May 5, 1964 N. J. LIPSTEIN 3,131,688

AIR TREATMENT MEANS FOR DOMESTIC COOKING APPLIANCES

Filed Oct. 8, 1962 3 Sheets-Sheet 1

Fig. 1.

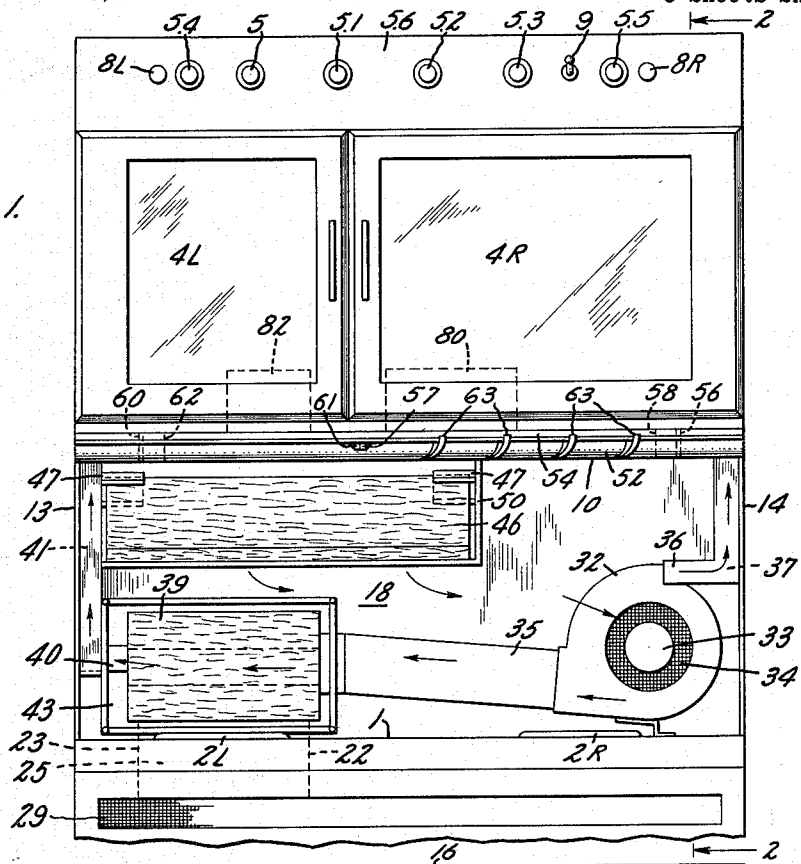
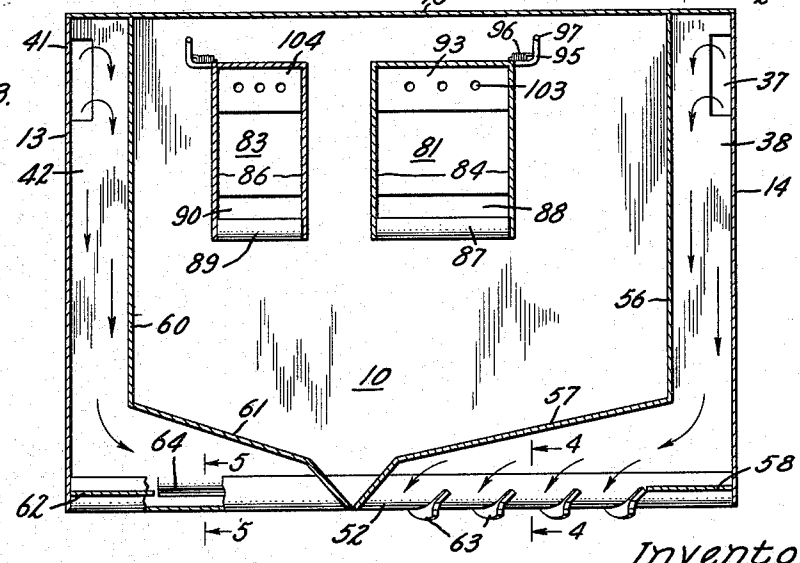


Fig. 3.



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AIR TREATMENT MEANS FOR DOMESTIC COOKING APPLIANCES

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Fig. 2.

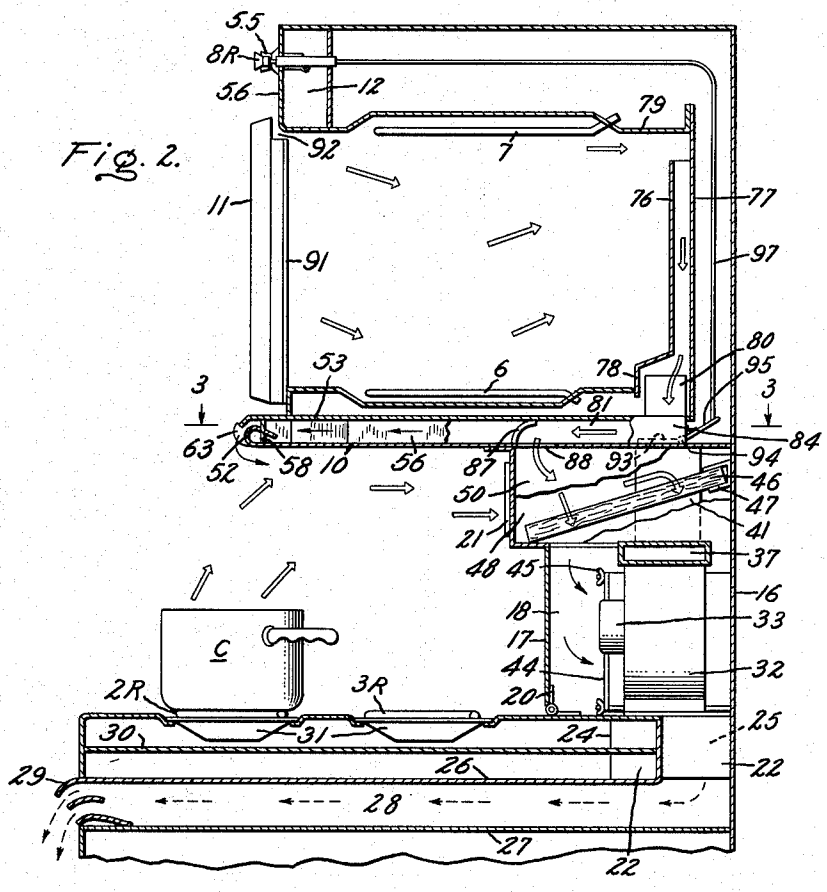

Fig. 4.

