United States Patent

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[54] MUFFLE-TYPE GAS-FIRED SELF-CLEANING OVEN

14 Claims, 3 Drawing Figs.

[52] U.S. Cl. ..... 126/21 A
[51] Int. Cl. F24c 15/32
[50] Field of Search ..... 126/21, 21 A, 299, 299 A, 299 B

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ABSTRACT: A self-cleaning gas oven having separated cooking and heating compartments in which the smoke and odor-containing gases from the cooking compartment are mixed with the air required for the combustion of fuel and passed into the heating compartment so that smoke and odor components are incinerated by the combustion process.

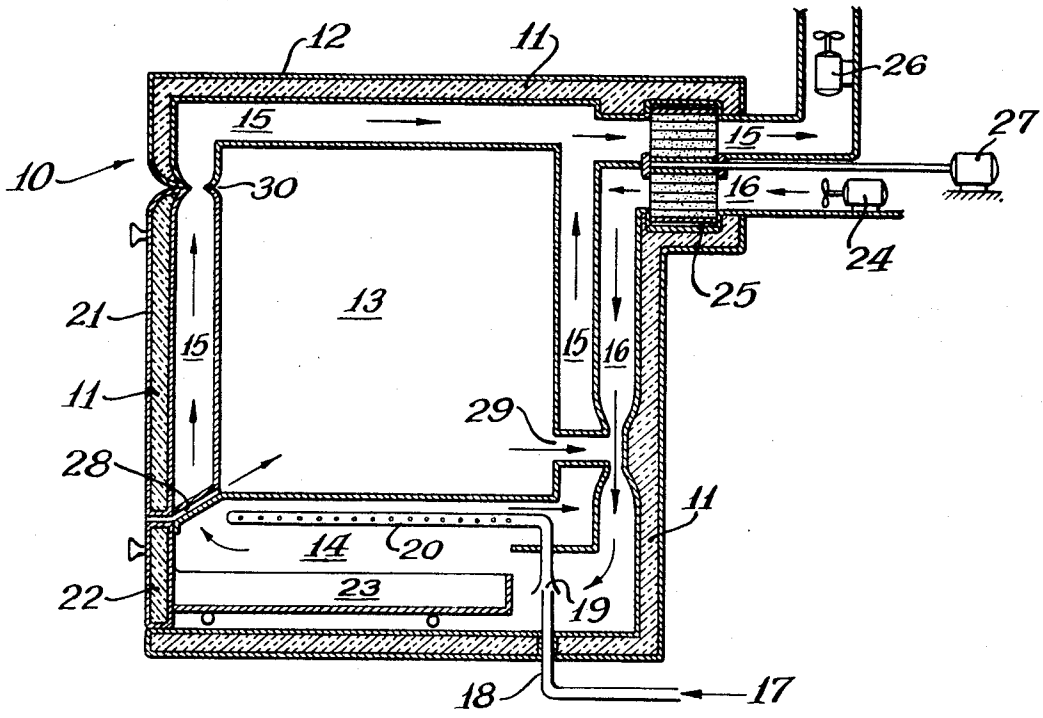


FIG. 1.

