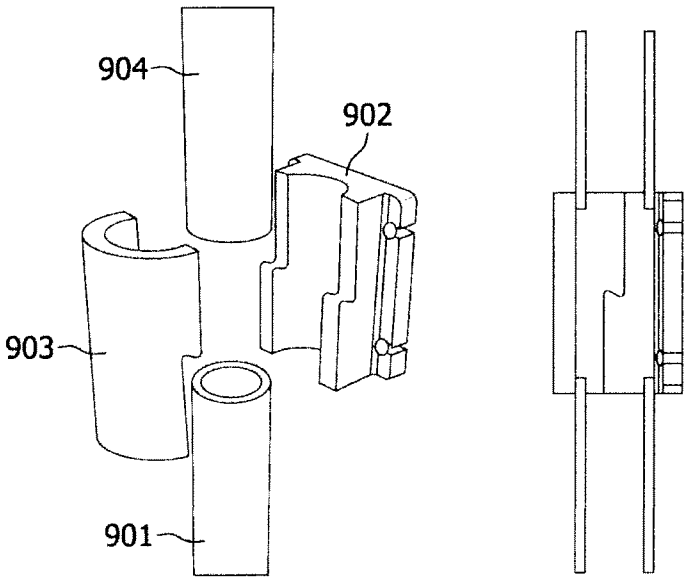

FIG. 9

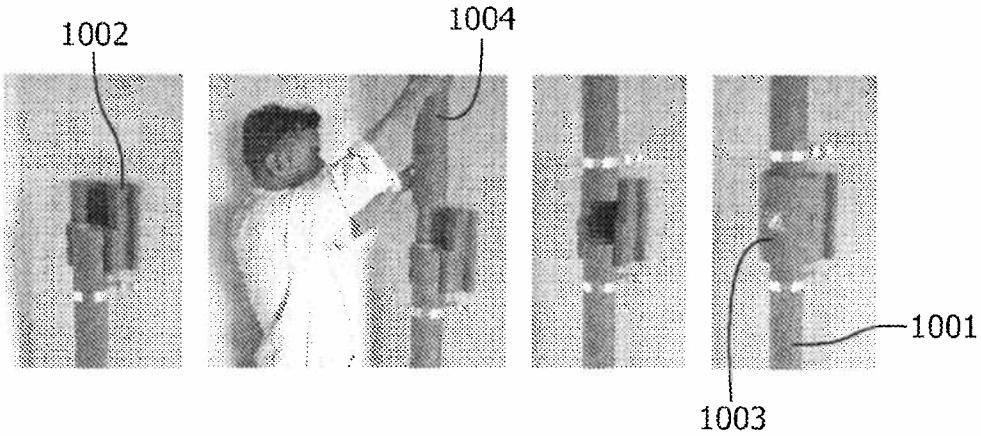

FIG. 10

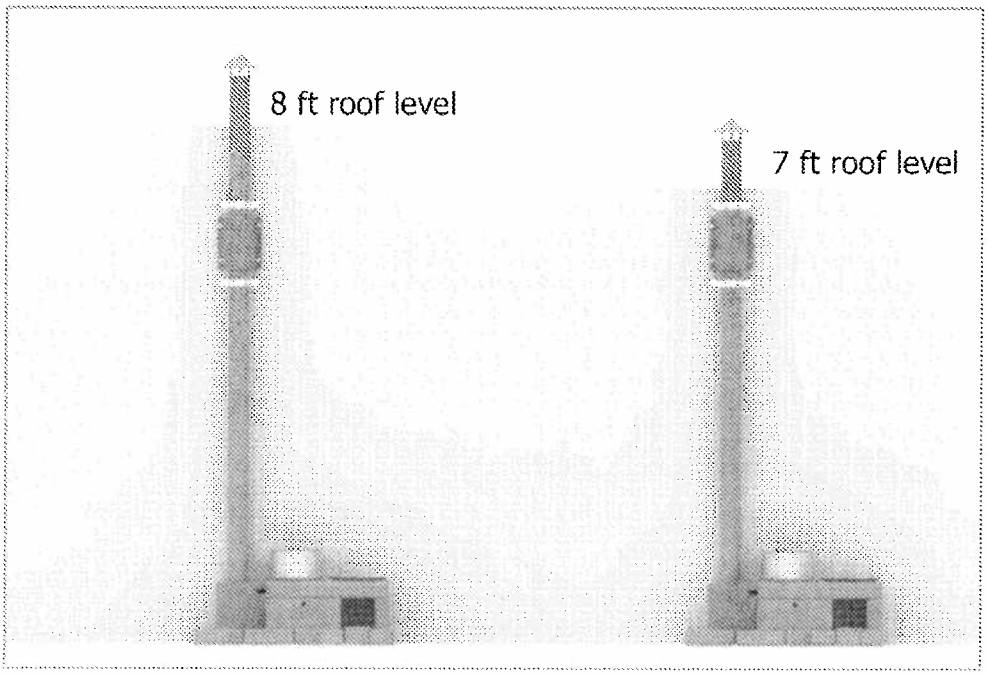

FIG. 11

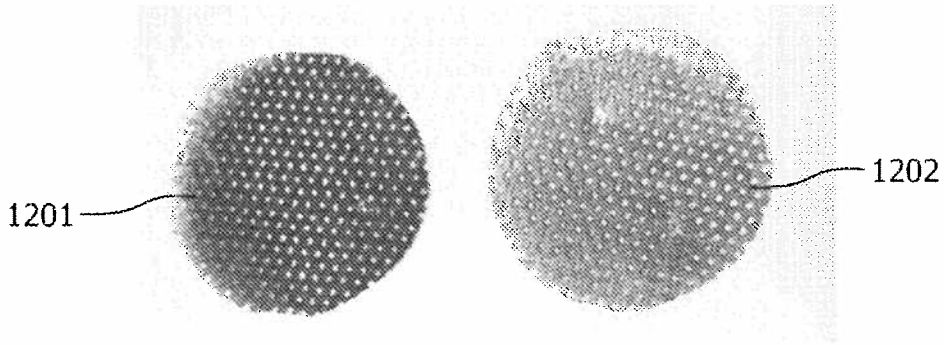

