Dec. 13, 1932. F. A. HOPPE 1,890,681

BAKE OVEN

Filed May 7, 1932 4 Sheets-Sheet 1

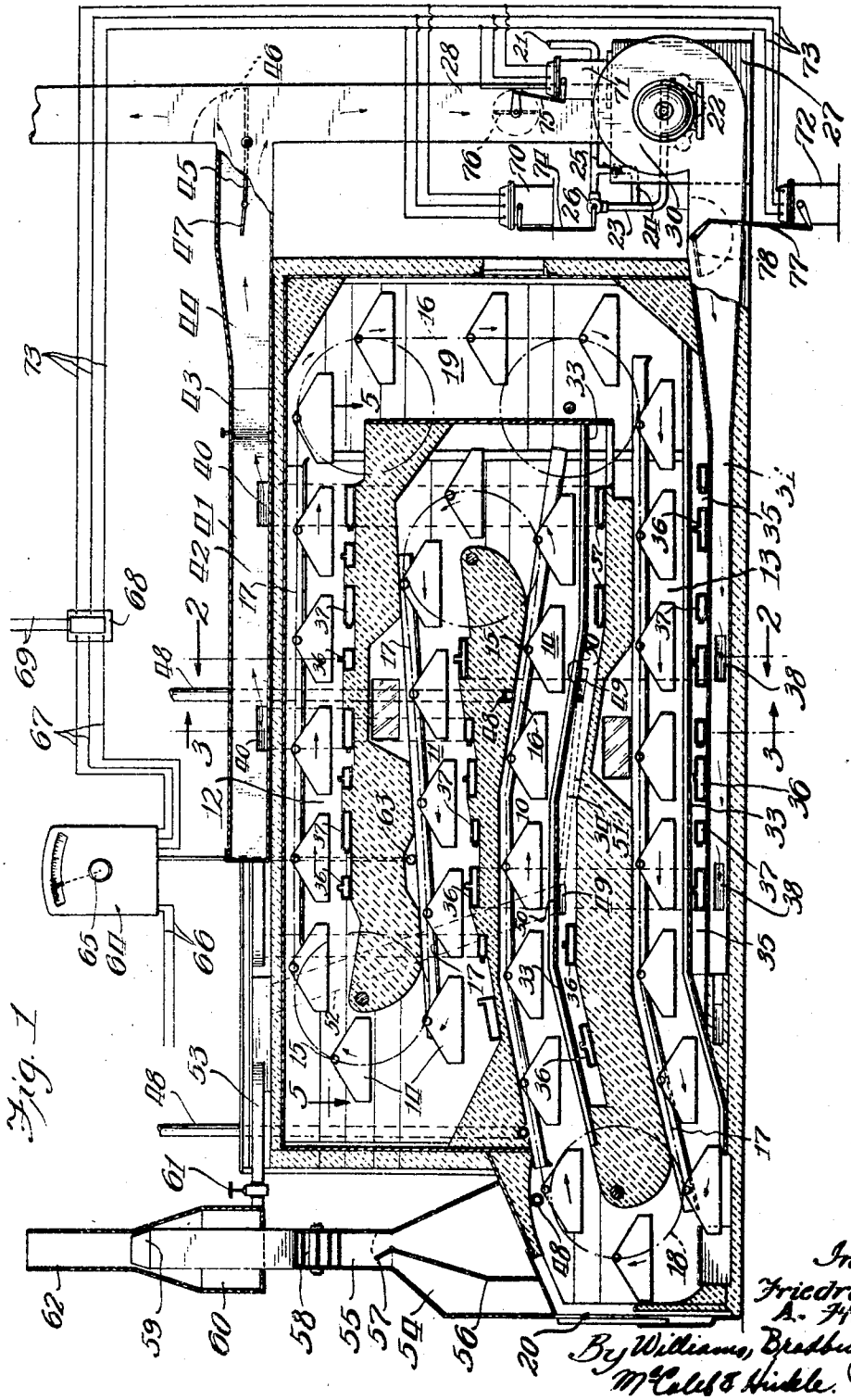


Fig. 1

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BAKE OVEN

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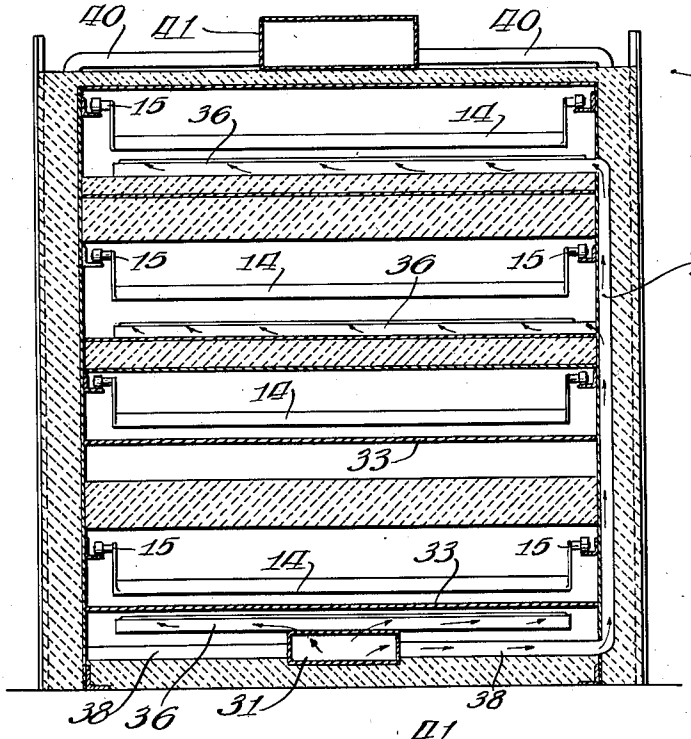


Fig. 2

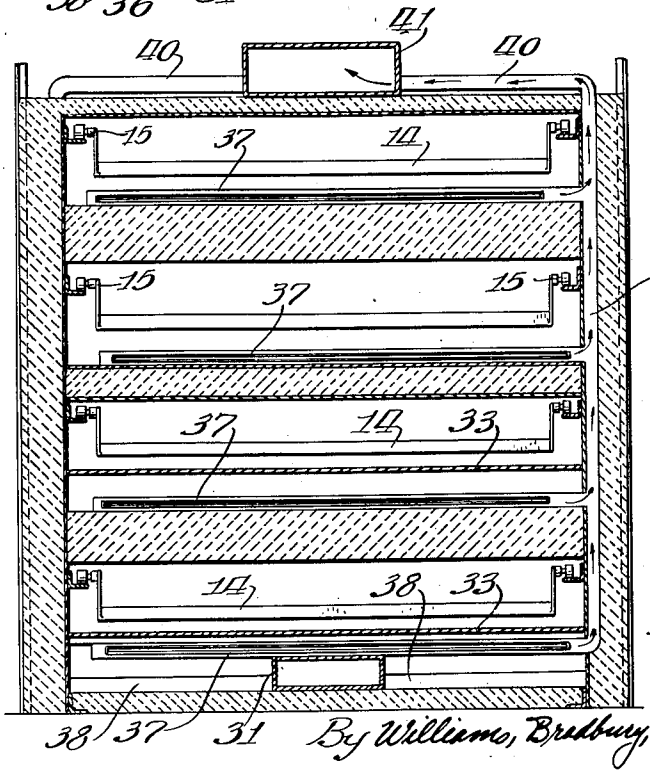


Fig. 3

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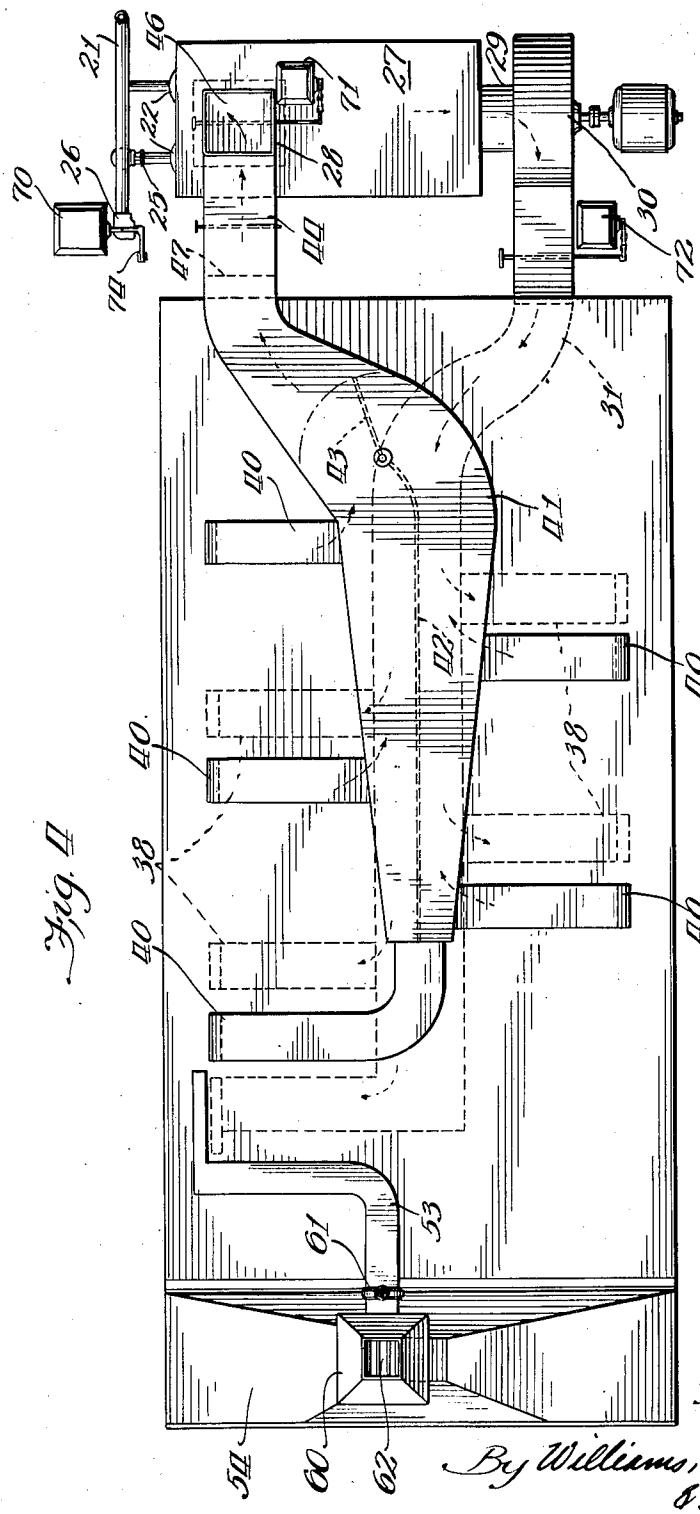


Fig. 4

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BAKE OVEN

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Fig. 5

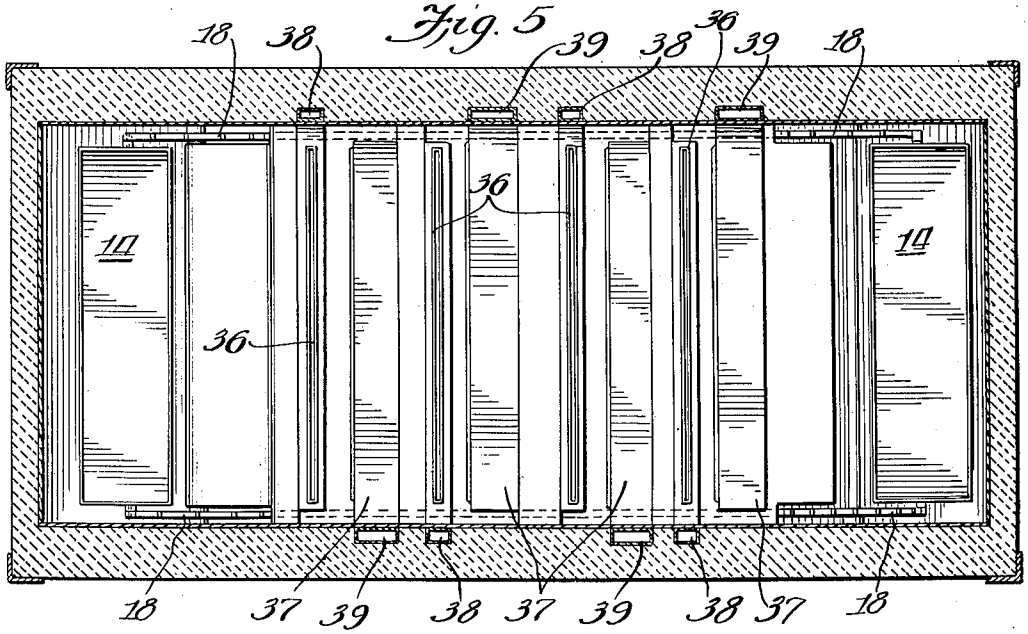
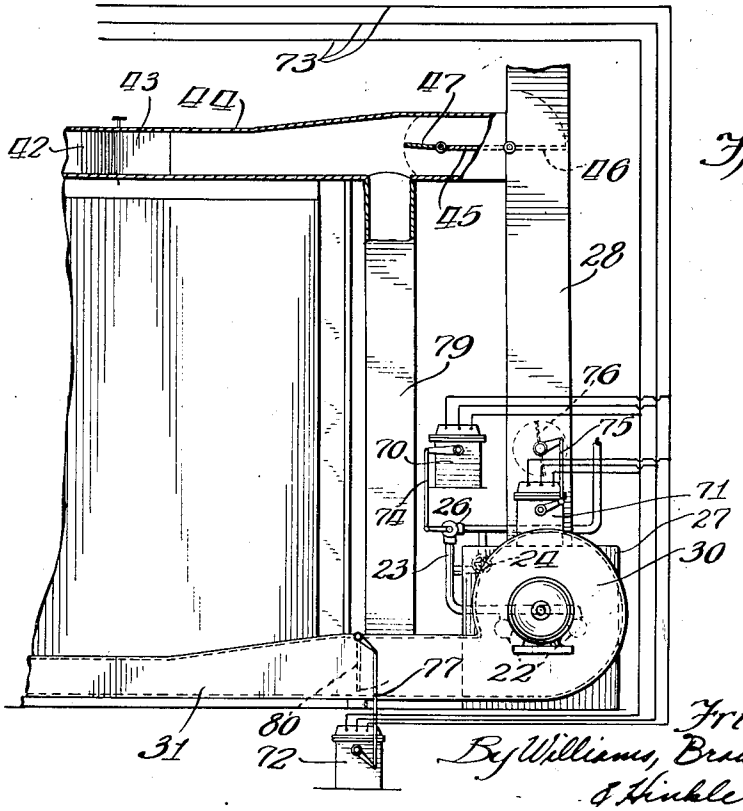


Fig. 6



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Patented Dec. 13, 1932 1,890,681

UNITED STATES PATENT OFFICE

FRIEDRICH A. HOPPE, OF CHICAGO, ILLINOIS, ASSIGNOR TO SCHMIDT SECURITIES COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS

BAKE OVEN

Application filed May 7, 1932. Serial No. 609,800.

This invention relates to bake ovens, and particularly to ovens in which the breadstuffs are carried through a circuitous path in which they are baked.

In such ovens the breadstuffs are normally conveyed by trays which form part of a conveyor, which conveyor runs backwards and forwards through substantially horizontal superposed runs interconnected at their ends, to provide circuitous baking chambers.

My invention is particularly concerned with an oven of the direct heating type, that is an oven in which the heating gases are admitted directly into the passages in which the breadstuffs are located, but it possesses features of general applicability which I intend to cover broadly within the scope of the appended claims.

The invention will be described hereinafter in its specific application to a bake oven in which the heating medium is recirculated. That is, for example the heating medium may consist of combustion gases and these are recirculated through the oven, a certain amount being allowed to escape, the escaped portion being replaced by highly heated combustion gases.

The distribution of heat within an oven of this type is a matter of considerable difficulty and it is the general object of this invention to improve this distribution. Thus, for example there is normally a tendency for one side of the oven to heat more strongly than the other and it has been practically impossible to completely remedy the defect in ovens which have been constructed heretofore.

One of the objects of the invention is to improve the manner in which the hot gases are supplied to the various chambers within the oven.

A further object of the invention is to improve the manner in which the recirculated gases are withdrawn from the various chambers of the oven.

A further object of the invention is to provide means whereby the withdrawal from both sides of the oven may be relatively controlled.

A further object of the invention is to provide an improved interrelated control for the heating means and for the recirculation of gases so that substantially uniform conditions may be maintained in the oven irrespective of variation of load, that is variation of the rate of supply of breadstuffs to the oven.

A further object of the invention is to provide an improved means for regulating the steam zone of the oven, whereby economy of steam and more uniform results are obtained.

A further object of the invention is to provide improved means whereby the removed products of combustion may be exhausted at a controlled rate and at an advantageous position.

Other objects, advantages and capabilities of the invention will appear from the following description of a preferred embodiment thereof taken in conjunction with the accompanying drawings, in which

Figure 1 is a longitudinal section through an oven embodying my invention;

Fig. 2 is a transverse sectional view thereof taken on the line 2—2 of Fig. 1;

Fig. 3 is a transverse sectional view thereof taken on the line 3—3 of Fig. 1;

Fig. 4 is a plan view of the oven;

Fig. 5 is a fragmentary sectional detail view taken on the line 5—5 of Fig. 1, and

Fig. 6 is a fragmentary side elevation, partly in section, showing a modified construction of recirculation control.

Referring to the drawings, the oven, which is substantially rectangular in shape, comprises internal partitions which define horizontal runs 10, 11, 12 and 13 through which extends a continuous conveyor shown by way of example as a plurality of trays 14 which depend from trunnions 15 which are connected by chains 16 in series, which chains ride upon guides 17 in the upper part of each

run and pass over sprocket wheels or the like 18 so as to move from one run to another. After the trays 14 pass inwardly through the run 10, outwardly through the run 11 and inwardly through the run 12, which is the highest run, they descend through a vertical run or flight 19 and pass outwardly through the lower run 13 to the unloading and loading position 20, at the front of the oven.

The oven may be heated by any suitable fuel, for example gas, which is supplied through a pipe 21 and delivered to burners 22 through two pipes 23 and 24. The pipe 24 is provided with a valve 25 whereby the supply of gas may be manually controlled. The pipe 23 is provided with a valve 26 the actuation or control of which will be hereinafter described. The burners 22 deliver their products of combustion into an enlarged chamber 27 into which extends a downcomer 28 which returns the gases to be recirculated. The mixture of recirculating gases and high-temperature combustion gases passes from the chamber 27 through an outlet 29 and is delivered to a fan or blower 30 which discharges the stream into a main supply duct 31. The main supply duct 31 is located in the bottom of the oven and extends therethrough for a substantial part of its length.

The runs 10 and 13 are heated indirectly, that is they are heated through impervious partitions 32 and 33. Means are provided for circulating heated gases through the chambers 34 and 35 provided on the underside of these partitions. The runs 11 and 12 are directly heated, that is the hot gases are delivered directly into the chambers or spaces provided by these runs. The hot gases are discharged into the chambers 34 and 35 and the runs 11 and 12 from boxes 36 which extend transversely of the oven and are provided in their upper face with discharge slits which extend the whole length of the boxes. The gases are exhausted by means of boxes 37 which also extend transversely of the oven and are provided with longitudinal slots, preferably along one side. Thus it will be seen that the incoming gases are projected upwardly while the gases removed are collected from a point near the floor of the run or heating chamber, as the case may be. Thus the heated gases, in the case of the runs 11 and 12 are projected vertically against the undersides of the pans 14 and between the pans up to the upper walls of the runs. After the gases have given up a portion of their heat and have dropped to the floor of the runs they are removed by the boxes 37. The operation within the heating chambers 34 and 35 is similar.

The hot gas supply boxes 36 receive their hot gases from the main supply duct 31 through vertical conduits 38 located in the side walls of the oven. As will be noted, more particularly in Fig. 5, the conduits 38 are staggered alternately on opposite sides of the oven along the longitudinal direction thereof so that in each run alternate boxes 36 receive their hot gases from one side and the other boxes receive their gases from the other side. This feature results in a much more uniform heating of the trays 14 and a much more satisfactory operation of the oven.

The exhaust boxes 37 communicate at one end with conduits 39, which are also located in the side walls and arranged alternately so that the alternate boxes 37 along one run discharge into conduits 39 in one wall and the other exhaust boxes 37 discharge into conduits 39 in the other wall. This feature likewise materially improves the uniform heating of the oven. The conduits 39 are connected by horizontal conduits 40, which are located in the top of the oven, with main exhaust duct 41, which is located on top of the oven and extends substantially centrally thereof. I prefer to provide a longitudinal partition 42 down the center of the main exhaust duct 41 so as to separate the gases discharged thereinto by the conduits 40. I provide at the end of the partition 42 means controlling the exhaust flow through each side of the oven. This means may suitably take the form of a damper 43 which can be located in any desired position so as to equalize the heating on one side of the oven with that on the other.

The main exhaust duct 41 gives into a conduit 44 which enters at right angles into the pipe 28. Adjacent the pipe 28 the conduit 44 is provided with a horizontal partition 45, the outer end of which carries a damper 46 which is adapted to close the pipe 28, in continuation with the partition 45. At the inner end of the partition 45 I provide a damper 47 which is provided with a horizontal axis about which it may be turned so as to divert a desired portion of the stream of gases passing through the conduit 44 above the partition 45. These gases possess considerable speed owing to the circulation set up by the blower 30, and their momentum is sufficient to carry them out to the atmosphere through the upper part of pipe 28, notwithstanding the suction or low pressure created in the conduit 44 by the blower 30. This action is assisted by the high temperature of the gases, the upper portion of the pipe 28 serving as a stack. The remainder of the gases, which preferably comprise about ninety percent of the total exhaust gases, passes downwardly through the pipe 28 into the chamber 27 in the manner described above.

The damper 46 is preferably employed when oil is used as fuel. It is opened when the oil burner is started so as to vent the soot and other products of incomplete combus-

tion and prevent same from entering the oven.

In the initial baking run 10 I provide in the well known manner steam pipes 48 which maintain in said run a high degree of humidity which is advantageous for the formation of a satisfactory crust. Heretofore, in ovens of this type, the steam consumption was very high, for the reason that there is an outward current of gases through run 11, run 10 and feed opening 20. That is, there is a considerable tendency for the steam to be removed immediately after it is injected. I avoid this objection to a considerable degree by locating within the run 10 and at a low level therein a suitable number of boxes 49, which extend across the run 10 and are provided in their upper faces with slots 50.

The boxes 49 are connected at one end by a suitable duct 51, suitably located in one side wall. The duct 51 communicates with a duct 52, also located in said side wall, which duct feeds into a duct 53 located at the top of the oven. Means adapted to produce suction are associated with the conduit 53 so as to withdraw relatively cold gases from a lower level of the run 10, thereby avoiding the expulsion of the steam laden gases through the feed opening. Above the feed opening 20 is provided a hood 54 which extends upwardly into a duct 55. The hood 54 preferably contains a transverse partition 56 which terminates at the lower end of the duct 55 and is provided there with a damper 57 which may be adjusted so as to regulate the withdrawal of the hot gases discharged through the opening 20, away from the operator who is normally stationed at the feed opening. The duct 55 is provided with an exhaust blower 58, driven in any suitable manner, and its upper end is reduced slightly as shown at 59. The upper end of the duct 55 extends through a chamber 60 into which communicates the duct 53. A gate valve or the like 61 controls the supply of exhaust gases from the conduit 53 to the chamber 60. The upper end of the chamber 60 tapers into propinquity with the tapered end 59 of the duct 55 and extends upwardly therebeyond in the form of a stack 62. The tapered portion of the chamber 60 and the tapered end 59 of the duct 55 cooperate to provide a Venturi effect so that the flow of gases through the duct 55 creates a suction within the chamber 60, which suction effects the removal of gases from the lower level of the run 10, through the boxes 49.

In accordance with my invention I provide automatic mechanism whereby both the recirculation and the supply of highly heated gases are correlated and adjusted. At 63 I show diagrammatically a thermo-electric device, such as a thermo-couple which is connected to an instrument 64 of known type, this instrument being capable of being set to any desired temperature by means of a handle 65. The instrument 64 is energized by leads 66. When this desired temperature is attained circuits are completed through leads 67 which throw switches within a relay 68 so as to divert power from lead 69 to suitable motors 70, 71 and 72 through a pair of conductors 73. When the temperature falls a certain amount, for example three degrees, the reverse action takes place and the switches of the relay 68 are thrown in the opposite direction so as to send the current through another pair of the conductors 73. The motors 70, 71 and 72 are of known type, being reversible motors equipped with limit switches so that at the end of the predetermined operation in either direction they stop, making the circuit for the other pair of conductors 73 to operate them in the opposite direction, when said conductors are energized in response to change of temperature. It will be understood that the instruments 64, 68, 70, 71 and 72 are of known type and are not claimed broadly, the present invention being concerned only with their application to a bake oven. The motor 70 is connected by suitable linkage 74 with the valve 26 so that this valve is completely closed in one extreme position of the motor 70 and is fully open in the other extreme position. The motor 71 is connected through a suitable linkage 75 with a damper 76 located in the downcomer 28.

The motor 72 is connected through a suitable linkage 77 with a damper 78 located at the outlet of the blower 30. The damper 78 is adapted to limit the flow of gases and not completely stop same. For example, it may be adapted to permit half the normal flow of gases to take place when in its closed position. The damper 76 is adapted to partially close downcomer 28 so as to increase somewhat the suction in chamber 27, with the result that sufficient air is drawn in to supply the burners notwithstanding the restriction provided by the damper 78 in the outlet of the blower 30.

It will be understood that when the motor 70 is actuated to close the valve 26, the motors 71 and 72 are simultaneously actuated to move the dampers 76 and 78 to their closed positions. The operation of this system is as follows. Assuming the dampers 76 and 78 to be open and the valve 26 to be open, the oven is working at full load, the maximum circulation is taking place and the maximum amount of hot gases are being supplied to the recirculating gases in the chamber 27. Supposing the temperature increased unduly, for example owing to a decrease in the amount of breadstuffs supplied in the feed opening 20, the temperature reaching that predetermined by the instrument 64. Then circuits are made through a pair of conductors 73 so as to actuate the motors 70, 71 and

72, with the result that the fuel supplied is cut down and the amount of gases recirculated is likewise cut down. The devices are preferably adjusted so that the ratio of gases recirculated to hot gases supplied is maintained substantially the same in both cases. In this way substantially uniformity of temperature is maintained throughout every part of the oven irrespective of whether the supply of gas or other fuel is at full fire or half fire.

In the modified construction shown in Fig. 6, a by-pass 79 connects the outlet of the blower 30 with the exhaust conduit 44. The damper 78 is replaced by a damper 80 which is adapted to close either the by-pass 79 or the entrance to the main supply duct 31. The damper 80 is controlled by the motor 72. In this modification the motors 71 and 72 are actuated simultaneously so as to close the valve 26, move the damper 76 to closed position and move the damper 80 so as to close the inlet to the main supply duct 31. Thus it will be seen that the fuel supply is reduced to a minimum and the supply of gases to the oven is shut off, the blower 30 serving to circulate gases through by-pass 79, exhaust conduit 44, downcomer 28 and chamber 27. The closing or partial closing of the damper 76 increases the suction within the chamber 27 so that an adequate supply of air is drawn in, to supply the burners. During this operation, which continues until the temperature of the oven falls to the desired point, a small amount of exhaust gas escapes upwardly through pipe 28.

Although the invention has been disclosed in connection with the specific details of a preferred embodiment thereof, it must be understood that such details are not intended to be limitative of the invention except in so far as set forth in the accompanying claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. A bake oven comprising a plurality of superposed zones, horizontal partitions separating said zones, said zones communicating at their ends in series to form a continuous chamber, means for injecting steam into the initial baking zone, and means for withdrawing gases at the level of the lower partition of said zone.

2. A bake oven comprising a plurality of substantially horizontal runs connected at their ends to provide a circuitous baking chamber, horizontal partitions between said runs, said oven being provided with a feed opening, pipes for injecting steam into the initial baking run, conduits opening into said run between the trays therein and the horizontal partition therebeneath, and means for abstracting gases therethrough to reduce the back flow of gases through said run and feed opening.

3. A bake oven comprising a plurality of superposed runs connected at their ends in series to form a continuous chamber, horizontal partitions between said runs, means for injecting steam into the initial baking run, conduits communicating with the initial baking run at the bottom partition thereof, and mechanical means for creating suction in said conduits.

4. A bake oven comprising a plurality of substantially horizontal runs connected at their ends to provide a circuitous baking chamber, said oven being provided with a feed opening, pipes for injecting steam into the initial baking run, conduits opening into said run at a low level thereof, and a blower adapted to remove gases discharged through said feed opening and adapted to create suction within said conduits.

5. A bake oven comprising a plurality of substantially horizontal runs connected at their ends to provide a circuitous baking chamber, said oven being provided with a feed opening, pipes for injecting steam into the initial baking run, conduits opening into said run at a low level thereof, a hood over said feed opening, an exhaust pipe communicating with said hood, a blower in said exhaust pipe, and Venturi means whereby the exhaust flow creates a suction in said conduits.

6. A bake oven comprising a plurality of substantially horizontal runs in superposed relation connected at their ends to form a circuitous baking chamber, a main for supplying hot gases, a main for exhausting cooler gases, a plurality of supply conduits in each run open across the oven, and vertical conduits in the side walls communicating between the supply main and supply conduits, said vertical conduits being staggered one on each side of the oven in the longitudinal direction thereof.

7. A bake oven comprising a plurality of substantially horizontal runs in superposed relation connected at their ends to form a circuitous baking chamber, a main for supplying hot gases, a main for exhausting cooler gases, a plurality of exhaust conduits in each run open across the oven, and vertical conduits in the side walls communicating between the exhaust main and exhaust conduits, said vertical conduits being staggered one on each side of the oven in the longitudinal direction thereof.

8. A bake oven comprising a plurality of substantially horizontal runs in superposed relation connected at their ends to form a circuitous baking chamber, a main for supplying hot gases, a main for exhausting cooler gases, a plurality of supply conduits in each run open across the oven, vertical conduits in the side walls communicating between the

supply main and supply conduits, said vertical conduits being staggered one on each side of the oven in the longitudinal direction thereof, a plurality of exhaust conduits in each run open across the oven, and vertical conduits in the side walls communicating between the exhaust main and exhaust conduits, said vertical conduits being staggered one on each side of the oven in the longitudinal direction thereof.

9. A bake oven comprising a plurality of substantially horizontal runs in superposed relation connected at their ends to form a circuitous baking chamber, means for supplying hot gases, a main for exhausting cooler gases from the runs, a plurality of vertical conduits communicating with the exhaust main and adapted to supply exhaust gases thereto, said vertical conduits being located on both sides of the oven, and a partition within said exhaust main separating the inlets from those on the conduits on one side from those on the other side.

