United States Patent

[11] 3,553,425

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[21] Appl. No. **835,678**
[22] Filed **June 23, 1969**
[45] Patented **Jan. 5, 1971**

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[54] **DOOR MOUNTED CATALYST EXHAUST ARRANGEMENT FOR A SELF-CLEANING OVEN**
4 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **219/393,** 126/190, 126/21: 219/475; 252/461
[51] **Int. Cl.** **F27d 11/00,** A21d 1/20
[50] **Field of Search** 219/393, 396, 397, 395, 400, 412, 408, 475; 126/21, 198, 190, 193; 252/461

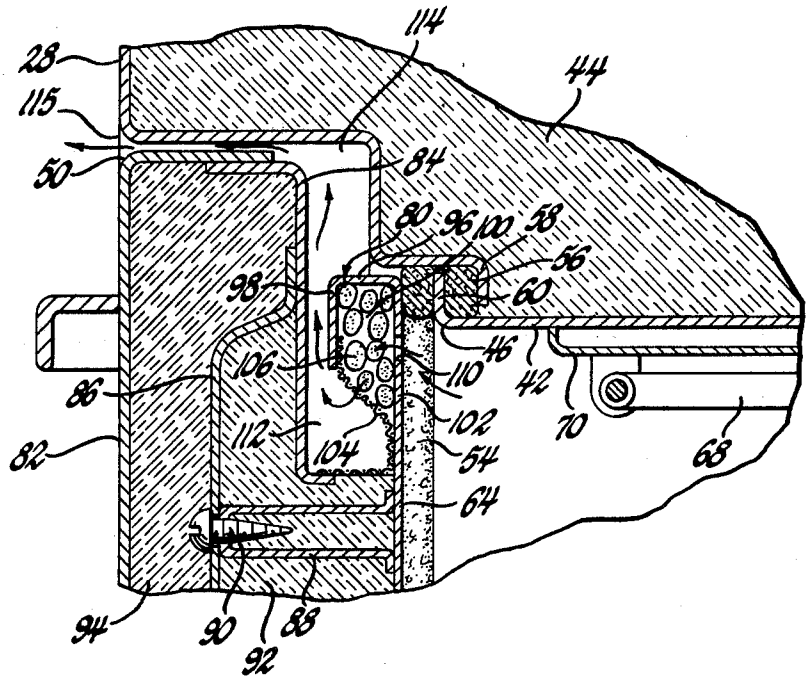
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ABSTRACT: A heat-cleaning oven has a complete seal between the oven and the oven door and heating units in the oven for heating the oven to heat-cleaning temperature. The oven exhaust is through a chamber in the door which includes a catalyst for eliminating smoke and heating the portion of the door adjacent the seal.



