Nov. 4, 1947. J. A. CAMPBELL, JR., ET AL 2,430,101

COMBUSTION CHAMBER

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FIG. 1

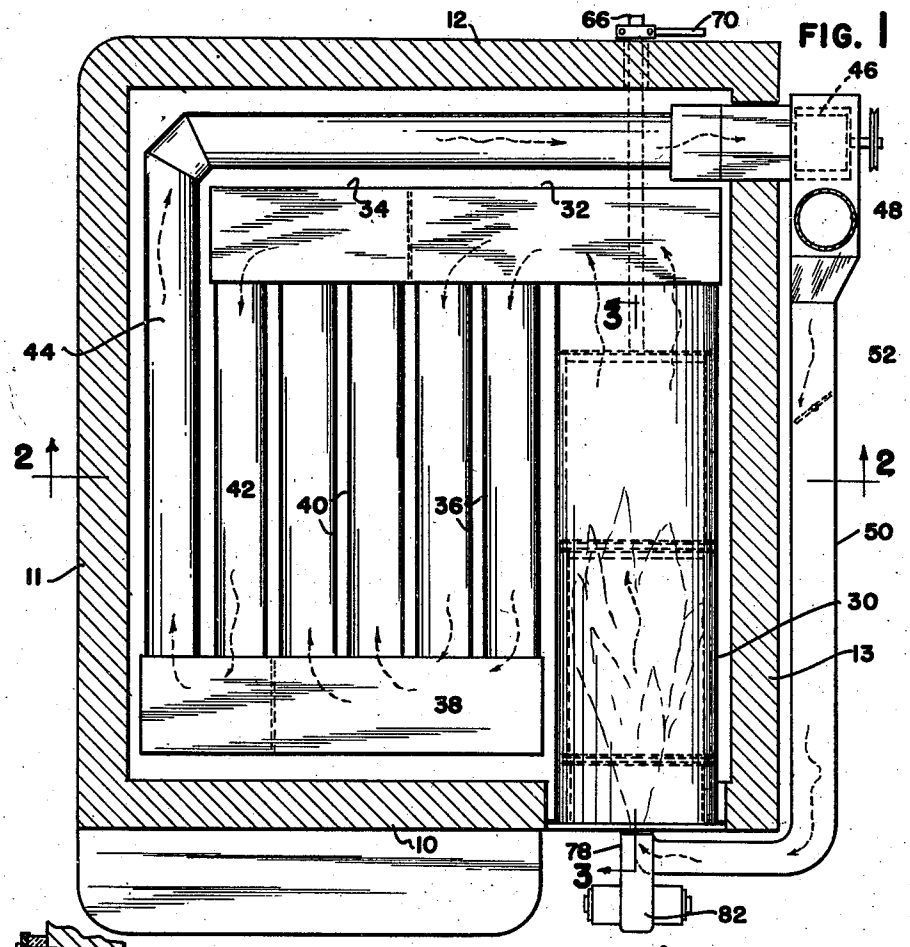
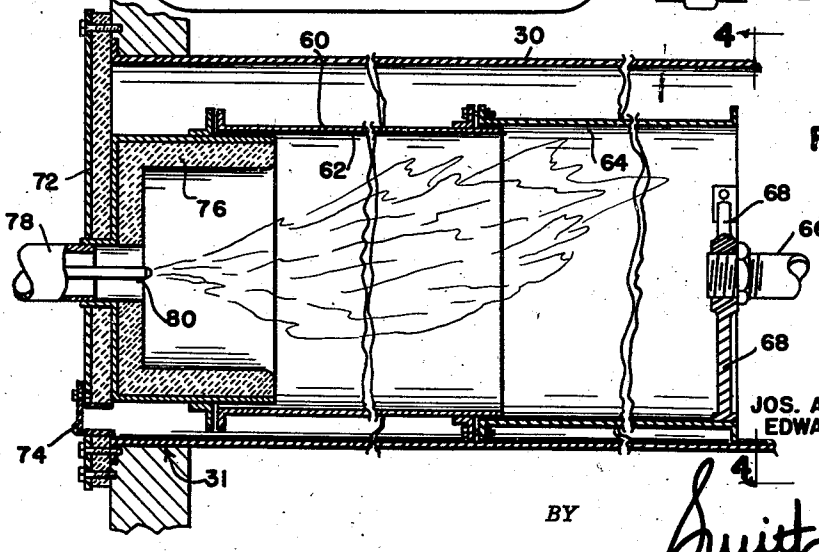


