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Perl

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[54] **DOMESTIC OVEN**

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Related U.S. Patent Documents

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[51] **Int. Cl.**[2] **F24C 15/32**

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

[58] **Field of Search** ..... 126/21 R, 21 A, 39 R, 126/39 C, 273 R

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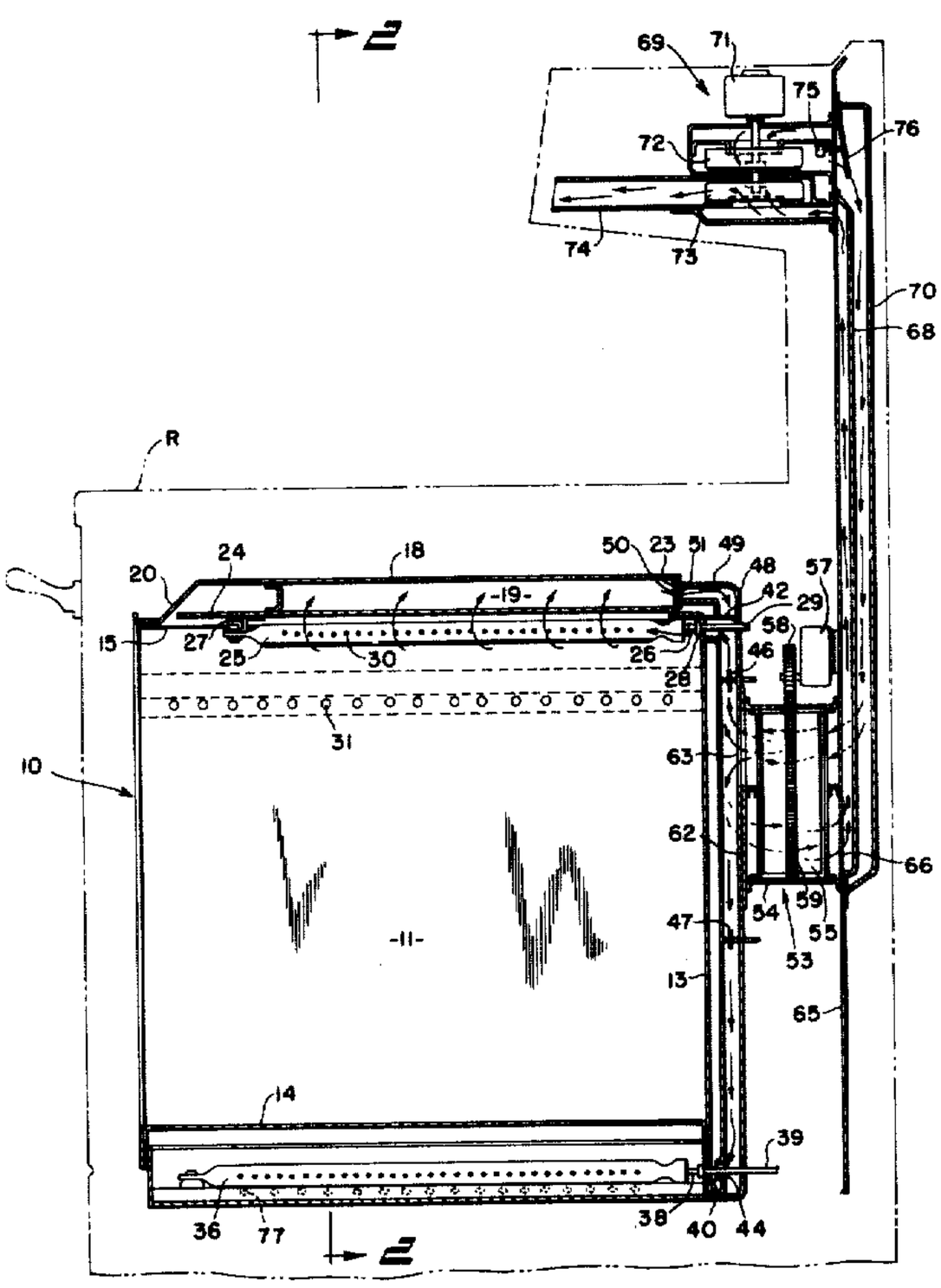
Attorney, Agent, or Firm—Donnelly, Maky, Renner & Otto

[57] **ABSTRACT**

A domestic gas-fired oven having a top burner in the cooking cavity and a bottom burner fully concealed beneath the bottom of the cavity. The heated products of the bottom burner are caused to flow in a wrapper over the bottom and partially over the side walls to openings in the latter where these products enter the cavity. Air under pressure is supplied to the burners by a fan and another fan withdraws flue products from the top of the cavity, with the incoming air and the exhaust flowing through different sections of a rotating regenerator wheel for heat transfer therebetween. The burners can be operated separately for broiling and baking and together for high temperature self-cleaning of the oven.