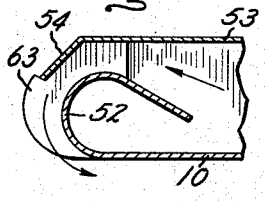

Fig. 5.

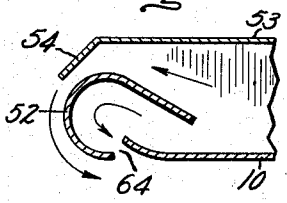

Fig. 10.

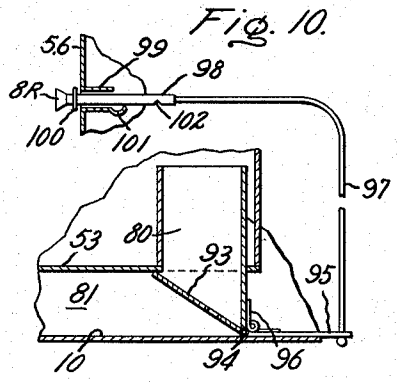

Fig. 11.

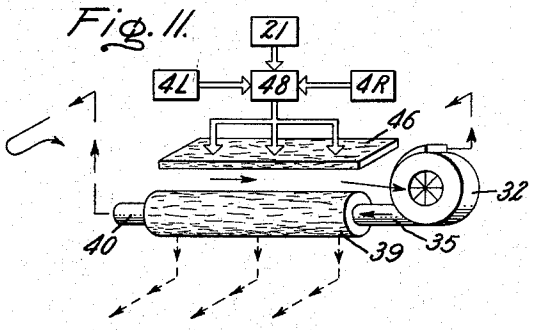

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Fig. 6.

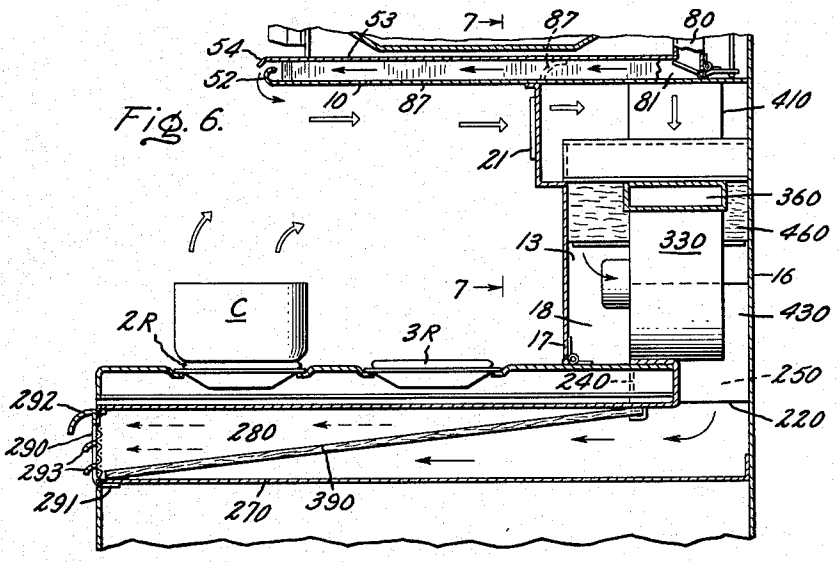


Fig. 7.

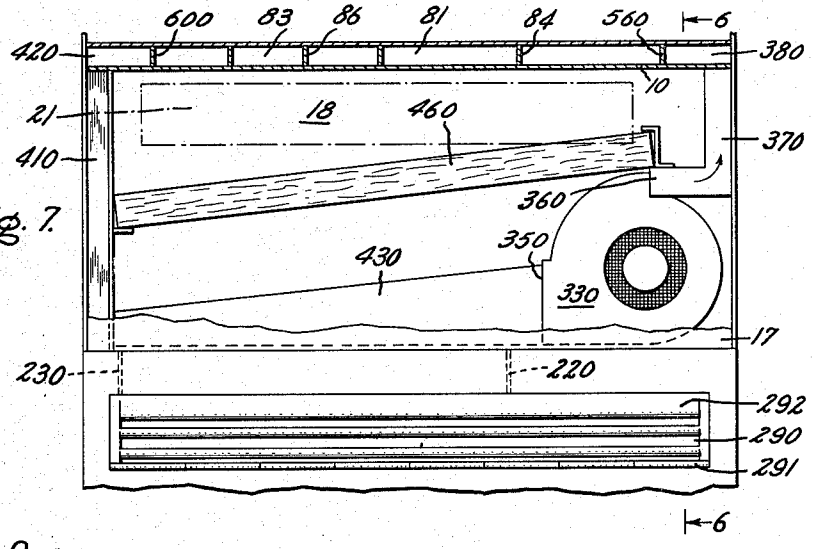


Fig. 9.

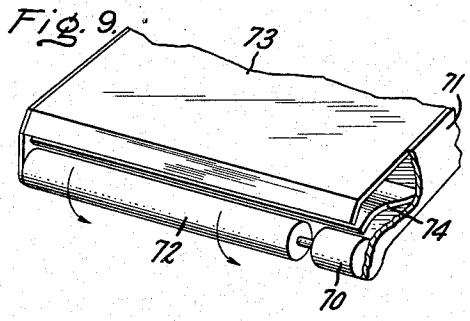
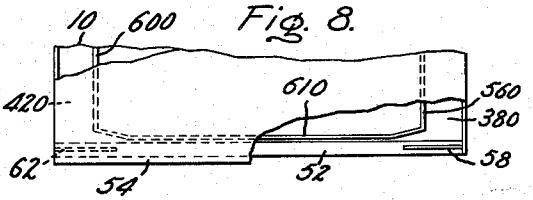


Fig. 8.



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United States Patent Office 3,131,688 Patented May 5, 1964

3,131,688

AIR TREATMENT MEANS FOR DOMESTIC COOKING APPLIANCES

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Filed Oct. 8, 1962, Ser. No. 228,864
17 Claims. (Cl. 126—299)

This invention relates to apparatus for filtering and otherwise conditioning air containing smoke and vapors resulting from cooking operations, to permit the air to be re-circulated within the kitchen without unpleasant effects on the occupants or furnishings of the kitchen.

