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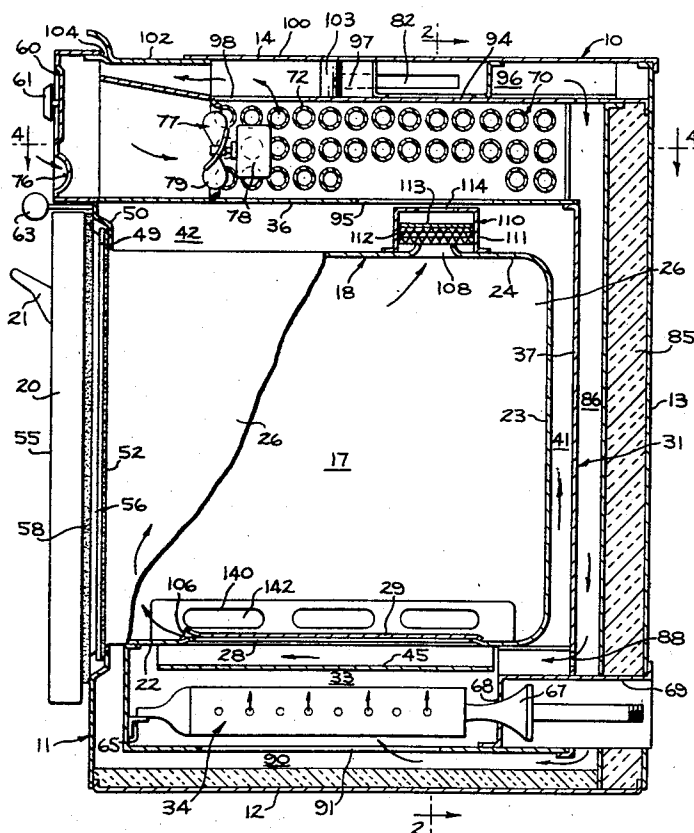
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[54] **SELF-CLEANING GAS OVEN**  
**14 Claims, 5 Drawing Figs.**

[52] U.S. Cl. .... 126/21A  
 [51] Int. Cl. .... F24c 15/32  
 [50] Field of Search. .... 126/19, 21,  
 21 (A), 39, 39 (C), 273

[56] **References Cited**  
**UNITED STATES PATENTS**  
 3,364,912 1/1968 Dills et al. .... 126/21A  
 3,417,742 12/1968 Perl ..... 126/21A  
 3,480,000 11/1969 Torrey et al. .... 126/21AX

**ABSTRACT:** A gas cooking oven where a main stream of the hot flue gases generated in the lower combustion chamber is passed around the outside of the oven liner, while a secondary stream of flue gases passes completely through the oven liner and then rejoins the said main stream before the flue gases are passed through a heat exchanger for extracting some of the heat therefrom. Cool room air is drawn into the oven cabinet and passed through the heat exchanger to extract some of the heat from the hot flue gases. Air passages are formed in heat transfer relation with the outer walls of the oven cabinet, and the heated air passes through the passages and picks up more heat from the walls of the cabinet before passing into the combustion chamber as preheated secondary air for the gas burner means. Some cool air bypasses the heat exchanger and passes directly to the oven cabinet, while other cool air mixes with the flue gases discharging from the heat exchanger to cool the gases further before the gases are returned to the kitchen atmosphere.