9 Claims, 3 Drawing Figures



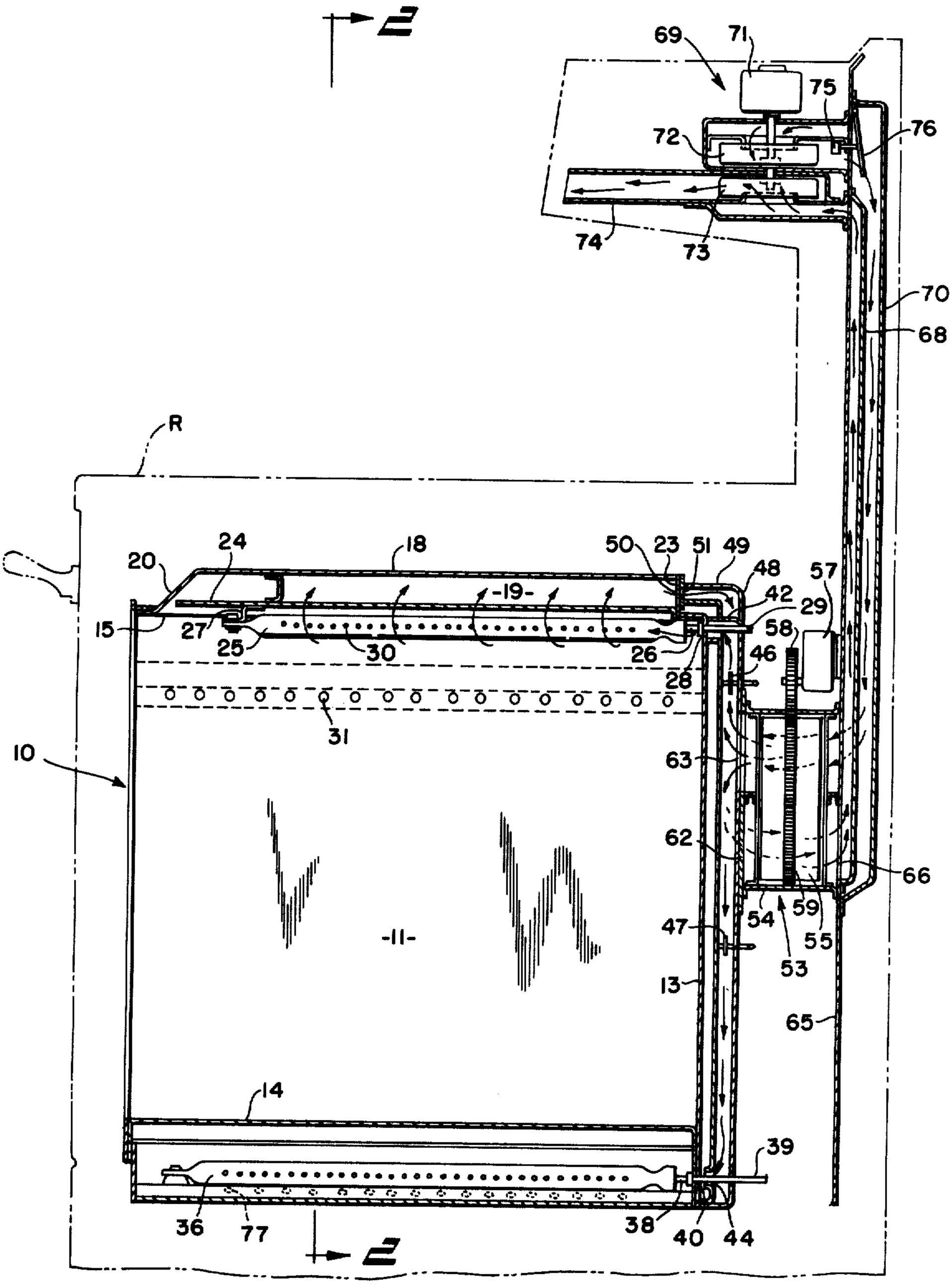

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Fig. 1

