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RECIRCULATING OVEN

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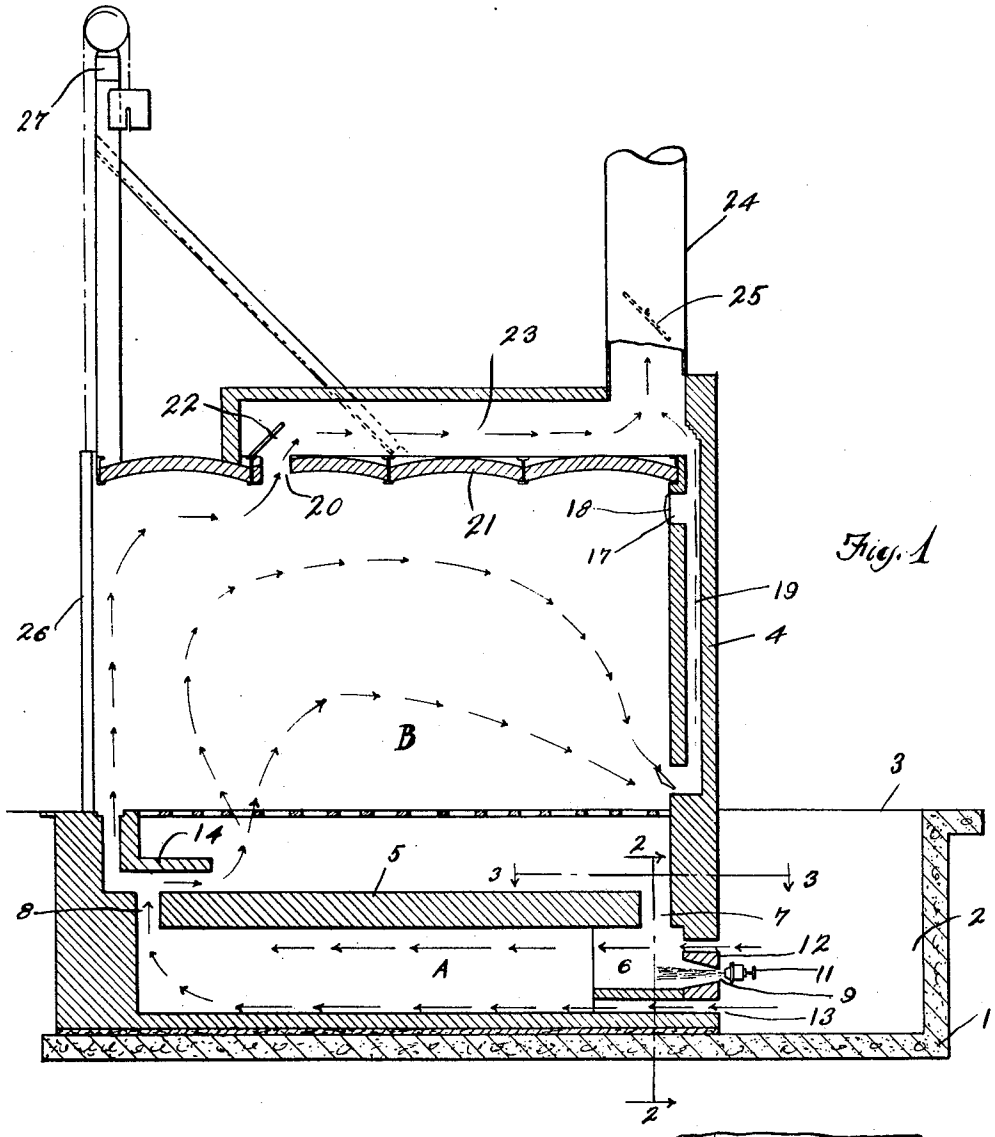