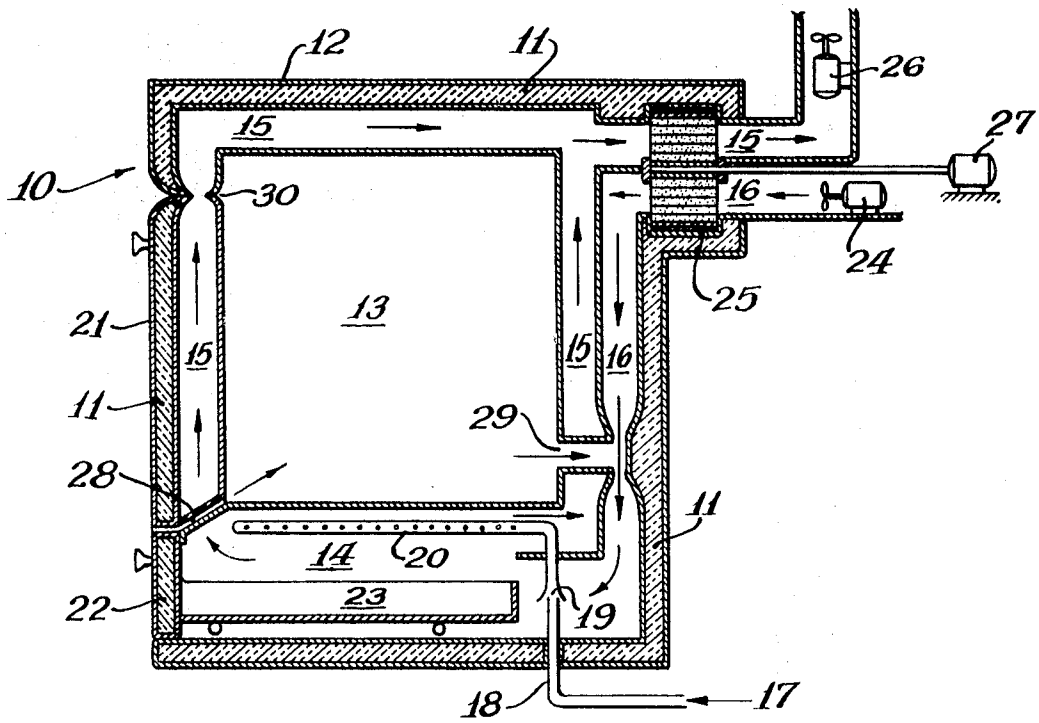


FIG. 2.

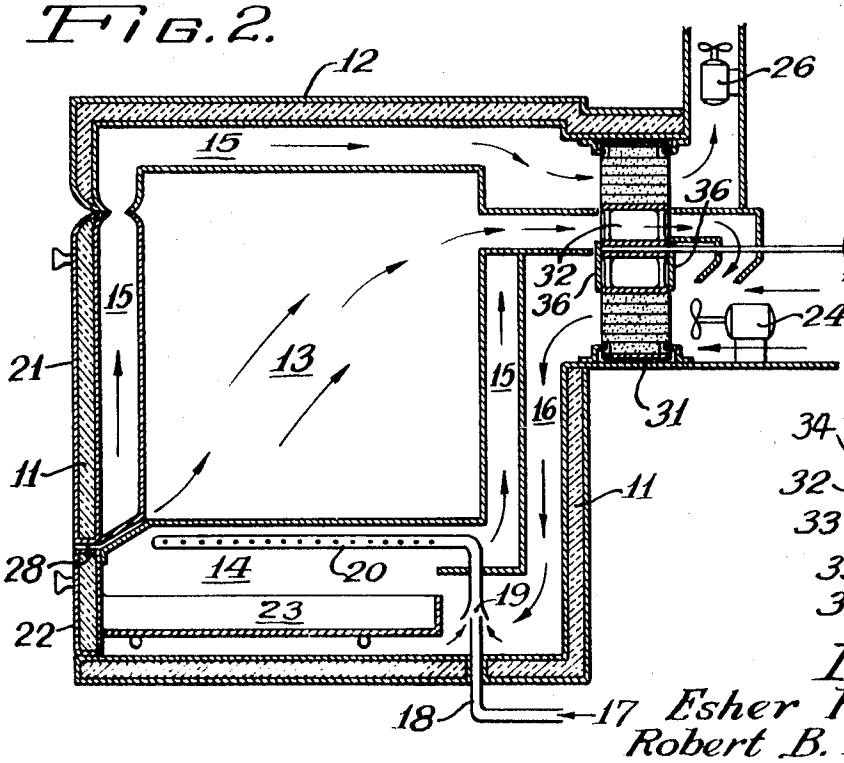
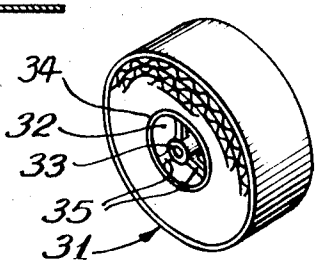


FIG. 3.



