Nov. 14, 1933. C. A. BARNETT ET AL 1,934,904

VERTICAL CONVEYER OVEN

Filed May 5, 1930 3 Sheets-Sheet 1

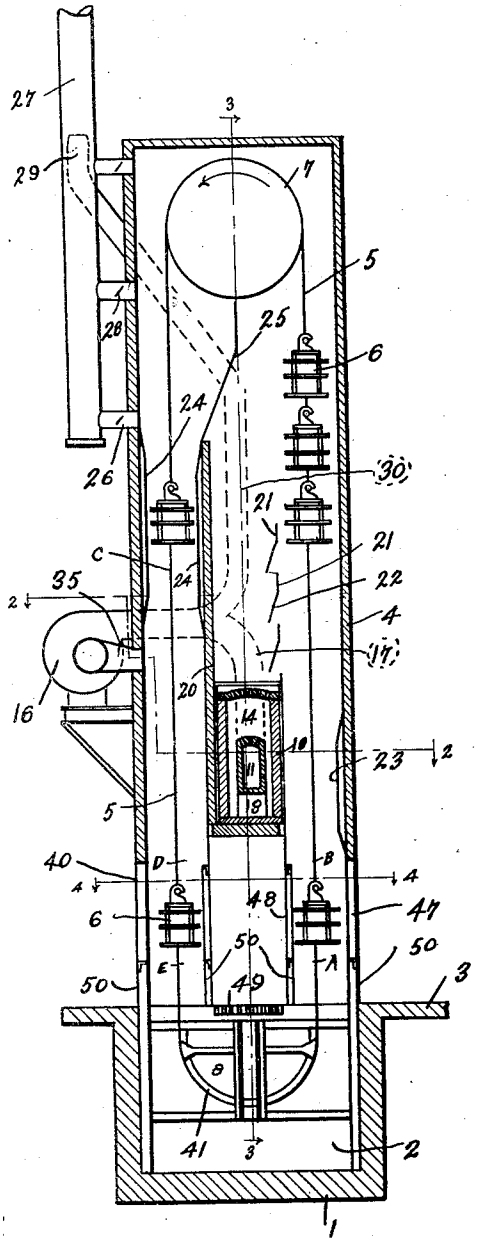


Fig. 1

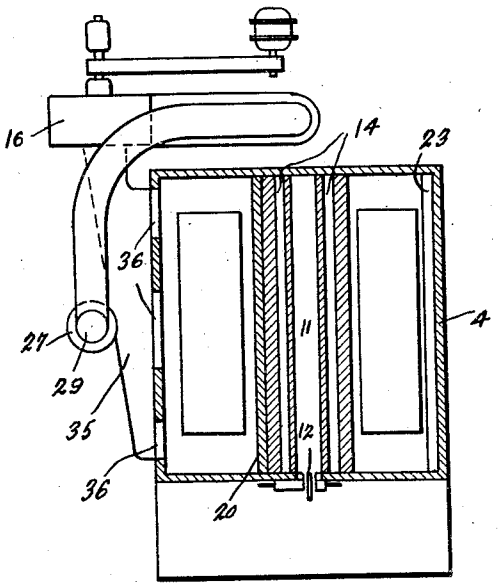


Fig. 2