Fig. 1

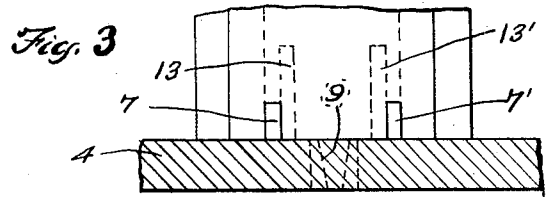


Fig. 3

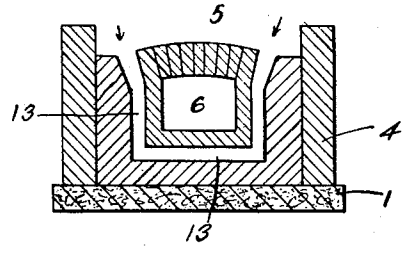


Fig. 2

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RECIRCULATING OVEN

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Application December 18, 1930, Serial No. 503,204

1 Claim. (Cl. 34—18)

This invention relates to apparatus and methods for heating in which gases from the combustion of fuels are caused to circulate over the work to heat the same and, more particularly, to ovens or the like in which work or materials are heated by gases from the combustion of fluid fuels. The system embodied by the invention is useful in any baking or drying processes, such as core baking, mold drying, heat treating, annealing, normalizing, etc., and for any type of oven, such as a portable rack type, shelf type, car type, drawer type or other, either large or small.

In our co-pending application Serial No. 503,203 filed of even date herewith, we have described a recirculating system to be used with any form of fuel but more particularly described with reference to the use of solid fuel. In the present application is set forth a system particularly adapted to the use of fluid fuels, although not limited thereto.

Among the objects of the invention are the provision of an under-fired oven having a system for the recirculation of gases, improved means for controlling the temperature of the gases passing over the work or materials being treated in the oven, economical and efficient regulation of heat, removal of spent gases, and the utilization of the injector effect of a fluid fuel to maintain circulation of gases in the system.

Although we herein show and describe a preferred embodiment of our invention, as constructed to be operated with an internal heating means utilizing fluid fuel, it is to be understood that this is for purposes of illustration and not of limitation, and that the principles underlying the invention are susceptible of other application.

In the accompanying drawing, forming part of the specification, Fig. 1 is a longitudinal vertical section of an oven equipped with an injector type of burner; Fig. 2 is a transverse vertical section along the line 2—2 of Fig. 1; and Fig. 3 is a horizontal section through the line 3—3 of Fig. 1.

Referring 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, which may be of brick, steel panels, or of built-up construction, etc., encloses the oven, and a partition 5, roofing the firebox 6, divides the oven into a firing zone, which will be termed zone A, and a work-holding or heated zone, termed zone B. For convenience of reference, the end of the oven at which the firebox is placed will be called the rear. The two zones above referred to, the function of which will be pointed out hereinafter, are, preferably, coextensive and are connected by passages 7 and 8 at the rear and front extremities of the oven, respectively, these zones being otherwise completely separated by the imperforate partition 5 of fire-brick or similar resistant and heat-insulating material.

In the rear wall of the oven is provided an inlet 9 through which a burner 11 of the injector type discharges a fluid fuel, such as oil or gas; for instance, fuel oil or natural gas, into the firebox 6. Air inlets or registers 12 and 13 are located in the oven wall adjacent the burner 11 to supply air to the firebox 6 and to the firing zone A, and air entering through these cools and thus protects the relatively thin walls of the firebox.

The work-holding zone B is equipped with a baffle 14 opposite the passage 8 and with a plurality of openings for the exit of gases. Of these latter, openings 15 and 17 in the rear wall of the oven, controlled by the dampers 16 and 18 respectively, communicate with the flue 19, while a passage 20 penetrates the oven roof 21, said roof being of any flat or arched design and built of tile, concrete, or any suitable material. This passage 20 is controlled by the gate 22 and communicates with the flue 23. Both the flues 19 and 23 lead into the stack 24, through which gases pass out into the atmosphere as permitted by the damper 25.