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MUFFLE-TYPE GAS-FIRED SELF-CLEANING OVEN

BACKGROUND OF THE INVENTION

This invention relates to self-cleaning kitchen ovens and more particularly, it relates to the gas-fired type of self-cleaning oven.

In view of the increasing demand for domestic appliances which require very little care and in view of the high cost of domestic help, there is a real need for an improved self-cleaning gas oven.

Self-cleaning gas ovens are known per se. See, e.g., Huebler et al. U.S. Pat. 3,416,509 and Perry U.S. Pat. 3,437,085. The present invention is an improvement of the self-cleaning gas oven disclosed in the Huebler et al. patent. The disclosure of Huebler et al. U.S. Pat. No. 3,416,509, insofar as it provides background discussions pertinent to the present invention, is hereby incorporated by reference.

Heretofore, the principal difficulties encountered in the construction of self-cleaning ovens have been the large amount of time and heat needed to clean the oven, the large amount of heat rejected by the cleaning process into the kitchen or the space in which the oven is located, and the smoke and odor generated by the cleaning process. These difficulties have been solved by the self-cleaning gas oven disclosed in Huebler et al. U.S. Pat. No. 3,416,509. The present invention is an improvement over the self-cleaning gas oven of Huebler et al. in that smoke and odor are further positively eliminated by direct burning or incineration prior to discharge from the oven.

It is, therefore, an object of the present invention to provide an improved self-cleaning gas oven.

Another object of the present invention is to provide a self-cleaning gas oven which discharges combustion products from the cleaning cycle into a room at relatively low temperatures.

It is still another object of the present invention to provide a self-cleaning gas oven which positively eliminates smoke and odor in the gaseous stream exhausted into the kitchen by means of direct incineration or burning.

Further objects of the invention can be gathered from the following detailed description.

SUMMARY OF THE INVENTION

In accordance with the present invention, we provide an improved self-cleaning gas oven which has separated cooking and heating compartments, wherein the smoke and odor containing gases issuing from the cooking compartment are mixed with the air required for the combustion of fuel and passed into the heating compartment for burning with the fuel gas to incinerate the smoke and odor components in the gases.

BRIEF DESCRIPTION OF THE DRAWINGS AND OF THE PREFERRED EMBODIMENT

The objects of the present invention are achieved by providing a self-cleaning gas oven in which the exhaust gases from the cooking compartment are incinerated at relatively high temperatures prior to discharging from the oven so that smoke and odor components in the exhaust gases are thoroughly eliminated. The incineration of the exhaust gases from the cooking compartment can be best achieved by providing separate cooking and heating compartments in the oven, and passing the exhaust gases from the cooking compartment to the heating compartment for contact with the burners prior to discharge from the oven. In this manner, substantially no gases will be discharged from the cooking compartment of the oven directly to the exterior of the oven without passage through the burner section of the oven.

The invention will now be described in detail in connection with the drawings, in which:

FIG. 1 is a schematic sectional view illustrating a preferred embodiment of the oven of the present invention;

FIG. 2 is a schematic sectional view illustrating another embodiment of the oven in the invention; and

FIG. 3 is a schematic view showing the heat regeneration device illustrated in FIGS. 1 and 2.