FIG. 12

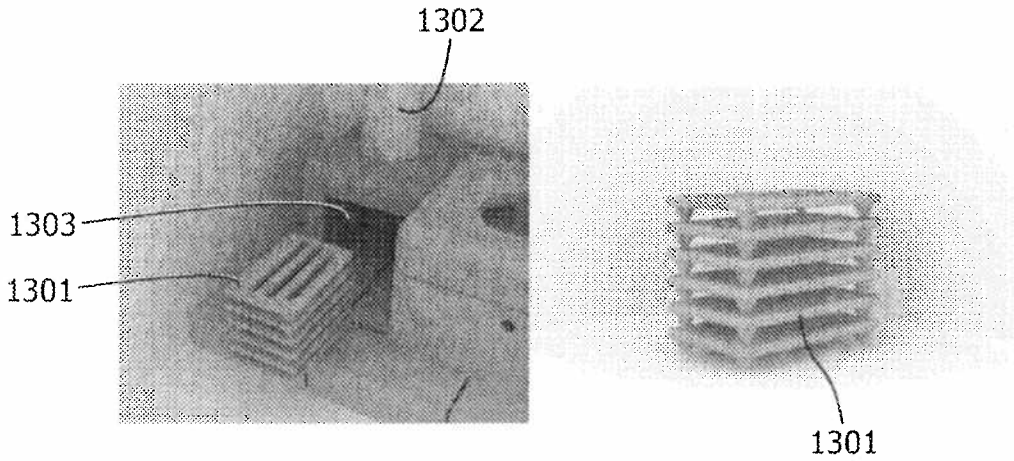

FIG. 13

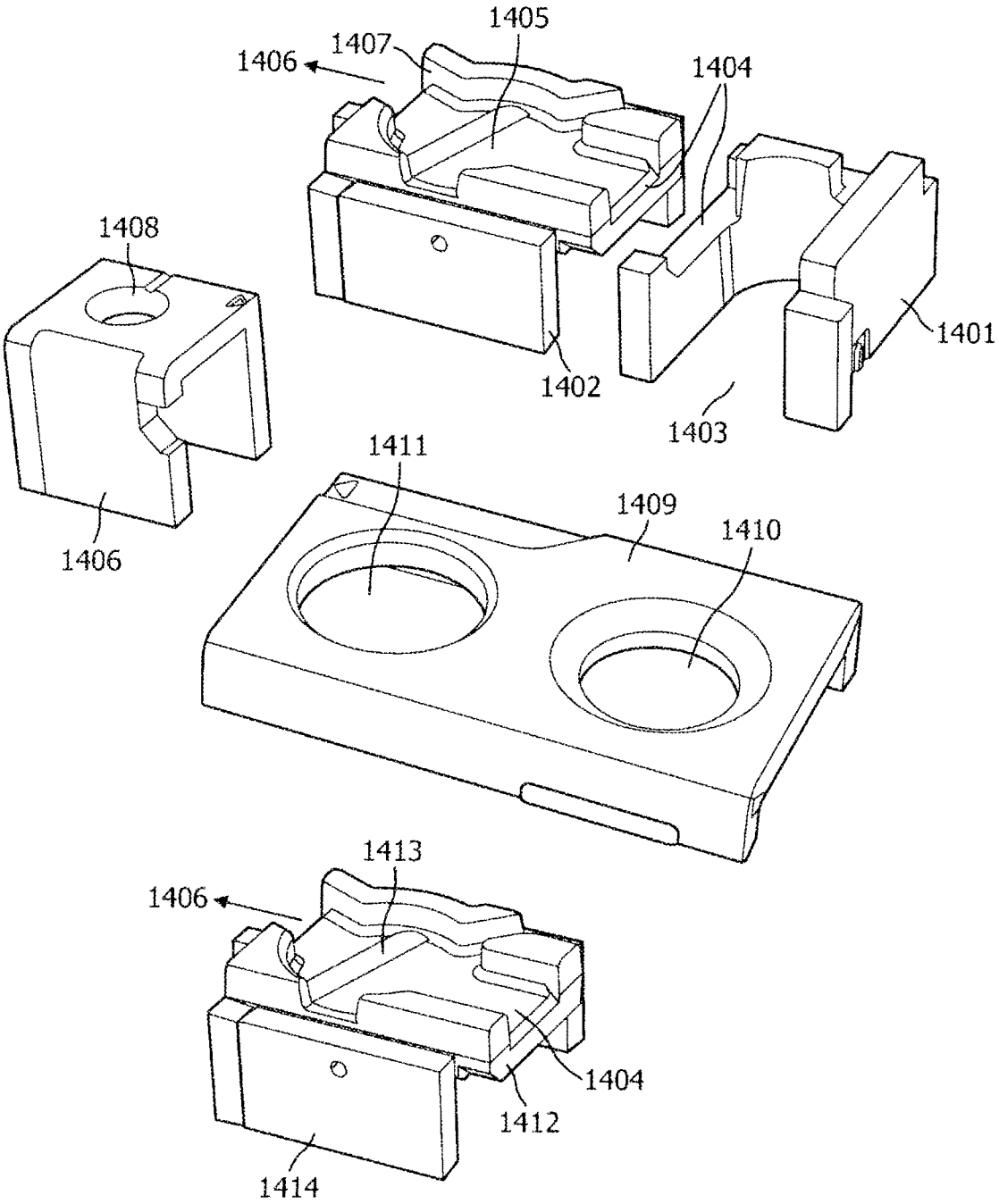
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FIG. 14