FIG. 3



JOS. A. CAMPBELL, JR
EDWARD C. NIST
INVENTORS

BY Smith & Tuck
ATTORNEYS

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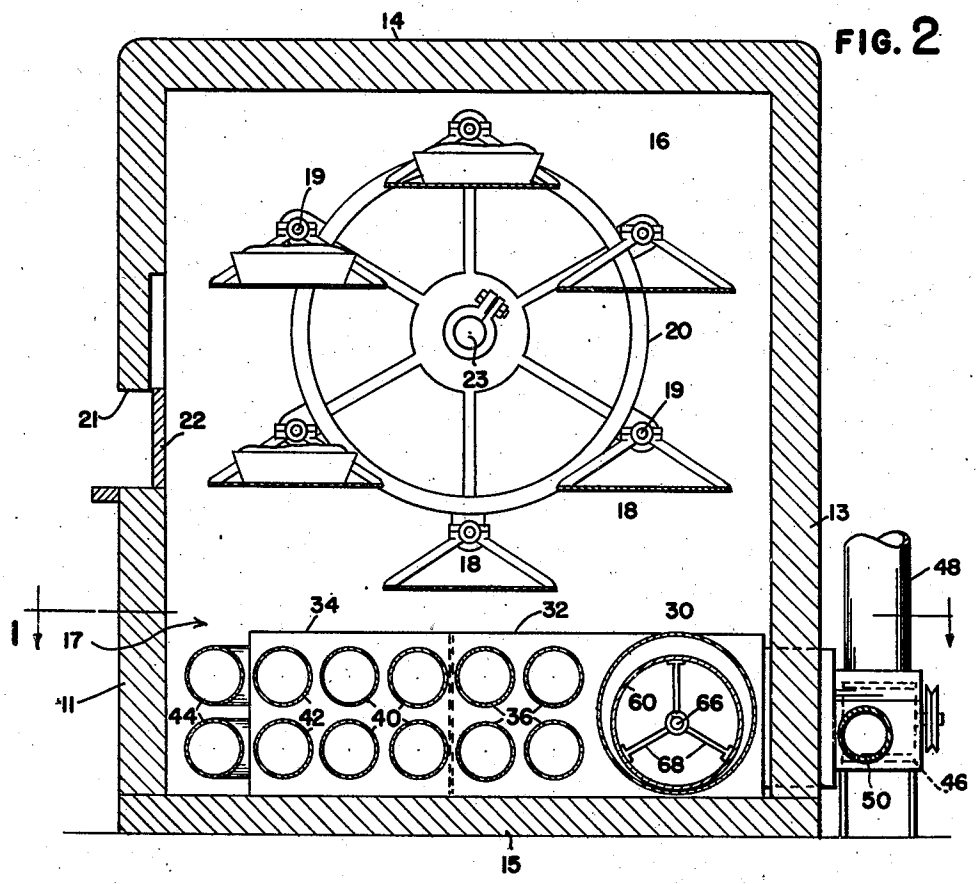
FIG. 2



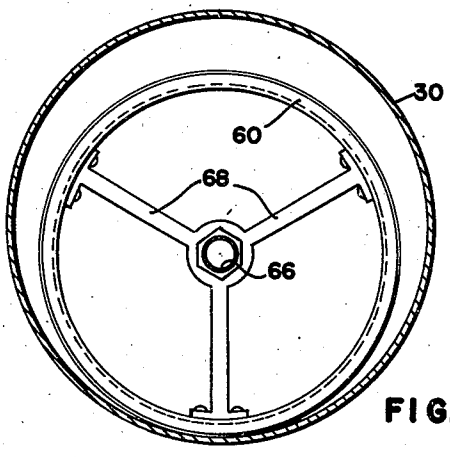
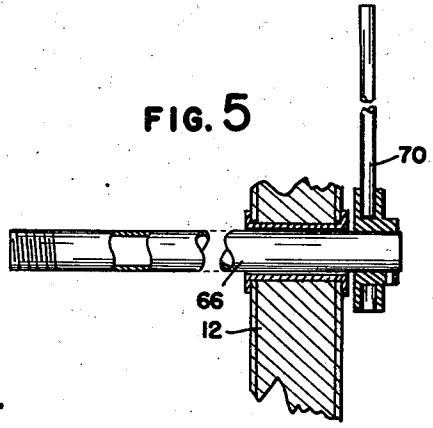


FIG. 4

FIG. 5



JOSEPH A. CAMPBELL, JR.
EDWARD C. NIST
INVENTORS

BY Smith & Tuck
ATTORNEYS

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COMBUSTION CHAMBER

Joseph A. Campbell, Jr., and Edward C. Nist, Seattle, Wash., assignors to J. A. Campbell Co., Seattle, Wash.

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3 Claims. (Cl. 110—86)

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Our invention relates to improvements in a combustion chamber and, more particularly, to an improved combustion chamber for bake ovens.

While we hereafter specifically describe our invention as it is incorporated in a bake oven it will be understood that such reference is only for the purposes of exemplification and that we do not thereby intend to restrict the invention solely to use in such an installation.

