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D. W. SCOFIELD
VAPOR TREATING MEANS

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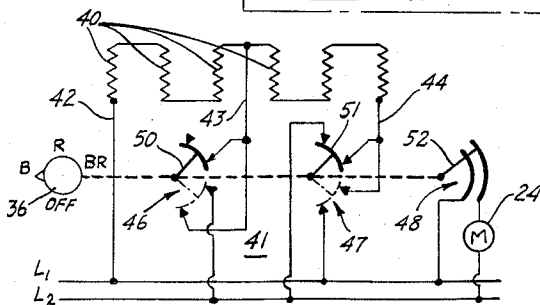
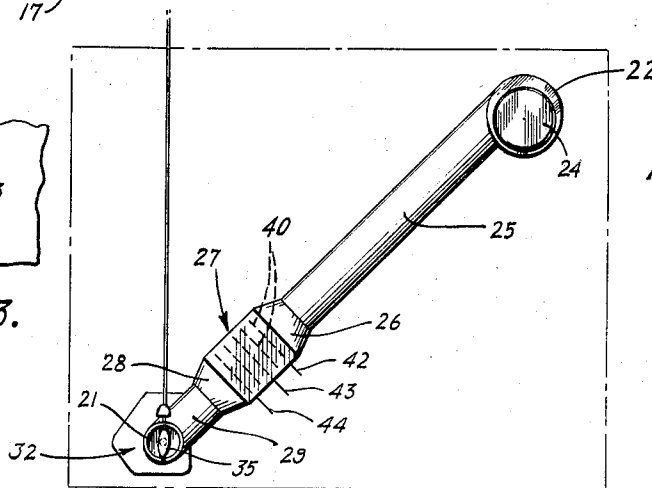
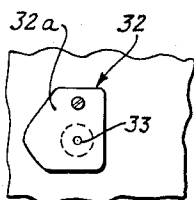
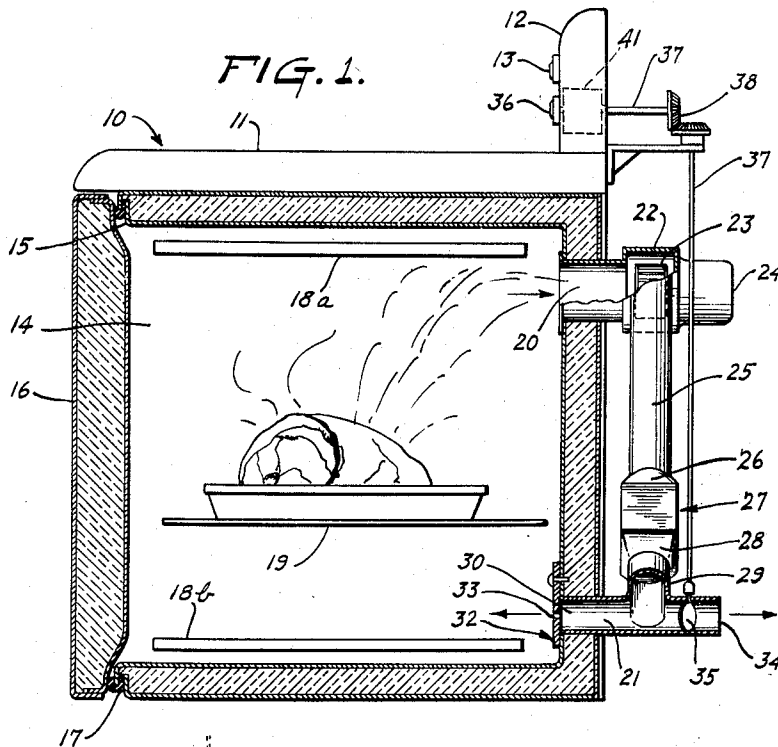


FIG. 4.

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VAPOR TREATING MEANS

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The invention hereinafter described and claimed has to do with apparatus for removing objectionable components of vapors which commonly emanate from the ovens of domestic cooking ranges. In one aspect, the present invention is concerned with elimination, by catalytic incineration, of the smoke and odors frequently arising during use of oven equipment.

One of the problems which is encountered in the use of ovens, and particularly in the use of ovens of the type incorporated in domestic cooking ranges, is the contamination of room air by smoke and odors escaping from the oven. Such smoke and odors, and particularly those which arise from volatilization of certain fats, are highly objectionable.

