

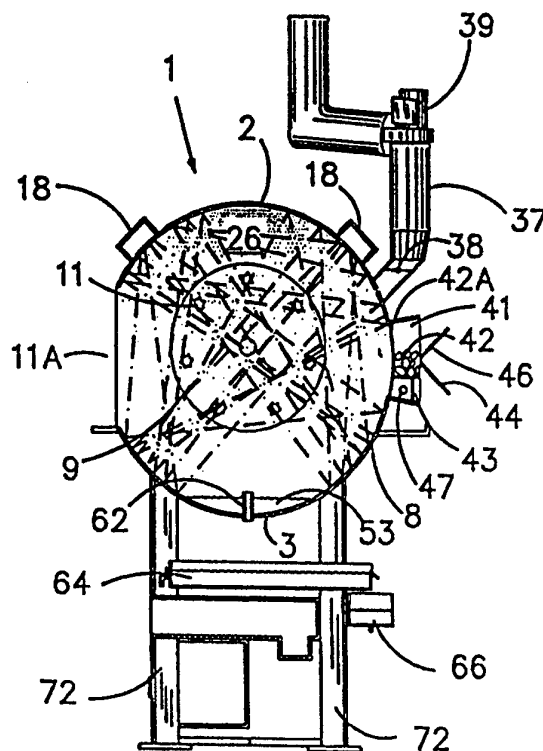


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(21) International Application Number: PCT/US94/14615 (22) International Filing Date: 19 December 1994 (19.12.94) (30) Priority Data: 08/192,279 4 February 1994 (04.02.94) US (71)(72) Applicant and Inventor: MORETH, R., Edward [US/US]; 920 NE 13 Street, Fort Lauderdale, FL 33304 (US). (74) Agent: SANCHELIMA, Jesus; Sanchelima and Associates, P.A., 235 S.W. Le Jeune Road, Miami, FL 33134 (US).		(81) Designated States: BR, CA, JP, RU, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report.</i>

(54) Title: ROASTING OVEN**(57) Abstract**

A roasting oven includes a spit assembly (9) disposed in the interior, at least one infrared radiation element (18) in the upper wall (2), a water cavity (53) in the lower wall (3) for holding water and drippings, a rotating shaft (12) disposed between the end walls (6, 7) for rotatably supporting the spit assembly (9), and drive elements (13, 14) coupled to shaft (12) for turning the shaft during roasting, in which an opening in the front of the cylinder is provided for inserting and removing meats to be roasted, and to provide an uninterrupted fluid communication between the oven interior and the atmosphere. The infrared element (18) faces the oven interior while the curvature of the upper wall (2) of the interior returns heated air which, together with the direct radiated heat from the radiation element (18) and the reflected radiation, creates oven temperatures in excess of 800 degrees Fahrenheit at a zone of compressive heating proximal to the upper wall (2).



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ROASTING OVEN

DESCRIPTION

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to an infrared roasting oven and, more particularly, is to an apparatus and process for cooking food items, particularly meats.

2. Description of the Prior Art

The prior art, as best known to the inventor is represented by U.S. Patent No. 4,321,857 (1982) to Best, entitled Infrared Gas Grill. The teaching of Best relates to a grill assembly primarily in the nature of a smoking system. Best differs from the instant invention in that it employs a process of open cooking, that is a grill-type system. Best, as a open air system, relies solely upon convection of heat for the cooking process, whereas the present invention, as more fully described below, employs a combination of convection and radiant infrared energy for the effective operation thereof. Accordingly, while Best and the instant invention make certain use of infrared heating, the respective invention otherwise have little relationship to each other.

Other prior art known to the inventor include U.S. Patent No. 4,214,516 (1980) to Friedl entitled Barbecue Oven. The oven of Friedl, which is commercially marketed as the HART ROTISSERIE, is analogous to that of a standard oven with the exception that Friedl employs an infrared heat source. The Friedl oven does not employ a heat chamber notwithstanding its use in infrared burners therein, nor does it burn wood or any other solid fuel. Further, the system of Friedl exhausts gas and heat out of the top of the cooking cabinet, this in distinction to the herein described inventive structure which

employs (as is more fully described below) a compressive high temperature heat chamber at the top of a cylindrical oven. Friedl, employing a square cabinet, is not able to make use of heating zones in the sense of this roasting oven. Friedl's oven uses infrared source to create a high temperature within the entire interior of the oven in which the only means of temperature control is that of cycling the burner on and off. Further, the system of Friedl skims heat off of the top of the interior cavity to an extent such that the compressive heating, which occurs in the curved upper region of Applicant's system, cannot occur. Further, as above noted, Friedl employs a closed chamber so that, in all respects other than its use of infrared element, it operates as a standard rotisserie oven.

Other prior art known to the inventor includes U.S. Patent No. 4,757,756 (1988) to Van Marr, entitled Transportable Outdoor Barbecue Grill. The structure of Van Marr is that of an outdoor barbecue which allows all heat generated therein to escape out of a special purpose flue, thereby obviating the possibility of compressive heating in the sense of my system. Van Marr teaches a portable outdoor barbecue grill, known in the trade as a cooker. That is, its operation relies upon the use of trapped heat and gases to maximize the penetration of charcoal into the meat to be cooked.

Further prior art known to the inventor is U.S. Patent No. 5,184,540 (1993) to Riccio, entitled Cooking Apparatus With Rotisserie and Reclamation Trap. The teaching thereof is essentially that of an rotisserie oven in which the spit rotates at a greater rate than the drive member thereof. Also, Riccio employs a reclamation trap disposed beneath the spit to recover juices produced during the cooking of food therein.

