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W. T. MORIN

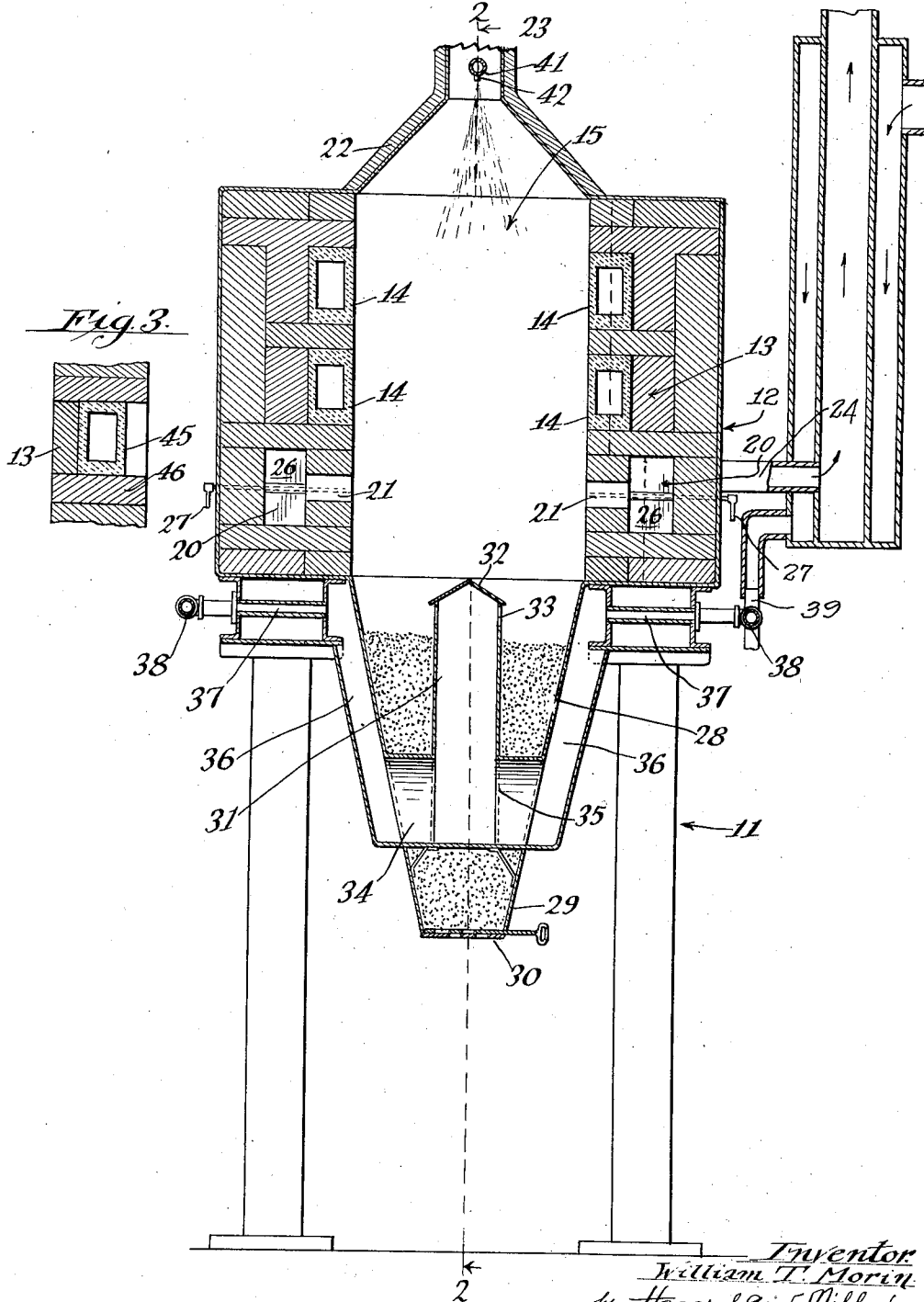
1,713,237

DRIER

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2 Sheets-Sheet 1

Fig. 1.