Many attempts have been made in the past to meet this problem, one of the earlier endeavors being embodied in the familiar hood structures which have been utilized frequently with oven equipment. Some ovens have been equipped with stacks intended to carry off the fumes and smoke resulting from use of the oven and to discharge such fumes and smoke outside of the building. Also ovens have been provided recently with filters of metal wool, or similar material. These and other devices have been resorted to in an effort to meet the problem with which this invention is concerned, but have not met with substantial success, particularly when adapted for use in modern domestic kitchens. In brief the problem has remained and, to a large extent, this has been the case because it has not been recognized that the mentioned smoke and odors could or should be eliminated directly and at their source, before they can escape into the kitchen or other room which houses the oven equipment.

With the foregoing in mind it is a primary object of my invention to eliminate the nuisance referred to above by treating at their source the smoke and odor-laden gases or vapors generated within the oven compartment and before there has been an opportunity for the objectionable components of said gases to spread throughout the kitchen. In accordance with this general objective I provide, in association with a heated oven compartment, means defining a gas treating chamber having an inflow port through which gas from the oven compartment enters said chamber and an outflow port through which treated gas is returned to the oven compartment. It is a further feature of the invention that the gases may be treated by apparatus which operates at elevated temperatures, and particularly by equipment for effecting catalytic incineration of objectionable components of said gases. Following such incineration, and in accordance with one mode of operation contemplated by the invention, the clean hot air is recirculated through the oven, this form of treatment minimizing loss of the energy (for example electrical energy) utilized to heat the oven and to raise the catalyst to the proper operating temperature.

In accordance with another important object of my invention there is provided vapor circulating and cleaning

means of the above mentioned kind, said means further being of such a nature as to maintain the oven compartment or enclosure at a pressure below that of the ambient atmosphere, thereby minimizing leakage of the contaminated air from the oven and passage of the same to the room. In the achievement of this objective, the circuit which provides for passage of smoke and odor-laden vapors through the cleaning unit or chamber includes flow-restricting means so constructed, and disposed within the air or gas flow-circuit, as to maintain the oven at the mentioned reduced pressure. The result is that oven vapors are not only treated, and cleaned, but passage of untreated air to the kitchen is also substantially impeded.

It is also an object of the invention to provide air circulating and treating apparatus having a degree of adjustability enabling it to meet various conditions resulting from different useage of the oven enclosure, as will be explained hereinafter.

In accordance with the invention there is provided a compartment or oven, herein illustrated as comprising the oven of a domestic electric cooking range, said oven having the usual heating elements adjacent the upper and lower walls thereof and being provided with suitable openings in the back wall thereof through which vapors or gases generated within the oven may be caused to pass through a treating chamber, preferably under the influence of a fan or blower. It is to be understood that the treating chamber may be disposed exteriorly of the oven as illustrated in the accompanying drawing or that it may, if desired, be disposed entirely within the confines of the oven.

The foregoing objects, advantages, and features of my invention will be fully understood from a consideration of the following detailed description, taken together with the accompanying drawing, in which:

Figure 1 is a sectional view of an electric range oven including vapor or gas treating apparatus embodying the concepts of my invention;

Figure 2 is a rear elevational view of said apparatus, the figure also indicating, in broken lines, the rear wall of the oven;

Figure 3 is a fragmentary view of adjustable restrictor means provided at the oven inlet opening; and,

Figure 4 is a diagram illustrating an electric circuit which may be employed to control the apparatus and to energize the catalytic treating coil.

Now making more detailed reference to the drawing, and particularly to Figure 1 thereof, it will be seen that the invention is therein illustrated as embodied in a domestic range 10 including a top wall 11 having along its rear edge a splash-guard 12, upon which is positioned a plurality of range control elements, one of which is illustrated at 13. Beneath the top wall 11 are side and bottom walls defining an insulated oven enclosure 14 having its open front 15 closed by a door 16. The door may be pivotally mounted upon the range structure by any suitable hinge means (not shown) and is sealed, as by means of the gasket member 17, against the door jamb provided by the oven structure. The oven has the unusual upper and lower broiling and baking elements 18a and 18b, an oven rack 19 being provided to support the pans in which the cooking takes place.