SUMMARY OF THE INVENTION

The instant invention constitutes a roasting oven including a housing having respective upper, lower, front and rear walls which, in combination, form a solid right hollow cylinder having a longitudinal axis which, together with right and left end walls, define an oven interior. Said oven further includes a spit assembly rotatably disposed in said cylinder interior, said assembly having an axis of rotation substantially parallel with said longitudinal axis. The inventive oven further includes at least one infrared radiation element in a part of said upper wall facing the interior thereof such that radiation therefrom is reflected from said cylindrical wall toward said oven interior and such that curvature of said upper wall retains hot air which co-acts with heat radiated from said infrared radiation element on said upper wall and with a quantity of said reflected radiation to create temperatures of at least 800_ F in an upper zone of the said upper wall of the oven to thereby effect a nutritious and naturally-tasting cooked product.

The roasting oven further includes a flue type conduit communicating with the oven interior at a point below the rear wall of said cylinder and above the longitudinal axis thereof. Included therein is a flue-type fan for discharging air from a portion of said oven interior while allowing the retention of hot air proximal to said upper wall.

Further included within the inventive oven is a water cavity in said lower wall for holding water and drippings from the cooked material. The rotating shaft is disposed between said end walls to support said spit assembly. Drive means are coupled to said rotating shaft for returning the shaft to move said spit assembly through the superheated upper wall of said oven interior during roasting.

It is, accordingly, an object of the invention to provide a infrared roasting oven which employs reflection of radiant infrared thermal energy to effect a more thorough and natural tasting roasting process.

It is another object to furnish a infrared roasting oven, having zones of intermediate and high temperature, which employs both convective and radiant infrared energy.

It is further object of the invention to provide an infrared roasting oven of the above set forth type in which the exhaust means thereof selectively withdraws air and heat to effect differential thermal zones.

It is a yet further object to provide an infrared roasting oven in which the cooking process is primarily a function of duration of exposure to infrared radiant energy, as opposed to convection heat.

A still further object of the invention to provide a infrared roasting oven in which the degree of humidity and circulation of air therein is regulated for purposes of maximizing taste-enhancing smoke from wood burning therein.

It is a still further object to provide a roasting oven of the above type which combines the advantages of infrared, flicker flame, and wood cooking methods.

The above and yet other objects and advantages of the invention will become apparent with the hereinafter set forth Brief Description of the Drawing, Detailed Description of the Invention, and Claims appended herewith.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an elevational front view of the invention;

Fig. 2 is right cross-sectional view of the invention seen along the Line 2 -- 2 of Fig. 1;

Fig. 3 is an elevational rear side view thereof;

Fig. 4 is an elevational side view of the invention showing the index disc and other details;

Fig. 5 is a diagrammatic cross-sectional fragmentary view showing an infra-red radiation element;

Fig. 6 is an elevational end cross-sectional fragmentary view seen along the Line 6-6 of Fig. 5;

Fig. 7 is a diagram showing a control chart for cooking several batches of meat in different time segments;

Fig. 8 is an end diagrammatic cross-sectional fragmentary detail view along the Line 8-8 of Fig. 1;

Fig. 9 is a diagrammatic fragmentary enlarged detail view showing a star-shaped end of a spit with a step-ahead arrangement;

Fig. 10 is a diagrammatic perspective view showing the rotating spit assembly;

Fig. 11 is a lateral cross-sectional view of the flicker light burner;

Fig. 12 is a cross-sectional view seen along the Line 12-12 of Fig. 11, showing the interior construction of the flicker light burner;

Fig. 13 is a diagrammatic view showing details of the spit with meat grippers; and

Fig. 14 shows an alternate step-ahead arrangement for the spits on the assembly.

Fig. 15 is a view of the control panel for the invention system.

DETAILED DESCRIPTION OF THE INVENTION

In Figs. 1, 2, 3 and 4 are shown the main structure of the invention, in which the main body of the oven is advantageously shaped as an elongate cylindrical oven body 1 having an upper side 2, a bottom side 3, a front side 4, a right hand side 6, a left hand side 7 and a rear side 8.

A spit assembly 9, (See Figs. 2 and 10) fills the major part or the interior of the oven body and serves to support meat pieces to be roasted, such as chickens and pork end roasts. The spit assembly 9 is composed of a set of parallel spits 11 on which the meat is skewered. The spit assembly 9 is supported on a rotating shaft 12 that is journaled on bearings in the end sides 6, 7 of the oven body 1. The rotating shaft 12 has, on either end, a sprocket wheel 13 coupled by a chain 14 to a motor M which rotates that spit assembly at some slow speed, e.g., three revolutions per minute. At the very rightmost end, the shaft 12 supports an index disc 17 external to the oven body that rotates with the shaft 12 and has, marked on its perimeter, a number of sectors, equal to the number of spits in the spit assembly, for example, eight spits as shown in Fig. 10. Each sector is aligned with its corresponding spit such that the sector faces forward when the corresponding spit is opposite an opening 11a in the oven body 1. It is to be understood that said opening 11a within the front side 4 of the oven body 1 provides for the insertion and removal of meats to be roasted. However, more importantly, opening 11a provides for a continuously uninterrupted fluid communication between the oven interior and atmosphere. Thereby a process of substantially cold cooking, but for the cooking action within upper zone 26 (more fully described below) is accomplished. The sectors can be marked with, for example, eight different colors, or with numbers or letters or both, so that the operator of the oven can identify meat on each spit or keep apprised of its roasting time by noting the position of respective sectors of the index disc 17 on a control chart (see Fig. 7).