Bakery ovens are usually large housings having movable or non-movable means interiorly for supporting pans of breads, biscuits and the like in the inner upper portions above a heating system located at or near the bottom of the housing. The heating systems, in the case of non-electric ovens, usually comprise a combustion chamber which is coupled with heat transfer conduit means for conducting the gases of combustion throughout the interior of the oven housing to radiate heat throughout the chamber for the conduct of the baking operation. In the case of those prior art systems employing fuel oil burned under forced draft, combustion was had in a suitable refractory chamber from which the gases passed into the radiator portion of the system. The prime purpose of the refractory chamber has been to absorb the high heat of actual combustion and prevent it acting directly upon metallic surfaces which would oxidize and disintegrate under the direct action of the flames. As so often happens, the solution to a problem often produces its own problems which more than offset the advantages. That is true in the use of the initial chamber of refractory material since it absorbs heat as well as insulates, thus requiring higher firing temperatures which tend to destroy the refractory; also the refractories are slow cooling thus prolonging the time period after baking before access can be had to an oven for cleaning or servicing; and, additionally, the heat stored in the refractories, after firing is terminated, cause carbonization of fuel on the burner nozzles thus requiring constant attention to maintain them for subsequent firing. The problem is largely the same with those systems in which fine coal or coal dust is burned. When the flame is discharged directly into a heat transfer casing not including a refractory chamber, the flame attacks the metal surfaces and produces oxidation that soon eats through them permitting combustion gases to escape in a highly disagreeable manner. Also warpage and distortion, which is undesirable, often takes place in the walls of the metal casing causing leaks and misalignment of parts.

Having in mind these and other defects of

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the prior art bake ovens, it is an object of our invention to provide a metallic combustion chamber that has a long life and does not require the large and undesirable refractory previously used.

Another object of our invention is the provision, in a heating system of the type described, of a revoluble chamber which may be rotated to present all surfaces to the effect of the flame.

Still a further object of the invention resides in the provision, in a heating system of the type described, of a heat transfer chamber associated with an enclosing casing in a manner that permits greater economy and efficiency in the operation of the firing system, all without undue complication of parts.

One other object of the invention is to provide a heat resistant metallic combustion chamber that is less deleteriously affected by flame oxidation than has heretofore been possible.

The foregoing objects and others ancillary thereto, we prefer to accomplish as follows:

According to a preferred embodiment of our invention we install the combustion chamber in a bake oven which comprises a chamber formed by heat insulated walls to which access may be had through suitable openings provided therefor. In the upper part of the oven where baking is carried on, means are provided to support the pans usually used in baking. In the lower part of the oven is installed the heating system, which includes a horizontal fire tube preferably cylindrical in shape. This fire tube is enclosed by a heat transfer casing from which extend radiator conduits that carry the products of combustion away from the fire tube and radiate heat throughout the oven under the baking area. The fire tube is mounted to be revolved in its enclosing casing and for this purpose a shaft having crank means externally of the bake oven housing is coupled with the tube. Rotation of the fire tube permits the presentation of all surfaces of the tube to the deleterious effects of the flame and prevents continuous local oxidation of the tube.

In a preferable installation of our invention an oil burner or gas burner mechanism is coupled with the fire tube for the generation of the desired and required heat for baking. Coal burners may also be used.

The novel features that we consider characteristic of our invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with additional advantages and objects thereof, will best be understood from the following description of a specific

embodiment when read in connection with the accompanying drawings, in which:

Figure 1 is a plan view of a heating system having our invention incorporated therein;

Figure 2 is a view in cross section taken on the plane indicated by arrows 2—2 in Figure 1;

Figure 3 is a longitudinal sectional view of the combustion chamber and its casing taken on the plane indicated by arrows 3—3 in Figure 1;

Figure 4 is a cross-sectional view of the casing and an end view of the combustion chamber as though viewed in the plane 4—4 of Figure 3; and

Figure 5 is detail view, with portions omitted for convenience of illustration, of revolving means for the combustion chamber.

A combustion chamber to overcome the defects hereinbefore enumerated must have at least two totally distinct characteristics; it must economically transfer heat of combustion into radiation; and it must do so in a manner that deterioration under hard usage is minimized. Accordingly, a preferred embodiment of our invention, referring to Figures 1 and 2 of the drawing is constituted by a combustion chamber which is incorporated in a heating system for a bake oven. The oven comprises insulated wall panels 10, 11, 12 and 13, top panel 14 and bottom panel 15 which enclose a space forming the upper baking area 16 and the lower heating area 17. Trays 18 depending from trunnions 19 on the rotatable spider 20, support pans in the baking area through which they are moved in a circular path above the heating system. Access to the interior of the oven is had through opening 21 in wall 11, which in Figure 2, is shown as closed by door 22. The spider 20 is turned upon rotation of shaft 23 to which the spider is securely attached.