In particular accordance with the present invention the rear wall of oven 14 is provided at its upper right-hand corner (viewing said wall from the rear as shown in Figure 2) with a port or duct 20 of relatively large diameter, and at its lower left-hand corner with a port or duct 21, of substantially smaller diameter. The outer extremity of duct 20 is in communication with the inlet opening of a blower housing 22 within which is positioned a fan or blower 23, adapted to be driven by motor

24. The discharge side of the blower housing 22 is provided with an elongated extension or conduit 25 connected to the inlet 26 of a treating chamber 27, the outlet 28 of said chamber being provided with an extension 29 coupled to duct 21, through which circulating air is returned to the oven.

In accordance with a feature of this invention, duct 21 is not only of reduced cross-sectional area, but is also provided with means, taking the form of a plate 32 apertured at 33, through the agency of which restricted communication is provided between the duct 21 and the oven 14. Plate 32 is pivotally mounted (see particularly Figure 3) in order that the opening 30 of said duct may be adjusted to a degree suitable to the conditions encountered in use.

From a consideration of Figures 1 and 2 it will be seen that the outer extremity of lower duct 21 is open to the ambient atmosphere, as at 34, and that the opening provided at 34 is controlled by a damper 35 which may be adjusted by a control knob 36 mounted upon the splashguard 12, adjustment being effected through the agency of shafts and gears shown, respectively, at 37 and 38.

In accordance with a broader aspect of this invention, any suitable means may be employed to clean or treat the gases within the chamber 27, it being important to bear in mind, however, that the invention not only contemplates making such treatment effective prior to escape of contaminated gases to the atmosphere, but also substantially impeding escape of any untreated air. To this end the oven is, at least under certain operating conditions, maintained at a pressure less than the pressure of the ambient atmosphere.

While my invention has this broader aspect, it is also an important and novel feature of the invention that the treating means be of the type effective to produce catalytic incineration of objectionable components of vapors or gases circulating through the chamber 27, and with this in mind it is preferred that the treating unit be of the kind disclosed and claimed in my co-pending application bearing Serial No. 467,726, filed November 9, 1954, and assigned to the assignee of the present invention.

As appears to best advantage in Figure 4, such a unit takes the form of a grid structure comprising a plurality of individual, electrically heated coils or conductors 40 each coated with a suitable catalyst, for example platinum, and having ohmic resistance such that when the coils are energized from a suitable source of electric current, said coils are maintained at the elevated temperature required for satisfactory activity of the catalyst. It is contemplated that when catalytic action has been established, it may in certain types of equipment, be possible to maintain the necessary temperature at the catalyst without the supply of any energy in addition to that resulting from the incineration process.

While there are a number of ways in which a suitable treating coil or conductor may be fabricated I prefer to utilize, as the base of this coil, wire of a nickel-chromium alloy, for example the alloy known as Nichrome. In preparation of a catalytic treating coil of the kind contemplated, the base wire or conductor is coated, in accordance with known technique, with a finely divided metallic coating which may be for example the kind known as "platinum black." The number and specific configuration of the coil sections to be used may readily be established by relatively simple tests. While the drawing is somewhat diagrammatic as respects the coil sections, it will be recognized that if good contact is maintained between the catalyst and the gases under treatment it is possible for such a device to be startlingly effective, rendering smoke and odors virtually undetectable immediately upon passage of the gases through the treating unit.

As shown in Figure 4, the various coil sections may be connected in series or in parallel, the ends of the composite coil and an intermediate coil point being connectable in the circuit by control means designated generally by the reference numeral 41, and which control means is actuated by the aforesaid knob 36. Conductors leading from the composite coil are adapted for connection across a suitable source of power L_1 — L_2 through the agency of switches and associated contact elements disposed to be actuated by knob 36. Similarly the blower motor 24 may be placed across the line through a switch associated with said knob.

Prior to a detailed consideration of the operation of apparatus of the kind described just above, it is desirable to refer briefly to the different conditions which are present when the oven is used for baking, for roasting, or for broiling operations. As will be understood the catalytic air treating device must be operated within an optimum elevated temperature range, if satisfactory air cleaning results are to be achieved. On the other hand, and as is well known, some air should be vented from the oven. This is particularly the case during the broiling operation since, in the absence of air venting, roasting rather than broiling results. In brief, different operating conditions necessitate adjustment in the degree of air recirculation permissible and, similarly, different operations commonly carried out within an oven result in contaminating the air to different degrees. When the apparatus is in use a part of the heat required at the catalyst is derived from the hot air or gases circulating through the cleaning chamber, and the remainder of the required heat—at least when operation is initiated—is generated directly in the catalytic coil as a result of the aforesaid resistance heating of the latter. When there is substantial recirculation of oven air, as is desirable during a baking operation, the greater proportion of the total heat required at the catalyst can be derived from the circulating air. Consequently it is not necessary under this condition to supply much heating energy to the catalyst per se. During broiling, on the other hand, it is desirable for cooking purposes that the major portion of the air withdrawn from the oven be vented to the atmosphere, and under this condition a certain amount of heat generated in the oven is, necessarily, lost and it is therefore necessary to supply a greater proportion of the total heat directly to the catalyst. The requirements of roasting are such that a relatively small amount of circulating air is vented to the atmosphere and, as will now be appreciated, the amount of energy which must be supplied directly to the catalytic coil under the roasting condition lies between the values required under the baking and broiling operations mentioned above.

Assuming that it is desired to provide a baked dinner which includes smoke and odor producing foods such, for example as cabbage, sauer kraut and the like, control element 13 is turned to a position energizing either or both of the oven heating elements 18a and 18b, this energization being accomplished by well known circuitry which it is not necessary to illustrate or describe herein. It will be noted that control knob 36 (see Figure 4) is provided with three positions bearing suitable indicia corresponding to baking, roasting, and broiling operations. In carrying out the baking operation, the knob 36 is turned to the baking position, shown in Figure 4 and indicated by the letter "B," thereby actuating contact element 51 in such manner as to bridge the upper contacts of switch 47 to connect the right-hand end of the composite coil, as by means of the conductor 44, to L_2 . It will be observed that the left-hand end of the composite coil is permanently connected through conductor 42 to the other side of the line, L_1 , and that contact element 50 of switch 46 is in a position such that the mid-conductor 43 is not connected to either side of the line. By means of the described connections the various sections of the composite coil are connected in series

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between L_1 and L_2 and, when thus connected, 250 watts is provided at the catalyst, assuming suitable values of voltage and coil resistance. The selected wattage is of course intended only by way of example, it being understood that any desired power value may be used.

Concurrently with the aforesaid movement of control knob 36, damper 35 (Figure 1) is rotated, through rods and gears 37 and 38, to a position transverse of duct 21. Simultaneously with this operation contact element 52 (Figure 4) bridges the contacts of switch 48, thereby energizing motor 24 and the associated blower 23, with the result that air is drawn from the oven through port 20, passes through duct 25 for delivery to the treating chamber 27, and thereafter returns to the oven through the restricted aperture 33. Because of the relatively large diameter of duct 20, the presence of at least a small aperture around damper 35 and the small size of outlet aperture 33, it will be understood that the quantity of air withdrawn from the oven, as compared with that returned to said oven, is such as to maintain the oven at a pressure somewhat lower than the pressure of the ambient atmosphere.

On the other hand the described operation causes an increase in air pressure within the chamber 27 whereby it is possible to raise the catalyst to its normal active temperature (700° F. or more, if platinum black is used as the catalyst) with lesser wattage delivered to the catalytic coil than would be required if the air were passing through the chamber at normal atmospheric pressure. This results in a substantial gain in operating efficiency, and to permit maximum realization of this advantage the apparatus is so designed as to make it possible to adjust the restriction of the inlet duct 21 as by rotating the plate 32 about its pivotal mounting.

Considering now the broiling operation it is to be understood that during broiling any substantial recirculation of oven air is undesirable and, prior to use of the equipment for broiling, the knob 36 is turned to the point designated "BR" on the dial, thereby causing contact element 50 to move to the position shown in broken lines, thus connecting the mid-point of the composite coil to L_2 , through the conductor 43. At the same time contact element 51, in moving to the position shown in broken lines, has bridged the lower contacts of switch 47 to connect the right-hand end of the composite coil to L_1 . The motor 24 is energized as indicated hereinbefore, and it will be understood that the two half portions of the composite coil are now connected in parallel across L_1 and L_2 . Under such conditions, and again assuming the proper value of line voltage and coil resistance, 1,000 watts is dissipated at the catalyst. This greater wattage is required because of the loss of heat to the atmosphere through the exhaust duct, and also by virtue of the fact that greater contamination of oven air results during the broiling operation.