One or more infrared radiation elements 18 are installed in the upper side 2 of the oven body 1, which serve to direct infrared radiation into the oven interior, in which such radiation is reflected back and forth between the inner walls so as to fill the interior with reflected infrared radiation creating temperature zones as indicated by dashed lines in Fig. 2, said upper zone 26 comprises a substantially higher temperature area than lower zone 15, as is more fully described below.

Figs. 5 and 6 are structural views of typical infrared radiation elements 18, which include a gas jet for injecting combustible gas into a tubular radiator body 21 of rectangular cross-section. A venturi 22 surrounding the gas jet 19 serves to draw atmospheric air to support combustion of the gas into the elements 18. A fireproof wall 23, facing the interior of the oven is formed of perforated high temperature ceramic material having small flame outlet holes 24 which serve to maintain the fireproof wall 23 at, advantageously, 1700_F. That is, the roasting oven according to the invention includes said infrared radiation elements 18, each formed as said tubular body 21, the gas jet 19 injecting gas at one end of the body. Venturi 22 surrounds the gas jet which supplies air to support combustion of the gas. A slot in the tubular body receives perforated ceramic heater modules for emitting a burning gas-air mixture into the oven interior, wherein the perforated ceramic modules emit infrared radiation into the oven interior.

As the meat pieces skewered on the spits 11 rotate with the rotating spit assembly, they are constantly exposed to the infrared radiation from all directions and are cooked to a high degree of tenderness without loss of flavor or moisture. The upper zone 26 of the oven interior (see Fig. 2 and 4) is filled with heated air generally at 850 to 1100_F which sears and roasts the skin of the meat pieces to a uniform golden color tone which much enhances the looks and flavor of the meat, and helps to retain meat juices. Accordingly, at

the upper zone 26, and in the curved region thereof, occurs a compressive heating of trapped superheated air through (1) direct heat rays of the radiation elements and reflected rays from a lens effect of the interior shiny stainless steel at the curved bottom of the oven (2) absorbed energy through the heavy construction of the oven; and (3) produce heat generated by burning gas within the radiant elements. This causes the metal thereof, upon heating, to become itself a radiant, giving-off mild infrared energy

An exhaust flue pipe 37, with an adjustable damper 38, serves to exhaust some air from the roaster interior to the outside via an exhaust fan 39, while drawing in enough fresh dry air to provide circulation and exhaust, without degrading the high temperature of upper zone 26. Fan 39 thereby exhausts humidity from the oven thereby reducing sweating of meat and of spices applied thereto.

It is thereby to be appreciated that in a process of cooking meats the inventor has discovered that the best results in regard to tenderness and taste of the roasted meat are attained with the use of infrared heat radiation as opposed to convection heat, this combined with (1) various means for maintaining the right degree of humidity and air circulation inside the cooking chamber, and (2) a controlled degree of the intensity and duration of the infrared radiation. In addition, it has been found that the infrared cooking process can be combined with the injection of taste-enhancing smoke from burning woods into the infrared radiated cooking chamber. Thereby the combination of controlled infrared radiation, reduced humidity, air circulation, and presence of smoke, lead to a superior cooked product.

As the spit assembly 9 (see Fig. 10) rotates about the shaft 12, each spit rotates with regard thereto. To this end the spit is rotatable within a pair of aligned holes 29, 31, in two opposite end plates 27, 28, centered on the rotatable shaft 12. In Fig. 9, one end of each

spit 11 is shaped like a star 31 with, for example, three arms or spokes 32 that couple with a step-ahead arrangement 34 in the end plate 27 having, for example, four arms 36. As the end plate rotates, the star 31 advances one quarter of a revolution for each turn of the end plate 28, in relation to the end plate 27, and also to the spit assembly 9. In that manner the meat on the spits 11 is constantly rotated in relation to the infrared elements 18, for an even more uniform exposure and browning without overexposure on one side or underexposure on the other side.

An alternative step-ahead arrangement for rotating the spit 11 is shown in Fig. 14, wherein the spit 11 turns in a bearing 73 in the spit assembly end plate 27 (see Fig. 10). The end plate exhibits a set of radially extending star spokes 74, e.g. five star spokes. A bumper post 72 is rigidly attached to the oven end plate (see Fig. 14), within reach of the star spokes. As the spit assembly turns in the direction indicated by Arrow A, the spit is turned one increment (e.g. one fifth) of a turn as the bumper post 72 advances the oncoming star spoke 74, turning the spit in relation to the spit assembly 9, as indicated by Arrow B, one increment. A spring element 76 allows another spoke 74 to advance, and prevents the spit 11 from turning back against the spring element 76.

A wood chamber 41 (see Fig. 2) is mounted on the back side 8 of the oven body and contains pieces 42 of aromatic wood, such as oak, hickory, mesquite or the like. The wood chamber is forward bounded by a grille 42A of, for example, of expanded metal, so that wood smoke can enter the oven chamber 26 to enhance the flavor of the meat as it cooks. An ash chamber 42 below the wood chamber 41 serves to collect burned wood ashes. An ash door 44 provides access to the ash chamber 41 for loading wood in the chamber.

A so-called flicker flame including a gas-fed burner 47 (See Fig. 2) is located below the wood chamber 41 and serves to throw a flickering gas light through the grille 42, which illuminates the back of the oven interior and maintains fire in the wood 42 in the

wood chamber 41. Figs. 11 and 12 show respective elevational sectional side views and end views of the flicker flame burner 47 which has a gas inlet 48 for drawing air into the burner, which has a plurality of holes 51 that issue a row of small gas streams 52. Vermiculite granules 49 are located in the path of the gas stream to disperse the gas.