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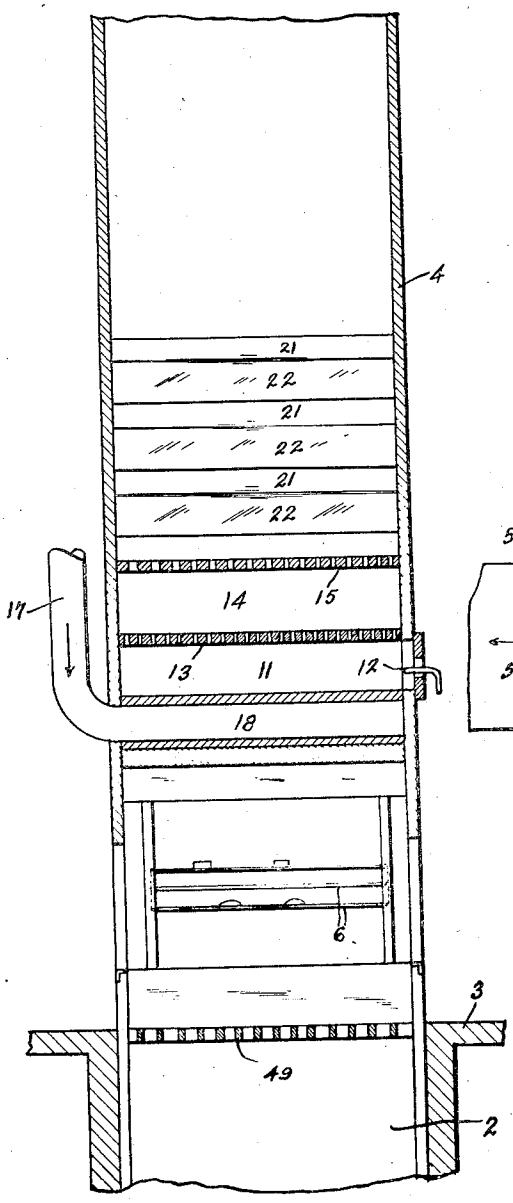


Fig. 3

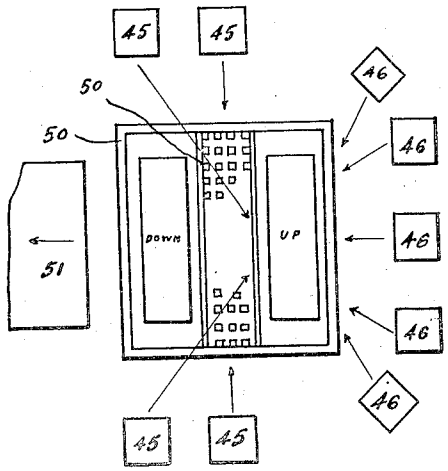


Fig. 4

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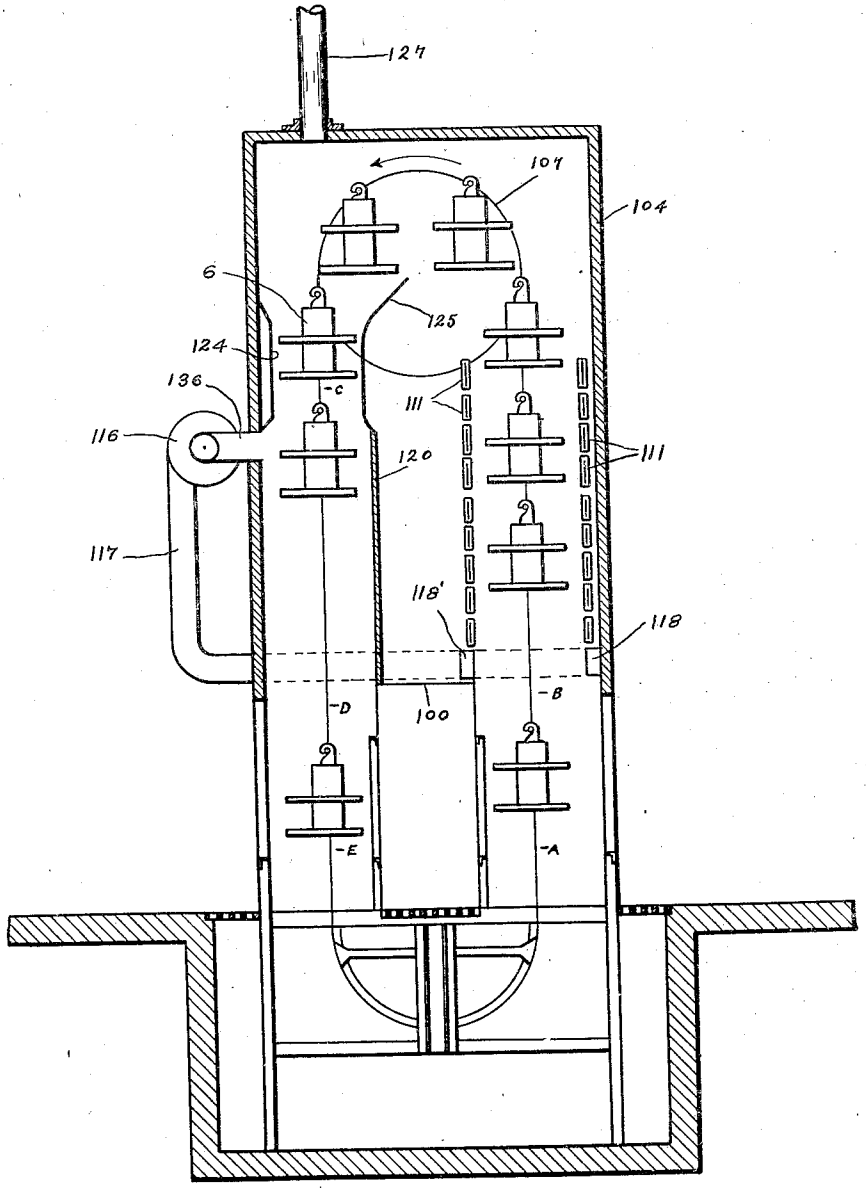