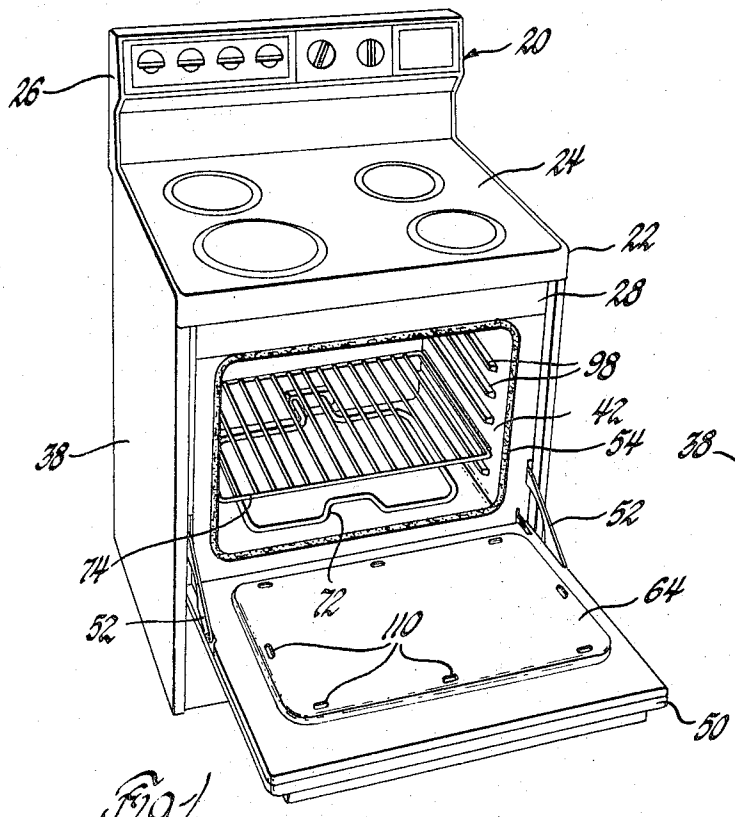


Fig. 1

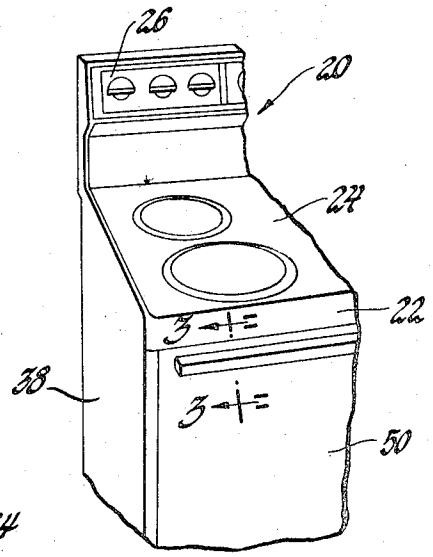


Fig. 2

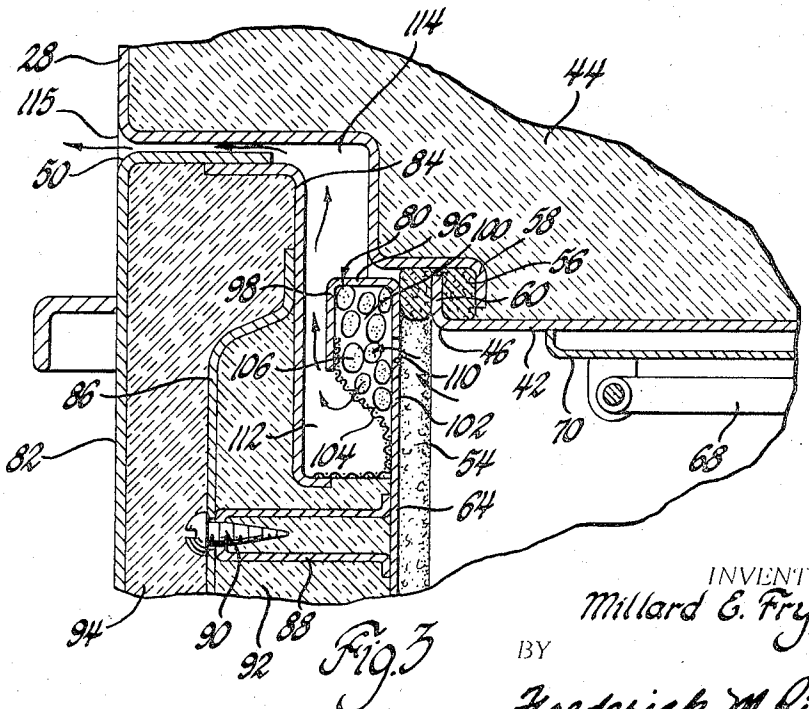


Fig. 3

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DOOR MOUNTED CATALYST EXHAUST ARRANGEMENT FOR A SELF-CLEANING OVEN

SPECIFICATION

This invention relates to a domestic appliance and more particularly to an improved catalytic oxidizing arrangement for a heat-cleaning oven.

In heat-cleaning ovens of the type described in U.S. Pat. 3,327,094 and manufactured by the assignee of this invention, a sealed oven is provided with a catalyst in a chimney leading from the oven. The catalyst alters smoke from the cleaning process into colorless and odorless products. Such smoke alteration by catalytic oxidation produces heat. Heat produced by the oven heating units is used as the means for degrading accumulated oven soils in a pyrolytic oven cleaning process. The jointure where the oven door seals against the oven liner is difficult to heat. Accordingly, this invention is directed to an arrangement which locates the catalyst oxidation for smoke elimination next to the door jointure. This, then, adds the heat of catalytic oxidation to the walls around the jointure which are also being heated for degrading the accumulated oven soils by the oven heating units.

It is therefore an object of this invention to locate an oxidation catalyst for a heat-cleaning oven where the heat of catalytic oxidation can be added to the walls being heat-cleaned.

