

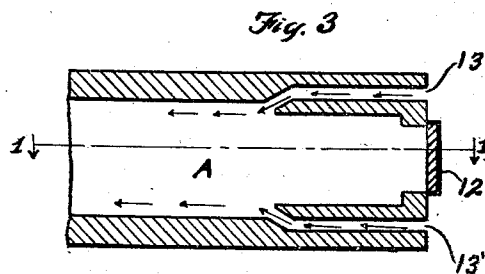
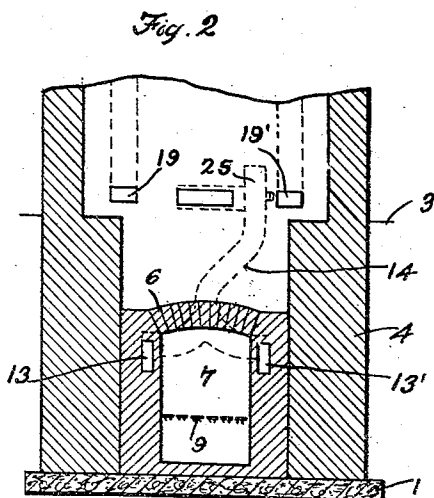
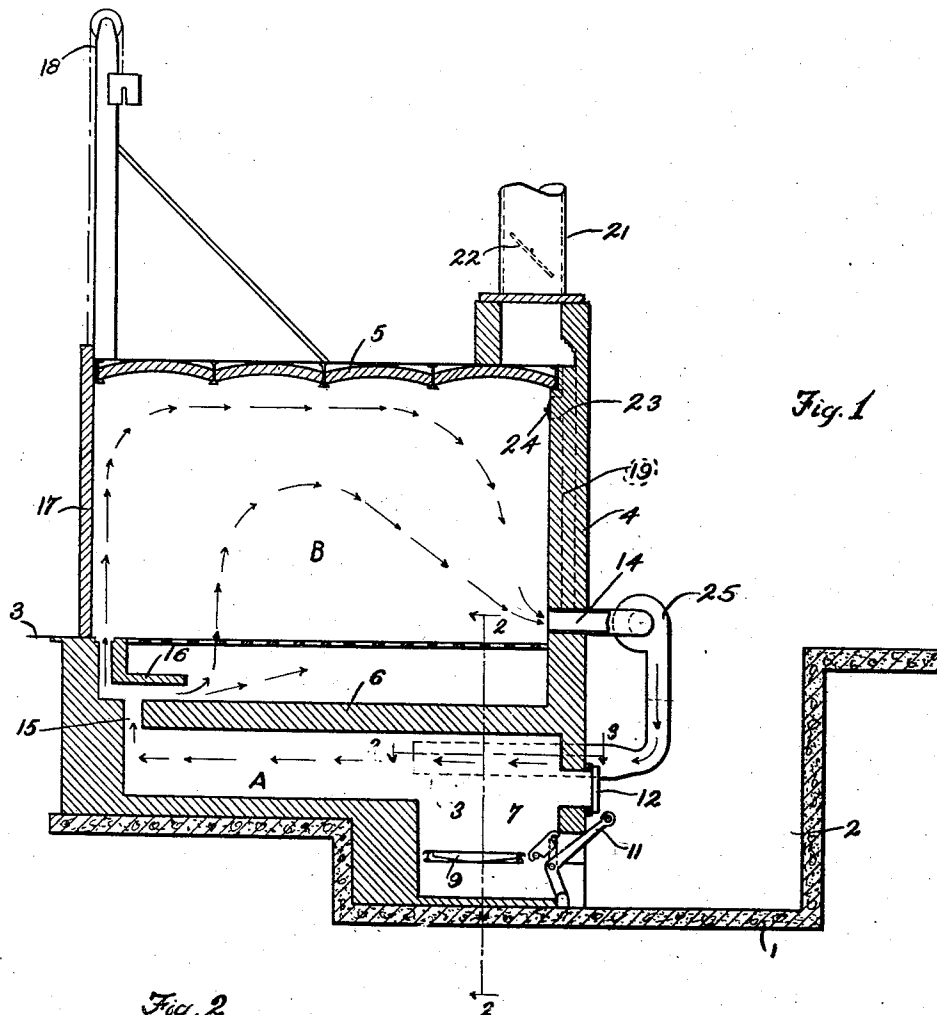
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C. A. BARNETT ET AL

1,950,212

RECIRCULATING OVEN

Filed Dec. 18, 1930



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UNITED STATES PATENT OFFICE

1,950,212

RECIRCULATING OVEN

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1 Claim. (Cl. 34—18)

This invention relates to ovens adapted to bake work or materials by direct contact with gases of combustion and, more particularly, to core baking ovens, although the invention is not limited thereto.