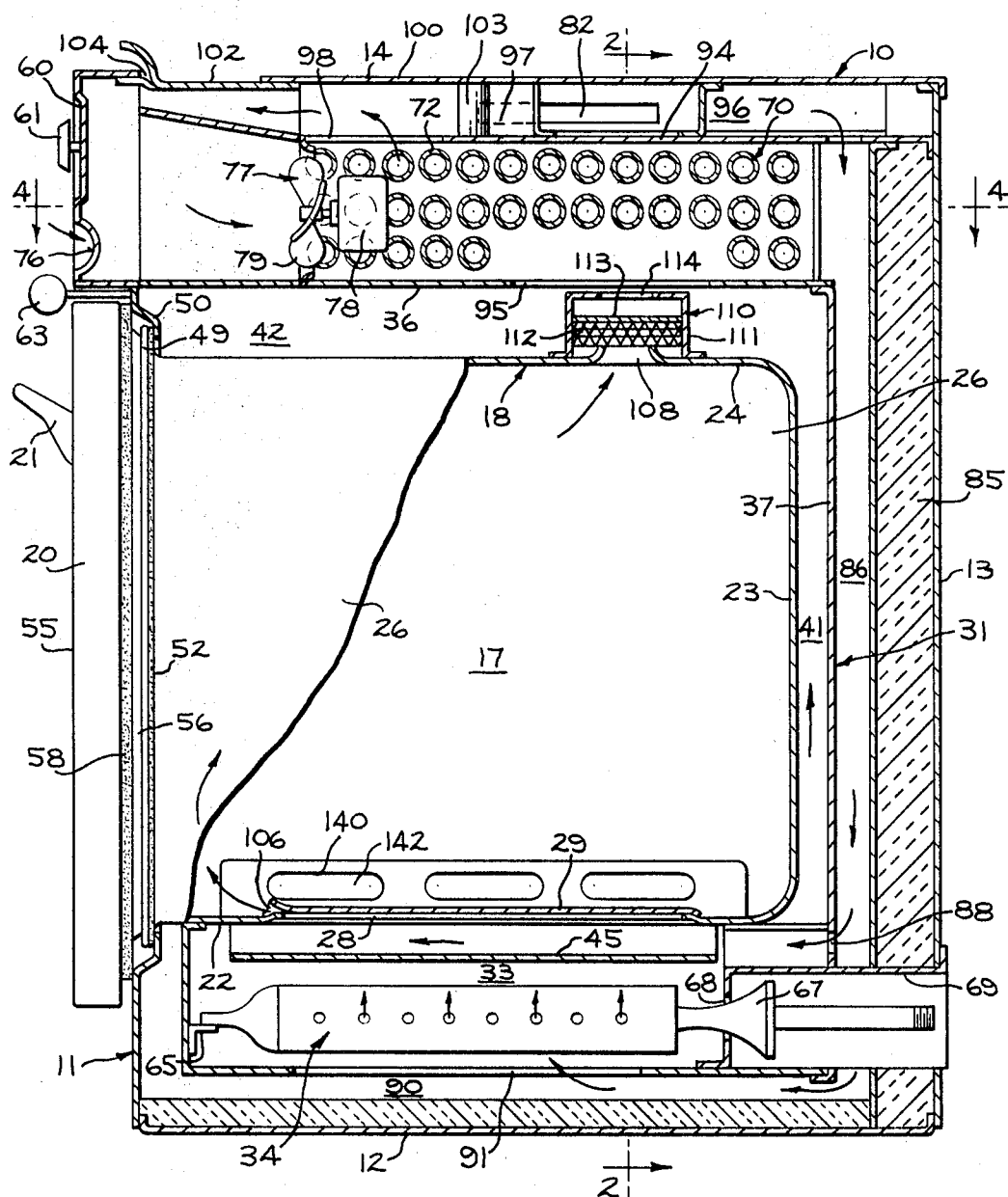


FIG. 1

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FIG. 3

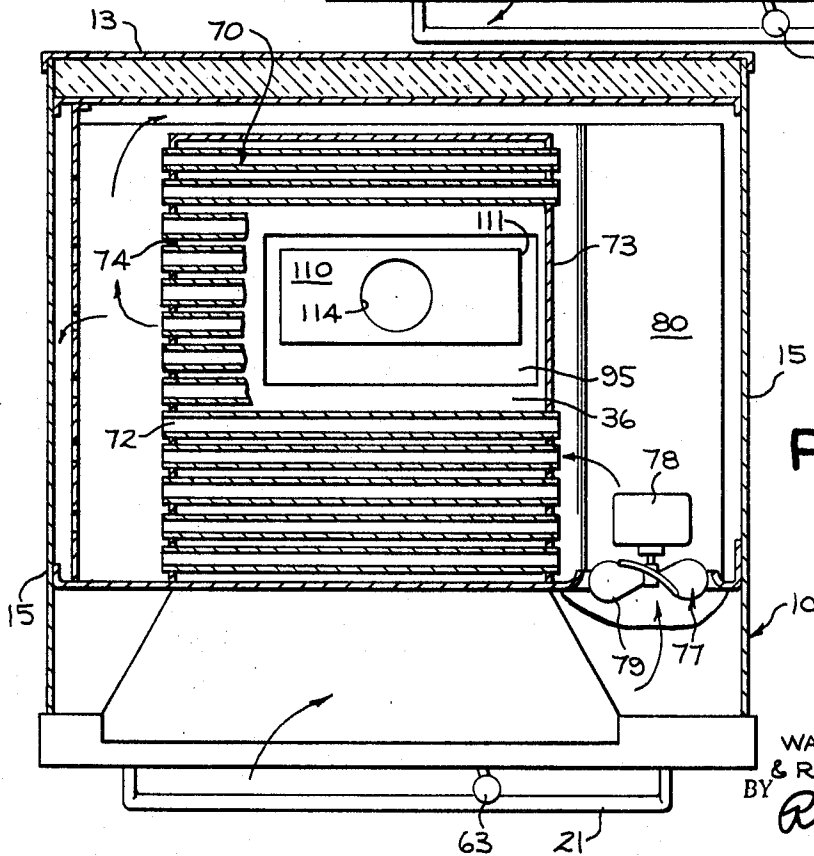
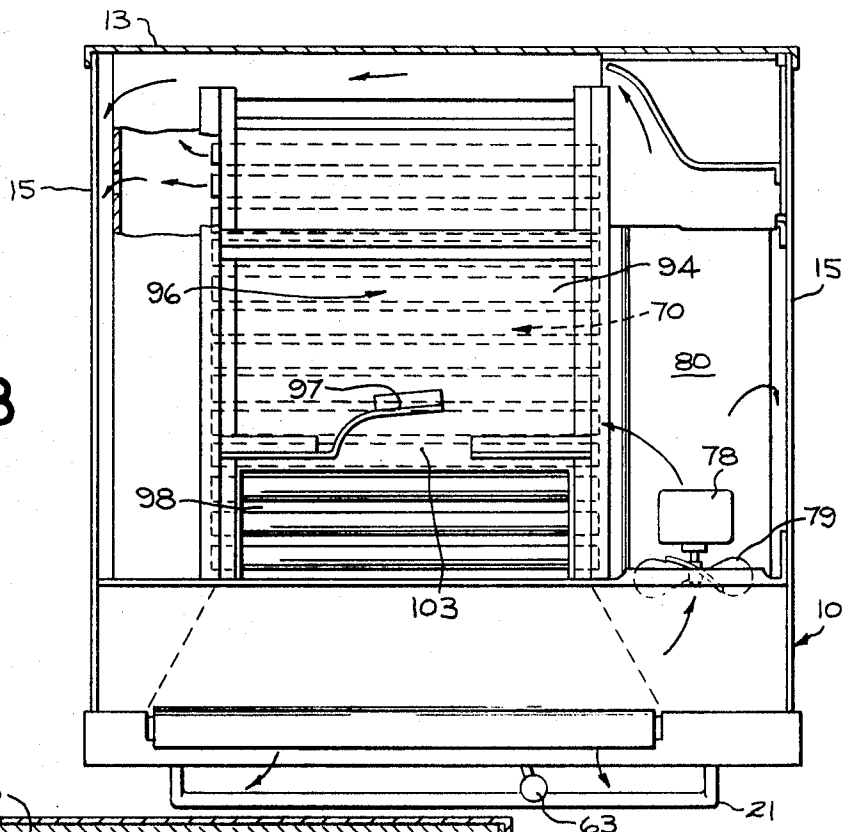


FIG. 4

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## SELF-CLEANING GAS OVEN

**BACKGROUND OF THE INVENTION** teachings of the basic patent of Bodhan Hurko No. 3,121,158 which discloses the controlled use of heat for automatically cleaning the food soils from the inner walls forming an oven cooking cavity. During the cleaning cycle an oven wall temperature somewhere between about 750° F. and about 950° F. is produced for a sufficient period of time for degrading the food soils into gaseous degradation products. The degradation products are then treated by an oxidation unit or smoke eliminator for oxidizing the gases before they are returned to the kitchen atmosphere.