In Fig. 8 it may be seen that bottom part of the oven chamber 26 forms a water chamber 53 adapted to contain a pool of water, supplied through a water line 54, with a water cock 56. During cooking meat juices and meat fat collect in the water chamber 53, wherein the fat floats as a layer or a pool of meat juices and water, forming a gravy 62 which can be topped off by pushing down a spring-loaded valve 58, as shown in Fig. 8. By pushing down the valve 58, holes 59 in the valve stem 60 align with holes 61 in the stand pipe 62a so that the gravy 62 can be drawn from a gravity drain hole 63 into a juice pan (Fig. 1). After the gravy is removed, the liquid grease 57 can be drawn off into a grease trap 66 (Fig. 2) and discarded.

The spits 11 are advantageously equipped with slidable meat grippers 67, as shown in Fig. 13, having pointed tines 68 that are inserted into the meat 69 and hold it during cooking. Each gripper 67 is secured to the spit 11 by set screws 71.

Fig. 7 shows an exemplary cooking schedule 76 with a horizontal axis 73 for marking cooking start and stop times, and a vertical axis, indicating Sectors 1 to 8 of the index wheel 17, each sector indicating a corresponding spit. The chef operating the oven can easily mark on a schedule 76, in the respective time fields 77, the start and stopping time for cooking each batch of meat on a spit corresponding to a sector 74 on the schedule 76. In this manner it is easy for the chef to keep track of all the meat cooking in the oven at all times.

stopping time for cooking each batch of meat on a spit corresponding to a sector 74 on the schedule 76. In this manner it is easy for the chef to keep track of all the meat cooking in the oven at all times.

The entire oven body 1 may be mounted on legs 72.

Fig. 15 shows the control panel for the inventive system.

While there has been shown and described the preferred embodiments of the present invention it is to be appreciated that the invention may be embodied otherwise than is herein and specifically illustrated and described and that, within the scope of such embodiment, certain changes may be made within the detail and construction of the parts without departing from the underlying idea of principles of this invention and within the scope of the appended Claims.

INDUSTRIAL APPLICABILITY

It is apparent from the previous paragraphs that an improvements of the type for such roasting oven is quite desirable to be used for cooking.

THE CLAIMS

Having thus described my invention what I claim as new, useful and non-obvious and, accordingly, secure by Letters Patent is:

1. A roasting oven comprising:
 - (a) a housing having respective upper, lower, front and rear walls, and left and right end walls, defining in combination, a hollow envelope having a curved upper surface thereof, said housing and envelope having a longitudinal axis, said housing including within said front wall thereof, an opening for inserting and removing meats to be roasted to thereby provide a continuously uninterrupted communication between an oven interior defined by said walls and the atmosphere;
 - (b) at least one infrared radiation element situated with said curved upper surface, said element facing said oven interior to enable infrared transmitted radiation thereinto to be reflected about said oven interior, said curved upper surface of said envelope of said housing retaining heated air to, in cooperation with direct radiated heat from said infrared element and reflected radiation therefrom, create oven temperatures in excess of 800 degrees Fahrenheit within said curved upper surface of said oven housing;
 - (c) a flue-type conduit in fluid communication with said oven interior at a level below said curved upper surface and above said longitudinal axis of said housing;

- (d) a fan, within said flue conduit, for discharging a limited quantity of air from said oven interior while allowing retention of heated air from said oven interior while allowing retention of heated air within said curved upper surface;
- (e) a spit assembly journaled within said end walls of said interior, having an axis of rotation parallel with said longitudinal axis of said housing; and
- (f) drive means coupled to said rotating shaft for turning said spit assembly in an arc or rotation passing through said curved upper surface of said envelope of the oven housing.

- 2. The roasting oven as recited in Claim 1, further comprising:
 - (g) a wood burner, within said rear wall, facing said front opening;
 - (h) an ash box located below said wood burner for catching wood ashes from said burner; and
 - (i) a grill separating said oven interior from said wood burner.

- 3. The roasting oven as recited Claim 2, further comprising:
 - a flicker flame burner disposed in said rear wall facing said oven interior for providing a flickering light illuminating the oven interior and igniting wood in said wood burner.

- 4. The roasting oven as recited in Claim 1, further comprising:
 - a rotating index disk integrally radially depending from said rotating shaft, said disk including a plurality of sectors marked upon said index disk, each sector corresponding to a respective spit of said spit assembly, for externally indicating a position for each spit.

5. The roasting oven as recited in Claim 1, further comprising:
a water inlet fluidly communicating with said water cavity for filling it with water.
6. The roasting oven as recited in Claim 5, further comprising:
an overflow pipe in said water cavity for discharging overflowing water, cooking juice and grease from said water cavity; and a juice pan disposed below said overflow pipe for catching overflowing water, cooking juice and grease.
7. The roasting oven as recited in Claim 6, further comprising:
a spring loaded release valve in said overflow pipe having release holes aligned with respective layers of cooking juice and grease for selectively releasing cooking juice and grease into said juice pan.
8. The roasting oven as recited in Claim 1, further comprising:
in said spit assembly a plurality of spits for mounting meat to be roasted said spits disposed parallel with said rotating shaft in a virtual cylindrical surface having a given radius from said rotating shaft.
9. The roasting oven as recited in Claim 8, further comprising:
spit turning means connected with each of said spits for turning each of said spits relative to said spit assembly during roasting.
10. The roasting oven as recited in Claim 9, further comprising:
two end plates mounted at opposite ends of said rotating shaft, each end plate having mutually aligned peripheral holes for receiving respective spits in said holes, said

spit turning means including for each spit a star-shaped body on each spit, and a respective star-shaped circumference in said mutually aligned peripheral holes in at least one of said two end plates, said star-shaped body having a number of spokes being smaller than the number of spokes in said star-shaped circumference.