Among the objects of the invention are the provision of an under-fired oven having a system for the re-circulation of gases, improved means for controlling the temperature of the gases passing over the work or material being treated in the oven, economical and efficient regulation of heat, removal of spent gases, and improved means for maintaining a draft in the heating system of such an oven.

In the accompanying drawing forming a part of the specification is set forth the preferred embodiment of the invention, but it is to be understood that this is for the purpose of illustration and not of limitation and that the principles underlying the invention are susceptible of other application.

In said annexed drawing:

Fig. 1 is a longitudinal vertical section of the oven; Fig. 2 is a transverse vertical section taken along the line 2—2 of Fig. 1; and Fig. 3 is a horizontal section along the line 3—3 of Fig. 1 through the lead-in portion of a duct connecting two parts of the oven.

Having reference now to Fig. 1, the oven comprises a unitary structure having its footings in a foundation 1 of concrete or other suitable construction material which forms the floor of a pit 2 below the plant floor level 3. A heat-insulated casing 4 of brick, steel plate, insulated panels, or the like, together with a roof 5, shown as being of multiple-arched type but which may be of any other flat or arched construction and may be built up of tile, concrete, etc., encloses the oven and the roof 6 of the firebox 7 divides it internally into two zones, a firing zone in the shape of a sub-floor flue extending the full length of the oven, which will be termed zone A, and a heated zone in the form of an oven chamber and coextensive with the firing zone, wherein the materials are treated, termed zone B. For convenience of reference, the end of the oven at which the firebox is placed will be termed the rear. The two zones are separated by the roof 6 of the firebox and this roof constitutes an imperforate partition having no means for passage therethrough of gases, except at the extreme front end of the oven.

In the firing zone A is located a grate 9 for installations using solid fuel, although it will be understood that the invention is applicable when liquid or gaseous fuels are used, and, in such case, a grate would not be necessary. The grate illus-

trated is shown as provided with a dumping device 11 but this is not necessary to the practice of the invention, stationary grates also being suitable. A door 12 provides access to the firebox 7 and grate 9. Also, in the upper portion of this zone are the lead-in portions 13, 13' of a duct 14, the function of which will be described at length hereinafter. The portion of the firing zone from the gas entrances 13, 13' to the passage 15 is called the mixing chamber.

A passage 15 leads from the front end of the zone A, at a point remote from the source of heat located in the firebox, outwardly into the zone B opposite a baffle 16. Work may be inserted into this zone by raising the sliding gate 17 equipped with raising and lowering means 18, or doors of other design, such as those of the vertical lift, hinge, rolling curtain, or side sliding type may be used for this purpose.

Leading off from the lower part of the heated zone B at the rear of the oven is the duct 14 above mentioned, and also the flues 19, 19' leading from the heated zone to the stack 21 provided with the damper 22. Passage 23 equipped with dampers 24 also connects the upper part of the zone B with the flues 19, 19'. Referring again to the duct 14, this element passes through the wall of the oven and extends downwardly outside the oven to a point opposite the upper part of zone A where it branches and re-enters the structure at two points on either side of the firebox 7. Extensions 13, 13' carry the duct inside zone A to a point beyond the firebox 7 and grate 9. In the line of the duct 14 is placed a fan 25 which serves to withdraw gases from zone B and to inject the same into zone A.

In operation the various parts of the oven structure cooperate to produce the desired results as follows: Gases arising from combustion of a solid, liquid or gaseous fuel, such as coke, coal, oil, gas, pulverized coal, etc., in the firebox 7, the latter constituting an internal source of heat for the oven, have a temperature of 1500° to 1800° F. and would normally reach the work in zone B at a temperature injuriously high. It is necessary to reduce the temperature of the combustion gases to one suitable for baking, but not burning, the materials, about 350° to 600° for cores.

This reduction of temperature is effected by withdrawing a portion of the gases from the zone B by means of a duct 14 after these have been partly cooled by passage over the work. The fan 25 then forces these gases through the duct and injects them back into the oven at a

point opposite the upper part of the firebox 7. The branched leads 13, 13' continue the duct into the interior of the oven to a point in the firing zone A above and beyond the grate 9 where the gases are injected into the zone adjacent the source of heat. The effect of the injection of gases into the firing zone at this point is to create a suction draft upwardly through the grate thus drawing atmospheric air therethrough. The above applies when solid fuel, such as coal or coke, is being used. When a fluid fuel, such as oil or gas, is used, burners replace the grate and air would be drawn into the firebox through auxiliary ports located in the oven wall near the burners, as is well understood with such furnaces. Of course, adapting the installation to the use of fluid fuel does not affect the operation of the principle underlying the invention, as will be obvious from consideration of the following description. The hot gases resulting from combustion of the fuel and having a temperature in the neighborhood of 1500° to 1800° F., as mentioned above, are immediately mixed with the relatively cooler gases returned from the zone B, the resulting mixture having a temperature low enough to be suitable for baking cores. The gas mixture then passes throughout the entire length of zone A, thus giving time for the hot component to become thoroughly diffused through the cool component and for the mixture to acquire a uniform, lowered temperature before contacting with the work. Heretofore, it has been the practice with sub-floor flues, such as that denominated zone A in the present installation, to have a series of heat ports or slots in the flue arch located along the length of the oven and through which hot gases enter the oven chamber or heated zone at varying temperatures depending on the degree of diffusion between hot combustion gases and injected cool gases (in prior systems admitted from a source external of the oven) which has taken place at the particular point of travel of the gases in the flue opposite each port. In the present construction all of the gases, including those coming from zone B as well as those arising directly from combustion, must traverse the entire length of the zone A, during which period of travel they are thoroughly commingled and no injuriously hot gas reaches the work.