Referring to FIG. 1, a self-cleaning gas oven in accordance with the present invention is generally shown at **10**. Oven **10** is surrounded by an insulating layer **11** to prevent leakage of heat into the kitchen. Oven **10** has a top surface **12** on which conventional burners and stove units may be placed. The oven **10** is generally divided into a cooking compartment **13**, a heating compartment **14**, conduit **15** for exhausting combustion products from the oven, and conduit **16** for admitting air into heating compartment **14** for supporting the combustion fuel therein. A suitable fuel gas is supplied from a source **17** through conduit means **18** into an orifice **19** and to burner element **20**. The fuel gas is mixed at orifice **19** with air from conduit **16** for burning at burner element **20**. Oven **10** has an upper door **21** for access to cooking compartment **13** and a lower door **22** for access to a broiler pan **23** located in heating compartment **14** below burner element **20**. Air for supporting combustion at burner element **20** is supplied by means of a fan **24** through a heat regeneration device **25**, to be described below, into conduit **16**. The combustion products from burner element **20** are circulated by way of conduit **15** around the cooking compartment **13** to thereby heat the same and exhausted through the heat regeneration device **25** by fan **26**. The heat regeneration device **25** is rotatably mounted and driven by a motor **27**.

An opening **28** near the front bottom of cooking compartment **13** is provided to admit a small amount of ambient air into cooking compartment **13** to aerate the same. The amount of this aerating air is relatively small and can be varied. We prefer to use an amount of this aerating air as compared to the air supplied to the heating compartment, of about 1:5 to 1:10. Opening **28** is relatively small and does not obstruct the flow of combustion products in conduit **15**. The air and vaporized soil from cooking compartment **13** leaves that compartment via opening **29** located adjacent to the conduit **16** for admitting air to support combustion of burner **20**. Conduit **16** forms into a venturi shape at about the point it meets opening **29** so as to aspirate the gases from cooking compartment **13**. In this manner, the gases from cooking compartment **13** are drawn out of that compartment and mixed with incoming air and passed on to burner element **20** for combustion thereat.

The combustion products from the burning of fuel and other gases at burner element **20** are conducted around cooking compartment **13** via conduit **15** so that heat is transferred from the hot combustion products to cooking compartment **13**. As shown in FIG. **1**, conduit **15** includes a portion formed on the inside of door **21**. In this manner, cooking compartment **13** is evenly and thoroughly heated by the hot gases passing through enveloping conduit **15**. However, it is not necessary to provide for the heating at the door to the cooking compartment.

The heat regeneration device **25**, which has been described and shown in more detail in said Huebler et al. U.S. Pat. No. 3,416,509, is rotated slowly by motor **27** to transfer heat from the hot combustion products in conduit **15** to the incoming air in conduit **16**. Regenerator **25** accomplishes this result by acting as a heat sink so that heat is transferred from the hot gases in conduit **15** to regenerator **25**, and then when the hot portion of the regenerator **25** is rotated to be in contact with the cool air in conduit **16**, heat is transferred from regenerator **25** to the relatively cool air. Although the embodiment shown in FIG. **1** employs a heat regenerator, the use of a tube and shell or finned heat exchanger in place of the regenerator **25** is also contemplated.

The heat regeneration device is preferably of corrugated or honeycomb design which permits the passage of gases therethrough. It may be made of heat-resistant material which has a high heat capacity. Examples of suitable materials for this purpose are asbestos impregnated with sodium silicate or a ceramic or refractory material.

As can be gathered by comparing the foregoing with the disclosure of Huebler et al. U.S. Pat. No. 3,416,509, the principal feature of the present invention is the collection and injection of the soil-laden gases from the cooking compartment **13** into the air stream to be fed to the burner element **20**. The ad-

vantages flowing from the present invention are the most complete oxidation and elimination of smoke and odor-carrying components in the gases exhausted from the oven while at the same time retaining the low-exhaust gas temperature realized by the invention of Huebler et al. In the oven-cleaning cycle, a temperature of 750°–1000° F. or 1100° F. is typically realized in the cooking compartment of the oven. Such high temperatures are usually sufficient to oxidize most of the soil in the oven and to vaporize the remaining soil. However, there is the possibility that extremely fine grease or smoke particles, containing incompletely oxidized materials, may be suspended in the gaseous stream and be exhausted into the kitchen. The presence of such fine smoke and grease particles, aside from its immediate objectionable effects on persons in the kitchen, will tend to deposit on the walls and furniture in proximity to the oven and eventually permeate through the house. It is the object of the present invention to eliminate, as completely as possible, the presence of such smoke and odor carrying components in the exhaust gases from the oven.