It has been generally accepted practice to use a suction fan to move the smokes and greasy vapors into a ducting system which discharges exteriorly of the building. In the average residential installation such systems are grossly inadequate. Smoke and vapor droplets are "captured" by entrainment in a moving air stream, and it is known that air velocity decays very rapidly with increasing distance from the suction intake. To accomplish even a tolerable level of smoke and odor removal, therefore, suction systems require blower performance far beyond residential acceptances. Also, ducting runs are costly, in the length usually required in residences; offer substantial resistance to air movement; and provide condensation surfaces on which grease and moisture will collect.

Recirculation systems have recently come into use. Such systems, as exemplified by the disclosure in Scharmer U.S. 2,886,124 of May 12, 1959, utilize in association with a hood arranged over the cooking range, a suction fan which draws air through a grease entrainment filter, passes it through some odor adsorbent mechanism, and then discharges it into the kitchen. Such units can be reasonably adequate if the blower intake is located within the collection hood immediately above the cooking surface of the range, and the blower is sufficiently powerful to move the air adequately through the several filtering devices. A basic limitation of substantial commercial importance is that these so-called "ductless hoods" cannot be used in new ranges of the type in which the ovens are located above the cooking surface. The rather large bulk of the oven structures interposes a substantial handicap to the flow of air to the suction intake and requires the suction intake to be too far from the cooking surface for adequate suction velocity immediately above the cooking surface. Also, there are presented large structural areas which will be wiped by the contaminated air rising from vessels on the cooking surface. Moisture and grease will condense on these surfaces, which are relatively cool.

The present invention provides a novel air translating mechanism in which a jet flow is used in combination with suction flow to entrain the contaminated air and move it through the filtering systems. Because of the improved air velocities accomplished by this combination, the suction intake may be positioned in wall structure at the rear of the cooking units on the range cooking surface, and yet provide air displacement which will entrap substantially all of the contaminants rising from the cooking units at the front of the cooking surface. Location of the suction intake and air translation mechanism at the rear of the range makes the present invention efficiently adaptable to high oven ranges, for the intake may be below the ovens, and air flow to the intake does not envelop the oven fronts or the oven control switches or valves which are usually on a panel above or to the side of the oven structures.

Pursuant to the presently preferred embodiment of the invention, the air translation mechanism and air conditioning devices are so arranged that air from the cooking

surface enters a suction inlet located in a rear wall immediately below the ovens, passes through a grease filter, and then enters a blower. Thus, sub-atmospheric pressure is present in the flow pattern between the inlet and the grease filter. During broiling operations conducted within an oven, air flow communication is provided between the oven and the blower, thereby maintaining the oven chamber at a sub-atmospheric pressure to prevent oven fumes and vapors from entering the kitchen directly.

Approximately three-fourths of the blower air discharges into a charcoal filter which traps and adsorbs the particulate smoke and odor generating substances. It will be observed, therefore, that about one quarter of the contaminated air, from which grease droplets have been removed by passage through the grease filter upstream of the blower, bypasses the adsorbent filter. As will presently be noted, however, the bypassed air is used to establish a jet flow which intercepts cooking vapors issuing from vessels on the surface cooking units, and enforces flow thereof to the suction intake. Thus, the contaminants in this flow are confined to the range circuit and are eventually removed by the filters. The bypassed air is discharged in a sheet-like jet flow below and substantially at the front edge of the ovens in a high oven range. In such a range this front edge is a little to the rear of the center line of the front cooking units on the cook top. The jet flow issues from structure which is above the cooking vessels on the front units, and cannot interfere with the use of the cooking vessels or with the use of the ovens. Optimum entrainment without interference with cooking operations occurs when the jet effects a cyclonic flow with axis below and essentially parallel to the front surface of the oven. This "cyclone" induces a velocity field over the front surface units which is directed vertically downward and towards the rear of the range. Cooking contaminants are contained within this induced velocity field and are thereby swept toward the suction intake of the air treatment system. For maximum effectiveness it is essential that the entire "cyclonic" flow and the associated jet enter the suction intake so as to prevent the escape of cooking smoke and vapors from the air treatment system.

The jet method which establishes the cyclonic flow described, and can contain the flow within the air entering the suction intake without detracting from the appearance of the range, utilizes the "Coanda effect" of jet deflection over a curved surface. Briefly stated, the phenomenon that a jet in unconfined space will attach itself to an adjacent surface is called the "Coanda effect." Within limits the jet will remain attached to a curved surface such as a cylinder. These limits can be greatly extended if the cylinder is rotated so as to reduce the relative velocity between the deflecting surface and the jet.

In the present invention, one or more jets of air issuing from below the forward edge of the oven structure, and discharging directly over a turning or Coanda tube, are reversed in their direction of flow and assume a flow path toward the suction intake at the rear of the range. It is the entrained air flow entering the jet rather than the jet flow itself which captures the contaminants. The velocities in the entrainment field are of a lower order of magnitude than in the jet itself and, in fact, have been found to be of the same order as convection currents over a pot of boiling water. This indicates that the velocities of the entrainment field are influenced by the heat input of the forward cooking units. Experimental data establish that in an embodiment of the invention described in detail hereinafter, in which the Coanda tube is approximately fifteen-sixteenths of an inch in diameter, and the entire jet assembly has a depth of about one and one-quarter inches, substantially one hundred percent of the contam-

inants are collected from a front cooking unit operating at "medium high" heat. The air movement requirements are 150 cubic feet per minute of suction flow, and 40 cubic feet per minute of jet flow. Equivalent results under maximum heat output from a surface unit may be obtained by increasing the thickness of the jet nozzle and comparably increasing the diameter of the Coanda tube.

A principal object of the present invention, therefore, is to provide a mechanism for purging air of smoke and greasy vapors generated during a cooking operation.

A further object of the invention is to provide an air conditioning system using a combination of jet flow and suction flow as a mechanism for effecting translation of air through filtering devices.

It is another object of the invention to provide in a cooking appliance having surface cooking units and one or more ovens located above the units, an air treatment system capable of collecting a large portion of odorous and greasy contaminants issuing from cooking vessels on the surface cooking units and from the ovens.

It is yet another object of the invention to provide in a cooking appliance in which broiling is performed, an air treatment system which permits the broiling operation to be conducted in a closed oven chamber while continuously withdrawing air therefrom, and removing smoke and odor constituents from the air, whereby the air may be discharged into the kitchen without unpleasant effects on the occupants thereof.

It is another object of the invention is provide a single air treatment system which is capable of simultaneously collecting a large portion of the contaminants issuing from cooking vessels on the surface cooking units and from the oven broiling operation.