The Huebler et al. Pat. No. 3,416,509 relates to a design of self-cleaning gas oven using a heat exchanger in cooperation with the gas burner means for preheating incoming air to be used for combustion in the self-cleaning oven process, while reducing the temperature of the hot flue gases before they are exhausted directly into the kitchen.

Of further background to the present invention are Pat. No. 3,364,912 of Raymond L. Dills and Bohdan Hurko, assigned to the present assignee, which relates to a muffle oven design for applying heat externally to a self-cleaning gas oven liner, and copending Application Ser. No. 755,555 of Bohdan Hurko and Raymond L. Dills, now Pat. No. 3,507,265 that is also assigned to the present assignee, and disclosing a muffle oven design for a gas self-cleaning oven in combination with a heat exchanger.

The principal object of the present invention is to provide a gas cooking oven with the capability of a high temperature, pyrolytic, self-cleaning oven cycle of operation wherein cooling air is used to extract some of the heat from the hot flue gases as well as from the walls of the oven cabinet and in so doing becomes heated to advantage and in its heated state is used as preheated secondary air for the gas burner means of the oven.

A further object of the present invention is to provide a gas self-cleaning oven of the class described wherein a forced draft of cool room air is used for cooling the outer walls of the oven cabinet, also for reducing the temperature of the hot flue gases by means of a heat exchanger, as well as being mixed with the flue gases exhausting from the heat exchanger to further lower the temperature of the gases before the gases are returned to the kitchen atmosphere.

## SUMMARY OF THE INVENTION

The present invention, in accordance with one form thereof, relates to a self-cleaning gas cooking oven having an oven cabinet supporting both an oven liner and a front-opening access door which in unison define an oven cooking cavity. A firebox surrounds the oven liner and is spaced outwardly therefrom to form external heating channels around the oven liner. A gas burner is located in the bottom of the firebox beneath the oven liner. A main stream of flue gases transfers heat to the oven liner by convection currents and by radiation from the hot flue gases which flow through the heating channels and into contact with the outside of the oven liner in a predetermined path. A heat exchange unit is located above the firebox and there is an air movement means for drawing cool room air into the oven cabinet and passing it through the heat exchanger for extracting some of the heat of the hot flue gases that also pass through the heat exchanger but in an opposite direction. The heated air then passes into heat transfer relation with the outer walls of the oven cabinet for further raising the temperature of the air as well as lowering the exterior temperature of the oven cabinet. Then this heated air is introduced into the combustion chamber as preheated secondary air for the gas burner means.

## BRIEF DESCRIPTION OF THE DRAWINGS

Our invention will be better understood from the following description taken in conjunction with the accompanying drawings and its scope will be pointed out in the appended claims.

FIG. 1 is a right side elevational view of a gas oven for use as a built-in, self-cleaning wall oven with some parts broken away and others in cross section to show the layout of the oven construction for observing the path of the cooling air with relation to the hot flue gases, with a heat exchange unit mounted at the top of the oven.

FIG. 2 is a transverse cross-sectional elevational view taken on the line 2-2 of FIG. 1 looking toward the back of the oven to again show the nature of the cooling air flow and the flow of the hot flue gases.

FIG. 3 is a top plan view of the oven of FIG. 1 with the rear portion of the top wall of the oven cabinet removed to show the fan for drawing cool room air into the oven cabinet and dividing it into three streams; a main stream that passes through the heat exchanger, a secondary stream that passes directly into heat transfer relation with the outer walls of the oven cabinet, and a secondary stream that is diverted from the heat exchanger and mixed with the flue gases being exhausted from the heat exchanger before the gases are returned to the kitchen atmosphere.

FIG. 4 is a cross-sectional top plan view similar to that of FIG. 3 but taken on the line 4-4 of FIG. 1 at a lower elevation, with part of the heat exchanger 70 broken away to uncover the smoke eliminator 110 therebeneath.

FIG. 5 is a diagrammatic flow chart of the oven cabinet cooling and oven heating systems of a gas self-cleaning oven embodying the present invention.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

Turning now to a consideration of the drawings and in particular to FIG. 1, there is shown a built-in, domestic gas oven 10 in right side elevational view comprising a sheet metal outer cabinet or body structure 11 of boxlike configuration having a bottom wall 12, a back wall 13, a top wall 14 and finally opposite sidewalls 15, 15 as are seen in the front view of FIG. 2. There is an oven cooking cavity 17 formed by a boxlike oven liner 18 and a front-opening access door 20. The door has a handle 21 for ease in moving the door. The oven liner has a bottom wall 22, a back wall 23, a top wall 24 and opposite sidewalls 26, 26. The bottom wall 22 of the oven liner is formed with a large rectangular opening 28, that is adapted to be substantially closed by a removable cover plate 29 which overlies the same.

Located within the oven cabinet 11, and surrounding the oven liner 18, is a sheet metal firebox 31 which is spaced outwardly from the oven liner to form narrow heating channels around the oven liner for the passage of convection currents of hot flue gases therethrough in the manner of a muffle oven. This firebox 31 is deepened at the bottom to form a combustion chamber 33 for accommodating one or more gas burner tubes 34. In addition to the walls forming the combustion chamber 33, the firebox 31 has opposite sidewalls 35, 35 and a top wall 36 and backwall 37 as seen in FIG. 1. Thus, the firebox 31 creates two side heating channels 40, 40, a rear heating channel 41 and a top heating channel 42.