FIG. 2 shows another embodiment of the oven of the invention. The embodiment shown in FIG. 2 is generally similar to that shown in FIG. 1, except that the heat regeneration device **25** is of a modified design (as shown in FIG. 3) and the exhaust gases from cooking compartment **13** are mixed with incoming air prior to the air's passage through the heat regeneration device **25**.

Referring to FIG. 3, the modified heat regeneration device **31** is shown to be constructed in a substantially annular and cylindrical form having a central opening **32**. At the center of opening **32**, there is a shaft **33** supported on bearing members which are in turn connected to the inner annular wall **34** of regenerator **31** by means of spokes **35**. As shown in FIG. 2, the hot combustion products in conduit **15** are passed through the regenerator **31** at its upper portion. The gases exhausted from cooking compartment **13** are passed through the upper half of opening **32**. After passing through opening **32**, the exhaust gases from cooking compartment **13** are then mixed with the incoming air by fan **24** and go through the lower portion of regenerator **31** with said air. The lower half of opening **32** in the regenerator **31** is closed off by baffle means **36** attached to the bearings supporting the shaft **33**. In this manner, the incoming air is prevented from bypassing the heat regenerator **31** by going through the lower half of opening **32**.

It can be seen from the above that the embodiment shown in FIG. 2 differs from that shown in FIG. 1 primarily in that the exhaust gases from cooking compartment **13** are mixed with the air supplied to burner element **20** before the air passes through the heat regeneration device. In FIG. 2, the opening **32** is provided in heat regenerator **31** so that the hot exhaust gases from cooking compartment **13** will not leave condensed smoke or odor carrying particles in the regenerator. Once the exhaust gases from cooking compartment **13** have been mixed with the relatively cool air, the combined gas stream is at a relatively low temperature and will be heated by regenerator **31** so that no substantial condensation can take place during the passage of the mixed gaseous stream through the heat regenerator. However, the embodiment shown in FIG. 1 is preferred since it is simpler and a more direct method for achieving the desired result.

The invention will now be described with reference to a particular example.

EXAMPLE

A muffle-type self-cleaning oven generally similar to the oven shown in FIG. 1, was operated under the following conditions. The over was preheated for about 20–30 minutes with a total heat input of about 7,100 B.t.u. to raise the temperature in the cooking compartment **13** to about 800° F. Thereafter, heat input to the oven was continued at a rate of about 6900 B.t.u. per hour for the cleaning cycle. When steady state was reached, the following temperatures were found in various portions of the oven. The cooking compartment **13** was at about 800° F.; the conduit **15** had an average temperature about 1060° F.; fresh air entering conduit **16** had a temperature about 75° F.; preheated air after passing through the heat regeneration device **25** had a temperature about 758° F.; preheated air after mixing with the gases from the cooking compartment **13** had a temperature about 765° F.; the temperature of exhaust gases entering heat regeneration device **25** had a temperature about 830° F. and the temperature of exhaust gases leaving the heat regeneration device had a temperature of about 285° F. The above temperatures were found for a heat regeneration device **25** in the form of a wheel with a 7-inch diameter and 2 inches thick. With a wheel 3 inches thick, an exhaust temperature about 230° F. may be obtained. Fresh ambient air was introduced into conduit **16** at the rate of about 12.4 pounds per hour. Air introduced into cooking compartment **13** by way of opening **28** was at the rate of 2.3 pounds per hour. The entire cleaning cycle took a little over 2 hours. The exhaust gases from the oven were substantially free of smoke and odor containing particles.

The self-cleaning gas oven of the invention can be made to be convertible into a convection oven by providing baffle means operable to pass the hot combustion gases from the heating compartment directly into the cooking compartment and thence to the heat regeneration device. In that case, of course, the opening **29** in FIG. 1 for recycling the gases from the cooking compartment back to the heating compartment must be closed.