The gases, at the desired uniform temperature, leave the zone A at the front end thereof through the passage 15 connecting with zone B where they meet the baffle 16 in the lower part of the latter zone and the gas stream is divided, circulating over the work in the direction indicated by the arrows on the drawing. It will be apparent that various baffle arrangements and other means of directing the gases over the work may be used in place of the arrangement shown in the drawing. In fact, any means may be used, without departing from the scope of the invention, which involves causing the gases to pass the full length of the firing zone or under-flue before contacting with the work, introducing the heat to the work at the opposite end of the oven from that in which the source of heat is located and then causing the gases to pass through the full length of the heated zone or oven chamber before being returned to the under-flue or up the stack.

With respect to the disposal of gases after passing over the work, these have lost some of their heat and are recirculated through the duct 14 into the zone A to mix with fresh combustion gases and renew the cycle. Through the gas out-

let means 19, 19', some of the gas which has given up its heat is diverted out through the stack 21 to the atmosphere, thus maintaining a balance between gas leaving the system and air entering the system through the under-flue or firing zone A. The proportions of cool gas which it is desired to re-circulate through the internal firing zone or under-flue and to discharge through the stack, respectively, are regulated by the damper 22 located in the stack 21, and by the speed of the fan 25.

The foregoing description sets forth a structure, method of heat control and system of circulation having manifest advantages over those heretofore used in the art. It is believed to be unique to have a re-circulating system characterized by an under-fired arrangement resulting in extraordinarily thorough diffusion of hot combustion gases and consequent uniform heating of work, as well as economy of fuel.

It is well known that, unless convection currents are adequately maintained in ovens of the class herein described, the baking or other heat treatment is uneven, work first contacting with the gases getting most of the heat, which may cause burning, and shielding work in the rear which, consequently, is insufficiently heated. By providing means for re-circulating the gases through the oven, it results that heat is applied to the cores or other work by convection in a highly advantageous manner, the vigorous circulation maintained by the fan in the gas circuit insuring that the heat will reach all of the work and the under-fired flue or firing zone insuring that the gases, constituting the heat carrying vehicle, will be of uniform temperature upon entering the heated zone. The re-circulating system with the under-fired arrangement of the oven together modify the temperature of the combustion gases to a point suitable for the work in hand.

The system of heat control embodied by the invention provides for a diffusion of heat over the work at temperatures suitable for baking, i. e., temperatures lower than those resulting directly from combustion, without waste of heat consequent on dilution of the combustion gases by gases from a source outside the oven, such as added air, other than that necessary for combustion and for oxidizing binders in core baking or for similar chemical reactions in other processes. Contrasted with such means of reducing the combustion gases to the requisite temperature and which would require that more heat be wasted up the flue in the form of sensible heat of an increased volume of gases expelled from the system, the present method utilizes the spent gases from one zone of the oven, which have partly given up their heat to the work, and returns these gases to the firing zone where they perform the function of cooling the combustion gases. In effect, a body of gas is continually re-circulated through the oven, giving up its heat to the work in one zone, and being reheated in the other zone. Just enough gas may be bled off through the flues and stack to compensate for the gas added to the gas circuit as a result of the admittance of air necessary to support combustion in the firebox and to oxidize binders in core baking or for similar chemical reactions in other processes, as mentioned above. The oven is thus a complete self-contained unit requiring no extraneous means for its operation.

Other modes of applying the principle of our invention may be employed in place of the one

described, change being made as regards the mechanism herein described, provided the means stated by the following claim or the equivalent of such stated means be employed.

5 We therefore particularly point out and distinctly claim as our invention:—

10 In an oven of the type having a door at the front end, a heat-insulating floor extending from rear to front, a work-supporting grating spaced above said floor, a furnace beneath said floor at the rear, a passage from said furnace beneath said floor at the front of the oven and a duct leading upward through said floor at the front of

the oven, means dividing said duct into a channel directed upwardly within the floor and a channel directed rearwardly beneath said grating, a suction passage in the rear of said oven near the bottom, means for withdrawing gas through said passage, and means for discharging gases so withdrawn into a space above and to the rear of said furnace, whereby said withdrawn gases are mixed in said first-named passage with furnace products of combustion. 80 85

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