The reason for the removable cover plate 29 in the bottom of the oven liner is to provide easy access from within the oven liner to the gas burner tube 34 within the combustion chamber 33. It is also necessary to shield the cover plate 29 from the burner 34 so that the plate does not become over heated due to its close proximity to the burner. We have chosen to use a second removable shield 45 which is seated beneath the opening 28 and is supported at its corners on brackets or ledges 47, as shown in FIG. 2. This heat shield 45 also should be removable, and it may be lifted out through the opening 28 in the bottom wall 22 of the oven liner by first shifting it sideways partially off the ledges 47 and then picking it up through the opening.

The front of the oven liner 18 is open, and it has an outwardly turned flange 49 on its front peripheral edge formed as part of the supporting means for the oven liner. Tension means (not shown) such as adjustable J-bolts or the like are

used at the rear of the oven to pull the oven liner 18 back into the oven cabinet 11 until the flange 49 bears against a surrounding collar 50 that represents the front frame of the oven cabinet 11. Sandwiched between the flange 49 and the front frame 50 is a thermal breaker 52 such as a continuous asbestos or fiber glass gasket which serves to break the path of the heat flow by conduction from the oven liner 18 to the front of the oven cabinet 11, as well as to provide a sealing means between these two elements and prevent flue gases from escaping from the front of the oven.

The oven door 20 is of a design for specific use with a high temperature self-cleaning oven. By that is meant that the door is heavily insulated so as to retain most of the heat within the oven cavity 17 so that the temperature of the outer surface of the door will be within a comfortable temperature range so as not to cause injury to those in the household who might come in contact with the door, as well as to prevent the wasteful loss of heat into the kitchen. The door 20 is shown with an outer door panel 55 of shallow pan shape and an inner door panel 56 which is adapted to be carried thereby but thermally isolated therefrom by means of a high temperature gasket 58 such as woven asbestos or the like that is sandwiched therebetween. This gasket serves to bear against the front frame 50 of the oven cabinet 11 to substantially close the front opening of the oven. For more detailed information on a suitable design of a door for the oven of the present invention, reference may be made to the patent of Clarence Getman No. 3,189,020 which is entitled "Oven Door With Floating Inner panel," and is likewise assigned to the assignee of the present invention.

The various manual control components of the oven are located in a control panel 60 positioned at the top of the oven cabinet directly over the oven door 20. Such components are generally identified as element 61, it being understood that such components would include oven burner control valves, an oven thermostat, an oven timer control and possibly an automatic meat thermometer unit; all as are well known in this art.

There is an oven door latching mechanism 63, shown diagrammatically as only a door latch handle, for locking the oven door 20 in the closed position and preventing the unlocking thereof while the oven temperature is above a predetermined maximum cooking temperature of about 600° F. Such a door latching mechanism does not form part of the present invention, therefore, it is neither shown nor described in detail. One satisfactory design is taught in the patent of Clarence Getman No. 3,189,375 which is likewise assigned to the present assignee.

The gas burner tube 34 is shown of a size and rating somewhere between 18,000 and 30,000 BTU's per hour for use with a standard gas discharge nozzle and gas pressure. There may be one burner or two burners as a matter of choice. A single burner would be conventional for a standard gas cooking oven. However, more heating energy is necessary in a gas self-cleaning oven than in a standard gas cooking oven. The burner 34 is supported at its front end on an angle bracket 65. The opposite end of the burner tube 34 has a venturi tube throat 67 which extends out through an opening 68 toward the back of the combustion chamber 33 and then through a duct 69 which is open to the kitchen atmosphere at the rear of the oven, as is best seen in FIG. 1, where a gas connection would be made. Primary air for the burner is obtained from the kitchen atmosphere through this duct 69 as relatively cool air at room ambient temperatures.

The necessary pilot and gas control valves are not shown nor are the temperature sensing and control systems since they may be of conventional design and do not form part of the present invention. A broil burner is not illustrated in the drawings, but it could be added in the top of the oven cavity 17 for use during normal broiling operations, however this is merely a matter of preference.

The lower gas burner in a standard gas baking oven normally has a rating of about 20,000 BTU's per hour which is equivalent in electrical terms to 5,850 watts of electrical

power. In order to reach the proper heat-cleaning temperature, which is preferably somewhere between about 750° F. and about 950° F. it would be necessary to increase the size of the burner to about 28,000 BTU's per hour or to an electrical equivalent of about 8,200 watts. During a standard baking operation the burner operates only for a short time at full rating, as for example 10 to 15 minutes during entire baking operation which may extend as much as several hours. However, during the heat-cleaning cycle the preheat period would be approximately 50 to 60 minutes with the burner operating at full rating, and the oven is then maintained at clean temperatures for up to 3 hours or longer depending upon the amount of food soil lodged on the walls of the oven liner and inner door. The rate of "heat to maintain" the standard baking oven at the maximum heat-cleaning temperature for a period of from 1 to 3 hours would be about 75 percent of the preheat rate or about 21,000 BTU's per hour, which when compared with electric heating is about 6,150 watts.

According to the above analysis, if we compare heat output between a standard gas oven and an electric oven during the heat cleaning cycle, the gas oven will produce approximately four times as much heat in the kitchen as an electric oven will, on the assumption that the heat absorbed in the oven system during cleaning is the same for both gas and electric ovens; namely, about 5,800 BTU's per hour. The reason for this is due to the method of heat transfer in a gas oven. Since most oven bake gas burners are located in a firebox outside of the oven cavity, the heat transfer to the oven takes place mostly by convection air currents heated by the burner. Heat transfer by convection currents of hot flue gases results in a low efficiency of 10 to 15 percent of heat transfer to the oven liner. In a standard gas oven large amounts of flue gases and hot air pass through the oven. The heating value of one pound of natural gas is about 20,000 to 23,000 BTU's per hour, depending upon the particular gas used. For ideal combustion it is necessary to have at least 15.3 pounds of air for each pound of gas. However, an excess amount of air is needed in heating up the oven; up to 300 percent of excess air, which means for each pound of gas up to about 61.2 pounds of air (15.3 times 4) may be needed to provide complete combustion, while holding the amount of carbon monoxide to a minimum.