It is also an object of this invention to provide in a plug portion of a door which seals an oven when the door is closed an exhaust duct from the oven which duct includes a circumscribing chamber portion having a catalyst therein for providing heat along the sealing jointure to minimize temperature gradients in the oven.

It is a more specific object of this invention to provide a door for a heat-cleaning oven which has a door plug completely sealing the opening into the oven, a peripheral portion of said door plug defining a chamber along the sealing jointure of the door plug with the oven. The chamber places the oven in communication with the atmosphere for exhausting smoke from the oven and encloses a bed of catalyst beads for eliminating the smoke as it passes through the chamber and in so doing adding the heat of catalytic oxidation to the peripheral portion of said door plug as an aid in uniform temperature distribution.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred embodiment of the present invention is clearly shown.

IN THE DRAWINGS:

FIG. 1 is a front perspective view of a heat-cleaning range with its oven door open;

FIG. 2 is a fragmentary front perspective view of a heat-cleaning range with its oven door closed; and

FIG. 3 is a fragmentary sectional view taken along line 3–3 in FIG. 2.

RANGE CONSTRUCTION

Referring now to FIG. 1 of the drawings, an electric range 20 suitable for use with the improved control arrangement of this invention is illustrated. More particularly, the range 20 is comprised of an upstanding substantially boxlike metal body 22 having a substantially horizontal metal cooking top 24 and an upstanding control console or backsplash 26 at the rear of the cooking top 24. The body 22 constitutes a shell or range casing and includes a front wall 28, rear wall (not shown) and a pair of outer sidewalls, one of which is shown as 38.

An oven forming liner 42 having a one-coat acid resistant porcelain finish is positioned within the body of the range and spaced from the walls thereof to form a chamber for insulation 44 which completely envelops the oven liner 42 except for the front opening 46 thereof which is closable by an oven door 50 hingedly mounted at 52 for opening and closing the oven liner to gain access thereto. A braided, rope form seal 54 of triple A grade asbestos completely circumscribes the opening 46 of the oven liner and includes at attachment portion 56 sandwiched between a flange 58 of the front wall 28 of the range casing and the flange 60 of the oven liner to minimize heat conduction therebetween. The front of the seal 54 abuts the pluglike inner panel portion 64 of the door 50 to seal the heat and other products of the heat-cleaning process in the oven. Air for the pyrolytic oven cleaning process enters the oven by leakage, not at the door where cleaning temperatures are maintained by means of the continuous seal 54, but at the liner openings which accommodate the oven heating elements and the oven light.

Heating within the oven liner 42 is provided by a broil heating element 68 carried on a reflector 70 at the top of the oven and by a bake heating element 72 at the bottom of the oven. Removable shelves, such as 74, are slidably positioned on embossments 98 on opposite sides of the oven liner.

To accommodate the smoke and products of combustion from an oven cleaning or cooking operation, this invention is directed to an improved catalytic oxidizing unit or fluid contact device 80 positioned on the door plug 64 of the door 50 to receive the exhaust from the oven 42.

More particularly and with reference to FIGS. 1 and 3 the catalytic oxidizing unit 80 comprises a peripheral portion of the door plug 64.

The oven door 50 includes an outer door panel 82, an intermediate door panel 84, an intermediate support panel 86 and the inner panel or door plug 64. In conventional fashion the door plug 64 through a bracket 88 is fastened with suitable means such as a screw 90 to a subassembly consisting of the intermediate door panel 84 and support panel 86. A batt of insulation 92 may be interposed. The outer door panel 82 is then fastened in a similar fashion to a subassembly consisting of the door plug 64, the intermediate door panel 84 and the support panel 86. Again, a batt of insulation 94 may be interposed.

The door plug along its peripheral edge is formed by return bend flange portions 96, 98 which strengthen the door panel and define two sides of a catalyst chamber 100 which runs around the outer edge of the door plug. The other sides of the chamber are formed by the planar surface 102 of the plug 64 together with a screen frame 104 of stainless steel or other suitable material. The screen 104 closes the gap formed by plug portions 98 and 102 and serves as a perforate retainer for a plurality of catalyst beads 106 in the chamber 100. The exhaust inlet 110 places the catalyst chamber 100 in communication with the oven liner 42. In turn the screen 104 places the catalyst chamber in communication with the atmosphere through a duct having one portion 112 thereof defined by the spacing between the flange portion 98 of the door plug and the inner door panel 84 and another portion 114 formed between the door 50 and the range front 28 when the door is closed leading to a duct outlet 115.