Other features and objects of the invention will be understood from the following detailed description of presently preferred embodiments thereof, read in connection with the accompanying drawings in which:

FIG. 1 is a front elevational view of a high double oven cooking range embodying one form of the present invention, the front panel of the filter chamber having been removed to disclose the mechanism therein;

FIG. 2 is a side sectional elevation of the range of FIG. 1 taken on lines 2—2 of FIG. 1;

FIG. 3 is a plan section taken on lines 3—3 of FIG. 2;

FIGS. 4 and 5 are side sectional elevations taken through the jet outlet structure, respectively taken on lines 4—4 and 5—5 of FIG. 3;

FIG. 6 is a fragmentary side sectional elevation taken on lines 6—6 of FIG. 7, showing a second arrangement of filtering mechanisms;

FIG. 7 is a front elevational view of the filtering mechanism of FIG. 6;

FIG. 8 is a fragmentary plan view of the jet discharge structure of the FIG. 6 embodiment;

FIG. 9 is a somewhat schematic perspective view of an entrainment jet structure having a rotating tube;

FIG. 10 is a schematic detail of the oven exhaust damper; and

FIG. 11 is a schematic view of the air flow pattern of the FIG. 1 embodiment.

FIG. 1 illustrates a "high oven" range in which the general structure includes a "cooking surface" 1 having a suitable plurality of surface cooking units, on which cooking operations such as boiling and frying are conducted. In accordance with presently conventional arrangements there are four such surface cooking units, arranged two adjacent the front of the cooking surface, and two near the rear thereof. The two front units are identified as 2–R and 2–L in FIG. 1; in FIG. 2 a rear unit is identified as 3–R. The ovens are identified by 4–R and 4–L in FIG. 1; the right hand oven 4–R is a large "family-sized" oven, and the left hand oven 4–L is a substantially smaller one. The surface cooking units and ovens may be heated by electric resistance heaters or by gas, for the mode of heating is immaterial to the present

invention. In view of the fact that applicant's assignee herein manufactures only electric cooking ranges, it will be assumed that the cooking units and ovens embody electric resistance elements of the type respectively shown in Vallorani et al. 2,662,158, granted December 18, 1953, for "Heating Unit and Method of Making the Same," and Quirk 2,850,612, granted September 2, 1958, for "Electric Baking and Broiling Ovens." Each of said patents is assigned to the assignee of this invention and application. Appropriate switch means 5, 5.1, 5.2, and 5.3 for control of the surface units, and 5.4 and 5.5 for control of the ovens, are disposed on a control panel 5.6 extending across the top of the oven. Said switch means may be of any conventional pattern, and electrically connect to the respective heating elements in well understood fashion. Each of the ovens has a lower heating unit 6 and an upper heating unit 7. Pursuant to conventional practices, unit 6 is energized at full rated wattage and unit 7 at one-quarter rated wattage during baking or roasting operations, and unit 6 is deenergized and unit 7 energized at full rated wattage during a broiling operation. The control panel 5.6 also includes a damper actuator for each of the ovens; said actuators are shown as pull knobs 8–R, 8–L, and are associated wtih mechanism later described. A toggle switch 9, of conventional single pole, single throw type, controls power to the blower motor, presently described.

The range structure is such that there is approximately twelve inches clearance between the top of the respective surface cooking units and the over-lying wall 10. It will be noted that the front edge of said wall 10 is a little to the rear of the center line of the front cooking unit 2–R, as viewed in FIG. 2. Also, the front 11 of the oven door is substantially in the same relationship to the center line of the unit. In cooking ranges not embodying the present invention, steam and greasy vapors rising from a cooking vessel C on a front unit would in substantial part pass upwardly in contact with the face of the oven door and other vertical surfaces. Some of the water vapor or grease vapor would condense out on the door, and some would condense out on the panel 5.6. Such a situation is unsatisfactory because it introduces difficult cleanability problems and may cause control switch failure if water vapor enters the space 12 within which the switch mechanisms are housed.

The range structure further includes wall means providing the respective end walls 13 and 14 rear wall 16, and front wall 17, of a relatively deep compartment 18 extending the full width of the range. Front wall 17 is hinged to the cook top 1 as by the hinge 20. Any suitable latch means (not shown) may be provided to releasably secure the wall 17 in a normally upright position, while allowing it to be swung forwardly for access to the interior of the chamber. The upper portion of front wall 17 is provided with an inlet grille 21 which extends from the left side wall 13 for about two-thirds of the width of the wall. This dimension or relation to the width of the wall is not a critical factor.

Also, the range structure includes wall means 22 and 23, cooperating with the above-noted rear wall and a wall 24 to provide a passageway 25 which collects air issuing from the charcoal and particulate matter filtering system as presently described, and walls 26 and 27 which with side walls 13 and 14 define a passageway 28 through which the air moves to a point of discharge identified by the grille 29 at the front of the range. Completing the description of the basic structure, a transverse wall 30 provides a drip-catching facility below the removable reflector bowls 31, with which electric surface units are usually equipped.

Looking now at FIGS. 1 and 3, the air translation system includes a blower 32 of the familiar bladed wheel type, driven by a direct-mounted motor 33 partially housed within the inlet 34 of the blower casing, as is common practice. The blower casing has a main discharge 35 and

an auxiliary discharge 36, the latter being provided by an offset in the casing, as shown. Discharge 36 communicates directly with a duct 37, discharging into the Coanda jet manifold 38. Discharge 35 is piped directly into an odor absorbent filter 39, which also serves to trap particulate matter. In the embodiment shown, the filter may comprise an accordion pleated cylinder of asbestos material coated with charcoal. The material of filter 39 is such that air may pass relatively freely through its walls. In the presently preferred design parameters, about 12% of the blower discharge passes through outlet 36, and 88% through outlet 35. Of the 88% entering the filter 39, about 12% exits axially through a tube 40 communicating with a duct 41, serving the Coanda jet manifold 42. The remainder passes through the walls of the filter 39 to enter the chamber 43 within which the filter is housed. The filtered air passes from chamber 43 and duct 25 to the passage 28. As suggested in FIG. 2, the chamber 43 is closed by a cover plate 44 (removed in FIG. 1) said plate having a wing nut fastening system 45, permitting easy removal for access to the filter. Within the compartment 18 housing the air translation system, and substantially coextensive with the inlet grille 21, is a grease filter 46 removably supported on suitable brackets, such as bracket 47. Said filter may be of glass or metal fibers, or other fire resistant materials, capable of entrapping grease particles. The filter 46 is within an open-bottomed header 48 formed in part by the range structure walls 13, 16 and 17 and a wall 50, to prevent short-circuiting of air flow relative to the filter 46.