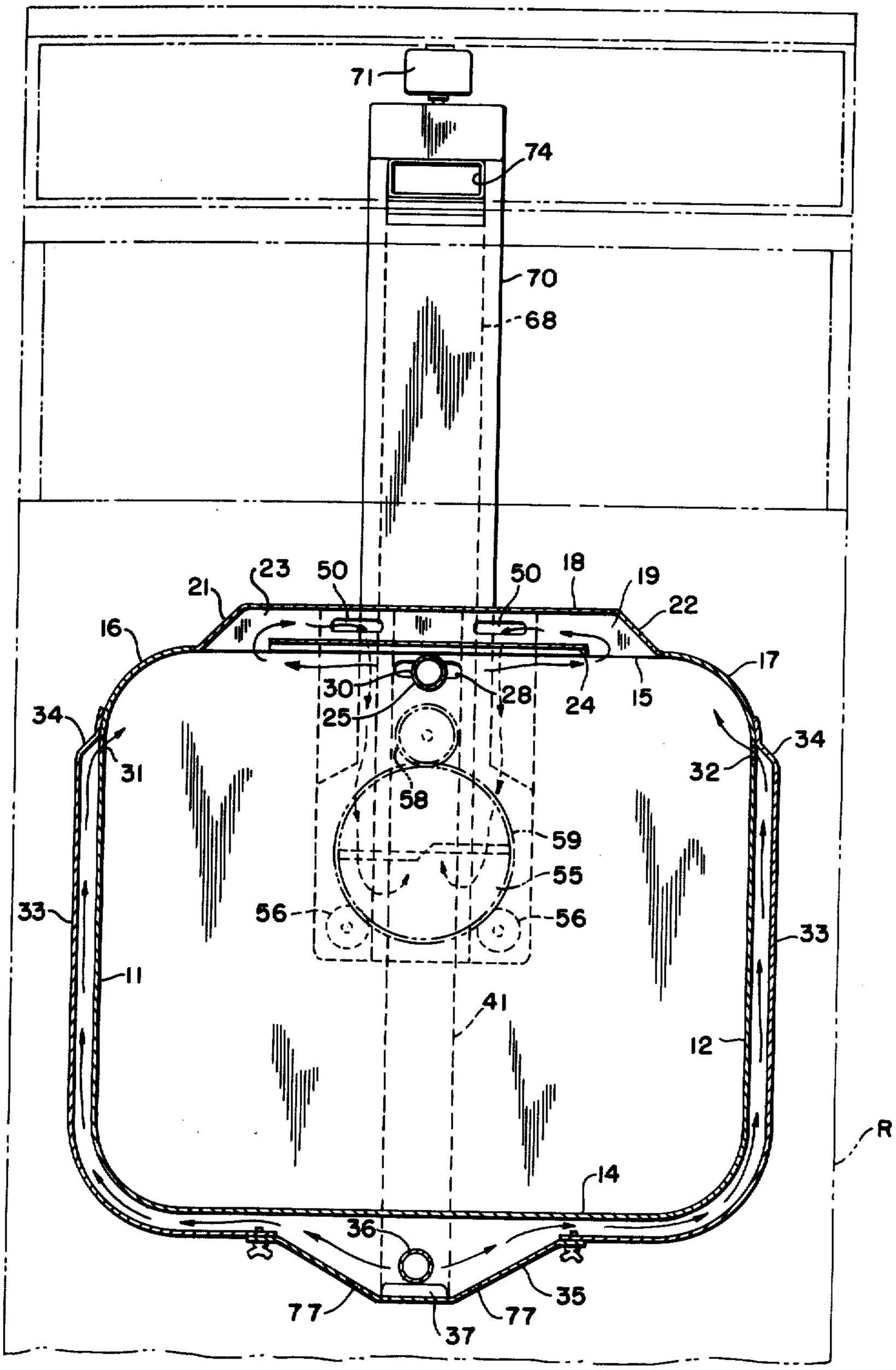
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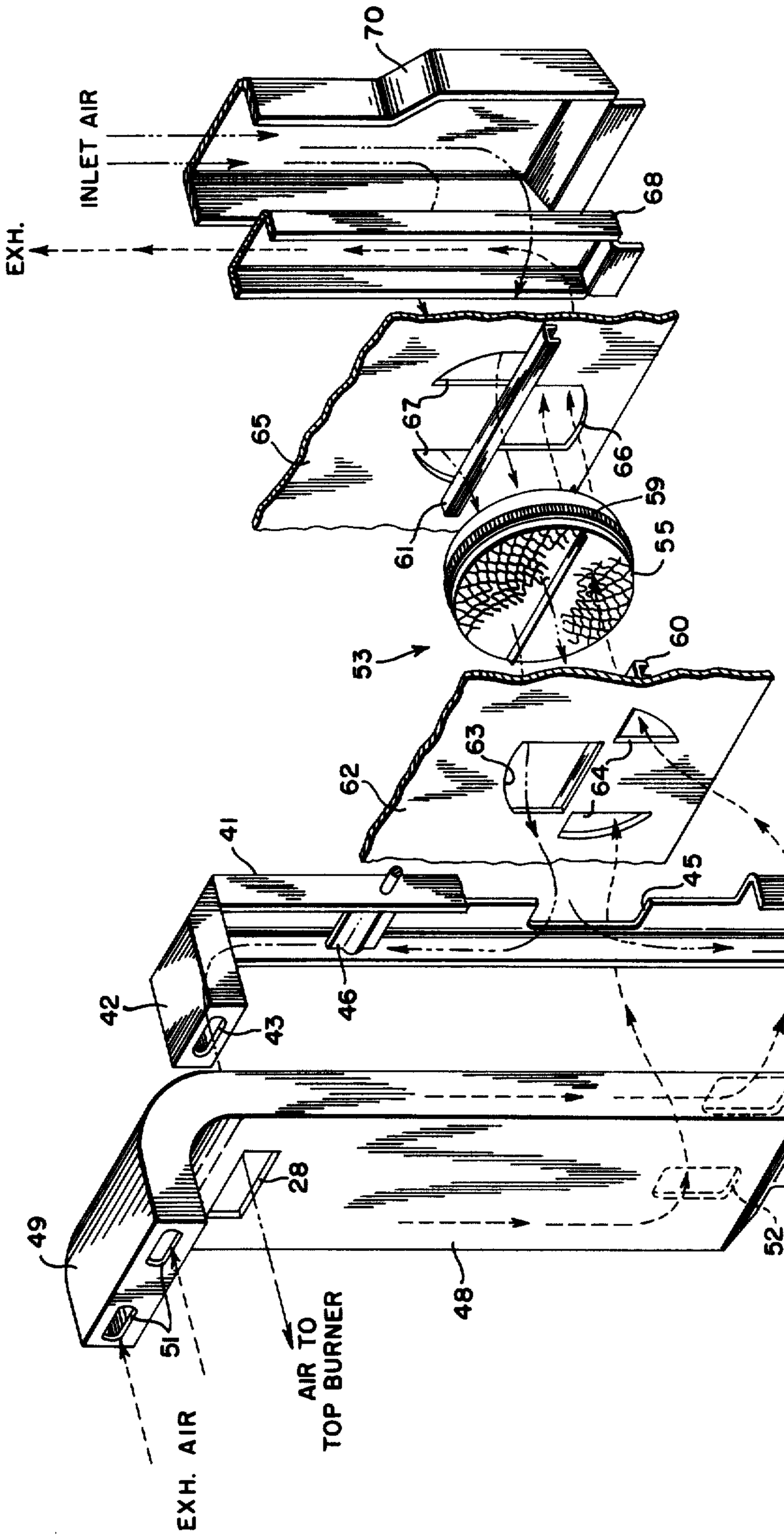
Fig. 2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INLET AIR
EXH.
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EXH. AIR
AIR TO TOP BURNER
AIR TO BOTTOM BURNER