Fig. 5

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UNITED STATES PATENT OFFICE

1,934,904

VERTICAL CONVEYER OVEN

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Application May 5, 1930. Serial No. 449,957

4 Claims. (Cl. 34—12)

This invention relates to vertical ovens of the type having the work carried through on a continuously moving conveyer at speeds such that loading and unloading can be effected while the conveyer elements pass openings in the oven structure, and particularly relates to core baking ovens, although not limited thereto. Among the purposes of the invention are greater facility of loading and unloading with generally more efficient organization of work at these points than has previously been possible; economical and efficient regulation of heat; application of heat to the work by convection as well as by radiation; supply of air to oxidize the work; removal of spent gases, arrangements for making minor repairs and adjustments without stopping the conveyer or interfering with loading and unloading.

Although we herein show and describe a preferred embodiment of our invention, as constructed for heating from an internal firebox, and as modified for electrical heating, it is to be understood that these are for purposes of illustration and not of limitation and that the principles are susceptible of other application.

In the accompanying drawings, Fig. 1 is a vertical section with the near wall removed; Fig. 2 is a horizontal section, partly in plan, on the line 2—2 of Fig. 1; Fig. 3 is a partial vertical section on the line 3—3, Fig. 1, but somewhat enlarged; Fig. 4 is a diagrammatic horizontal section on the line 4—4, Fig. 1, showing arrangements for loading and unloading; and Fig. 5 is a vertical section corresponding to Fig. 1 but showing the furnace modified for electric heating.

Referring now to Fig. 1, our oven comprises a tower-like structure which may conveniently be built of an angle bar frame with its footings in a concrete foundation 1 which forms the floor of a pit 2 below the plant floor level 3. The frame is open in the pit and up to a point about six feet above the floor 3, but the remainder of the tower is suitably walled with a heat-insulated casing 4 and outside metal sheeting, or the like, all of known construction, stopping high enough above the floor level 3 to allow full headroom. A chain conveyer, shown in somewhat diagrammatic style and generally indicated at 5, carries trays such as 6 up in one side of the structure and down in the other side, movement being imparted by a head sprocket 7 which turns in the direction of the arrow. A bottom return guide 8 takes up and tensions the chain. The exact construction of the conveyer does not form a part of the invention and therefore only such conveyer features as directly cooperate with our invention will be described in further detail.

