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Mutchler

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[54] **OVEN COMBUSTION PRODUCTS DISTRIBUTION SYSTEM**

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[52] **U.S. Cl.** ..... **126/21 A**

[51] **Int. Cl.** **F24c 15/32,** A21b 1/10

[58] **Field of Search** ..... 126/44, 21 A, 39 D, 19, 126/273

[56] **References Cited**

UNITED STATES PATENTS

1,209,683	12/1916	Detwiler	126/39 D
3,324,844	6/1967	Huffman	126/21 A
3,480,000	11/1969	Torrey et al.	126/39 D

FOREIGN PATENTS OR APPLICATIONS

432,481	7/1935	Great Britain	126/39 D

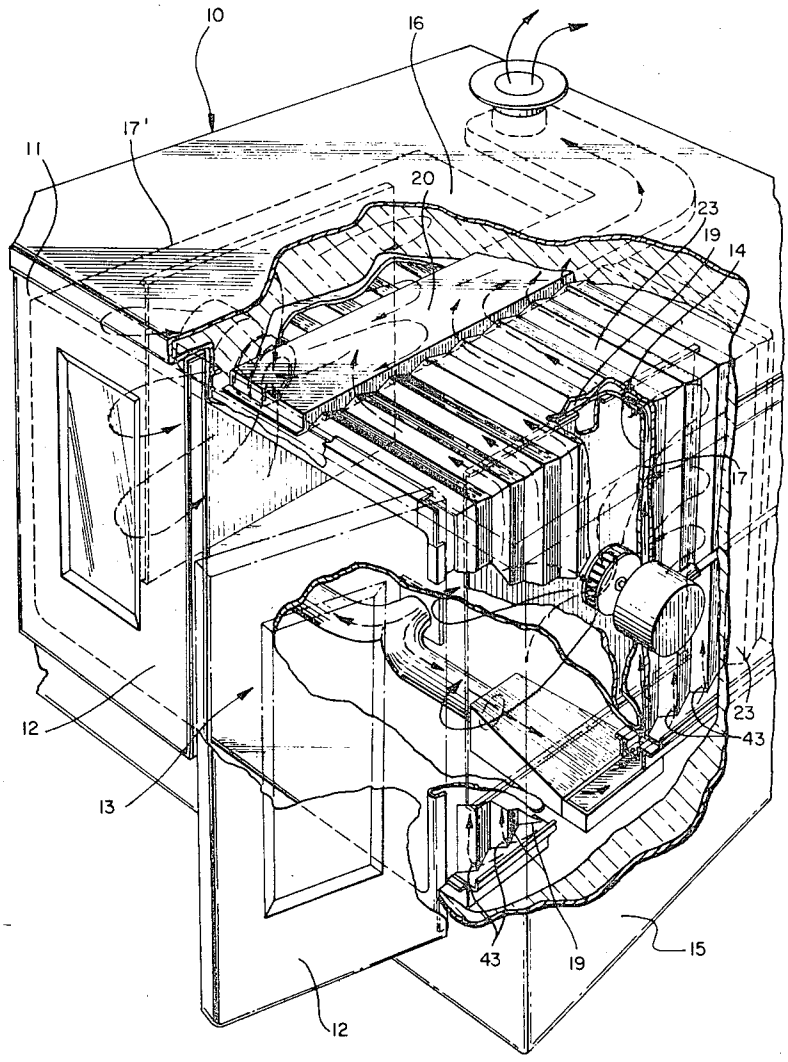
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[57] **ABSTRACT**

A liquid fuel-fired convection oven wherein the gases of combustion from a burner are blended with cooling air flowing through an annular space surrounding the combustion chamber and the blended hot gases are divided into two streams each of which is caused to flow through a plurality of channels which extend vertically along the side wall and across the top wall of the oven, emptying into an exhaust manifold on the top of the oven. The contiguous, hollow channels allow the hot gases to flow in substantially uniform streams in contact with the side and top walls to provide a uniformly efficient transfer of heat to the oven.

6 Claims, 2 Drawing Figures



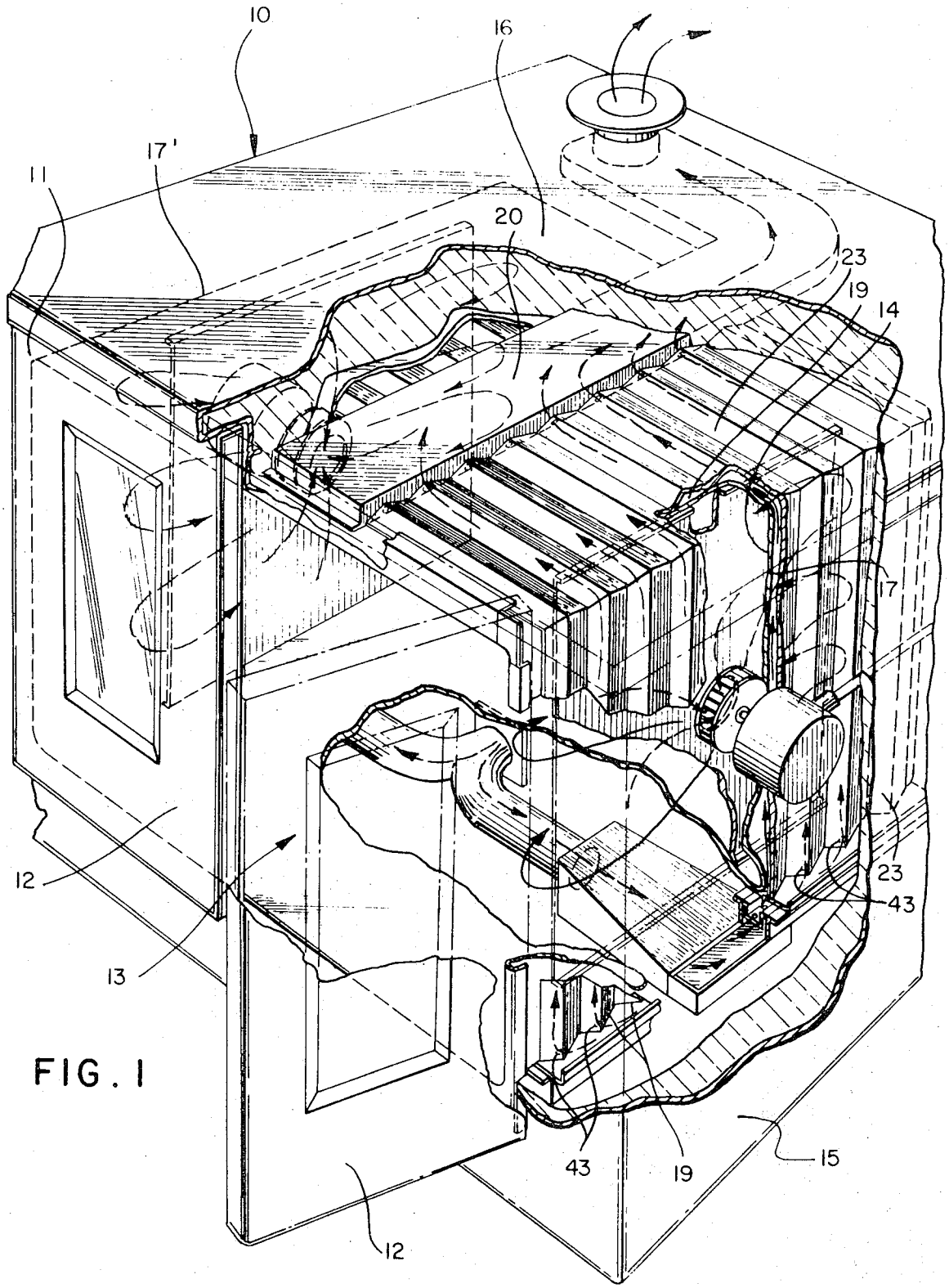


FIG. 1

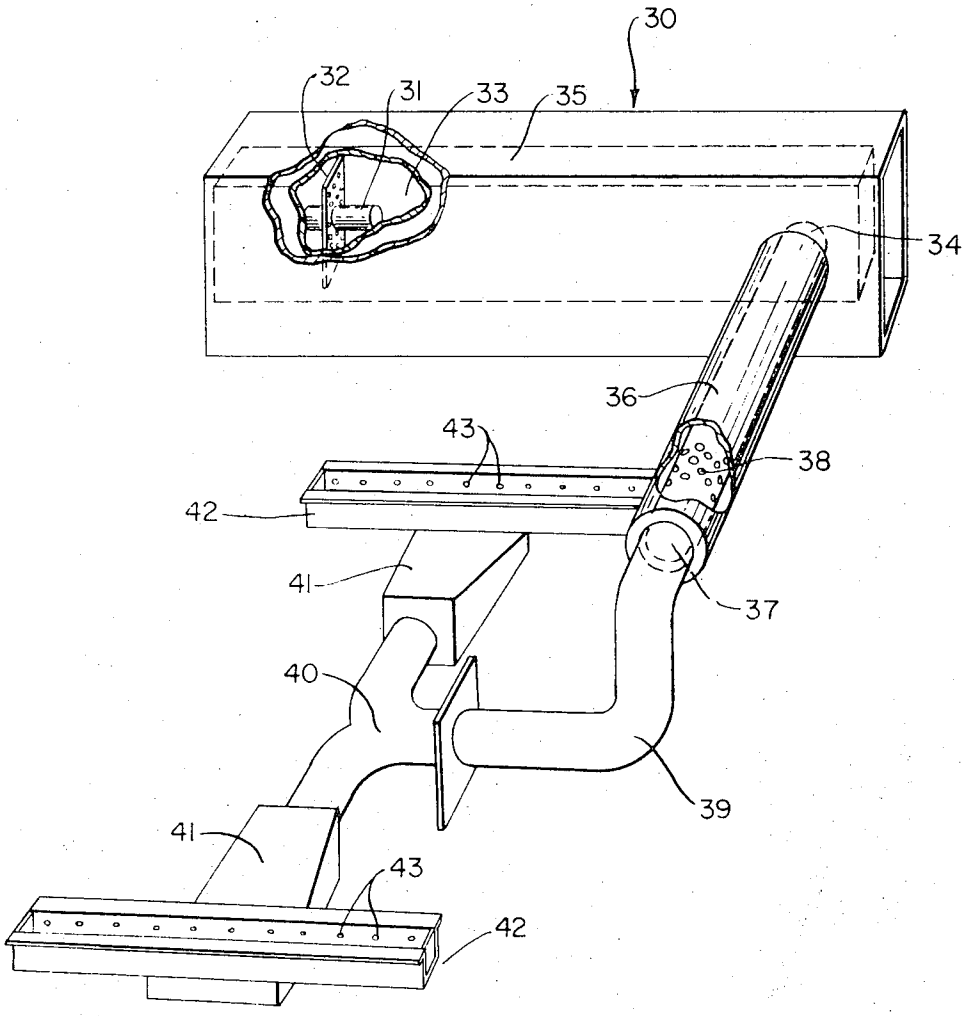


FIG. 2

OVEN COMBUSTION PRODUCTS DISTRIBUTION SYSTEM

The invention described herein may be manufactured, used and licensed by or for the Government for governmental purposes without the payment to me of any royalty thereon.

BACKGROUND OF THE INVENTION

This invention relates to oven heating systems and, more particularly, to a combustion products distribution system for heating an oven.

Oven heating systems are known in the art wherein different heating arrangements have been employed in an attempt to effectively utilize thermal energy from different sources. The specific heating arrangement or system to be utilized will, of course, depend in large measure on the specific source of thermal energy, e.g., solid, liquid, or gaseous fuel or electrical energy. Heating arrangements which have proven satisfactory in the past with respect to most thermal energy sources are not satisfactory for use in connection with liquid fuel sources since the temperature of the combustion gases conventionally generated thereby are greatly in excess of the temperatures normally required for cooking food. In U.S. Pat. No. 3,408,999, there is disclosed a liquid fuel-fired cooking apparatus wherein the combustion gases flow from the burner through an enclosed header channel, around the peripheral branch channels and then flow through a passageway beneath the oven floor. Gases also pass, to a limited extent, by convection through a gas passage which is a hollow space surrounding the side and top walls of the oven. This system does not provide for an even application of heat to the walls of the oven since the transfer by convection along the side and top walls will be of minimal effectiveness with the greater portion of the heat transfer occurring at the bottom wall of the oven which is in contact with the flowing combustion gases. This invention, on the other hand, allows the heat energy in the combustion gases to be significantly more uniformly distributed over more of the surface area of the oven so as to more efficiently and effectively heat the oven cavity.

SUMMARY OF THE INVENTION

The present invention provides a novel, highly efficient, and unobvious heating system for an oven and especially for an oven utilizing a liquid fuel heat source. The products of combustion from the thermal energy source are blended with ambient air to achieve a proper temperature range and the thus blended gases are caused to flow through a plurality of separate gas-tight channels in contact with and along each side wall and across the top wall of the oven, meeting in a common duct which leads, in turn, to a gas vent. The heat energy from the combustion gases is thereby uniformly applied to the top and side walls of the oven in a manner which will provide for a highly efficient transfer of the heat energy within the combustion gases.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a partially broken-away, perspective view of a liquid fuel-fired oven and the heating system therefor according to the present invention;

FIG. 2 is a partially broken-away perspective view of the combustion chamber and duct work leading to the oven of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1 of the drawing, there is illustrated an oven having a unique heating arrangement or system by which it can effectively and efficiently utilize hot gases from some thermal energy source and especially combustion gases from a liquid fuel source. The oven, designated generally as **10**, is a typically rectangular, box-like design, made of sheet metal and insulated where appropriate. On the front wall **11** are hinged double doors **12** (access means) which open to allow access to the oven cavity **13**. Although not shown the drawing, the cavity is adapted to contain and utilize the usual complement of supports and racks. The oven is of double wall construction, i.e., having an inner shell **14** which defines the oven cavity **13** and is designed for easy cleaning, and a spaced apart outer shell **15** which encloses the top, sides and back of the inner shell. In the space between the inner shell **14** and outer shell **15**, there is found conventional insulation as well as the heat transfer means to be described hereinafter. The inner shell **14** of the oven consists of opposed side walls **17** and **17'**, a top wall **16**, a bottom wall **22**, back wall **18** and front wall **11**. Within the space between the inner **14** and outer **15** shells and against the surface of the side walls and the top wall is located the hot gas conduction means which consists of a plurality of separate hollow channels **19** which are formed of corrugated sheet metal **23** positioned tightly against the inner shell **14**. Channels **19** define gas-tight passageways against the inner shell **14** and each channel **19** extends vertically along the side wall **17** or **17'** and continues horizontally over the top wall **16** toward the center where each channel connects with a common exhaust means, an exhaust manifold **20** having an exhaust stack **21** through which the hot gases are vented to the atmosphere. While the size and number of the channels **19** will affect the efficiency of the heat exchange, it has been found to be essential that at least four separate channels be employed on each side wall. The channels are preferably contiguous so as to cover the entire side **17** and **17'** and top **16** wall area and thereby uniformly heat those wall areas.

Referring to FIG. **2**, there is shown a liquid fuel burner designated generally as **30**, having mounted therein a liquid fuel combustor **31** of the type described in U.S. Pat. No. 3,408,999. The combustor is centered on a rigid plate **32** and is connected to a source of liquid fuel and a source of combustion air under pressure, neither of which are shown in the drawing. Sprayed liquid fuel and combustion air are blended and caused to burn within the combustion chamber **33**. The hot combustion gases emerge from the combustion chamber into a combustion products pipe **34**. Combustion chamber shroud **35**, having its walls spaced from the walls of the combustion chamber **33** completely enclose the latter. Cooling air, from a source not shown, is forced under pressure to pass through the spaced between the combustion chamber **33** and shroud **35** cooling the wall of the combustion chamber. A cylindrical shroud **36** spaced from and enclosing the combustion products pipe **34** causes the same flow of cooling air to pass therebetween cooling the pipe **34**. The combustion products pipe **34** is closed at its end **37**/nd has a plurality of openings **38** adjacent thereto **37** and allow the combustion gases to exit therefrom and blend with

the cooling air forced through the shroud **36.** A hollow cylindrical tube **39** is connected with shroud **36** and conveys the blended combustion product gases and cooling air to a point beneath the bottom wall **22** of the oven. At this point, tube **39** leads into a "Y" connector **40,** the branches of which connect with separate conduits **41** which are positioned beneath the bottom wall **22** of the oven and join or connect with oven manifolds **42** which are positioned beneath each of the oven side walls **17** and **17'**. The oven manifold has a plurality of small, annular orifices **43** along its top surface, with each orifice opening into a separate hollow channel **19.** Tube **39,** connector **40,** conduits **41** and manifolds **42** constitute the gas inlet means which carries the combustion gases from the combustor to the hollow channels on the walls of the oven.

In operation, fuel and combustion air are delivered to the combustor **31,** blended and caused to burn in the combustion chamber **33.** The temperatures of the combustion gases as they exit from the combustion chamber range from 1,000° to 1,800° F. Cooling air is caused to flow through the space surrounding the combustion chamber **33** and combustion products pipe **34,** cooling the walls of the chamber and the pipe and thereafter blending with the combustion gases adjacent the end of pipe **34.** At this point, the temperature of the gaseous mixture is preferably of the order of 300° F. to 1,100° F. The gas mixture flows through tube **39** where it is divided by "Y" connector **40** and passes into equally divided streams through each conduit **41** which, in turn, empty into oven manifolds **42** under each side wall. The hot gases exit uniformly through each of the orifices **43** into each of the respective channels **19.** The orifice opening is small or undersized as compared with the passageway defined by each channel **19,** and, as a consequence, the gases flow under pressure into an oversized channel producing a turbulent flow of hot gases within the channel, such turbulence improving the heat transfer efficiency within the channel. The hot gases flow through each of the channels along each side wall and over the top wall of the oven and exit into a common exhaust manifold **20.** The distribution of gases to each of the channels is quite uniform because of the back pressure created by the undersized orifices **43** in the oven manifolds **42** so that the heat input is relatively even across the width of the oven side walls. This even distribution of hot gases throughout the channels and the turbulence produced within the channels combine to provide a uniform and highly effective mechanism for transferring the heat energy of the combustion gas mixture to the oven cavity **13.** Three wall surfaces, both side walls **17** and **17'** and the top wall are uniformly heated by this system which necessarily results in a more efficient application of thermal energy to the oven than is the case when one surface, normally the bottom surface, is the exclusive heat transfer surface. The temperature of the combustion gases delivered to the oven channels can be controlled by regulating either the rate of liquid fuel delivered to the combustor and also by regulating the quantity of cooling air ultimately blended with the combustion gases.

I claim:

1. A convection oven heated by combustion gases having,

spaced opposed side walls, spaced opposed front and back walls and spaced opposed top and bottom walls which define the oven cavity,

means located on said front wall to permit access to said cavity,

gas inlet means associated with the underside of said bottom wall which conducts combustion gases from a burner to the base of each side wall, said gas inlet means dividing the flow of combustion gases into two streams which are delivered to separate oven manifolds beneath each oven side wall, said manifolds having undersized orifices which communicate with each of said channels through which the combustion gases pass under pressure in a turbulent stream,

gas conduction means associated with each of said side walls and said top wall adapted to conduct said combustion gases from said gas inlet means in a plurality of separate and substantially uniform streams in a vertical direction along and in contact with each of said side walls and then in a horizontal direction across and in contact with said top wall, said gas conduction means being composed of a plurality of gas-tight channels in heat conducting relationship with said oven side and top walls, and

exhaust means on said top wall in communication with said gas conduction means and adapted to receive and vent the combustion gases,

whereby said combustion gases are forced to flow through said gas inlet means through said gas conduction means into said exhaust means to uniformly and efficiently heat the side and top walls of said oven.

2. A convection oven according to claim **1** wherein said side and top oven walls form one side surface of said gas-tight channels.

3. A convection oven according to claim **2** wherein said hollow channels are contiguous and completely cover the side and top walls of said oven.

4. A convection oven according to claim **3** having at least four separate channels on each of said side and top walls.

5. A convection oven according to claim **4** having in combination therewith a burner, said burner having a combustion chamber wherein the fuel is burned, an annular air passageway surrounding said combustion chamber through which cooling air is caused to flow to cool the walls of said combustion chamber, burner exhaust means in communication with said passageway and said combustion chamber wherein said combustion gases and said cooling air are mixed and then caused to flow into said gas inlet means.

6. A convection oven according to claim **6** wherein said burner is fired with liquid fuel.

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