FIG. 2

DOMESTIC OVEN

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

This invention relates to oven structure for household kitchen use and, more particularly, to an improved gas-fired oven having self-cleaning capacity.

It is a primary object of the invention to provide a single-cavity gas cooking oven having bake, broil and self-cleaning conditions of operation, with the interior surfaces of the oven in such cleaning being raised by a combination of radiant and convective heating effects to the relatively high temperature needed to effect decomposition of accumulated food soils thereon.

Another object is to provide such oven structure in which the cooking cavity is defined by a liner having a smooth, unobstructed and imperforate bottom, and at least two gas burners are used singly or in combination for the heating of the cavity.

It is also an object of the present invention to provide a domestic single-cavity oven having plural gas-fired heating devices to which combustion air is delivered under a pressure differential and under such regulation that the air can thus be delivered selectively to one or more of the devices.

A further object is to provide a multi-burner cooking oven in which room air is supplied under pressure to the burners and flue products are exhausted from the oven in heat exchange relationship to the inflow of the room or ambient air.

Other objects and advantages of the present invention will become apparent as the following description proceeds.

To the accomplishment of the foregoing and related ends the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawings setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principle of the invention may be employed.

In said annexed drawings:

FIG. 1 is a sectional view of domestic oven structure in accordance with the present invention suitable for incorporation in a free-standing kitchen range shown in phantom outline;

FIG. 2 is a transverse cross-section of such oven structure as viewed from the plane of the line 2—2 in FIG. 1; and

FIG. 3 is an exploded perspective view of a combined air supply and exhaust assembly included in the oven structure.

Referring now to the drawings in detail, the dashed outline R will be recognized as depicting the form of a kitchen range cabinet and backguard and is intended only to represent a conventional exemplary environment for the oven structure which forms the present invention.

Such oven structure comprises a liner designated generally by reference numeral **10** which is approximately cubical and open at the front for access, with the front opening of course to be closed by suitable oven door. The liner thus forms opposed side walls **11** and **12**, rear wall **13**, and bottom wall **14**, with the latter flat or

smooth, imperforate, and preferably integral with the side walls as in a tub oven or one in which there is a continuous peripheral wrapper with rounded corners as illustrated. In the present construction, however, the top section of such wrapper has an opening **15** extending substantially the full depth of the oven and between the two upper curved corner portions **16**, **17**, and a relatively shallow housing **18** open at the bottom is applied to the wrapper to enclose such opening and form a plenum chamber **19**. Such housing has a front wall **20** and side walls **21** and **22**, respectively, which are inclined upwardly and inwardly from the corresponding margins of the wrapper opening **15**, and a rear vertical wall **23**. A baffle plate **24** extends from such chamber rear wall **23** horizontally forwardly substantially to the front wall **20** and is of such width as to extend from the longitudinal center of the chamber laterally more than half of the distance to the side wall at each side, with this baffle being approximately in the plane of the wrapper opening *and thereby forming a top oven liner wall.*

An elongated top burner **25** is disposed horizontally centrally beneath the baffle **24** in spaced relation, with its rear end supported on a gas spud **26** and its front end by suitable bracket **27**, with the burner preferably being readily detached from such supports. The rear liner wall **13** has an opening **28** for a gas line **29** connection of the spud to an available source of gaseous fuel under pressure and, for a purpose to be described, this opening **28** is appreciably larger than the line **29** to provide clearance about the latter. The gas burner **25** which has been illustrated is of simple tubular form with two rows of ports **30** at the respective sides, and it will be appreciated that this device can be of any specific form appropriate for use as a top or broiler burner, including the various screen and other incandescent types which are essentially completely radiant heat generators.

The liner side wall **11** is provided with a plurality of apertures **31** arranged in a horizontal row at an intermediate elevation, shown in the illustrated embodiment as just below the contiguous curved upper corner portion **16**, and the opposed side wall **12** is similarly provided with apertures **32**. An outer wrapper **33** of channel form encloses the periphery of the liner **10** from an exterior line on the side wall **11** just above the apertures **31** about the bottom **14** to a corresponding line just above the other side wall apertures **32**. Such wrapper is closed at its ends **34** and has a downwardly recessed removable bottom section **35** in which a second or bottom gas burner **36** also of elongated ported form is housed in spaced relation centrally beneath the liner bottom **14**. This burner housing section **35** is preferably easily detached for convenient access to the burner for servicing and the like, and the burner is supported at its front end by a block **37** and at the rear on a further gas spud **38** having a fuel supply line **39**. The wall which closes the rear of the burner housing section **35** has an opening **40** larger than the gas line **39** through which the latter extends, so that this arrangement is similar to that of the top burner in such respect.

The outer wrapper or liner 33 defines with the box-like inner oven liner 10 a firebox encompassing the latter, with such firebox being of course structurally open at the front so as not to obscure access to the oven liner and the latter extending rearwardly and thereby behind the front opening. The flue gases from the burner 36 flow upwardly through the firebox around the opposite sides of the oven liner as shown by the arrows, most clearly in FIG. 2. Those

sections of the outer liner 33 opposed to the vertical side wall 11 and 12 of the inner liner form therewith flue channels surrounding such vertical walls, and the flue gases proceed across the top of the oven liner through the top plenum chamber or heating channel 19 to the rear, as also shown by the arrows in the drawings.

An air supply duct **41** is arranged vertically behind the liner rear wall **13** and has a forwardly directed upper end section **42** having a discharge opening **43** and engaging the rear liner wall about the opening **28** in the latter behind the end of the top burner. A further discharge opening is provided in the lower end portion of the duct **41** in spaced register with the rear wall opening **40** behind the supply end of the bottom burner. The duct has an intermediate inlet opening **45**, through which air under pressure is admitted in a manner which will be described, and contains two dampers **46** and **47** respectively above and below this inlet, with these dampers operable by suitable linkages or the like, not shown, for control of the air supply to the top and bottom burners as will also be more fully explained hereinbelow.