11. The roasting oven as recited in Claim 1, further comprising:

internal to said infrared radiation element, an elongate tubular body;

a gas jet for injecting gas at one end of said body;

a venturi surrounding said gas jet for supplying air to support combustion of said gas;

a slot in said tubular body for receiving perforated ceramic heater modules for emitting burning gas-air mixture into said oven interior, said perforated ceramic modules emitting infrared radiation into said oven interior.

12. The roasting oven as recited in Claim 3, further comprising:

an elongate tubular burner body in said flicker flame burner;

a gas jet in one end of said elongate burner body;

and gas openings in said elongate burner body for ejecting streams of gas to mix with air upon being dispersed by refined vermiculite granules in which the burner is embedded.

13. The roasting oven as recited in Claim 1, further comprising:

a damper in said flue type conduit for selectably controlling the amount of air discharged from said oven interior.

14. A roasting oven, comprising:

(a) a housing having walls defining an interior hollow envelope having a curved upper surface, said housing having a longitudinal axis, said housing further

having a non-closable front opening for inserting and removing meats to be roasted, said opening providing a continuously uninterrupted fluid communication between said oven interior and the atmosphere;

- (b) a source of radiant thermal energy in said housing;
- (c) a fluid discharge pipe communicating with said interior hollow envelope at a level below said curved upper surface thereof and above said longitudinal axis of said housing, the location of said pipe permitting air to be retained within said curved upper surface of said envelope of said housing; and
- (d) a rotating shaft disposed between said walls of said housing for rotatably turning a spit assembly in an arc of rotation passing through said curved upper surface of said envelope of said housing.

15. The roasting oven as recited in Claim 14, further comprising:
a damper in said discharge pipe for selectably controlling the amount of air discharged from said oven interior.

16. The roasting oven as recited in Claim 14, further comprising:
a flicker flame burner disposed in said rear wall facing said oven interior for providing a flickering light illuminating the oven interior and igniting wood in a wood burner.

17. The roasting oven as recited in Claim 16, further comprising:
an elongate tubular burner body in said flicker flame burner;
a gas jet in one end of said elongate burner body;

and gas openings in said elongate burner body for ejecting streams of gas to mix with air upon being dispersed by refined vermiculite granules in which the burner is embedded.

18. The roasting oven as recited Claim 14, further comprising:

a rotating disc integrally radially dependent from said rotating shaft; a plurality of sectors marked on said index disc, each sector corresponding to a respective spit in said spit assembly, for visibly indicating position of each spit.

19. The roasting oven as recited in Claim 14, further comprising:

in said reflecting heat source an elongate tubular body;
a gas jet for injecting gas at one end of said body;
a venturi surrounding said gas jet for supplying air to support combustion of said gas;
a slot in said tubular body for receiving perforated ceramic heater modules for emitting burning gas-air mixture into said oven interior, said perforated ceramic modules emitting infrared radiation into said oven interior.