In the following description and in the claims, the entire apparatus is considered as divided into zones, according to the operations which take place along various parts of the conveyer path. Thus the portions of the apparatus adjacent the path A—B, constitute the loading zone, from B up and around to C is the heating zone, from C to D is the first cooling zone, or work cooling zone, from D to E the unloading zone, and from E to A the second cooling zone, or cooling zone for work holders. The zones A—B and D—E, taken together are referred to as the work-handling zone.

Although there is a direct cooperation between the thermal arrangements and the work-handling arrangements, as will become apparent later, they may be more conveniently described separately.

Heating system

The furnace 10 is supported on suitable elements of the framing, having its bottom a little above the bottom of the casing 4. The furnace consists of a combustion chamber or fire-box 11, preferably oil or gas fired as by a burner 12, the fire-box being made of the usual refractory materials, and having a perforated roof 13. The combustion chamber is surrounded except at the ends by a diffusion chamber 14, also of refractory material, and also having a perforated roof 15. Air from a blower 16, mounted outside the casing 4 is carried by a duct 17 into a flue 18 beneath the combustion chamber 11, and passes out and up around the side walls of the combustion chamber and mixes in the diffusion chamber with the products of combustion, thence rising through the perforations in the roof 15 into the heating zone. This supply of air serves to reduce the heat of the combustion chamber, about 1500° to 1800° F. to a suitable temperature for baking, but not burning the material on the conveyer, about 350° F. to 600° F. for cores. At the same time, the excess of air provides oxygen for oxidizing the cores. By reason of the thorough diffusion and because of recovery of heat from outgoing work, as will be described below, a large oven can be operated with a small combustion chamber and very economical use of fuel.

The hot air from the combustion chamber rises between a heat-insulating wall 20 and a short non-insulated wall 21, the former constituting part of the inner side of a passage for outgoing work and the latter constituting part of the in-

ner side of a passage for incoming work. Damper gates 22, regulable from outside the oven, control the intensity of application of heat to the new work.

For efficiency and for accurate temperature regulation it is necessary to prevent any large inflow of air to the heating zone except through the duct 17. To accomplish this, a false wall 23 is placed adjacent the path of the conveyer opposite the diffusion chamber wall 10, thus narrowing the passage to just clear the conveyer trays 6. These may be either solid plates or closely slatted racks. The narrow passage or throat is of a length greater than the distance apart of two successive conveyer carriers, so that the throat is always blocked by one or more of the trays 6, with the result that only an inconsequential amount of air can enter. A similar throat is formed on the outgoing side by false walls 24, but this is located considerably higher than the incoming throat.

The insulated inner wall 20 stops at a point opposite the upper end of the false walls 24, but the inner of these false walls is continued up as at 25 with an inward inclination to about the bottom of the headwheel 7, to prevent short-circuiting of heat currents to the outlet flues 26 and stack 27.

It results from the above arrangement that heat is applied to the cores by convection rather than by radiation, thereby giving uniform treatment to all the cores. Convection heating is particularly important where there is a direct radiant heat supply adjacent the work, as in electrically heated furnaces. Unless convection currents are set up in such furnaces the baking is uneven because the work next to the heaters gets most of the heat and shields work in the rear which consequently is insufficiently heated.

Several vertically separated outlet flues 26, each having its individual damper 28, controlled from the floor, carry spent gases from the discharge side of the upper part of the heating zone to a stack 27. A lively draft is provided without the necessity of a tall stack by the exhausting effect of a nozzle 29 above the topmost flue 28. This nozzle is supplied with a portion of the air stream from the blower 16, by an upward branch 30 taken off the duct 17.

It will be observed from the foregoing that work coming in past the constriction 23 is exposed somewhat gradually to the baking heat, according to the degree of opening or closing of the damper gates 22. By reason of the slow travel of the conveyer, the work is well heated by the time it is exposed, above the baffle 21, to the full blast from the diffusion chamber.