The air supply duct **41** is in part enclosed by an exhaust manifold **48** which extends generally from about the midpoint on such duct to a point above the top of the latter. This manifold has a forward top extension **49** the end of which is against the rear wall **23** of the top plenum chamber **19**, and the abutting sections are formed with registering slots **50, 51** for outflow of flue products from the chamber. The manifold is, as shown most clearly in FIG. **3**, wider than the air supply duct, and its rear wall has two bottom outlets **52** respectively at the sides of the duct, so that flue products and the like entering the exhaust manifold can flow downwardly therethrough over the enclosed air supply duct **41** to and from such lower outlets **52**.

A heat exchanger designated generally by reference numeral **53** is associated with duct **41** and manifold **48**, with this exchanger illustrated as comprising a housing **54** having one end against the duct and manifold in the region of the inlet **45** of the former and outlets **52** of the latter. A regenerator wheel **55** having a multiplicity of axial passages is supported within the housing **54** on rollers **56**, with its axis horizontal, and such wheel is rotated relatively slowly by drive means shown as comprising an electric motor **57**, a drive gear **58** on the motor shaft, and a toothed ring **59** affixed about the wheel or drum. Channels **60** and **61** are horizontally disposed against the respective ends of the wheel **55** and effectively divide the same into top and bottom halves. A flow plate **62** is provided at the forward end of the housing **54** having an opening **63** in register with the inlet **45** of the air supply duct **41** and with the central section of the top half of the wheel **55**. Such plate is also provided with a pair of lower openings **64** respectively in register with the manifold outlets **52** and the bottom half of the wheel at the sections thereof outboard of the central section which corresponds to that in which the top half opening **63** is provided.

A second flow plate **65** is applied to the rear end of the housing **54**, and this plate has an opening **66** in register with the central section of the bottom half of the wheel **55** and upper openings **67** registering with the outboard sections at the top half, so that the openings of this second plate are in relatively inverted arrangement as compared to those of the first plate **62**.

A vertical exhaust duct **68** extends from the outer or rear flow plate **65** of the heat exchanger, from the bottom half opening **66** in such plate, to remote blower means designated generally by reference numeral **69** and, in the illustrated embodiment, adapted to be housed within the backguard assembly of the environmental kitchen range R. The exhaust duct **68** is enclosed within a large inlet air duct **70** having communication with the top half openings **67** of the rear flow plate **65**, with such inlet air duct also extending to the blower means **69** and above the upper end of the vertical exhaust duct **68**. Such blower means comprises an electric motor **71** having right and left hand fans **72** and **73** on its drive shaft, with the first fan **72** forcing room or ambient air into the upper end of the inlet duct **70** and the second fan **73** serving to draw flue products and gases from the upper end of the exhaust duct **68** and deliver the same through a discharge section **74** to the room. An air safety switch **75** is shown associated with the air supply fan **72**, this switch including a hinged closure **76** for the outlet of this fan which is displaced when the fan is operating to permit the switch to open. Such safety can of course be incorporated in the control system for the oven to insure that the latter cannot be operated unless the fan is supplying the pressurized air to the burner or burners.

It will accordingly be evident that relatively cool ambient air flows downwardly through the inlet duct **70**, and hence about the enclosed exhaust duct **68**, to the upper half of the slowly rotating regenerator wheel **55** through the flow plate openings **67**. Such supply air proceeds through the axial passages of the wheel and the forward flow plate opening **63** to the inlet **45** of the burner air supply duct **41** and, depending upon adjustment of the control dampers **46** and **47**, this air under pressure is delivered to either one or both of the burners **25 and 36**. The gases and vapors produced in the operation of the oven are drawn about the edges of the top oven baffle **24** into the plenum chamber **19** and proceed from this chamber downwardly through the exhaust manifold **48** and through the outlets **52** thereof and the forward flow plate openings **64** to the bottom half of the rotating drum or wheel **55**. These flue products proceed through the bottom half of the wheel, giving up heat thereto, then continue through the rear flow plate opeing **66** to the vertical exhaust duct **68** and the suction fan **73**.