It has previously been noted that a collection system based solely on suction intake is a most extravagant way of fume and smoke collection from cooking vessels located on the front cooking units of a range. The smoke and vapor droplets are captured by entrainment in a moving air stream; the drag due to relative motion between the air and the particle conveys the particle with the flow. I have found that the problem is essentially not one of velocity magnitude, but rather of establishing a flow of even minimal velocity above the forward cooking units, and directing that flow so that it enters the suction intake. In systems embodying only flow induced by suction, the velocity decays very rapidly; the velocity of the air stream at the forward edge of the oven, for example, is only a small fraction of that at the suction intake. The present invention consists in establishing a combination of jet flow and suction flow which carries the contaminants from the front surface units toward the suction intake. This is accomplished by causing the air issuing through the passages 36 and 41 to discharge as a wide, thin jet directly over a turning or "Coanda" tube. The flow is discharged toward the cook top center line at an angle of from 80° to 60° from the front to rear axis of the range. This angle, hereinafter identified as the beta angle, causes the jet to twist around the Coanda tube and form a vortex or cyclonic motion on the underside of the oven.

Referring now to FIGS. 4 and 5, the turning tube is advantageously formed by circularly forming the front edge of the wall 10 to provide the cylindrical portion 52. In overlying relation to the turning tube I provide a wall 53 which is preferably coextensive with wall 10 and in parallel spaced relation thereto. A lip 54 of wall 53 slopes downwardly toward the turning tube at an angle of the order of 45° from the horizontal. The spacing and angular relationship of the lip 54 to the tube provides a jet flow having a thickness ranging between ⅛" and 1/32", as later explained.

As best shown in FIG. 3, the jet stream may be applied in an assymetric air flow system. The duct 38, which is formed in part by the range structural walls 10, 14, 16 and 53, the internal walls 56, 57, and the short frontal wall 58, has substantially greater discharge length than is provided for duct 42. The latter duct is formed in part by the structural walls 10, 13, 16 and 53, the internal walls 60, 61, and the short frontal wall 62. It will be noted that the walls 57 and 61 join at their forward ends, whereupon the jets supplied by the ducts 37 and 42 issue independently over the turning tube. It will be noted in FIGS. 3 and 4 that the right hand jet area is equipped with a plurality of directional vanes 63 which assist in establishing air discharge at a beta angle of from 70° to 80°. The jet thickness of this right hand area is about ⅛". The left hand jet area does not have directional vanes, but as best shown in FIG. 5, the wall 10 is slit along the length between the rightward end of wall 62 and the juncture of the walls 61 and 57, and is bent upwardly to form the supplemental discharge slot 64 which is of the order of ⅛ of an inch in width. A portion of the air passing through the duct 42 will be deflected by the inner wall of the turning tube to pass through the slot 64 to move rearwardly along the wall 10. Above the turning tube, however, the jet is preferably of the order of 1/32 of an inch. Each of the discharging jets follows the contour of the turning tube and is directed rearwardly along the wall 10.

It has previously been noted that the wall 10 is about twelve inches above the cooking surface. It is therefore apparent that the air inlet grille 21 is substantially above the tallest cooking vessel useable on any of the cooking elements.

In the embodiments of FIGS. 6, 7 and 8 the grease filter and particulate filter is shown as 460 and the charcoal filter as 390. A redistribution and relocation of the filtering functions in this manner affords an opportunity to obtain more effetcive odor control and increased filter surface. Essentially, the basic structure of the air translation mechanism is as in the first embodiment; the hinged wall 17 has an air inlet grille 21 which, in this instance, may extend substantially the full width of the range. Behind wall 17, in the compartment 18 defined by other wall structures as previously noted, the blower 330 has a discharge 360 from its housing. Discharge 360 supplies the duct 370 communicating with the jet supply duct 380; the principal discharge 350 connects to the manifold 430 which terminates in the vertical duct 410 serving the jet supply duct 420. A bottom discharge opening in manifold 430 communicates with the passage 250 supplying the passage 280 within which the charcoal filter 390 is located.

The grease filter 460 extends substantially the length of the blower compartment 18, and as indicated in FIG. 6, extends the depth of the compartment as defined by the lower portion of the walls 17 and the rear wall structure 16. In this arrangement it is not necessary to provide baffle plates or guard walls to prevent short circuiting the filter. The passage 250 into which manifold chamber 430 discharges, is defined by walls including walls 220 and 230, and the wall 240 at the rear cook top structure. The duct 280 of the FIG. 6 embodiment is substantially deeper than its counterpart in FIG. 2 so as to accommodate the charcoal filter 390. This filter may comprise a tray-like structure having a width substantially equal to the width of the grilled outlet 290 so that air cannot discharge through said outlet without having been in contact with filter 390. Because of the location of this filter the grilled outlet 290 may advantageously be formed as part of a wall hinged to the wall 270 as by the piano type hinge 291. A deflection plate 292 and baffles 293 divert the discharging air downwardly; plate 292 also provides a handle-like structure by means of which the hinged wall may be swung. Any suitable catch or latch (not shown) may releasably hold the grilled wall in its closed position.

The turning tube 52 and walls 10 and 53 are identical with the previous embodiment, but the air flow to the Coanda jet nozzle is symmetrical and no deflection vanes 63 are used. As best shown in FIG. 8, the respective ducts 380 and 420 are defined by walls 560 and 600, which reach nearly to the front of the structure, and then angle sharply to connect with a wall 610 which extends parallel to the tube 52 about one inch to the rear of the

lip 54. This arrangement provides a beta angle of the order of 60°. The end walls 58 and 62 block off about four inches of the jet opening at each end.

In FIG. 9 I have illustrated a jet and turning tube combination in which an electric or air-powered motor 70 mounted on wall structure 71 rotates a cylinder 72 to which jet forming structure is related in a manner similar to the foregoing embodiments. The jet opening is formed by the upper and lower walls 73 and 74, corresponding in general function to the walls 53 and 10 of the other embodiments. Wall 74 is configurated as shown to bring the issuing air stream into proper angular relationship to the cylinder 72. The peripheral velocity of the cylinder need only be a small fraction of the jet efflux velocity to greatly increase the deflection of the jet around the tube.