During heat-cleaning the heating units 68 and 72 heat the walls of the oven liner 42 and the panel 102 of the door plug. The accumulated soil thereon starts to degrade and produces smoke. The smoke leaves the oven along the path depicted by flow arrows in FIG. 3. Interposed in this flow path is the catalyst chamber 100 filled with catalyst beads 106. As the smoke flows through the chamber 100 it is catalytically altered to colorless and odorless products. In the process of this alteration heat is given off. The heat given off is added to the walls of the catalyst chamber, one of which is the peripheral portion of the door plug. This peripheral portion forms one side of a sealing jointure between the door plug 64 and the seal 54. This is inherently an area of high heat loss from the oven. During cooking it adversely affects the temperature gradient and thus the temperature distribution in the oven. During heat-cleaning the temperature of the wall portions adjacent the sealing jointure between door and oven liner is generally lower than the wall portions remote from the jointure. Thus to assure adequate temperatures along the periphery of the door plug, adequate heat-cleaning requires higher than necessary temperatures elsewhere in the oven liner. This also adversely

affects the temperature gradient in the oven. With this invention the heat of catalytic oxidation is added where it is needed most—at the jointure between the door plug and the oven seal.

THE CATALYST

The bead form of catalyst provides greatly increased contact surface for the effluent and, thus, facilitates a better and more thorough oxidation of the noxious products. It should be understood that flow through the catalyst bed can also be controlled by varying the size of the beads or pellets.

The thickness of the catalyst bed determines the resistance to effluent flow from the oven—the greater the thickness or the more compact the bed, the greater the resistance to fluid flow. In this way the amount of effluent passing through the catalyst bed can be regulated to the capacity of the beads so that the decomposition products from an oven cleaning or oven cooking operation have a chance to completely oxidize.

In general, the catalyst material **106** is formed as a bead with alumina acting as the carrier for an active catalytic agent.

The catalyst is effective mainly because of the Cr_2O_3 (chromic oxide) but the activated amorphous (gamma) alumina is also catalytically active. With use at high temperature the amorphous alumina very slowly crystallizes and thus reduces in catalytic activity. This rate is slow enough, however, that it will not significantly affect the expected appliance life. The catalyst shows good oxidation effectiveness in the 700°—800° F. range and increases in effectiveness at the 1000°—1200° F. range. Thermal shock tests in the laboratory show good effectiveness even to the 1600° F. level.

In general, catalyst manufacture occurs in these steps:

1. The alumina is prepared in desired shape, i.e., bead, cake, etc.
2. Alumina is then specially activated.
3. The shape is then impregnated with chromium salt in solution.
4. Water is driven off by heat.
5. Finally the chromium is converted to oxide by heat to activate it.

The specification for the preferred oxidation catalyst for a range oven is set forth next following, types A and B referring to bead size and type A being the preferred size:

A. SCOPE - This specification covers a bead-form catalyst for the oxidation of pyrolizate from food residues in ovens.

B. CONSTITUTION -The catalyst shall consist of specially activated chromic oxide (Cr_2O_3) supported on alumina (gamma or amorphous alumina).

1. Chromic Oxide content, Min. (On the basis of whole beads)

Type A 17.5 Percent

Type B 17.5 Percent

2. At least 90 percent of the beads shall show complete impregnation (green color) throughout the bead.

C. BEAD SIZE -This shall be determined by analysis through U.S. Standard Sieves and shall conform to the following:

Type A (3-5 Mesh)	Type B (5-8 Mesh)
Retained on 2½ mesh 0% Retained on 3 mesh 5% max. Retained on 4 mesh 60% min. Retained on 6 mesh 99% min. Retained on 20 mesh 99.5% min. Through 100 mesh 0.1% max.	Retained on 5 mesh 5% max. Retained on 8 mesh 85% min. Retained on 12 mesh 99% min. Retained on 20 mesh 99.5% min. Through 100 mesh 0.1% max.

D. DENSITY -The "apparent" density of the beads when measured in a 1000 ml. graduate, shall be:

Type A 0.880 to 0.930

Type B 0.890 to 0.940

E. SHAPE -The beads need not be perfect spheres. However they shall be reasonably spherical and exhibit no significant amount of corners or edges which would restrict gas flow and help cause dusting. There shall be no more than 3percent by weight fractured or granular particles.