While, contrary to general practice during broiling, the door 16 is kept closed during use of the apparatus of the present invention, there is a constant flow of heated air through the treating chamber 27 and thence outwardly of port 34. It will be understood that the catalytic unit operates to incinerate and thereby substantially eliminate all objectionable smoke and odors prior to venting of the circulating air to the ambient atmosphere, air so vented being replenished by air which leaks in around the oven door and past the sealing gasket 17.

Assuming now that it is desired to cook a roast in the oven, the knob 36 is turned to the position marked "R" in which position contact element 50 bridges the middle contacts of switch 46 and connects the mid-point of the composite coil to L_2 . The right-hand end of the coil is open circuited. By virtue of such adjustment one half of the catalytic conductor is energized, this preferably being the half which is located closer to the blower. Under this condition the total energy delivered directly

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to the catalyst, in distinction to the heat energy derived from the circulating air, amounts to 500 watts. When this adjustment is effected damper 35 is moved to a position in which it partially closes the port 34 of conduit 21. Some venting of air is desirable during roasting, and for this reason the wattage supplied directly to the catalytic coil is somewhat greater than the wattage supplied under the baking operation and less than the energy supplied during broiling. It is to be noted that if the first or leading half of the catalytic coil is energized under the roasting condition, incineration also takes place at the second half of the coil, since the latter half is maintained at an elevated temperature as a result of the catalytic incineration taking place at the energized portion of the coil. If, on the other hand, the second half of the coil were to be energized during roasting, rather than the first half thereof, the first half would be relatively ineffective in the elimination of vapors and smoke and its catalytically coated surfaces might become contaminated by the vapors passing in contact with it.

From the foregoing description it will be understood that the present invention provides novel and highly advantageous apparatus for treating and cleaning oven vapors as they arise in the oven and prior to passage of the same to the ambient atmosphere. It is to be noted that maintenance of oven pressure at a value below that of the atmosphere insures that vapors pass to the kitchen only after treatment in chamber 27, through the vent outlet 34, thereby preventing any outward flow from the oven, for instance in areas where the seal effected by the door gasket 17 is relatively weak.

While the invention has been described with reference to a preferred embodiment thereof, it is to be understood that the disclosed apparatus is susceptible of various changes and modifications without departing from the essential spirit of my invention. It will be understood however that such changes and modifications are contemplated as come within the scope of the appended claims.

I claim:

1. In combination with an oven compartment forming part of a domestic cooking range and having a substantially open front and a door for substantially closing said front, which door partially seals the front when closed: heating equipment for the compartment; a vapor passage having an inlet and an outlet in the compartment; vapor purifying means in said passage; a vent arranged for venting purified vapor from the passage into the ambient atmosphere; a vapor blower for moving vapor from the compartment through the passage and through the vapor purifying means therein to said vent and also back to the compartment; means for simultaneously controlling the degree of opening of the vent and the degree of heating provided by the heating equipment; and means associated with said passage for lowering the pressure of circulated vapor, inside the compartment, below the normal pressure of the ambient atmosphere at all degrees of opening of the vent.

2. A domestic kitchen appliance comprising: a baking and roasting oven having an oven compartment with a substantially open front; a door for substantially closing and partially sealing said front; a vapor passage leading from and back to said compartment; vapor treating means in said passage; a vent for venting treated vapor from said passage to the ambient atmosphere; vapor blower means for moving vapor from said compartment through the passage and through the vapor treating means therein and then to the oven and the vent; a plurality of heating means selectively controllable for heating the compartment in one way for baking and in another way for roasting; means for variably controlling the heating means for roasting and baking and means for simultaneously variably controlling the circulation of vapor effected by the blower means to the vent and back to the

oven; said vapor passage being so arranged that throughout the operation of the blower means the pressure inside the oven is below normal atmospheric pressure.

3. An appliance as described in claim 2 additionally comprising means whereby the heating means may be selectively utilized in one way for baking, in another for roasting, and in still another for broiling, said means for variably controlling the circulation of vapor being adapted to control the vent heating means differently for said baking, roasting, and broiling.

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