It is well known in the cooking art that broiling operations in electrically heated ovens are now conducted with the oven door in an ajar position, so that the oven temperature will not exceed the temperature at which the oven thermostat will cycle the broil unit. Usually the "broil" designation of an oven thermostat corresponds to a cycling temperature of about 550° F. However, substantial amounts of greasy smoke are generated during broiling operations; this smoke literally billows through the door opening, and has been a persistent source of customer complaint. In contrast to broiling operations, baking and roasting operations are carried out at lower temperatures which are not usually generative of smoke, and only moderate oven ventilation is required. The present invention provides for "closed door" broiling, and means whereby the greasy vapors are passed through the filtering system so that in-kitchen discharge of the conditioned air is without unpleasant effect.

In Swetlitz application, Serial No. 189,006, filed April 20, 1962, for "Domestic Appliance" and assigned to my present assignee, there is disclosed an electric cooking oven in which removable side, bottom and rear internal panels afford unusual cleanability and oven wall temperature reduction. The rear wall panel, such as the panel 76, FIG. 2, is formed with marginal side wall flanges which space it about one-half inch forward of the oven rear wall 77. Said panel has a forward offset 78 at its base. As apparent in FIG. 2, the panel 76 terminates short of the top wall 79 of the oven. At the rear of the base wall of the larger oven I provide a rectangular conduit 80 in direct communication with the forwardly extending passage 81. Similar wall structure in the smaller oven provides the conduit 82 (FIG. 1) in communication with the forwardly extending passage 83. Said passages 81 and 83 are defined by appropriate wall means 84, 86, respectively, within the space between the horizontal wall structures 10 and 57; the front wall of passage 81 may be curved, as shown at 87, FIG. 2, to direct air through an opening shown at 88. A similar wall 89 and opening 90 are provided for the passage 83 of the smaller oven. It will be understood that the openings 88 and 90 communicate with the manifold chamber 48 within which is housed grease filter 46, said chamber being defined in part by the wall 50 and the rear wall 16 of the range structure, as previously noted. For the illustrated size relationship of oven 4–R to oven 4–L, the area of the passage 80 may be of the order of eight square inches, and that of the passage 82 about four square inches. In each oven the door is gasketed along the bottom and two sides as indicated at 91, FIG. 2, but is ungasketed across the top, whereby to provide a passage 92 for inlet of fresh air to the oven.

It has been noted that air movement through the oven in quite substantial volume is required during broiling operations, whereas the ventilation required for baking and broiling is largely a matter of disposing of the moisture which is given up by the foods. I therefore provide a damper at the base of each of the passages 80 and 82, said dampers being manually operable by the push-pull knobs 8–R and 8–L, respectively. As suggested in FIG. 10, a plate-like damper 93 is disposed at the intersection of passages 80 and 81, being fitted with any suitable hinging device 94. An actuating arm 95, fixed to the plate 93, is arranged in operative association with a spring 96 which biases the damper in clockwise roation. An actuating wire 97 of the flexible-case "Bowden" type is fixed at one end of the arm 95, and at the other end to a shaft 98, the outer end of which carries the button 8–R. Said shaft rides within the tubular guide 99 fitted to the panel 5.6. A shoulder 100 on shaft 98 abuts the panel 5.6 to limit movement in one direction; the guide 99 has a detent finger 101 engageable with a notch or the like 102 of the shaft to establish the fully open position of the damper, this being the position for the broiling operation.

Although it would be quite possible to provide means for intermediate damper adjustments to provide the restricted air discharge for baking and roasting, it seems preferable to have the damper assume either an open or a shut condition and to provide openings such as the openings 103, shown in the damper 93, FIG. 3. Because baking and roasting operations are generally more numerous than broiling in the normal use of a domestic range, the dampers are arranged to assume their normally closed, FIG. 10, position.

The damper 104 for the discharge 82 may be similar to damper 93, and similarly actuated.

FIG. 11 is a schematic representation of the air flow and filtering mechanism of the FIG. 1 embodiment. The outlined arrows represent air contaminated by cooking vapors; the single line arrows represent air which has had some treatment, such as passing through the grease filter; and the dotted arrows represent completely conditioned air which passes through the absorbent filter and issues into the kitchen at the front of the range. It is apparent, therefore, that it is the purpose of the charcoal and particulate filter 39 to condition the air for in-kitchen discharge. In all such filters the efficiency increases with the pressure drop therethrough. In the present invention, optimum performance within the dimensional limitations imposed by the range structure is obtained by causing a portion of the air to bypass the filter 39. It would normally be expected that bypassing would reduce the efficiency of the filter. However, in the present invention the bypassed air is ejected in a manner insuring its recirculation into the filter intake as part of the contaminated air flow thereinto. The contaminants in this recirculation flow are confined to the range circuit, and are eventually removed by the filters. In brief, this bypass flow:

A. Relieves the restriction of the charcoal filter;
B. Improves blower capability; and
C. Supplements suction flow for collection of contaminated air issuing from surface cooking units.

In the embodiment of FIGS. 1 through 5, and assuming that both ovens are broiling, approximately 52 c.f.m. air enters by way of the ovens (33 c.f.m. through 4–R and 19 c.f.m. through 4–L) and only about 90 c.f.m. enters the system through the inlet grille 21. The resistance of the inlet grille reduces the pressure in the plenum upstream of the grease filter. This is necessary for operation of the ovens; a pressure drop equivalent to about 0.07 inch water is required for satisfactory ventilation of both ovens. The oven flows noted above were adequate to prevent thermostat cycling during broiling of a one-and-one-half inch thick steak in each oven.

The system resistance of the flow circuit is appreciably affected by the operation of the ovens. For example, with both ovens in operation, the system's resistance is approximately 375 resistance units, requiring the blower to provide 0.81 inch of water static pressure at 200 c.f.m.; whereas with the ovens out of service the resistance rises to about 535 units, requiring the blower to provide 1.34 inches of water static pressure at 200 c.f.m. This reduction in resistance when the ovens are broiling, results from the fact that the inlet grille is then partially bypassed.

The arrangement disclosed in FIGS. 7 and 8 affords an appreciable reduction in blower requirement, for the elimination of the cannister type charcoal and particulate filter 39 of FIG. 1, and the substitution therefor of the filter 390, renders the chamber 430 available as a blower discharge diffuser. The resistance of air flow into the cook top discharge duct, which in the FIG. 1 embodiment represents almost 25% of the total circuit resistance, is reduced to the extent that blower pressure would rise by the order of 0.2 inch water static pressure at 200 c.f.m.