Work is placed in the work-holding zone B by raising the sliding door 26 equipped with raising and lowering means 27, or other means for this purpose may be used, such as, a door of the vertical lift, hinge, rolling curtain, or side sliding type. The work is supported in the zone B by any of various means (not shown) such as those of the rolling drawer type, car type, portable racks, shelves, etc.

In operation, a combustible fluid, such as oil or gas, is injected through the nozzle 11 under considerable velocity into the firebox 6 where it is ignited and burns in the presence of air drawn through the registers 12 and 13. The combustion gases formed have a temperature of 1500° to 1800° F. and would normally reach the work in zone B at a temperature injuriously high, and it is, consequently, necessary to reduce the temperature of the gases to one suitable for baking cores and other materials without burning them, about 350° to 600° F. for cores. One method of securing the requisite reduction in tempera-

ture is to dilute the hot combustion gases leaving the firebox with cold air or other gas from an external source, but it will be seen that such a method involves considerable loss of heat in the form of sensible heat of an increased volume of gases passing up the stack.

The system herein described effects the requisite cooling of combustion gases without introduction of air or other gas from outside the system, other than that required for combustion and the air necessary to oxidize binders in core baking or for similar chemical reactions in other processes. Liquid or gaseous fuel is injected through the burner 11, the velocity of the fluid stream carrying gases, resulting from combustion of the fuel, through the firing zone A. At the same time, the injector effect of the jet of fuel creates suction on the passage 7, located above the line of travel of the fuel and adjacent the burner 11, and causes gases which have already passed over the work to be drawn into the firing zone at this point. These gases have been cooled by contact with the work and are now mixed with fresh, hot combustion gases, the mixture being compelled to pass throughout the entire length of the firing zone A, since the partition 5 is imperforate, having no openings permitting gases to enter zone B until passage 8 is reached. The progress of the mixed gases throughout the length of the firing zone to the passage 8, which is remote from the injecting means 11, gives 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 the hot gases enter the oven chamber or heated zone at various temperatures depending upon the degree of diffusion between hot gases and added 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 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 reach the zone A at the extreme front end thereof through the passage 8 connecting with the zone B, where they meet the baffle 14 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 involve causing the gases to pass the full length of the firing zone or underflue 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 in thorough contact with the work before being reutrned to the under-flue, or up the stack, as operation of the oven may indicate. With respect to disposal of gases after passing over the work, these have lost some of their heat and are drawn back by suction through the passage 7 to recirculate in the system together with fresh combustion gases, thus renewing the cycle. In fine, the gases have been compelled to traverse a circuit defined by zones A and B and the connecting means 7 and 8. Through the gas outlet means 15, 17 and 20 some of the gas which has given up its heat is diverted through the stack 24 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 cooled gas which it is desired to recirculate through the firing zone or underflue and to discharge through the stack, respectively, are regulated by the damper 25 located in the stack 24, or other means of regulation may be employed within the scope of the invention.

It will be appreciated that the injector effect of the jet of fluid fuel admitted through the burner 11 provides the necessary impulse, together with the natural draft resulting from combustion, to promote and maintain the required continuous recirculation of gases through the two zones of the oven. The location of the passage 7 above the entering stream of fuel causes gases to be drawn from zone B into zone A, and the velocity of the stream causes all of the gases in the vicinity of the firebox to proceed through the zone A back into the zone B, as described above.

The novel system of heat control and circulation set forth in the foregoing description includes a recirculating system characterized by an under-fired arrangement utilizing fluid fuel and the injector effect of supplying this fuel to the system, as well as the means to operate said system in practice.

Other modes of applying the principles of our invention may be employed instead of the one explained, change being made as regards the means and the steps herein disclosed, provided those stated by the following claim or their equivalent be employed.

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

In combination in an oven of the class described a furnace below the entire length thereof, a solid roof separating said furnace from the work-holding zone, a work-holding grating above said roof, an inlet passage from the work-holding zone through said roof at the firing end of the furnace, an outlet passage to the work-holding zone at the opposite end of the furnace, a baffle above said outlet passage and below said grating.

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