If the flue gases are at the necessary temperature of about 900° F. above the room ambient temperature ( $\Delta t$ ) when the gases break contact with the walls of the oven liner during the cleaning cycle, and the heating rate is 1 pound of gas burned per hour, then the heat of exhaust may be calculated as follows:

$$\begin{aligned} Q &= C_p \Delta t (m_a + m_g) \\ &= 0.26 \times 900 \times (61.2 + 1) = 14,650 \text{ BTU's} \\ &\text{per hour (approximately)} \\ m_g &= \text{pounds of gas} \\ m_a &= \text{pounds of air} \\ C_p &= \text{specific heat of flue gas} \\ \Delta t &= \text{temperature differential} \end{aligned}$$

The exhaust heat of 14,650 BTU's per hour is equivalent to heating a kitchen with an electric heater of 4,300 watts. In addition to this amount of heat there will be the usual heat losses from the oven cabinet which will be of the same order of magnitude as the heat losses in an electric oven and will depend upon the maximum surface temperature of the oven cabinet.

In an electric oven, the amount of circulated air through the oven is very low, on the order of less than 3 cubic feet per minute, as compared with a gas oven with about 38.6 cubic feet per minute. Hence, the heat exhausted by an electric oven would be less than 8 percent of the heat exhausted by a gas oven during the heat-cleaning cycle. It has been calculated that the efficiency of the heating system of the early gas self-cleaning ovens would be very low, on the order of less than 30 percent.

Our present invention, which introduces an improved air system, including a heat exchanger, to a gas self-cleaning oven, has the effect of substantially increasing the efficiency of the heating system of the oven. Theoretically, the efficiency

of the gas heating system could be increased from about 28.3 percent up to about 85 percent when using the oven with heat exchanger and air flow system of the present invention. This has the advantage of a saving in fuel, but the saving in the cost of fuel will not be the only factor. With the heating system using much less fuel, the amount of heat in the exhaust will be proportionally smaller as is shown in the Table below.

| Efficiency, percent | Heat absorbed in system during cleaning, B.t.u./hr. | Total heat input, B.t.u./hr. | Burned fuel, Lb./hr. | Burned air, lb./hr. | Exhaust, lb./hr. | Heat in exhaust B.t.u./hr |
|---------------------|-----------------------------------------------------|------------------------------|----------------------|---------------------|------------------|---------------------------|
| 28.3.....           | 5,800                                               | 20,450                       | 1.0                  | 61.2                | 62.2             | 14,300                    |
| 85.0.....           | 5,800                                               | 6,850                        | 0.315                | 19.4                | 19.7             | 1,050                     |

It will be understood that a gas oven using our invention will probably not reach the maximum efficiency of 85 percent shown in this theoretical example above, but the efficiency will be substantially increased over the approximately 30 percent efficiency of the standard oven.

Our improved heat exchanger and air flow system whereby the burner efficiency is increased and the heat losses reduced will now be explained. As seen in the drawings, the system incorporates a heat exchanger 70 which is shown assembled above the firebox 31 directly behind the control panel 60. Such a heat exchanger is for recovering much of the heat from the hot flue gases before the gases are exhausted to the kitchen atmosphere, and at the same time preheating a stream of cool room air when it passes through the heat exchanger and before it is supplied to the combustion chamber 33 as preheated secondary air for the gas burner 34. The heat exchanger 70 comprises a series or bank of tubes 72 which are mounted at each end through apertured plates 73 and 74 respectively. Relatively cool room air is designed to pass through the hollow tubes 72 of the heat exchanger 70. There is an air inlet opening 76 into the oven cabinet 11 in the form of an apertured panel or grill work arranged along the bottom edge of the control panel 60. Between the heat exchanger 70 and the air inlet opening 76 is positioned a fan 77 comprising a small electric motor 78 and fan blades 79. When this fan 77 is energized it is designed to draw cool room air into the oven cabinet through the air inlet opening 76. Downstream of the fan 77 is a plenum chamber 80. The main stream of cool air from the plenum chamber is arranged to pass through the hollow tubes 72 of the heat exchanger 70, while a secondary stream is designed to pass in heat transfer relation with the outer walls forming the oven cabinet 11, as is best seen in FIG. 2.

Notice in FIG. 2 that a layer of thermal insulation 81 is arranged against the outside of the two sidewalls 35,35 of the firebox 31. Thus at each side of the oven between the insulation 81 and the sidewall 15 of the oven cabinet there is formed a vertical air channel 83. Looking at FIG. 1, there is shown a layer of insulation 85 arranged against the backwall 13 of the oven cabinet and spaced from the backwall 37 of the firebox 31 to form a vertical air channel 86. Notice the lower end of the rear air channel 86 is provided with a vent opening 88 which joins with the combustion chamber 33. Moreover, the lower ends of the two side air channels 83,83 empty into a bottom air channel 90 which underlies the combustion chamber 33 and is joined therewith through an elongated opening 91 in the bottom wall of the firebox located directly beneath the gas burner tube 34. A layer of thermal insulation 93 is placed over the bottom wall 12 of the oven cabinet.