An air conditioning system has been described which can collect contaminant laden air and after suitable filtration return the purified air to the kitchen. With simple modification the system can be adopted for exhausting the air outside of the kitchen via a suitable run of ducting. For this purpose the charcoal filter 39 or 390 in embodiment FIGURES 1–5 or 6 and 7 respectively, would be eliminated. Duct 25 would be closed off by a plate (not shown), and a knock-out in wall 16 provided for the accommodation of an external venting duct communicating with manifold 43 of FIG. 1, or 430 of FIG. 7. The elimination of the charcoal filter from the circuit compensates for the pressure required for the external discharge duct. Thus no additional adjustments are required in the blower circuit. The respective grease and particulate filters 46 and 460 remain in the flow circuit upstream of the blower so as to protect the interior of the range and the external ducting from grease accumulation.

While there have been described what are at present thought to be the preferred embodiments of the invention, it will be understood that various modifications may be made therein and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

I claim as my invention:

1. A cooking appliance comprising, in combination:
structure providing a horizontal cooking platform having at least one heating element on which to place a cooking vessel;
structure providing an upstanding wall rearwardly of said cooking platform, said wall having an air inlet opening;
an air blower behind said wall, said blower having air inlet means and air outlet means;
wall means providing an air inlet duct communicating between said blower inlet means and said wall opening;
air filtering means in said inlet duct;
means providing a passage communicating with said blower outlet means and extending forwardly of said upstanding wall to terminate above said heating element;
means for discharging a sheet-like flow of air in a generally forward direction from said passage;
and means for reversing the direction of travel of said sheet-like flow whereby said air is confined to a path which is wholly above and substantially parallel to said cooking platform and enters said air inlet duct through said wall opening.

2. A cooking appliance comprising, in combination,
structure providing a horizontal cooking platform having adjacent the front edge thereof at least one heating element on which to place a cooking vessel;
structure providing an upstanding wall rearwardly of said cooking platform, said wall having an air inlet opening;
an air blower behind said wall, said blower having air inlet means and air outlet means;
wall means providing an air inlet duct communicating between said blower inlet means and said wall opening;
air filtering means in said inlet duct;
means providing a first passage communicating with said blower outlet means to receive a portion of the air issuing therefrom, said passage extending forwardly of said upstanding wall to terminate above said one heating element;
means for discharging a sheet-like flow of air in a generally forward direction from said passage;
means for reversing the direction of travel of said sheet-like flow whereby said flow moves toward said wall opening in a path wholly above and substantially parallel to said cooking platform;
and means providing a second passage communicating with said blower outlet means to conduct substantially the remainder of the discharging air away from said cooking platform.

3. A cooking appliance comprising, in combination:
structure providing a horizontal cooking platform having at least one heating element on which to place a cooking vessel;
structure providing an upstanding wall rearwardly of said cooking platform, said wall having in its upper portion an air inlet opening facing said heating element;
an air blower behind said wall, said blower having air inlet means and air outlet means;
wall means providing an air inlet duct communicating between said blower inlet means and said wall opening;
air filtering means in said inlet duct;
means providing a first passage communicating with said blower outlet means and extending forwardly of said upstanding wall to terminate above said heating element;
means providing a first air discharge means for discharging a sheet-like flow of air in a generally forward direction from said passage;
means for reversing the direction of travel of said sheet-like flow whereby said flow moves rearwardly above said cooking platform and enters said air inlet duct through said wall opening;
and means providing a second passage communicating with said blower outlet means, said second passage having a substantially greater flow capacity than the first and terminating in discharge means remote from the first said air discharge means.

4. A cooking appliance as set forth in claim 2, in which the volume of air discharging from said first-named passage is substantially less than that discharging through said second-named passage.

5. A cooking appliance as set forth in claim 2, in which said second-named passage includes a body of odor adsorbent material.

6. A cooking appliance as set forth in claim 2, in which said blower outlet means includes a manifold with which said first and second-named passages respectively communicate.

7. A cooking appliance comprising, in combination:
structure providing a horizontal rectangular cooking platform having a plurality of mutually spaced heating elements on which to place cooking vessels;
structure providing an upstanding wall at the rear of said cooking platform, said wall having in its upper portion an elongated opening facing said heating elements;
an air blower behind said wall, said blower having air inlet means and first and second air outlet means;
means providing an air inlet passage communicating between said wall opening and said blower inlet means;
air filtering means in said inlet passage;
means providing first and second air passages communicating respectively with said first and second blower outlet means, each said passage extending forwardly of said wall at a level above said wall opening, and each said passage terminating at a forwardly directed air discharge slit extending parallel to the front edge of said cooking platform above the forwardmost of said heating elements;

and substantially cylindrical wall means immediately below said discharge slit and coextensive therewith to reverse the direction of air issuing therefrom to cause said air to flow toward said wall opening, said air flow being wholly above said cooking platform.

8. A cooking appliance comprising, in combination:
structure providing a horizontal rectangular cooking platform having a plurality of mutually spaced heating elements on which to place cooking vessels;
structure providing an upstanding wall at the rear of said cooking platform, said wall having in its upper portion an elongated opening facing said heating elements;
an air blower behind said wall, said blower having air inlet means and first and second air outlet means;
means providing an air inlet passage communicating between said wall opening and said blower inlet means;
air filtering means in said inlet passage;
means providing first and second air passages communicating respectively with said first and second blower outlet means, each said passage extending forwardly of said wall at a level above said wall opening and parallel to said cooking platform, each said passage terminating at a narrow air discharge opening extending parallel to the front edge of said cooking platform above the forwardmost of said heating elements;
wall means coextensive with said opening to reverse the direction of air relative to its travel through said first and second passages to cause said air to flow in a sheet-like pattern toward said wall opening;
and means providing another air passage communicating with said first blower outlet means to conduct a major portion of the air discharging therefrom to an exit beyond the influence of said blower inlet means.