Cooling system

After the work has been baked it passes out of the heating chamber through the throat formed by the false walls 24. At this point the work begins to be shielded from the heat by the upper part of the insulated wall 20. Below the walls 24 and suction nozzle 35 of the blower 16 is connected over several apertures 36 in the casing 4, and the outgoing passage is widened at and below this point sufficiently to permit air to flow past the conveyer trays therein in quantities adequate to the capacity of the blower. The open construction of the bottom of the tower permits free access of air from the room into the outgoing passage, with the combination of several desirable results; namely, the cooling of the work so that it can be handled when it reaches the unloading opening 40, the preheating of the air supplied at 18 to the diffusion chamber 14, and bringing fresh air constantly to the unloading and loading stations, thus maintaining comfortable conditions for the workmen there.

In operating our apparatus as a core oven, the cores are removed during the travel from D to E, but the core plates and core dryers are left on the trays 6. For reasons that will be explained hereafter, it is necessary to cool these to a temperature lower than that at which the cores can be unloaded. Diffusion of heat from the plates and dryers during the travel from E to A accomplishes this result.

The bottom take-up of the conveyer is an adjustable frame located below the level of the floor 3, and having semi-circular guides 41 for the conveyer chain, sufficiently above the floor of the pit 2 for the conveyer trays to clear. On account of the slow travel of the conveyer, adjustments and minor repairs can be made in the pit without stopping the machinery. For example, a tray can be removed and a new one hooked on in the zone.

Loading and unloading

A difficulty previously encountered with vertical ovens has been to find space for a sufficient number of core-makers to work and have access to the loading side of the conveyer, without getting in one another's way. We accomplish this by the arrangement of the handling zone features, and by leaving the core plates and dryers on the conveyer from the unloading back to the loading side.

Referring now to Fig. 4, the core-makers are stationed at benches 45, 46 on the floor 3 on three sides of the oven. As the conveyer trays 6 come up to the openings 47, 48, the core-makers, moving as generally indicated by the arrows, take off the empty plates and dryers for their individual work and load new work on. The cores, on the down travel of the trays, have been unloaded through the opening 40 by a man, wearing heavy gloves, whose station is indicated at 51. The core-makers must work with bare hands; thus, if it were not for the second cooling zone E—A, it would be necessary to take off the core plates and dryers also at 51 and set them to one side to cool before they could be used, so that the zone E—A saves extra handling and saves floor space which would otherwise be necessary to hold the cooling plates and dryers. A grating 49 continues at the floor level across the pit 2, so that the men at the benches 45 work from the inside through the opening 48, Fig. 1, while those at the benches 46 work through the outside opening 47. Outer and inner casings 50 guard the conveyer shafts.

Electric furnace

In constructing this type of furnace for electric heating, or for any sort of heating where the heat is from radiant sources on the sides of the conveyer pathway instead of from a firebox, certain modifications may be made in details, as shown by Fig. 5.

In Fig. 5 the construction and principles of operation are fundamentally the same as for the forms in the other figures, but the omission of the firebox necessitates some changes in detail.

The space between the incoming and outgoing conveyer passageways, which in the form of Fig. 1 is closed by the bottom of the furnace struc-

ture, is closed in the present form by a horizontal flooring 100.

The conveyer trays pass up from the loading zone A—B between the two sides 118 and 118' of a recirculating duct 117 into a passage extending approximately to the sprocket wheel 107, which passage is formed by a series of vertically superposed electric heaters 111 which may conveniently be set edgewise with small intermediate air spaces.

A baffle wall 120—125 extends from slightly below the axis of the sprocket 107 to the bottom of the cooling zone, being bent toward the center of the furnace at the top to allow the downward passage of conveyer trays, and being vertically disposed further down opposite a false wall 124, thereby forming a throat through which the conveyer trays 6 pass downward in their entrance to the cooling zone C—D. The wall portion 120 below the throat is heat-insulated and is spaced somewhat inward from the line of movement of the inner edges of the conveyer trays to allow circulation of incoming air for cooling around the trays, the outer wall 104 of the furnace structure being similarly related to the tray path.