As to the top portion of the oven cabinet 11, notice in FIG. 2 there is a cover plate 94 which overlies the heat exchanger 70. This cover plate serves to form a top horizontal air channel 96 which is open at the right side by means of slots 8 to the plenum chamber 80 formed behind the fan 77. The channel is open at its other end to the left side air channel 83 by means of slots 82, as well as to the rear channel 86, as is seen at the top rear corner of FIG. 1. Hence to summarize, some of the cool air drawn into the oven cabinet by the fan 77 bypasses the heat exchanger 70 and moves in heat transfer relation with the outer walls of the oven cabinet 11 through the air channels 83, 96, 83, 86, 90 and finally enters into the combustion chamber 33 after removing some of the heat in the walls of the oven

cabinet and becoming heated thereby. It thus becomes preheated secondary air for the gas burner 34.

A second secondary stream of cool air bypasses the heat exchanger 70 by passing directly into the top horizontal air channel 96 and being deflected forward through an opening 103 by means of a diverter plate 97. This cool air diverted through the opening 103 mixes with the hot flue gases coming

up through the exhaust opening 98 from the heat exchanger 70. Thus the hot flue gases are mixed with and cooled by the secondary stream of cool air before they are returned to the kitchen atmosphere through an air outlet opening 104.

The gas burner 34 generates hot flue gases having a main stream that passes through the firebox 31 around the outside of the oven liner 18 by way of the two side heating channels 40,40 and the rear heating channel 41 into the top heating channel 42. There is an opening 95 in the top wall 36 of the firebox 31 so that the hot flue gases pass through the opening 95 and then disperse through the heat exchanger 70 by passing between the bank of tubes 72 between the two end plates 73 and 74. The top of the heat exchanger 70 is closed with a cover plate 94 except for an opening 98 in the front thereof. The diverter 97 is formed above this opening 98 for catching some of the cool air from the fan 77 passing through the top horizontal air channel 96 and mixing it with the flue gases in this area. There is a duct 102 which connects with an air outlet opening 104 so that the flue gases may be returned to the kitchen atmosphere at a reduced temperature.

Most of the hot flue gases from the combustion chamber 33 pass around the outside of the oven liner 18, but a secondary stream of flue gases is allowed to flow through the cooking cavity 17. The removable cover plate 29 in the bottom of the oven liner 18 is provided with a series of elongated slots 106 along the front edge of the plate. This passage of flue gases into the oven cavity provides a supplement to the heat lost through and around the oven door 20 so as to insure that the temperature of the inner surface of the door has substantially the same operating temperature as the walls of the oven liner so as to obtain a generally uniform wall cleaning capability. The principle problem area in many self-cleaning ovens has been a failure to clean properly the lower edge of both the door and the adjacent portion of the oven liner. This problem does not exist in the design of the present invention where additional heat is biased towards the front of the oven.

An oven vent opening 108 is formed in the top wall 24 of the oven liner 18 so that the flue gases and the gaseous degradation products created from the food soil being removed from the oven liner may be exhausted therefrom. Positioned over the vent opening 108 is a catalytic oxidation unit 110 which may comprise a hollow housing 111, as is best seen in FIG. 2, with a central opening 115 in its bottom wall, a corrugated ceramic block 112 on either side of the opening and a cover plate 113 seated on top of the blocks. There is an outlet opening 114 in the top of the housing 111 above the cover plate 113 such that the gas flow through the smoke eliminator 110 is up through the bottom and then horizontally in opposite directions through the pair of corrugated ceramic blocks 112,112 which have a high ratio of surface area to volume and are coated with a thin layer of a catalytic material to serve as a self-sustaining gas burner when it is heated to a high temperature by the flue gases passing therethrough. A satisfactory design of such smoke eliminator is taught in the copending application of Wayne L. Henderson, one of the present applicants, in Ser. No. 707,056, which is likewise assigned to the present assignee. This smoke eliminator 110 is positioned beneath an opening 95 of the top wall 36 of the firebox 31 as can be seen in FIGS. 2 and 4. Thus the main stream of flue gases rising up the heating channels 40, 40 and 41 surrounding the oven liner mixes with the exhaust from the smoke eliminator 110 before passing through the heat

exchanger 70.

For a more comprehensive understanding of both the oven cabinet cooling and the oven heating system of this oven construction, attention is directed to the diagrammatic flow chart of FIG. 5 where reference numerals are applied to some of the elements of the chart to designate elements of the oven which cooperate in affecting the proper flow patterns. For example, the elements are an air intake opening 76, the fan 77, the heat exchanger 70, the oven cabinet 11, the combustion chamber 33 and the oven liner 18 with its smoke eliminator 110 and finally the outlet opening 104. There are times when either the air or flue gas flows are divided into a major flow and a minor flow hereinafter referred to as a main stream and a secondary stream. A main stream is depicted by a wide line, while a secondary stream is shown as a thin or single thickness line. For example, the cool room air drawn through the intake 76 by the fan 77 is divided into three streams; a main stream 120 and two secondary streams 122 and 124. The main stream 120 passes through the tubes 72 of the heat exchanger 70. The first secondary stream 122 bypasses the heat exchanger 70 and moves in heat transfer relation with the outer walls of the oven cabinet 11 through the two side cooling channels 83, 83 the top cooling channel 96, the rear channel 86 and then the bottom channel 90. Simultaneously, the main stream of now heated air 128 exhausts from the heat exchanger 70 and also passes into heat transfer relation with most of the walls of the oven cabinet such as the left side cooling channel 83, the rear channel 86, and the bottom channel 90. Then the heated air passes as a main stream 126 into the combustion chamber 33 through the slot 91 in the bottom wall of the combustion chamber and through the opening 88 in the lower portion of the rear channel 86. Hot flue gases are generated in the combustion chamber and pass as a dual main stream 130, 130 around the oven liner through the heating channels 40, 40 and 41, while a secondary stream 132 passes into the oven cavity through the slot 106 adjacent the front of the oven, and out through the smoke eliminator 110 for mixing with the main streams 130, 130 before passing through the heat exchanger 70 around the bank of tubes 72 and out of the heat exchanger as main stream 134. Notice that the second secondary stream 124 of cool room air also bypasses the heat exchanger 70 for mixing with the main stream 134 of hot flue gases coming from the heat exchanger 70 and finally passing out of the outlet opening 104.