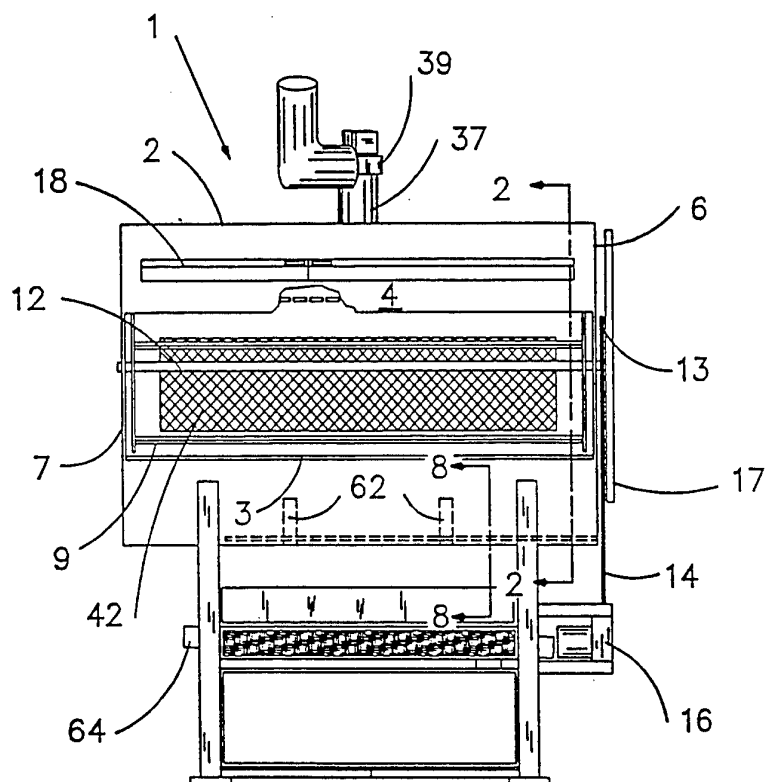


FIG. 1

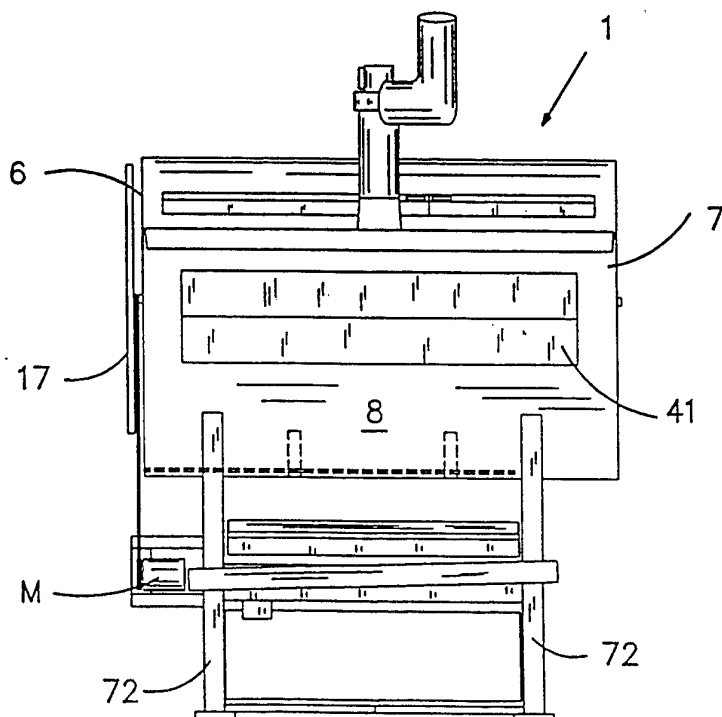


FIG. 3

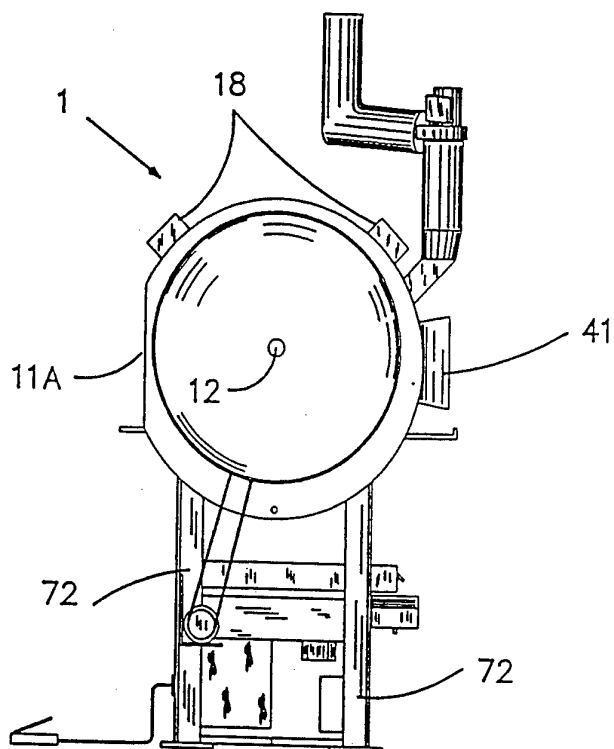


FIG. 4

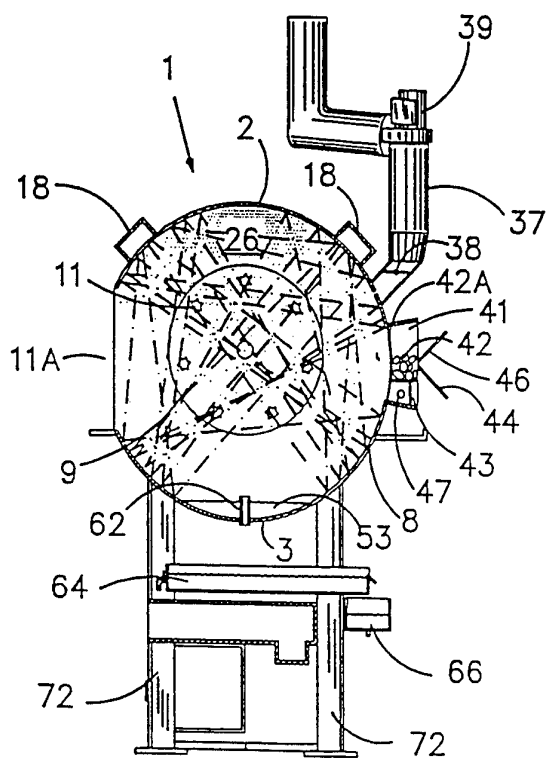


FIG. 2

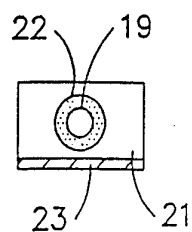
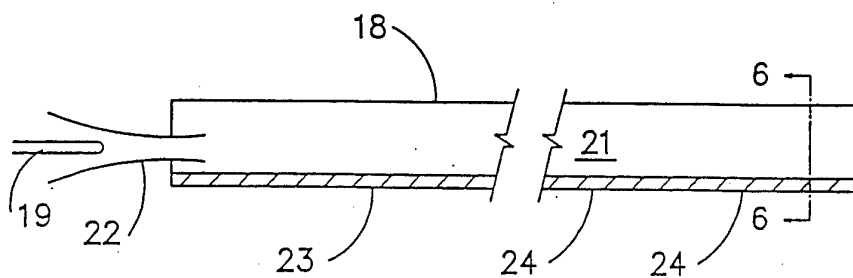


FIG. 5

FIG. 6

76

73

	10	11	12	1	2	3	4	5	6	7	8	9	10
1													
2													
3													
4						<u>77</u>							
5													
6													
7													
8													

74

FIG. 7

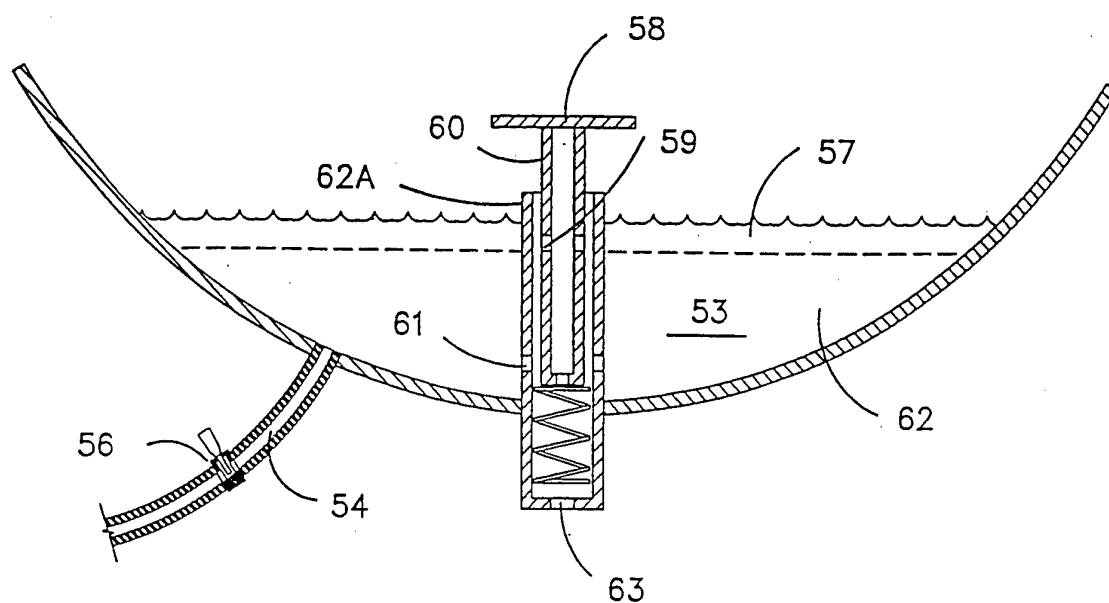


FIG. 8

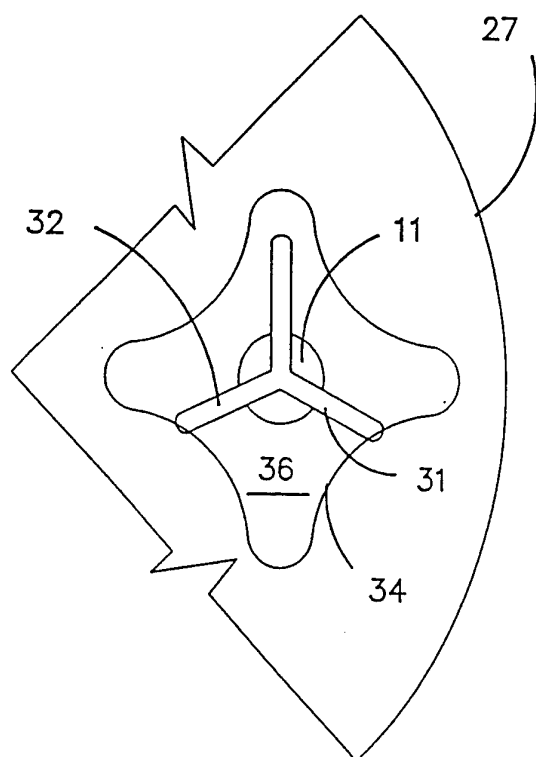


FIG. 9

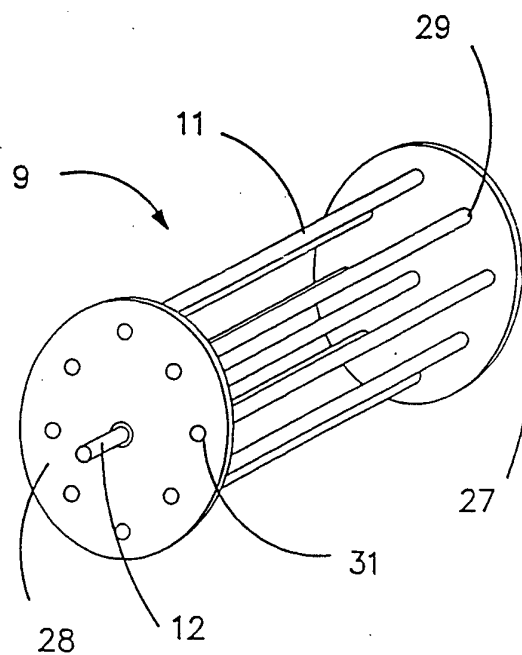


FIG. 10

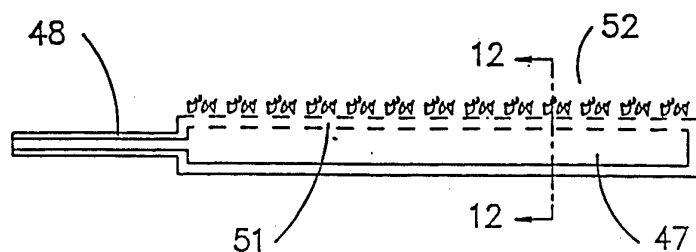


FIG. 11

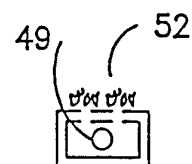


FIG. 12

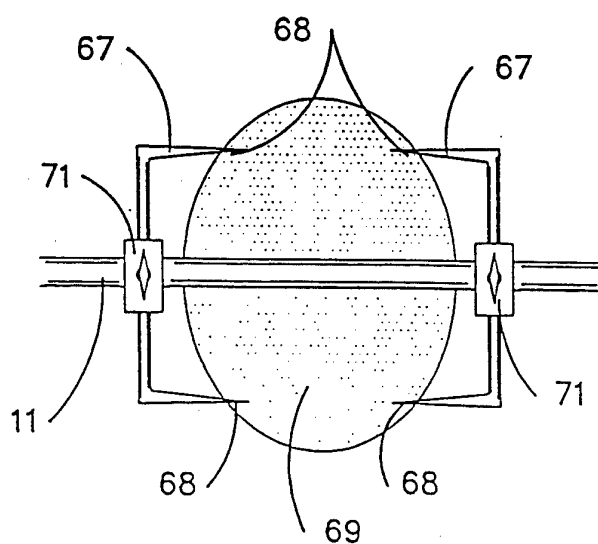


FIG. 13

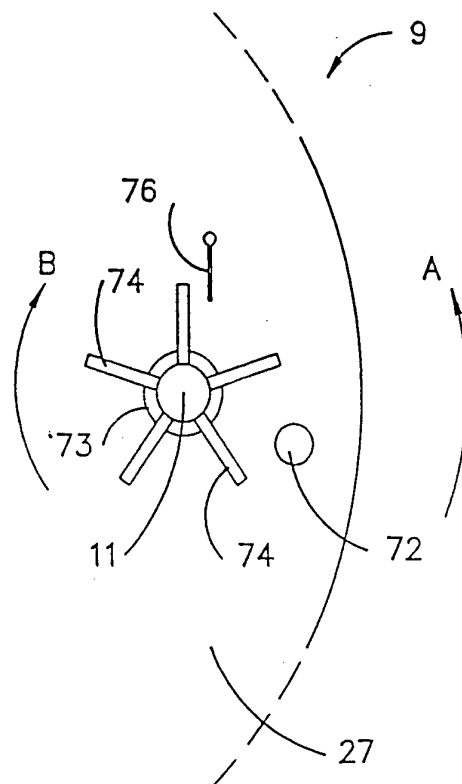


FIG. 14

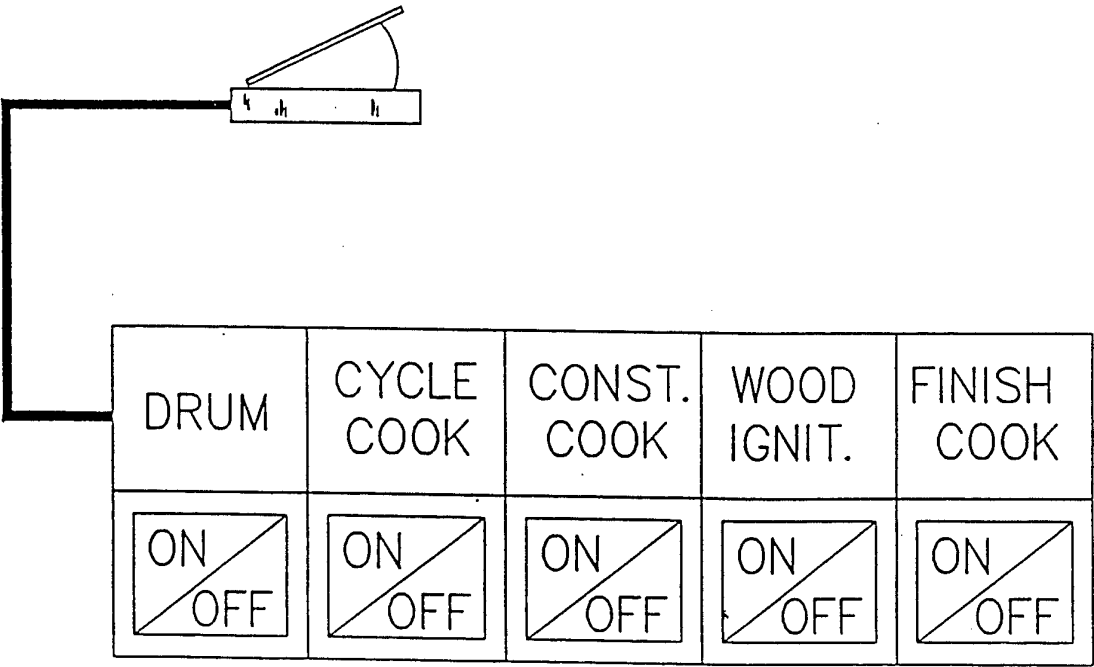


FIG. 15

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/14615

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :A47J 37/04

US CL : 99/421 H

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)

U.S. : 99/421 H, 482, 451, 421 P, 421 HH, 421 R, 446, 444, 327, 335

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
NONE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 1,964,372 (TYGART) 26 June 1934, see entire document.	1-19
A	US, A, 3,811,374 (MANN) 21 May 1974, see entire document.	1-14
A	US, A, 4,214,516 (FRIEDL ET AL) 29 July 1980, see entire document.	1-14
A	US, A, 4,321,857 (BEST) 30 March 1982, see entire document.	1-14
A	US, A, 5,184,540 (RICCIO) 09 February 1993, see entire document.	1-14
A	US, A, 5,213,027 (TSOTSOS ET AL) 25 May 1993, see entire document.	1-14

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Z"	document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means		
"P" document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 05 MARCH 1995	Date of mailing of the international search report 28 MAR 1995
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer <i>Shirley H. Vermy</i> Paralegal Specialist Group 2400 JAMES F. HOOK Telephone No. (703) 308-0771

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/14615

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 5,279,214 (LAMENDOLA) 18 January 1994, see entire document.	1-14