The heating system includes the initial heater casing 30, preferably cylindrical, that extends from opening 31 in wall 10 inward of the bake oven to join with the cross header 32. The products of combustion flow from chamber 30 into the header 32 and thence to conduit tubes 36 which lead the gasses and the like to the secondary header 38 from which they are returned by conduits 40 to header 34. Outgoing gasses pass from header 34 into tubes 42, thence to tube 44 that leads circuitously to fan 46 from which it either is exhausted out stack 48 or is returned for recirculation to the inlet end of casing 30 by conduit 50, depending upon the set of valve 52.

Our combustion chamber 60 is preferably cylindrical and is mounted in the casing 30 eccentric thereof so that the general relation is that shown in Figure 4. The chamber 60 is formed of separable telescopically related sleeve sections 62 and 64 that are joined rigidly together when installed in a heating system by suitable fasteners. Chamber 60 is revoluble inside casing 30 by means of rotative power applied thereto from exterior of the oven housing. The pipe 66 is secured to the spider 68 anchored to sleeve 64 and extends to the exterior of the oven to receive lever 70 which facilitates manual rotation of the sleeves forming chamber 60.

The end of casing 30 and the opening 31 are closed by door 72 ported at 74 and suitably insulated on its inner face, to prevent the escape of heat therethrough. Door 72 also supports on its inner face the refractory basin 76 and both the door and this basin are ported to receive the air tube 78 and burner nozzle 80 of the oil burner 82. As seen in Figure 3 the left end of sleeve 62 is slipped over the basin 76 which forms a trunnion therefor.

It is preferable to form the combustion chamber 60 of steel or steel-alloy that is highly resistant to heat, flame and other conditions to which it is exposed. We have found that a "stainless" steel having heat resistance of 2100° F., a melting point of about 2750° to 2800° F., and resistance to the corrosive action of sulphuric acid is fully satisfactory to serve for our purposes. Such a steel comprises carbon, chrome, silicon and manganese.

In the operation of the device, the appropriate fuel is supplied to the burner 82 and thence is delivered into the combustion chamber through the nozzle 80 along with auxiliary air through the tube 78. Initial ignition is had by means of any of the well known devices. The ignition zone of the incoming fuel is in the refractory basin 76, from which the flame passes into the revoluble heat transfer portion 60 of the combustion chamber.

Recirculated combustion products from the duct 50 are passed into the heater casing 30 and around the combustion chamber to reduce its temperature and to pick up heat therefrom. The combined products commingle at the outlet end of the combustion chamber and continue on through the radiator and out the stack, portions of the combustion products being recirculated through the duct 50.

The air in the baking space is warmed by transfer and convection of heat from the radiator system. This hot air acts on the bread in the oven to perform baking.

From time to time the combustion chamber 60 is rotated by the handle 70 to bring new areas into contact with the uprising flame which tends to impinge on the top portion of the chamber. This rotation of the chamber distributes the oxidation and warping of the chamber wall, and relieves stresses which would be set up by a prolonged heating in one spot. While the rotation of the chamber is shown as being had by a simple handle, it is considered desirable to provide other means such as a motor to effect rotation of the combustion chamber. This rotation may be either intermittent or continuous.

While we have shown and described particular embodiments of our invention, it will occur to those skilled in the art that various changes and modifications may be made without departing from the invention, and we, therefore, aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of our invention.

Having thus described our invention, we claim:

1. In a bake oven housing, heat transfer means comprising: a horizontal, stationary, cylindrical, refractory basin; means forming a horizontal, cylindrical, combustion chamber having one end revolubly surrounding the open end of said basin; a fuel nozzle discharging into said basin and chamber; a cylindrical heater casing eccentric of and surrounding said basin and chamber with the lower part of said chamber resting on said casing; and means for rotating said chamber relative said casing.

2. In a bake oven housing, heat transfer means comprising: a horizontal, stationary, closed-end, cylindrical, refractory basin; means forming a horizontal, cylindrical combustion chamber having one end revolubly surrounding the open end of said basin; a fuel nozzle in the end wall of said basin and discharging thereinto and axially into said chamber; a cylindrical heater casing eccentric of and surrounding said basin and chamber

with the lower part of said chamber resting on said casing; and means for rotating said chamber relative said casing.

3. In a bake oven housing, heat transfer means comprising: means forming a horizontal, cylindrical combustion chamber, means forming a trunnion for said chamber, a fuel nozzle discharging into one end of and axially of said chamber, a cylindrical heater casing eccentric of and surrounding said chamber with the lower part of said chamber resting on said casing, said chamber being rotatable relative said casing and said trunnion, and means for effecting the occasional rotation of said chamber relative said casing.

JOSEPH A. CAMPBELL, JR.
EDWARD C. NIST.

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