This regenerator wheel type of heat exchanger is known and may comprise, for example, spirally wrapped corrugated asbestos sheet impregnated with sodium silicate. It will also be apparent that the incoming relatively cool air and the flue products exhaust are in heat exchange relationship in both the manifolding between the regenerator wheel and the oven and in the vertical ducting which extends over substantial distance from the other side of the regenerator wheel. *Such heat exchange structure thus provides multiple surfaces across the opposite sides of which the incoming air and the flue products or gases are caused to flow to recover heat from the latter, for example, the walls of the air supply duct 41 and the wheel 55 immediately at the rear of the oven liner, and the exhaust duct 68 in the continuation of the circulation system.* This heat exchange serves to lower the temperature of the ultimate exhaust to the room to such tolerable level that even the high temperature cleaning cycle can be carried out without the need for venting to the outside of the house. The use of pressurized air to the burners also permits conservation of the secondary air for combustion, whereby the heat output is also relatively diminished on this account. The housing for

the concealed bottom burner **36** can be provided if necessary with a plurality of apertures **77** to provide added secondary air in this area.

The controls for the oven have not been shown and will of course be conventional. As is also conventional, the top burner **26** is utilized for broiling and like operations in the normal use of the oven and, for this condition, upper damper **46** in the air supply duct **41** will be fully opened and lower damper **47** fully closed, whereby all of the room air supply is delivered to the top burner. As earlier noted, this burner could be of full radiant type, and it is also possible that the baffle **24** closely above the same could be made of or coated with a readily incandescing material or carry screening to be heated by the flame to add the baffle area as a radiating source.

For baking and roasting in the oven, only the concealed bottom burner **36** will be operative, with the air supply damper **47** full open and damper **46** fully closed. The heated products from the bottom burner of course flow upwardly through wrapper **33** over the exterior surfaces of the oven bottom **14** and enclosed portions of the side walls **11, 12** to and through the apertures **31, 32** respectively at the sides and from the latter to the top plenum chamber **19** for exhaust therefrom in the manner previously described.

It has been determined that the usual food soils which accumulate on the interior surfaces of a cooking oven can be incinerated at a temperature of about 750° F., and the oven herein disclosed is intended also for operation at and above this temperature. Such heat-cleaning cycle is carried out by simultaneous firing of both burners for combined radiant and convective heating effect, with the radiant effect provided by the top burner largely directed beneficially to the smooth bottom of the oven which usually receives most of the drippings and the like which cause the soiling. In such high temperature cleaning cycle, both of the air supply dampers **46** and **47** will preferably be half open for division of the pressurized air substantially equally to the two burners. The oven will be of course suitably insulated and preferably constructed to withstand cavity temperatures on the order of 1000° F.

The circulation of the products of the fully concealed bottom burner through the upper portion of the cooking cavity provides the disclosed single point of collection, in the top plenum chamber, for the exhausting of the cavity, which facilitates the handling of the exhaust and also the preferred heat exchange relationship of the incoming air therewith. The regenerator wheel used in this connection can be replaced by other exchangers of known design and, in some cases, the preheating of the incoming air may not be utilized, for example, where a higher level of exhaust heat might be tolerated. With adequate sealing of the cavity, a single fan at either the supply or exhaust might also serve to provide the desired circulation, but the two fans used as disclosed conveniently provide by adjustment or selection thereof either a negative or positive pressure to be maintained within the cavity as desired. It has, for example, been found that a slight positive pressure can be beneficial in the heat cleaning of the oven door surface, and this condition can readily be realized by using fans of suitable differing capacity. A more sophisticated system might provide variation of the pressure over a range of negative and positive values within a time-controlled operating cycle.

[Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims or the equivalent of such be employed.]

I, therefore, particularly point out and distinctly claim as my invention:

1. A domestic oven comprising a liner forming a cooking cavity having top, bottom, side and rear walls, the bottom walls being substantially smooth and imperforate, broiler burner means mounted in the upper portion of said cavity, with the top wall thereabove having an opening for exhaust of the cavity, bake burner means disposed exteriorly of the cavity, means for delivering combustion air under pressure selectively to either the broiler or bake burner or both, means for circulating the heated products from the bake burner in operation over exterior surfaces of the bottom and side walls, the latter being provided with openings for inflow of such heated products to the cavity and exhaust therefrom through the top wall opening, and means for directing the flue products from such top wall opening to a remote discharge.

2. A domestic oven comprising a liner forming a cooking cavity having top, bottom, side and rear walls, the bottom wall being substantially smooth and imperforate, broiler burner means mounted in the upper portion of said cavity, with the top wall thereabove having an opening for exhaust of the cavity, bake burner means disposed exteriorly of the cavity, means for circulating the heated products from the bake burner in operation over exterior surfaces of the bottom and side walls, the latter being provided with openings for inflow of such heated products to the cavity and exhaust therefrom through the top wall opening, means for directing the flue products from such top wall opening to a remote discharge, and means for delivering ambient air to at least one burner in heat exchange relationship to the flue products withdrawn from the cavity.