As a modification of the present invention, instead of a muffle oven design for both cleaning and cooking, it is possible to convert the oven to a flow-through oven for the cooking operations by providing slots 140 and an enlarged damper 142 along the lower edge of each side 26, 26 of the oven liner 18. Each damper 142 is pivotally mounted along its upper edge and it may be shifted by a linkage mechanism (not shown) from a closed, heat-cleaning position of FIG. 2 to an open, cooking position where the dampers would close or seal the bottom of the heating channels 40, 40 so that the hot flue gases would be precluded from passing around the oven liner 18 but would be forced through the cooking cavity 17 and out the oven vent opening 108. A similar damper (not shown) would be located at the bottom of heating channel 41 for closing this channel during a baking or broiling operation within the oven. No slots through the oven liner cooperating with the rear damper would be necessary in a flow-through gas cooking oven.

Having described above our invention of a gas self-cleaning oven with an improved air flow system and heat exchanger and a method of operating same, it should be readily apparent to those skilled in this art that we have been able to increase the efficiency of combustion of the heating system and hence reduce the consumption of fuel, for the same amount of heating value in the oven liner. In particular, we have been able to recover a large amount of the heat energy from the flue gases that would otherwise be lost through the oven exhaust. Accordingly, the temperature of the flue gases will be reduced to a comfortable level. In addition, the room air drawn into the oven cabinet is directed into contact with the outer walls of the cabinet for deriving heat from the cabinet and restricting

the maximum exterior temperatures of the cabinet. This too improves the efficiency of the system.

It should be apparent to those skilled in this art that we have described what, at present, is considered to be the preferred embodiments of this invention in accordance with the Patent Statutes. Changes may be made in the disclosed oven without departing from the true spirit and scope of this invention.

We claim:

1. The method of cleaning food soils from the interior surfaces of both an inner oven liner and an access door defining an oven cooking cavity within an oven cabinet where the food soils are accumulated thereupon during the previous carrying out in said oven cavity of food cooking operations in the normal food cooking temperature range extending from about 150° F. to about 550° F., wherein said oven liner is surrounded by an outer oven liner defining a firebox spaced from the oven liner, and a heat exchanger located at the top of the oven cabinet; said method comprising drawing room air into the oven cabinet, passing the main stream of room air through the heat exchanger for taking heat from the exchanger, directing the heated room air into contact with the outer walls of the oven cabinet for deriving heat from the cabinet and restricting the exterior temperature of the cabinet, and then supplying this heated room air to a gas burner in a combustion chamber beneath the oven liner as preheated secondary air to form hot flue gases, a main stream of the flue gases from the burner being directed up around the outside of the inner oven liner between the inner oven liner and the firebox, while a secondary stream of the flue gases is allowed into the oven cavity for passage therethrough, discharging the secondary stream of flue gases from the oven liner and combining both streams of flue gases before they are directed through the heat exchanger to transfer some of its heat to the said cool room air, so as to reduce the temperature of the flue gases before they are returned to the kitchen atmosphere.

2. The method of cleaning food soils from the interior surfaces of an oven liner defining an oven cooking cavity within an oven cabinet where the food soils are accumulated on such surfaces during the previous carrying out in said oven cavity of food cooking operations in the normal food cooking range extending from about 150° F. to about 550° F., wherein said oven liner is surrounded by a firebox having a combustion chamber beneath the oven liner, and a heat exchanger positioned over the firebox; said method comprising drawing cool air into the oven cabinet, passing a main stream of cool air through the heat exchanger for deriving heat therefrom, directing the heated air exhausting from the heat exchanger over the inner surface of the oven cabinet both for raising the temperature of the heated air and lowering the temperature of the outer surface of the oven cabinet, and then supplying this heated air to a gas burner in the combustion chamber as preheated secondary air to create hot flue gases, simultaneously directing the flue gases from the burner around the outside of the oven liner and through the firebox and thence through the heat exchanger to transfer some of the heat of the flue gases to the said cool air passing through the heat exchanger, and mixing the flue gases with a stream of cool air to further reduce the temperature of the flue gases before exhausting the gases to the kitchen atmosphere.

3. The method as recited in claim 2 wherein a small portion of the flue gases from the burner is passed into and throughout the oven liner and then discharged from the oven liner and mixed with the flue gases being directed around the outside of the oven liner.

4. In a gas heated built-in wall oven, the method of cleaning food soils from the interior surfaces of both an oven liner and a front-opening access door defining an oven cooking cavity where the food soils are accumulated thereupon during the previous carrying out in said oven cavity of food cooking operations, wherein said oven liner is surrounded by an insulated firebox having a combustion chamber located beneath the oven liner and a heat exchanger located above the firebox, there being an exterior oven cabinet surrounding the assembly; said method comprising the step of operating a forced draft system for drawing cool room air into the oven cabinet in

the form of a main stream and at least one secondary stream, the step of passing the main stream of cool air through the heat exchanger to be heated thereby, then passing the heated air into contact with the outer walls of the oven cabinet for both reducing the exterior temperature of the cabinet and raising the temperature of the heated air, and then supplying this heated air to a gas burner in the combustion chamber as preheated secondary air to generate hot flue gases that are divided into a main stream and a secondary stream, the main stream of flue gases being confined by the firebox and directed over the outside of the oven liner, while the secondary stream of flue gases pass throughout the oven cavity for heating the walls forming the oven cavity into the heat cleaning temperature above about 750° F., and discharging the flue gases from the oven cavity and from the firebox, passing the flue gases into the heat exchanger for transferring heat to the said cool air entering the heat exchanger, and then exhausting the flue gases from the heat exchanger and mixing the flue gases with the said secondary stream of cool air before the flue gases are returned to the kitchen atmosphere at a reduced temperature.