Inventor
William T. Morin
by Hazard and Miller
Attorneys

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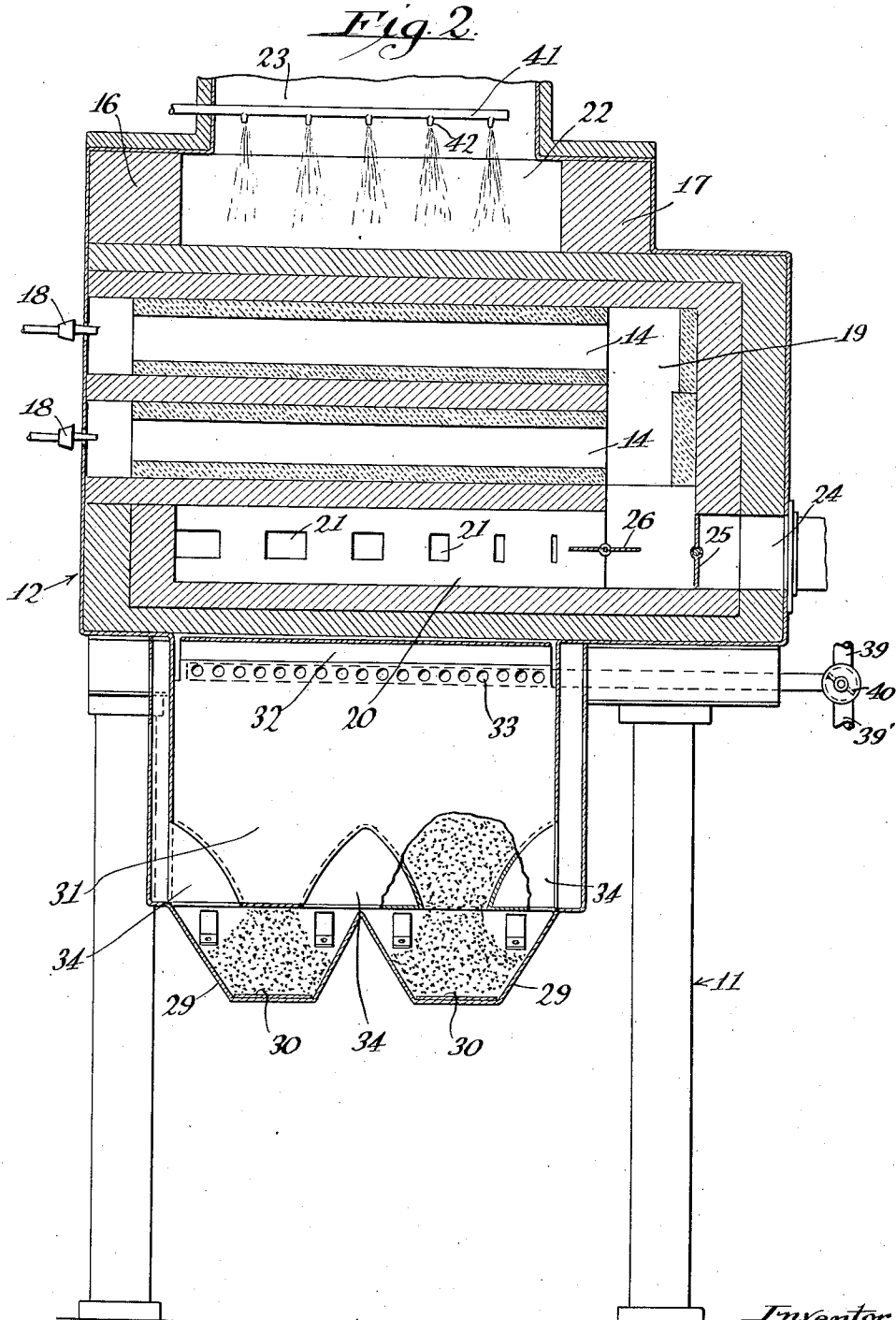
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Inventor
William T. Morin
by Hazard and Miller
Attorneys

UNITED STATES PATENT OFFICE.

WILLIAM T. MORIN, OF LOS ANGELES, CALIFORNIA, ASSIGNOR TO PACIFIC ABRASIVE SUPPLY COMPANY, OF LOS ANGELES, CALIFORNIA, A CORPORATION OF CALIFORNIA.

DRIER.

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My invention is a drier and method of drying, in which materials drop through a heating chamber in a loose state and in such dropping action are subjected to a drying action.

An object of my invention is a drier and method of drying various materials, in which such materials are dropped by gravity in a loose manner to a drying chamber and in such chamber are subjected to the heat of radiation transmitted from a radiating surface without the materials contacting such surface and with there being no intermediary structure between the surface and the materials. By this procedure heat of radiation is transmitted through a gaseous medium to the material to be dried.

In addition to utilizing the radiant heat, I may also subject material to drying by heat of convection, in which hot gases or hot air passes upwardly through the downwardly dropping loose material. My drier and method may be applied as a drier of liquids in a finely divided state or pulverized or granular material and may also be employed for heating material in various industrial procedures without performing the function of drying.

In one form of my invention I may pass hot products of combustion through flues or other passages therefor, these flues being made of material having high thermal conducting properties so that heat will be radiated from the surface of such flues and such radiated heat is used directly to dry the materials to be treated. In addition to this, if desired, the materials may be also subjected to direct convection drying by passing the products of combustion upwardly through the downwardly descending material. Or if the products of combustion would be injurious to the material being dried I may use a heat interchanger, heating air by the products of combustion and passing the air upwardly through the material to be dried, thus drying by convection in addition to direct radiation.

In constructing my drier I preferably utilize a furnace having flues passing along opposite sides with a drying chamber between the flues. At the top of the chamber there is a suitable means to pass the materials to be dried therein, these materials dropping into a collecting receptacle, and

then into a discharge spout. The flues have at least one wall adjacent the drying chamber and are made of material which is highly refractory and having a high thermal conductivity such as silicon carbide or fused aluminum oxide or equivalent materials.

If desired, by means of suitable dampers, or by the original building construction of the furnace, I may pass the products of combustion upwardly through the drying chamber and dry the material by convection heating. Or I may pass the products of combustion through a heat interchanger and pass the air so heated upwardly through the drying chamber.

My invention will be more readily understood from the following description and drawings, in which:

Figure 1 is a vertical transverse section through the heater.

Fig. 2 is a longitudinal section through the drier on the line 2—2 of Fig. 1 in the direction of the arrows.

Fig. 3 is an alternative construction of the manner of locating the flues.

In the illustration I provide a suitable supporting structure 11 on which is built a furnace designated generally by the numeral 12. This furnace has side walls 13 with suitable heat insulation and with longitudinally extending flues or combustion chambers 14. Between the flues there is a large drying chamber 15 extending longitudinally of the furnace and having at each end of such chamber front and back walls 16 and 17.

The furnace is provided with burners 18 at the front, there being a burner discharging into each flue, and at the ends of the flues there is one or more vertical collection ducts 19 for the products of combustion connected to the flues. These vertical ducts connect to horizontal ducts 20 extending along each side of the furnace and there are a plurality of openings 21 extending therefrom into the drying chamber. At the top of the drying chamber there is a roof structure 22 having a stack 23 therein.

In addition to this construction there is an outlet connection 24 leading to a heat interchanger and this outlet is controlled by an outlet control damper 25. The ducts 20 are also controlled by a damper 26. These may be controlled in any suitable manner

such as by rods and hand levers 27. Below the furnace there is a collection receptacle 28 preferably formed of metal and having a discharge spout 29 at the bottom controlled by a discharge gate 30. Extending vertically in the collection chamber there is a flat pipe 31 having a cover 32 at the top to prevent the material being dried falling therein, and with openings 33 adjacent the top. As the pipe 31 extends from end to end of the drying chamber there are provided a plurality of cross passages 34 leading into the base thereof, as indicated at 35. These cross passages are connected to chambers 36 on the outside of the collection chamber 28; and at the upper end of each of these chambers there are a plurality of ducts 37 leading outwardly therefrom. Such ducts are connected on opposite sides to manifolds 38. The manifolds are connected by a pipe 39 having a valve 40 to the heat exchanger, and a pipe 39' to the air.

The heat exchanger is designated generally by the numeral 47 in which there is a central stack 48 which connects at the bottom with the outlet connection 24. Surrounding this stack there is an air passage 49 having an intake 50 at the top and an outlet 51 at the bottom connecting to the pipe 39. Therefore when the products of combustion pass up the stack the air drawn in around the stack is heated and flows inwardly to the drying chamber through the manifolds 38.

There are many ways in which the material to be dried may be passed into the drying chamber and that illustrated is by means of a pipe or series of pipes 41 having jets 42 through which a liquid spray may be ejected.

In some cases it is desired to set the flues outwardly from the face of the drying chamber, and this is accomplished as shown in Fig. 3 in which case the heating flues 45 are set outwardly from the face 46 of the drying chamber, this, in case of any breakage or scaling of the flues prevents the material of the flues from becoming mixed with the material being dried.

The manner of operation and functioning of my drier is substantially as follows:

As above mentioned the material to be dried is fed into the drier above the drying chamber in any suitable manner and drops downwardly into the collecting receptacle 28. The hot gases and other products of combustion in passing through the flues 14 heat these to a high temperature and as I use material of a high thermal conductivity, to form such flues, a considerable amount of heat is radiated. This causes the material to be dried in descending through the drying chamber to be subjected to radiated heat, thereby extracting a certain amount of moisture from such material.