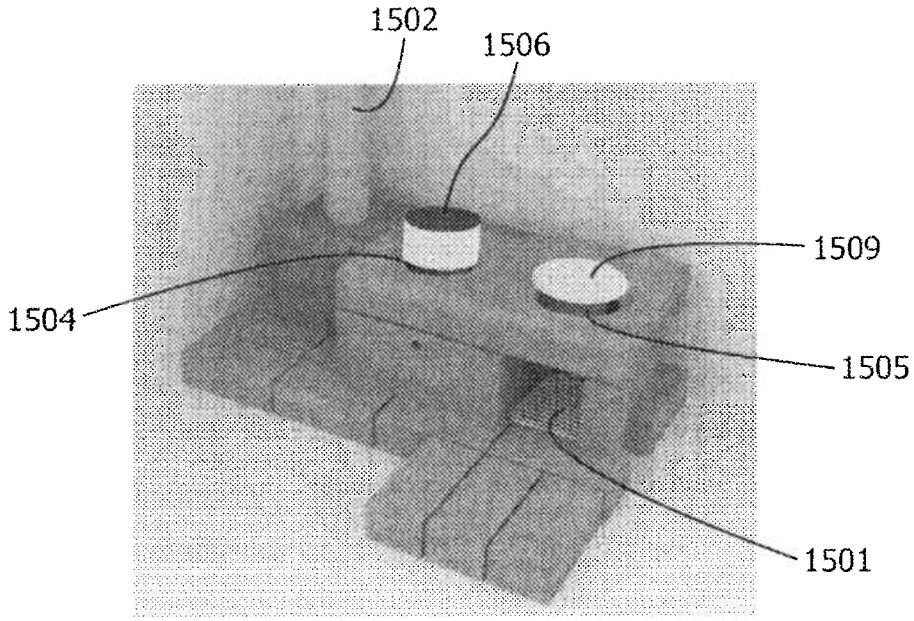

FIG. 15

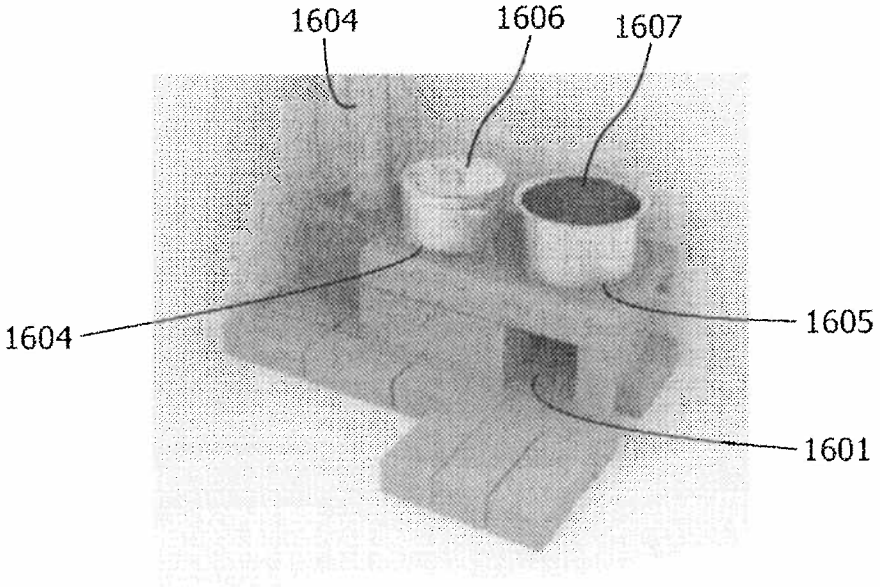

FIG. 16