Nov. 21, 1950 D. J. McGOWAN ET AL 2,531,148

DRYING FURNACE

Filed Dec. 19, 1946 5 Sheets-Sheet 1

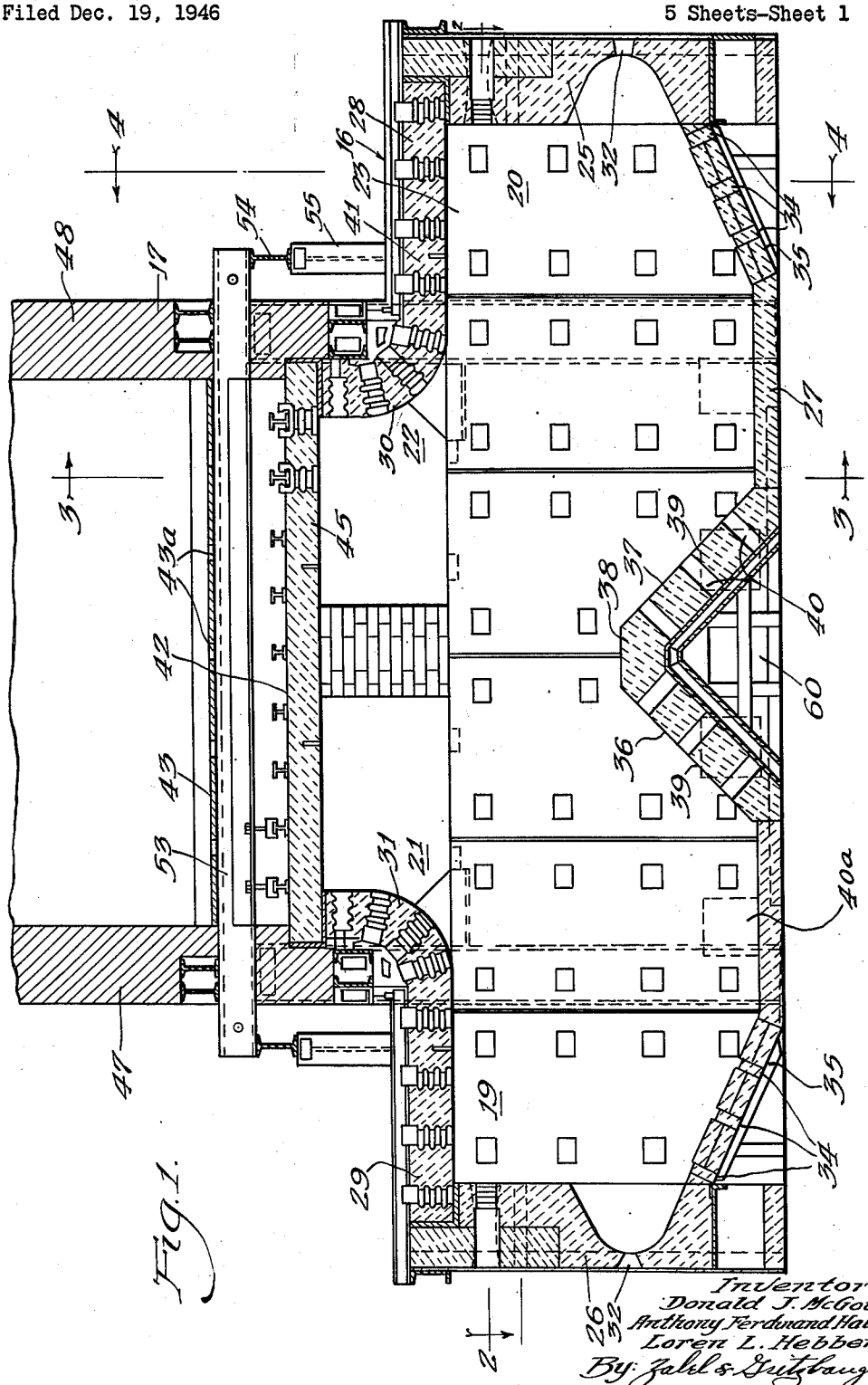


Fig. 1.

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DRYING FURNACE

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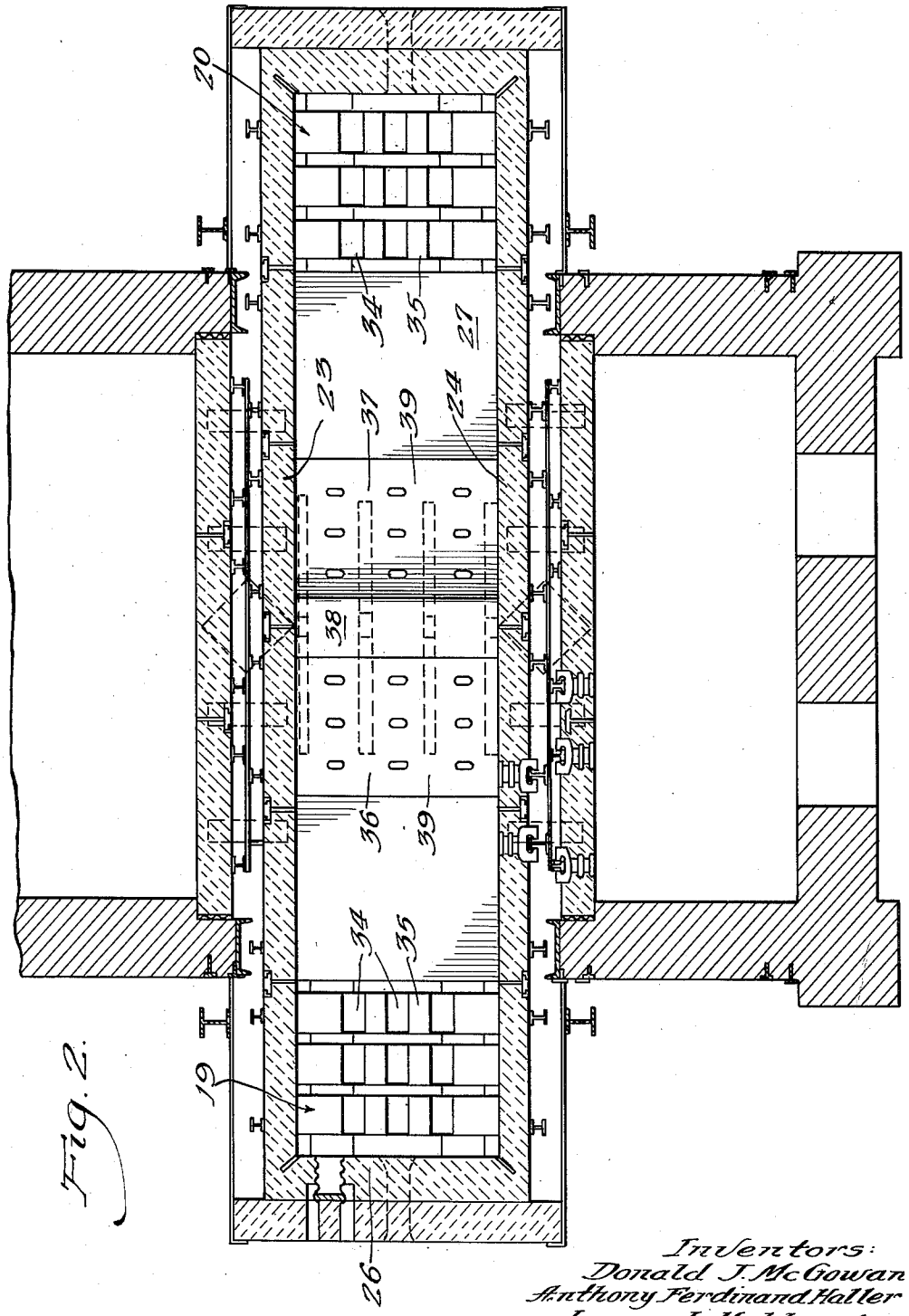


Fig. 2.

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DRYING FURNACE

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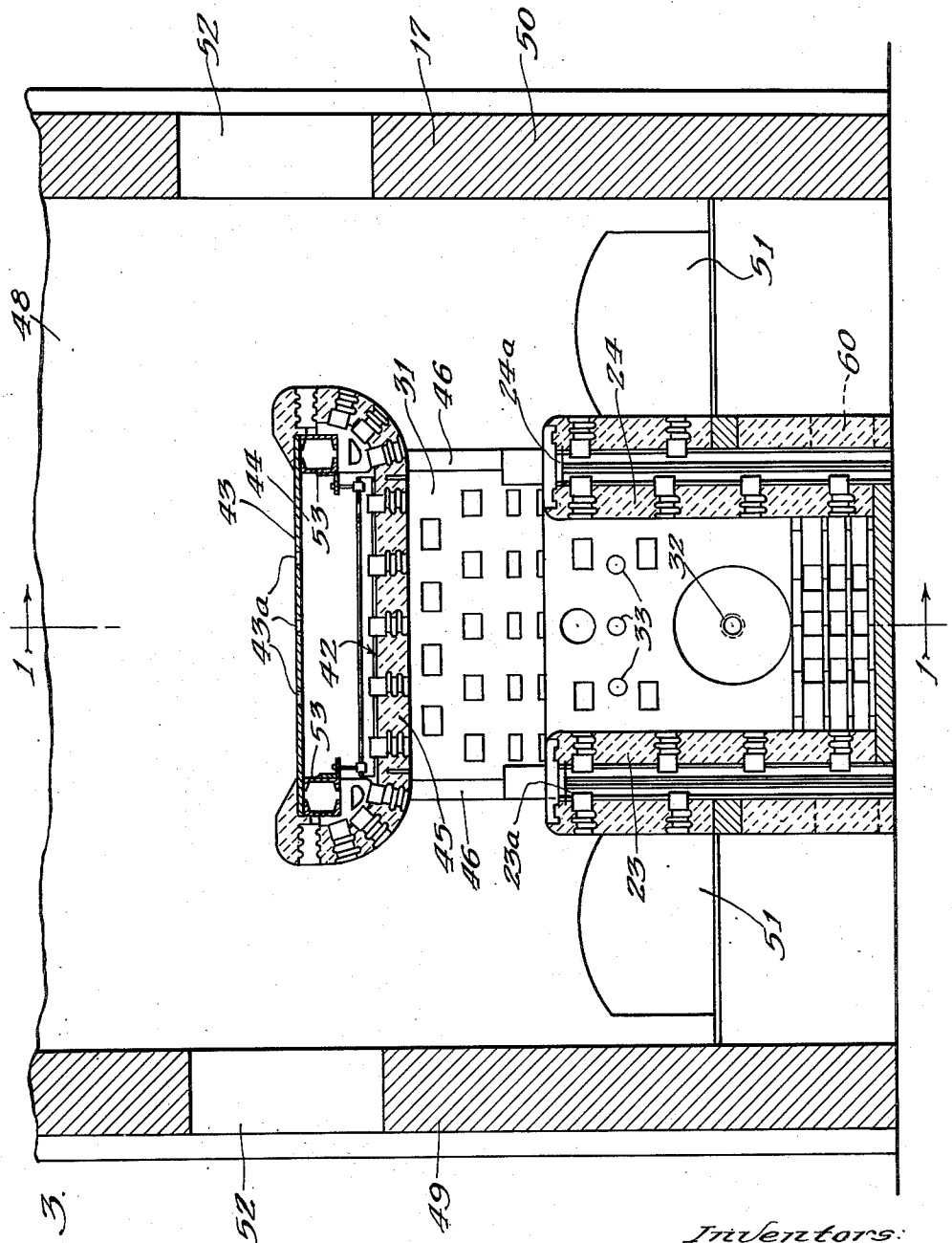


Fig. 3.

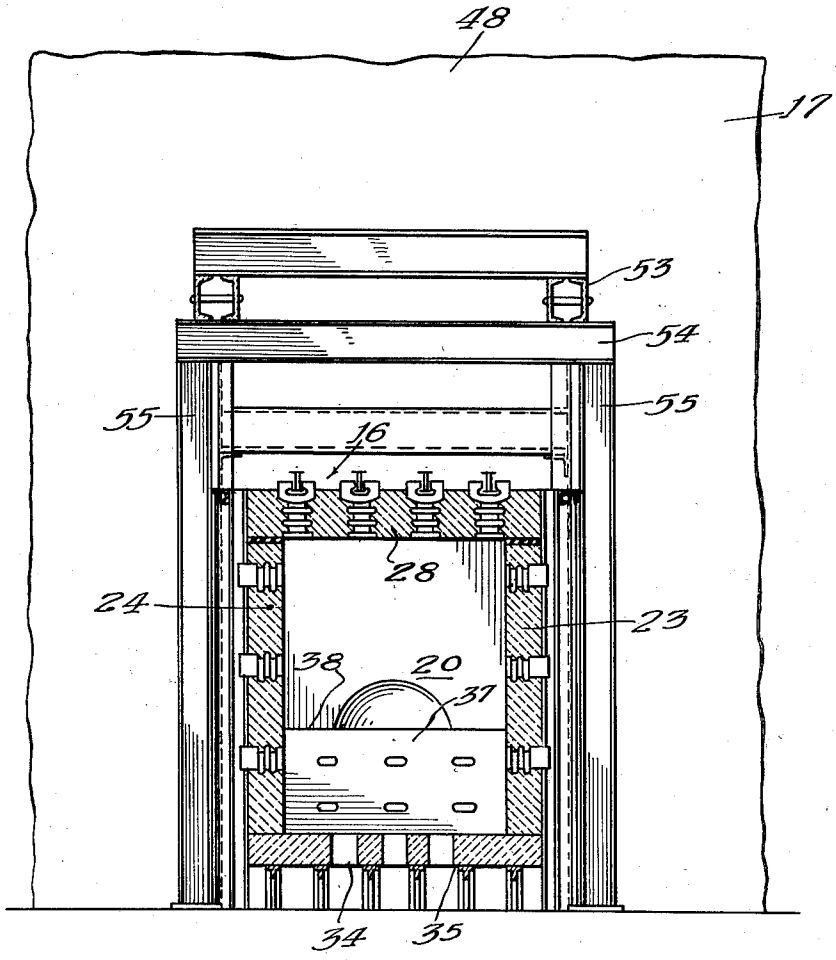
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DRYING FURNACE

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Fig. 4.



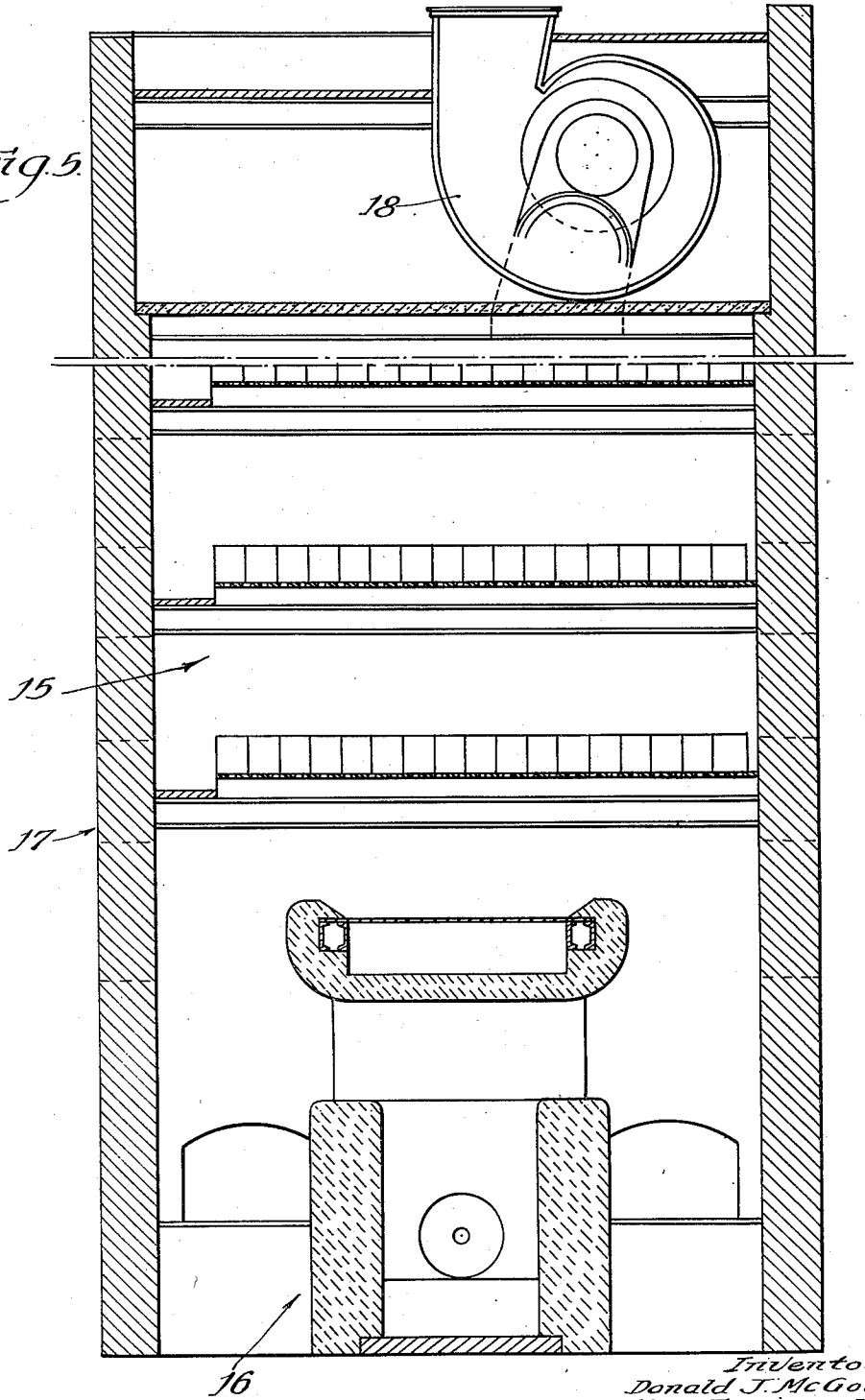
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Fig. 5.



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UNITED STATES PATENT OFFICE

2,531,148

DRYING FURNACE

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Application December 19, 1946, Serial No. 717,262

3 Claims. (Cl. 263—19)

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The present invention relates to drying furnaces used, for example, in supplying large volumes of uniformly heated gases for drying malt where the gas temperature is controlled within a limited range.

The device is intended to supply these large volumes of gases in an efficient manner wherein cost of operation and maintenance of the equipment is reduced to a minimum. Only a relatively small amount of high temperature gases are produced in the combustion chamber of the furnace and as soon as the combustion of the fuel that is burned in this chamber has been completed, a relatively large volume of cool air is introduced into the stream of hot gases so as to provide the necessary large volume of hot dry gases required for the drying operations. This introduction of cool air should be brought about as soon as possible after the combustion of the fuel is complete so that the temperature of the gases entering the stack are sufficiently low to eliminate the necessity of using a large amount of refractory lining in the stack. Thus it is primarily in the combustion zone that refractory material must be used and the problem of replacement of such material is therefore minimized considerably. Complete combustion of the fuel is also guaranteed so that the opportunity for unburned or partially burned gases to enter the stack is remote and therefore the danger of contaminating the malt, or other material to be dried, is reduced to a minimum.

In addition to the foregoing objects of the invention it is intended to provide a drying furnace that furnishes uniformly heated gases to the drying room. Devices previously used for drying malt supplied gases to the drying room in a very uneven temperature condition; i. e., the temperature of the gases passing over some of the malt was so hot as to burn the material whereas in other parts of the drying room the gases were too cool to effect complete drying. The present invention overcomes this difficulty by providing a device that furnishes to the drying room gases having even temperature conditions throughout all parts of its volume.

The foregoing constitute some of the principal objects and advantages of the present invention and others will become apparent from a reading of the following description.

In the drawings:

Fig. 1 is a vertical, sectional view through a furnace and a portion of the stack showing an embodiment of the present invention;

Fig. 2 is a horizontal, sectional view through

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the furnace, the view being taken on the line 2—2 of Fig. 1;

Fig. 3 is a vertical, sectional view through the furnace and a portion of the stack, the view being taken on the line 3—3 of Fig. 1;

Fig. 4 is a vertical, sectional view through the furnace, the view being taken on the line 4—4 of Fig. 1; and

Fig. 5 is a diagrammatic view illustrating the entire drying apparatus embodying the invention and including the furnace, the stack and the blower.

For purposes of illustration one embodiment of the present invention has been selected in compliance with the requirements set forth in the Revised Statutes. It is recognized, of course, and will be apparent to one skilled in the art, that many modifications may be made in the specific device as shown without departing from the intended scope of the invention.

The invention is concerned with providing a relatively large quantity of hot dry air to a room or other enclosure for drying purposes. It has been proven to be exceptionally useful and satisfactory in connection with the drying of malt.

Referring to Fig. 5 of the drawings the drying room or enclosure is indicated at 15. The furnace for producing the necessary heat for the gases is indicated at 16 and a stack 17 communicating with this furnace 16 conveys the hot gases to the drying room 15. A suitable blower or fan 18 may be employed to move the required volume of hot gases through the drying room.

Referring now to Fig. 1 the furnace 16 as shown generally comprises a pair of combustion chambers or zones 19 and 20 and intermediate dilution chambers or zones 21 and 22 for each of the combustion chambers. The stack 17 rises above the furnace and the dilution chambers 21 and 22 empty into the stack.

The furnace 16 and the various chambers 19 to 22 inclusive are formed by a pair of side walls 23 and 24 (Figs. 2 and 3), end walls 25 and 26, a floor generally indicated at 27 and suspended arches or roofs 28 and 29. The roofs 28 and 29 bend upwardly as at 30 and 31 respectively and join with the vertical walls of stack 17.

Each of the end walls 25 and 26 is provided with a fuel inlet port 32 for introducing fuel to be burned into the corresponding combustion chamber 19 or 20. As shown in Fig. 3 each of the end walls 25 and 26 is also provided with air ports 33 for introducing air into the combustion chamber 20 above the fuel inlet port 32. Additional air inlet ports are provided adjacent to

the bottom of the furnace and passages 34 are provided in an upwardly inclined portion 35 of the floor 27 of the furnace. These passages 34 are disposed closely adjacent to the fuel inlet port 32. Thus fuel such as gas, is introduced through the port 32 along with air into the combustion chamber 20 and is mixed with the necessary additional quantity of air through ports 33 and passages 34 and burned in chamber 20. It is intended that the burning of this fuel be restricted primarily to the combustion chamber 20 so that by the time this fuel, which is traveling toward the stack 17, reaches the diluting chamber 22 it is substantially completely burned.

The floor 27 of the furnace adjacent to the center of the furnace is inclined upwardly in opposite directions as at 36 and 37, meeting at 38 adjacent to the center line of the furnace so as to provide an inclined face 39 that serves to reflect heat toward the gases leaving the combustion zones. Each of these inclined faces 39 is provided with a plurality of passages 40 for introducing air into the furnace and these passages are adapted to discharge air into the gas stream approximately at right angles to the direction of movement of said gas stream. The air thus admitted into the gas stream produces a churning action so as to effect rather complete mixing of this cooler air with the hot gases leaving the combustion chamber 20. This serves to dilute and thus cool the hot gases and also provides additional air that may be required to complete the combustion of the gases in the event the combustion was not completed in the combustion zone.

It will be noted in the drawings that the combustion chambers 19 and 20 and diluting chambers 21 and 22 are lined as at 41 with refractory material. The stack 17 may be made out of firebrick or some such suitable material but because of the diluting and cooling of the gases in chambers 21 and 22 it is not necessary to provide a refractory liner on the inner walls of the stack.

Referring now to Fig. 3, directly above the diluting chambers 21 and 22 and disposed adjacent to the upper ends of the curved upper walls 30 and 31 of these chambers is an arch member generally indicated at 42. This arch 42 comprises a hollow box-like portion 43 that extends entirely across the open ends of the diluting chambers. This box-like portion 43 provides a passage 44 therein through which air may be passed for purposes of cooling the arch member. This air enters the stack gases through apertures 43*a*. The outer exposed faces of the arch 42 are lined as at 45 with a suitable refractory material. Side openings 46 are provided just below the arch 42 so that air and hot gases directed from the furnace to the stack may pass therethrough and enter the stack. The direction of gas flow is changed by the arch 42 and is induced by the blower to flow through the openings 46. The walls 23 and 24 are provided with passages 23*a* and 24*a* respectively that open out adjacent to the bottom of openings 46 and a large amount of cool air is introduced into the gas stream through these passages. This air serves to further dilute and cool the gases and also to cool the furnace walls 23 and 24.

It is to be noted from Fig. 3 that the air introduced through passages 23*a* and 24*a* into the gas streams passing through openings 46 is directed at right angles to the direction of flow of the gases. This air is introduced through doors 60*a* (Fig. 1) and serves additionally to cool the side walls of the furnace. Again this produces a churning action which effects thorough mixing of the cool air with the gases.

Referring to Figs. 1 and 3 the stack 17 comprises walls 47, 48, 49 and 50. Walls 49 and 50 are spaced laterally with respect to the walls 23 and 24 respectively of the furnace. Auxiliary firing equipment such as a hand fired grate and grate opening generally indicated at 51, may be disposed in each of the spaces located between the stack walls 49 or 50 and the adjacent furnace wall.

After the mixture of gases and air leaves openings 46, their direction of flow is again changed so that the flow is directed upwardly. At this point of direction change additional air is introduced into the gas stream, this air entering through the auxiliary firing equipment indicated at 51 and rising into the gas stream.

In each of the stack walls 49 and 50 is an opening 52 (Fig. 3) through which air may pass so that a relatively large volume of air may be introduced into the stack through these openings. This air is also introduced into the gas stream substantially where the direction of gas flow is changing.

Thus it is to be noted that cool air is introduced into the gas stream at each point where the direction of gas flow changes. This produces a churning action of the hot gases and the cooler air in these regions so as to effect a complete mixing of the two gases thereby providing uniform temperature conditions throughout the mixture.

Suitable supporting members such as channels and I-beams 53 and 54 respectively may be employed for supporting the arch 42 together with additional supporting structure, such as columns 55.

In the normal operation of the present device fuel to be burned together with air is introduced at opposite ends of the furnace through fuel ports 32 and sufficient additional air is introduced into combustion chamber 20 through the passages 33 and 34 to support the combustion of this fuel. As previously mentioned it is intended that substantially all of the fuel is to be burned in the combustion chamber 20 and as a result of the burning of this fuel, gas at a high temperature is produced in the combustion chamber. Movement of this hot gas is induced along the furnace by the fan indicated at 18 in Fig. 5 and is brought in contact with air that is entering the furnace through the passages 40. Doors 60 in the furnace side walls introduce this air into the space below passages 40. Sufficient turbulence is created in the hot gases and the air as previously mentioned to create a rather thorough mixing of these two gases in the diluting chambers 21 and 22 of the furnace. In this manner not only is additional air provided to insure combustion of the gases, if such is needed, but the temperature of the hot gases is reduced considerably so that by the time this mixture reaches the upper end of the mixing chambers 21 and 22 its temperature has been greatly reduced. This mixture of gases, directed by arch 42, leaves the furnace proper through the openings 46 (Fig. 3). Relatively large volumes of air are introduced at these points through passages 23*a* and 24*a* and from the auxiliary firing region 51. Sufficient turbulence is created in this gas leaving the furnace so that it is thoroughly mixed with this relatively large volume of cool air entering the gas stream. The cool air entering the stream through openings 52 is in sufficient quantities to bring the ultimate tempera-

ture of the gases to the desired level. Thus the gases rising in the stack are thoroughly mixed and are brought to the drying room 15 at the required uniform temperature. The gases now are drawn through the malt to be dried in the drying room 15 and are then exhausted by fan 18 into the atmosphere.

Thus relatively large volumes of air are introduced at a multiplicity of positions in the furnace and stack in a manner not only to effect thorough mixing of the air, but also to cool the refractory materials in the furnace and stack so as to reduce the maintenance.

We claim:

1. A drying furnace having combustion chambers with diluting chambers therebetween and above the combustion chambers and a stack about said furnace having a drying room therein above said chambers, the top wall of the respective combustion chambers leading into the respective dilution chambers, the walls of said combustion chambers having fuel and air inlet openings, a floor for said furnace having air inlet ports adjacent said fuel inlet ports, said floor having a centrally located raised portion below the diluting chambers providing inclined faces substantially facing the combustion chambers and deflecting upwardly towards the diluting chambers the combustion gases moving from the combustion zones, said inclined faces having ports for introducing air into the furnace to mix with the gas stream at an angle to the direction of movement of said stream to cause turbulence therein; a baffle positioned across the diluting chambers for changing the direction of the gas stream, passages in the furnace around said baffle and leading to the stack to carry the diluted gases to said stack, air intake flues in the furnace walls and ports leading from said walls to the baffle to lead cold air thereto at an angle to the direction of flow to mix with the gases flowing from the dilution chambers to the stack to cause further turbulence, ports in the stack wall at a height substantially coincident with the height of the baffle to introduce air into the stack where the cooled gas stream from the dilution chamber passes around the baffle to cause still further turbulence and to further dilute the combustion gases before they pass to the drying chamber.

2. A drying furnace having spaced combustion chambers and a dilution chamber at a higher level therebetween, a floor for said furnace having a centrally located raised portion providing inclined faces to deflect gases from said combustion chambers to said dilution chamber, a baffle across the top of said dilution chamber, a stack around said furnace, said baffle deflecting the gases from said diluting chamber to said stack, cool air inlet ports in said furnace at each deflection point arranged to direct cool air into the flow of combustion gases to cause a mixing thereof, and an air inlet in the stack adjacent said baffle to introduce additional cool air into the stream at an angle to the direction of flow to cause further mixing of the diluted combustion gases around the baffle to cause further turbulence and further dilute the combustion gases, said deflection points and air inlet ports occurring at successively higher positions in the furnace along the path of flow of the gases.

3. A furnace according to claim 2, in which the baffle has an air chamber throughout its length, a cool air inlet and an outlet for said air, the outlet leading to said stack.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,522,914	Schumacher	Jan. 13, 1925
1,676,070	Bluemel	July 3, 1928
1,703,635	Ransom	Feb. 26, 1929
1,711,273	Manker	Apr. 30, 1929
1,832,151	Stein	Nov. 17, 1931
2,398,654	Lubbock	Apr. 16, 1946
2,445,466	Arnhym	July 20, 1948