10. A bake oven comprising a plurality of substantially horizontal runs in superposed relation connected at their ends to form a circuitous baking chamber, means for supplying hot gases, a main for exhausting cooler gases from the runs, a plurality of vertical conduits communicating with the exhaust main and adapted to supply exhaust gases thereto, said vertical conduits being located on both sides of the oven, a partition within said exhaust main separating the inlets from the conduits on one side from those on the other side, and means at the end of said partition operable to equalize the flow on each side thereof.

11. A bake oven comprising a plurality of substantially horizontal runs in superposed relation connected at their ends to form a circuitous baking chamber, means for supplying hot gases, a main for exhausting cooler gases from the runs, a plurality of vertical conduits communicating with the exhaust main and adapted to supply exhaust gases thereto, said vertical conduits being located on both sides of the oven, a partition within said exhaust main separating the inlets from the conduits on one side from those on the other side, and a damper pivotally mounted at the end of the partition adapted to equalize the flow on either side thereof.

12. A bake oven comprising a baking chamber, a blower adapted to circulate hot gases through the oven in heating relation to the breadstuffs, means for supplying highly heated gases to the recirculating gases, and an outlet for gases on the suction side of the blower located so that the momentum of the gases carries them out of the system.

13. A bake oven comprising a baking chamber, a blower adapted to circulate hot gases through the oven in heating relation to the breadstuffs, means for supplying highly heated gases to the recirculating gases, an outlet for gases on the suction side of the blower located so that the momentum of the gases carries them out of the system, and a damper adapted to control the flow of gases through said outlet.

14. A bake oven comprising a baking chamber, a blower adapted to circulate hot gases through the oven in heating relation to the breadstuffs, means for supplying highly heated gases to the recirculating gases, an outlet for gases on the suction side of the blower located so that the momentum of the gases carries them out of the system, and an adjustable damper pivotally mounted adjacent said outlet and presented against the stream.

15. A bake oven comprising a baking chamber, a blower adapted to circulate hot gases through the oven into direct contact with the breadstuffs, means for supplying highly heated gases to the recirculating gases, an outlet for gases on the suction side of said blower so located that the momentum of the gases carries them out of the system, and a stack into which said outlet leads.

16. A bake oven comprising a baking chamber, a blower adapted to circulate hot gases through the oven into direct contact with the breadstuffs, means for supplying highly heated gases to the recirculating gases, an outlet for gases on the suction side of said blower so located that the momentum of the gasses carries them out of the system, an adjustable damper pivotally mounted adjacent said outlet and presented against the stream, and a stack into which said outlet leads.

17. In a recirculating bake oven, in combination, a conduit for returning heating gas to the oven, a blower for causing said recirculation of gases, means for supplying highly heated gases to the recirculating gases, means for controlling the said heat supply means, and means in said conduit on each side of said heat supply means for controlling the flow of gases through the conduit, and means responsive to oven temperature for actuating said controlling means in unison.

18. In a recirculating bake oven, in combination, a conduit for removing exhaust gases from said oven, means for removing a portion thereof from the system, a mixing chamber into which said conduit discharges, a fluid fuel burner for supplying highly heated gases into said chamber, a blower adapted to withdraw mixed gases from said chamber, a conduit adapted to receive said gases and supply same to the oven, a damper in each said conduit, a valve controlling said fuel supply, and temperature actuated electrical means for controlling said dampers and valve in co-relation.

19. In a recirculating bake oven, in com-

bination, a conduit for removing exhaust gases from said oven, means for removing a portion thereof from the system, a mixing chamber into which said conduit discharges, a fluid fuel burner for supplying highly heated gases into such chamber, a blower adapted to withdraw mixed gases from said chamber, a conduit adapted to receive said gases and supply same to the oven, a by-pass connecting last said conduit to first said conduit, a damper in the first said conduit between said by-pass and said mixing chamber, a damper in last said conduit adapted to close said conduit and to close said by-pass, a valve controlling said fuel supply, and temperature actuated electrical means for controlling said dampers and valve in correlation.

20. A bake oven comprising a baking chamber, a conduit connecting one point of the chamber to another point thereof, a blower in said conduit adapted to pass gases therethrough, and an exhaust conduit having an open mouth in the first said conduit on the suction side of the blower and directed against the flow of the stream whereby the momentum of the gases tends to exhaust a part thereof through said mouth.

In witness whereof, I hereunto subscribe my name this 28th day of April, 1932.

FRIEDRICH A. HOPPE.