If it is desired to pass the products of combustion through the material to be dried to heat by convection, the dampers 25 and 26 are so turned that the combustion gases from the flues 14 are led along the ducts 20 and pass through the openings 21 into the drying chamber, and thence flow upwardly. When used in this way, the valve 40 is usually turned so that air is drawn through the pipe 39' from the atmosphere, which air flowing through the manifolds 38, the pipes 37 and the chamber 36 flows upwardly through the flattened pipe 31 and is discharged through the openings 33; thereby giving an upward current of air through the material being dried.

If it is desired to utilize air only in the drying chamber, the products of combustion are led from the collection ducts 19 through the discharge 24 to the heat interchanger in which interchanger air is heated and passes through the pipe 39 and the manifold 40, and is discharged upwardly from the flattened pipe 31. In this case substantially all the heating by convection is by air heated in the heat interchanger, and on account of the reversal of dampers 25 and 26 none of the products of combustion pass upwardly through the drying chamber.

From the above description it will be seen that I have developed a simple drying apparatus for drying materials in their downward passage through a drying chamber in which a radiant heat is utilized to a large extent in the drying, and with this I may use the heat of convection, this heat of convection being from the products of combustion or air heated thereby in a suitable heat interchanger.

A feature of my invention is that the materials to be treated drop freely by gravity in the drying chamber and do not come in contact with the surface of the flues from which the radiant heat is radiated and there is no intermediary structure between the material to be treated and these heat radiating surfaces. Therefore substantially all the radiated heat is utilized in drying or otherwise treating the material. It is obvious by my construction that my plant may be utilized for calcining or similar operations as well as drying.

Various changes may be made in the principles of my invention without departing from the spirit thereof, as set forth in the description, drawings and claims.

I claim:

1. A drier comprising in combination a structure having a drying chamber with fixed flues in the walls thereof, said flues conveying hot gases, means to pass material to be dried downwardly through said chamber but out of contact with the flues, such material being subjected directly to heat of radiation from the flues, and means to select-

tively pass said gases upwardly through the material or pass said gases to a heat interchanger and pass the hot air from said heat interchanger upwardly through the drying chamber to subject the material to heat of convection.

2. A drier comprising in combination a structure having a vertical drying chamber extending therethrough with flues running longitudinally of said chamber, said flues being constructed of refractory material having high thermal conductivity, there being collection ducts at the end of said flues and horizontal ducts connected to said collection ducts, there being openings from the horizontal ducts to the said chamber, means to pass material to be dried downwardly through the chamber, said material being subjected to heat of radiation from the flues and to heat of convection by the gases passing through the flues.

3. A drier, as claimed in claim 2, an outlet connection from the collection ducts to a heat interchanger and means to selectively pass the hot gases from the flues to said heat interchanger, and means to pass air from the heat interchanger upwardly through the material to be dried.

4. A drier comprising in combination a structure having a drying chamber extending vertically therethrough with fixed flues running lengthwise of the walls of said chamber, said flues being adapted to carry products of combustion, said structure having ducts, passages and openings connected to the flues to discharge the products of combustion into the drying chamber, and means to pass material to be dried downwardly through said chamber out of contact with said flues, a collection receptacle at the base of the drying chamber, said receptacle having an elongated flat pipe extending upwardly therethrough, means to pass products of combustion from the flues to a heat interchanger, and means to pass air from the heat

interchanger upwardly through the said pipe.

5. The method of drying comprising passing material to be dried downwardly, subjecting said material to radiant heat derived directly from gaseous products of combustion, selectively passing the products of combustion upwardly through said material or heating air by said products of combustion, and passing the heated air upwardly through said material to heat the material by the heat of convection.

6. A drier comprising in combination a structure having a vertical drying chamber with fixed flues in the walls thereof, said flues conveying hot gases along the walls, means to pass material to be dried downwardly through the said chamber, but out of contact with the flues, such chamber being subjected directly to heat of radiation from the flues, a heat exchanger, means to convey hot gases from the flues to the exchanger, and means to flow air from the heat exchanger upwardly through the chamber, whereby the material is subjected to the heat of convection.

7. A drier comprising in combination a structure having a drying chamber with fixed flues in the walls thereof, said flues conveying hot gases, means to pass materials to be dried downwardly through the said chamber but out of contact with the flues, said material being subjected directly to heat of radiation from the flues, a passage having openings to the lower part of the chamber and connecting to the flues, a heat exchanger connected to said passage, the heat exchanger having an air connection to the drying chamber below the flues, and means to selectively direct the hot gases through the said passage into the drying chamber or through the heat exchanger.

In testimony whereof I have signed my name to this specification.

WILLIAM T. MORIN.