It should be understood that the cooking compartment may be divided by a baffle into a standard baking and a standard broiling compartment. Further, the heating compartment may also serve as the broiler compartment for the oven with the heating compartment having a gas passageway substantially surrounding the cooking compartment for transfer of heat thereto. This is illustrated both in FIGS. 1 and 2, the burner **20** serving as the broiler burner for the broiler tray **23**. During the baking cycle, baffle means between the cooking and heating compartment are open so that a portion of the combustion product can heat the cooking compartment directly. Conversely, during the self-cleaning cycle, the baffle means are closed with the oven operating as above described.

The invention has been described in detail with reference to particular and preferred embodiments thereof, but it will be understood that variations and modifications can be made within the spirit and scope of the invention as described hereinabove and as defined in the appended claims.

1. A self-cleaning gas-fired cooking oven which comprises: a cooking compartment; a heating compartment in heat-exchanging relationship with said cooking compartment; a fuel gas burner disposed within said heating compartment; means for supplying fuel gas to said burner; means for supplying air to said heating compartment for combustion with said fuel gas to thereby heat said cooking compartment; means for exhausting combustion products from said heating compartment; means for aerating said cooking compartment; means for exhausting hot gases from said cooking compartment into said heating compartment to be mixed with the gases therein for complete incineration of combustible matter; and means for exchanging heat between said exhausted combustion products and said air supplied to said heating compartment to thereby preheat said air and cool said combustion products prior to discharging the same from said oven.

2. A self-cleaning oven according to claim 1 wherein said heating compartment also serves as the broiler compartment for said oven, and said heating compartment having gas passageway substantially surrounding said cooking compartment for transferring heat to the latter.

3. A self-cleaning oven according to claim 1 wherein said means for exchanging heat comprises a heat regenerator which includes a rotatably mounted heat sink means for serially contacting said exhausted combustion products and said air supplied to said heating compartment.

4. A self-cleaning oven according to claim 1 wherein said means for exchanging heat comprises a heat exchanger.

5. A self-cleaning oven according to claim 1 wherein aerating means comprises conduit means communicating between the exterior of said oven and said cooking compartment.

6. A self-cleaning oven according to claim 1 wherein said means for exhausting hot gases from cooking compartment comprises: conduit means communicating between said cooking compartment and said heating compartment; and aspirating means in said heating compartment at the terminus of said conduit means for aspirating gases from said cooking compartment.

7. A self-cleaning oven according to claim 1 wherein said means for exhausting hot gases from cooking compartment comprises conduit means communicating between said cooking compartment and said means for supplying air to said heating compartment.

8. A self-cleaning oven according to claim 1 further comprising: baffle means between said cooking and heating compartments; and means for closing said baffle means during cleaning cycle of said oven and for opening said baffle means during baking cycle of said oven so that a portion of the combustion products can heat said cooking compartment directly.

9. A method for cleaning a cooking oven which comprises:

passing fuel gas and air into a heating compartment in said oven for combustion thereat;

heating the cooking compartment in said oven with the heat from said combustion to vaporize the soil in said cooking compartment;

aerating said cooking compartment to remove vaporized soil therefrom;

passing the aerated gases from the cooking compartment to the heating compartment and mixing the same with said air so that the vaporized soil will be incinerated; and

bringing said air supplied to said heating compartment into heat exchanging relationship with the combustion products prior to the latter's discharge from the oven to thereby preheat said air and cool said combustion products.

10. A method according to claim 9 wherein said aerating step is carried out by admitting a controlled amount of ambient air into said cooking compartment.

11. A method according to claim 9 wherein the rate of passing fuel gas and air into said heating compartment is sufficient to heat said cooking compartment to a temperature at least about 750° F.

12. A method according to claim 9 wherein the rate of passing fuel gas and air into said heating compartment is sufficient to heat said cooking compartment to a temperature between about 850°–1100° F.

13. A method according to claim 9 wherein said combustion products are cooled to about 230° F. before discharging from said oven.

14. A method according to claim 10 wherein the ratio of said aerating air supplied to said cooking compartment and said air supplied to said heating compartment is about 1:5.