9. A cooking appliance comprising, in combination:
structure providing a horizontal rectangular cooking platform having a pair of heating elements on which to place cooking vessels, said elements being disposed in mutually spaced relation adjacent the front of said platform;
structure providing a hollow upstanding wall at the rear of said cooking platform, said wall having in its upper portion an elongated opening facing said heating elements;
an air blower within said wall, said blower having air inlet means and first and second air outlet means;
means within said wall providing an air inlet passage communicating between said wall opening and said blower inlet means;
air filtering means in said inlet passage;
means providing first and second air passages communicating respectively with said first and second blower outlet means, each said passage extending forwardly of said wall at a level above said wall opening, and each said passage terminating at a forwardly directed air discharge slit extending parallel to the front edge of said cooking platform above the forwardmost of said heating elements, the cumulative length of the air discharge slits spanning the distance between said heating elements;
substantially cylindrical wall means immediately below said discharge slits and coextensive therewith to reverse the direction of air issuing therefrom to cause said air to flow in a sheet-like pattern toward said wall opening, said air flow being wholly above said cooking platform and substantially parallel thereto;
and wall means providing another air passage communicating with said first blower discharge means and extending below said cooking platform to a point of discharge at the front thereof, said last-named air passage having removably disposed therein a filter containing activated charcoal.

10. A cooking appliance comprising, in combination:
structure providing a horizontal rectangular cooking platform;
a plurality of heating elements disposed thereon in mutually spaced relation adjacent the front edge of said platform;
structure providing an upstanding hollow wall at the rear of said platform, said wall having an elongated air inlet opening facing said heating elements;
wall structure providing a cooking oven extending forwardly from the top of said rear wall to a point above said heating elements, said wall structure additionally providing an air flow passage extending under said cooking oven from within said hollow rear wall to the front of said oven;
an air blower within said rear wall, said air blower having air inlet and air discharge means;
wall means providing a first air duct within said hollow wall, said duct communicating between said air inlet opening and said blower air inlet;
an air filter in said duct;
means providing a second air duct communicating between the interior of said oven and said first-named air duct, said second air duct terminating upstream of said air filter;
damper means for controlling air flow through said second air duct;
means providing a third air duct communicating between said blower outlet and said under-oven air passage to supply air to said passage;
and means disposed immediately below the front of said oven and extending coextensive therewith above said heating elements to receive air from said air flow passage and direct it rearwardly in a sheet-like flow moving below said oven toward said air inlet opening.

11. A cooking appliance, comprising, in combination:
structure providing a horizontal rectangular cooking surface having a plurality of heating elements including two which are adjacent to the front edge of said cooking surface;
structure providing an upstanding wall at the rear edge of said cooking surface;
an air translating mechanism behind said wall, said mechanism having an air inlet system and an air outlet system;
means in said wall openly facing said heating elements for admission of air into said inlet system, said means providing an elongated opening of which at least a substantial portion is higher than the tallest cooking vessel normally to be used on any of said heating elements;
an air discharge system above the said elongated opening and extending laterally of said cooking surface for a distance encompassing at least the center-to-center distance between the said two heating elements, said air discharge system constituting an elongated slit disposed substantially at the center of at least one of said heating elements;
wall means in said discharge system for dividing said slit into first and second discharge areas of which one is a relatively small fraction of the total length of said slit;
duct means communicating with the air outlet system of said air translating mechanism for conducting air to said first and second discharge areas;
and means immediately below said elongated slit to reverse the direction of air issuing therefrom to cause such air to flow rearwardly toward said air admission means.

12. A cooking appliance, comprising, in combination:
structure providing a horizontal rectangular cooking surface having a plurality of heating elements of which two are in a line parallel and adjacent to the front edge of said cooking surface;

structure providing an upstanding wall at the rear edge of said cooking surface;

an air translating mechanism behind said wall, said mechanism having an air inlet system and an air outlet system;

means in said wall openly facing said heating elements for admission of air into said inlet system, said means providing an elongated opening of which at least a substantial portion is higher than the tallest cooking vessel normally to be used on any of said heating elements;

an air discharge system above the said elongated opening and extending laterally of said cooking surface for a distance approximating at least the center-to-center distance between the said two heating elements, said air discharge system constituting an elongated slit immediately rearwardly of said two heating elements;

duct means communicating with the air outlet system of said air translating mechanism for conducting air to said air discharge slit;

a cylindrical member fixed below said slit and extending parallel thereto in close spaced relation thereto;

and means for directing air discharging from said slit downwardly and tangentially of said cylindrical member to accomplish a reversal in direction of air flow by Coanda effect.

13. The combination according to claim 12, in which said cylindrical member extends forwardly of said air discharge slit and said directing means comprises a plate extending downwardly and forwardly from above said slit into relatively close spaced relation with the adjacent wall of said member.

14. The combination according to claim 12, in which said cylindrical member is power driven for rotation in the direction of said discharging air.

15. The combination according to claim 12, in which said air discharge slit is provided with directional air vanes disposed at an angle between 50° and 80° relative to a line perpendicular to said upstanding rear wall.

16. A cooking appliance, comprising, in combination:

structure providing a horizontal rectangular cooking surface having a plurality of heating elements;

means providing a hollow upstanding wall structure at the rear of said cooking surface;

structure providing a cooking oven projecting forwardly from said rear wall in parallel spaced relation to said cooking surface, said oven having air inlet means at a forward wall thereof;

heating elements in said cooking oven;

an air blower within said hollow wall structure, said blower having an air inlet system and an air outlet system;

an air filtering mechanism in said inlet system;

means disposed in said wall structure below said oven for admission of air into said inlet system;

an air discharge system supplied by said air blower outlet system for discharging a sheet-like flow of air from below the front edge of said ovens and directed rearwardly toward said air admission means;

air duct means communicating between said oven and said air filtering mechanism for passage of air from said oven therethrough;

valve means in said air duct means;

air treatment means in the outlet system of said air blower;

duct means for conveying air from said air treatment means for discharge externally of said appliance;

and means for energizing said air blower.

17. A cooking appliance, comprising, in combination:

structure providing a horizontal rectangular cooking surface;

structure providing an upstanding hollow wall at the rear of said cooking surface, said wall having an air inlet opening in its upper portion;

structure providing cooking ovens projecting forwardly from said rear wall above said wall opening in parallel spaced relation to said cooking surface, the bottom of said oven structure providing forwardly extending air passages at each side thereof;

an air blower within said wall, said blower having an air inlet system communicating with said inlet opening and an air outlet system;

air passage means communicating between said air blower outlet system and said forwardly extending passages to supply the same with a portion of the air discharging through said outlet system;

duct means supplied from the respective oven air passages for discharging a sheet-like flow of air below and forwardly of the front edge of said ovens;

means for reversing said air flow to cause the same to pass below said ovens toward said air inlet opening;

an air filtering mechanism in the air inlet system upstream of said blower;

means providing an air passage communicating between said blower air outlet system and a point of discharge below and at the front of said cooking surface;

air treatment means in said last-named passage;

and means for energizing said blower.

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