3. A domestic oven comprising a liner forming a cooking cavity having top, bottom, side and rear walls, the bottom wall being substantially smooth and imperforate, broiler burner means mounted in the upper portion of said cavity, with the top wall thereabove having an opening for exhaust of the cavity, bake burner means disposed exteriorly of the cavity, means for circulating the heated products from the bake burner in operation over exterior surfaces of the bottom and side walls, the latter being provided with openings for inflow of such heated products to the cavity and exhaust therefrom through the top wall opening, means for directing the flue products from such top wall opening to a remote discharge, and means for delivering ambient air under pressure selectively to one or both of the broiler and bake burners in heat exchange relationship to the flue products exhausted from the cavity.

4. A domestic oven comprising a liner forming a cooking cavity having top, bottom, side and rear walls, the bottom wall being substantially smooth and imperforate, broiler burner means mounted in the upper portion of said cavity, with the top wall thereabove having an opening for exhaust of the cavity, bake burner means disposed exteriorly of the cavity, blower means for causing ambient air to flow to the burners under a pressure differential, flow-regulating means for directing such ambient air flow substantially fully to either the broiler or bake burner, respectively for broiling and baking operations, or dividing the flow between the two

burners for joint operation thereof at a relatively high-temperature self-cleaning cycle, means for circulating the heated products from the bake burner in operation over exterior surfaces of the bottom and side walls, the latter being provided with openings for inflow of such heated products to the cavity and exhaust therefrom through the top wall opening, and means for directing the flue products from such top wall opening to a remote discharge.

5. A domestic oven comprising a liner forming a cooking cavity having top, bottom, side and rear walls, the bottom wall being substantially smooth and imperforate, broiler burner means mounted in the upper portion of said cavity, with the top wall thereabove having an opening for exhaust of the cavity, bake burner means disposed exteriorly of the cavity, first fan means for delivering ambient air under pressure to at least one burner, means for circulating the heated products from the bake burner in operation over exterior surfaces of the bottom and side walls, the latter being provided with openings for inflow of such heated products to the cavity and exhaust therefrom through the top wall opening, and second fan means for withdrawing the flue products from the cavity through the top exhaust opening thereof to a remote discharge.

6. An oven as set forth in claim 5, including an electric motor commonly driving the first and second fan means in counter-rotating relation.

7. An oven as set forth in claim 6, including means for bringing the ambient air delivered by the first fan means into heat exchange relationship to the flue products exhausted by the second fan means.

8. The method of heating the walls of a baking oven for the heat cleaning of soils from the interior wall surfaces of both an oven liner and an access door defining an oven cooking cavity which includes soils accumulated thereupon during the previous carrying out in said oven cavity of normal food cooking operations in the normal food cooking temperature range; said method comprising generating flue gases by a gas burner located in a fire box beneath the bottom of the oven liner, directing the flue gases up around the opposite sides of the oven liner and across the top of the oven liner and then down the back portion of the oven liner, passing the flue gases over a heat exchanger surface and then exhausting the flue gases to the atmosphere, while at the same time passing relatively cool ambient air over the exchanger surface so as to use the heat from the flue gases to heat the ambient air, then supplying the heated air as preheated secondary air for the gas burner, whereby the heat recovered from the flue gases lowers the exhaust temperature of the flue gases to the temperature range between about 300° F. and 550° F. and also increases the efficiency of combustion of the gas burner, so as to reduce the consumption of fuel and hence the amount of the exhaust gases and the total heat in the exhaust gases.

9. A self-cleaning gas cooking oven comprising an oven body supporting a box-like oven lineer and a front-opening access door which define an oven cooking cavity, a fire box disposed beneath the bottom wall of the oven liner, a gas burner located within the fire box, heating channels extending up to the opposite side walls back across the top wall and down the rear wall of the oven liner and communicating with the fire box so that convection currents of flue gases from the burner may pass through the channels thereby heating the walls forming the oven cooking cavity, a vertically arranged stationary heat exchanger located adjacent at least one of the heating channels, a flue gas inlet at the bottom of the heat exchanger, and a flue gas outlet at the top of the heat exchanger, an ambient air inlet at the top of the heat exchanger and an ambient air outlet at the bottom of the heat exchanger, said ambient air outlet supplying heated air to the fire box as pre-heated secondary air for the burner, whereby the flue gases flowing through the heat exchanger give up much of their heat to the ambient air.

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