A fan 116 taking air from the top of the cooling zone through a duct 136 recirculates the air through the passage 117 to the ducts 118—118' as already mentioned.

The stack 127 allows hot air and the gases which result from the baking operation to escape. Since this furnace has no gases of combustion to be handled and no fire to be supported, it is not necessary to provide a blast in the stack, although a blast such as illustrated in Fig. 1 could be provided for if necessary. Such might be the case if, for example, rows of gas flames should be used instead of the heaters 111.

The recirculation of air in this electric furnace, besides providing oxygen to oxidize the binder used in making the cores, also causes uniform baking of the cores for the reason that the heat is applied by convection and not solely by direct radiation. The use of convection heat currents is particularly necessary in this type of furnace, as otherwise the work next to the heaters would receive the greater part of the heat and cut it off from the work in intermediate positions on the trays, and indeed the work directly exposed to the heat would be baked more on one side than the other. A good circulation of air, as we have provided for, avoids these disadvantages.

As in the firebox type of furnace, the recirculated air also reduces the amount of heat which must be primarily applied and diffuses the heat.

The division of this furnace into zones, loading and unloading arrangements, and the conveyer construction are the same as in Fig. 1.

Operation

The operation is believed to be apparent from the foregoing description, but will be briefly reviewed.

The cores are loaded onto both sides of the conveyer at the openings 47 and 48 as each tray 6 slowly travels from A to B. Approximately at B the work enters the heating zone, but is exposed gradually, being shielded from the direct blast of hot air and gas at first by the wall 10 and later by the wall 21. If it is advisable to apply the full heat earlier, one or more of the damper gates 22 can be opened.

The air from the diffusion chamber 14, which has been heated from the firebox 11, is forced by the baffle 25 to follow the conveyer path to the outlet flues 26 and travels down a greater or less distance according to whether the various dampers 28 are open or closed. This air, forced in by the blower 16, provides the oxygen necessary to oxidize the cores during baking, but part of the stream is diverted to supply the exhaust at 29.

At the walls 24 the work starts out of the heating zone, and as it passes the blower suction opening 35 comes into a cooling current so that at the point D it can be taken off by the unloader, wearing heat-proof gloves.

The core plates and dryers are still too hot to be moved with bare hands, but further travel from E down under and up to A gives them time to cool, so that each coremaker, working with bare hands, can take off his own, and he also has time, before the tray rises to B to load on the new work. The grating platform 49 and inside opening 48, allow some of the coremakers to get to the trays at one side, while others are standing on the floor 3 and handling material through the opening 47 at the other side.

Other modes of applying the principles of our invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed, provided the means stated by any of the following claims or the equivalent of such stated means be employed.

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

1. A vertical conveyer oven comprising, in combination, an upper casing and a lower portion open to the atmosphere and for work-handling on both sides of the upward and downward runs of the conveyer, a conveyer having a path of travel through said casing and said open portion, heat-supplying means in said upper casing, heating and cooling zones in said upper casing, a work-handling zone in said lower portion, means for drawing atmospheric air through said handling zone and past work moving through said cooling zone.

2. In a vertical conveyer oven comprising a casing having a conveyer therein adapted for continuous movement up one side and down the other, heating and air-circulating means applied to said conveyer, including as a source of heat a diffusion chamber within the casing, a combustion chamber within the diffusion chamber, means for extracting heat from outgoing work and returning the same to the oven by a current of air to maintain combustion and to oxidize the work.

3. In a vertical conveyer oven comprising a casing having a conveyer therein adapted for continuous movement up one side and down the other, heating and air-circulating means applied to said conveyer, including as a source of heat a diffusion chamber between the upward and downward conveyer runs, a combustion chamber within the diffusion chamber, single means for supplying air to said combustion chamber, for mixing additional air with combustion products, and for extracting heat from outgoing work.

4. In a conveyer oven having lines of conveyers passing one another in opposite directions, means of access to both lines from within and without the boundaries of the oven, said means being constantly open and means for maintaining said means of access at prevailing room temperatures.

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