5. A gas cooking apparatus comprising an outer oven cabinet with a substantially boxlike oven liner and a front-opening access door having walls defining an oven cooking cavity, an insulated firebox spaced around the oven liner, gas burner means positioned in a combustion chamber in the bottom of the firebox beneath the oven liner, the gas burner means serving to generate flue gases which circulate through the firebox for heating the walls forming the oven cavity, a heat exchanger unit means for drawing cool room air into the oven cabinet and passing it through the heat exchanger for raising the temperature of the cool air, means for passing the heated air leaving the heat exchanger into contact with the oven cabinet for further raising the temperature of the air as well as lowering the exterior temperature of the oven cabinet, means for introducing the heated air to the combustion chamber as preheated secondary air for the gas burner means, means for passing the flue gases from the gas burner means through the heat exchanger to withdraw some of the heat of the flue gases and transfer it to the incoming cool air, and then means for exhausting the flue gases to the kitchen atmosphere.

6. A gas cooking apparatus as recited in claim 5 with a diverter arranged to siphon off some of the cool air before it reaches the heat exchanger and to mix it with the hot flue gases exhausting from the heat exchanger to reduce the temperature of the gases before they reach the kitchen atmosphere.

7. A self-cleaning gas oven comprising walls forming an outer oven cabinet, a boxlike oven liner positioned in the cabinet, a front-opening access door for closing the oven liner and forming an oven cooking cavity, a firebox surrounding the oven liner and spaced outwardly therefrom to form a combustion chamber beneath the oven liner with gas burner means located therein, vertical heating channels and a top heating channel communicating with the combustion chamber, a layer of insulation on the bottom of the oven cabinet, a layer of insulation covering each of the two opposite sidewalls of the firebox, a layer of insulation on the backwall of the oven cabinet, cooling air channels formed across the insulated bottom wall, inside each of the opposite sidewalls of the oven cabinet, inside the top wall of the oven cabinet and outside the backwall of the firebox, a heat exchanger arranged above the top of the firebox, an air inlet opening adjacent the top of the oven cabinet, a blower adjacent the air inlet for passing cool room air through both the heat exchanger and through the air channels so that the air becomes heated thereby, the heated air being exhausted into the combustion chamber as preheated secondary air, the said gas burner means generating hot flue gases which pass around the oven liner through the heating channels formed between the oven liner and the firebox, the flue gases passing from the firebox and through the heat exchanger, and an outlet opening for

discharging the gases to the kitchen atmosphere.

8. A self-cleaning gas oven as recited in claim 7 with a diverter downstream of the blower for bleeding off some of the cool room air and mixing it with the flue gases exhausting from the heat exchanger for lowering the temperature of the flue gases before they return to the kitchen atmosphere.

9. A self-cleaning gas oven as recited in claim 8 wherein an opening is formed in the bottom of the oven liner whereby some of the hot flue gases pass into the oven cooking cavity, an oven vent adjacent the top of the oven liner for exhausting the flue gases therefrom and into the heat exchanger.

10. A self-cleaning gas oven having walls forming an outer oven cabinet, an oven cooking cavity formed by a boxlike oven liner and a front-opening access door, a firebox surrounding the oven liner and spaced outwardly therefrom, the lower portion of the firebox being enlarged to form a combustion chamber enclosing a gas burner means therein, means for supplying gas and ambient primary air to the gas burner means, hot flue gases formed by the gas burner means, a main stream of flue gases passing around the oven liner, a secondary stream of flue gases passing into the oven liner at the bottom thereof and out the oven liner at the top to mix with the main stream of flue gases, a heat exchanger for receiving the flue gases therethrough and taking heat therefrom so as to reduce the temperature of the flue gases, an air outlet opening in the oven cabinet for discharging the flue gases to the atmosphere, a room air inlet opening in the oven cabinet, blower means within the cabinet for drawing room air into the cabinet and through the heat exchanger for receiving some of the heat from the hot flue gases, air passages in heat transfer relation with the oven cabinet, the heated room air from the heat exchanger passing through the said air passages thereby reducing the outer surface temperature of the oven cabinet and then discharging the heated air into the combustion chamber as preheated secondary air.

11. A self-cleaning gas oven as recited in claim 10 wherein a secondary stream of cool room air bypasses the heat exchanger and passes directly to the air passages throughout the oven cabinet.

12. A self-cleaning gas oven as recited in claim 10 wherein a secondary stream of cool room air bypasses the heat exchanger and mixes with the hot flue gases exiting from the heat exchanger and further reduces the temperature of the flue gases before they pass through the said air outlet opening in the oven cabinet.

13. A self-cleaning gas oven as recited in claim 10 wherein a secondary stream of cool room air bypasses the heat exchanger and passes directly to the air passages throughout the oven cabinet, while a second secondary stream of cool room air also bypasses the heat exchanger and mixes with the hot flue gases passing from the heat exchanger and further reduces the temperature of the flue gases before they pass through the said air outlet opening in the oven cabinet.

14. A gas cooking apparatus comprising an outer oven cabinet with an oven liner defining an oven cooking cavity, an insulated firebox spaced around the oven liner, gas burner means positioned in the bottom of the firebox beneath the oven liner, the gas burner means serving to generate flue gases for heating the walls forming the oven cavity, a heat exchanger unit located above the firebox for receiving flue gases therefrom, blower means for bringing cool room air into the oven cabinet and passing it through the heat exchanger for cooling the flue gases, means for exhausting the cooled flue gases from the heat exchanger to the atmosphere, and means for passing the air leaving said heat exchanger into heat transfer relation with the oven cabinet for lowering the temperature of the exterior of the oven cabinet, and means for then introducing this heated air over the gas burner means as preheated secondary air, whereby the overall efficiency of the oven is increased concomitantly with reductions in the exhausting flue gas temperature and the outer cabinet temperatures.