F. BEAD STRENGTH -The average force required to crush individual beads of a 10 bead random sample shall be:

Type A 25 lbs. Min.

Type B 7 lbs. Min.

G. ATTRITION OR DUSTING RESISTANCE (DRY) -One hundred milliliters of the "as received,"but dried (1 hour at 400° F.) and sieved (100 mesh), catalyst shall be used. When shaken 450,000 cycles in a vertical stroke of 1 -¾ inches at 330 cycles per minute the 100 ml. of catalyst in a glass jar 1 -⅞ inches × 2 -⅞ high (metal cap, fiber lining removed) shall develop not more than 0.5 percent dust which will pass through a 100 mesh U.S. Sieve.

H. THERMAL SHOCK RESISTANCE -50 preselected nonfractured beads, when heated to 1600° F. and cooled to room temperature, alternately every 30 minutes for a period of 8 hours shall show no broken or fractured beads, and shall retain at least 50percent of the crush strength listed in paragraph "F" above.

I. OXIDATION PERFORMANCE -(LABORATORY TEST) -When burning natural gas (essentially methane) at a temperature of 1000° F. and a concentration of 0.50 percent in air flowing over 70 ml. of catalyst in a stainless steel pipe 1 inches inside diameter at a rate of 15.0 liters per minute the following combustion should be attained:

	Type A	Type B
Proportion remaining methane, percent, max.*	26	0
Carbon monoxide, percent, max	8	0,5
Carbon dioxide	Remainder	Remainder

These percentages are simply a relative ratio of the methane, carbon monoxide and carbon dioxide peaks as determined in a gas chromatograph. Other materials such as ethane, water and other trace combustion products are disregarded in this calculation.

It should now be seen that an improved catalytic oxidation unit has been provided for use with a chamber in which smoke is being generated, said unit having a plurality of beadlike, chrome-alumina catalyst balls in a peripheral chamber of a door plug adjacent the sealing jointure of the door plug with the oven liner opening.

While the embodiment of the present invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted.

I claim:

1. A cooking range including walls defining an oven having an opening, a door for closing said opening including an inner panel facing said opening and exposed to said oven when the door is closed, seal means extending around said opening for substantially closing the jointure between the inner panel of the door and the walls which form said opening, heating means for heating in said oven at one temperature for cooking therein and at a higher temperature for degrading accumulated food soils on the walls thereof whereby to create oven fluids as the result of said cooking and degrading, duct means providing a passageway between said oven and the atmosphere for said oven fluids, said duct means having a duct inlet in said inner panel connected to said oven for receiving said oven fluids and a duct outlet connected to atmosphere,

catalytic fluid contact means in said duct means comprising container means including a plurality of catalyst beads therein, a portion of said container means being formed by a portion of said inner panel adjacent said seal means and including said duct inlet, said portion of said inner panel thereby supporting said catalyst beads adjacent said seal means and in immediate communication with the interior of said oven through said duct inlet, said catalyst beads forming a catalyst bed positioned in oven fluid intercepting relationship between the duct inlet connection of said duct means with said oven and the duct outlet connection of said duct means with the atmosphere, the voids between said catalyst beads in said catalyst bed defining a passageway for oven fluid leaving said oven, whereby oven fluid passing from the oven through said passageway necessarily contacts the surface of said catalyst beads during its passage and is thereby altered to colorless and odorless products, said catalyst bed in accordance with the altering of said oven fluid heating said portion of said inner panel adjacent said seal means as an aid in raising the temperature of this portion of said inner panel for improving the degradation of accumulated food soils thereon when said oven is being heated at said higher temperature.

2. The cooking range of claim 1 wherein said seal means completely circumscribes the jointure between the inner panel of the door and the walls which form the oven opening.

3. The cooking range of claim 1 wherein said door includes an intermediate door panel spaced from said container means to form therewith a portion of said duct means.

4. The cooking range of claim 1 wherein said catalyst beads are formed with alumina acting as a carrier for an active catalytic agent.

PO-1050
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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,553,425 Dated January 5, 1971

Inventor(s) Millard E. Fry

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, line 46, before "These percentages" insert an asterisk -- * --.

Signed and sealed this 25th day of May 1971.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents