Dec. 29, 1942. H. F. MOORMAN 2,306,462

INTUMESCENT FURNACE

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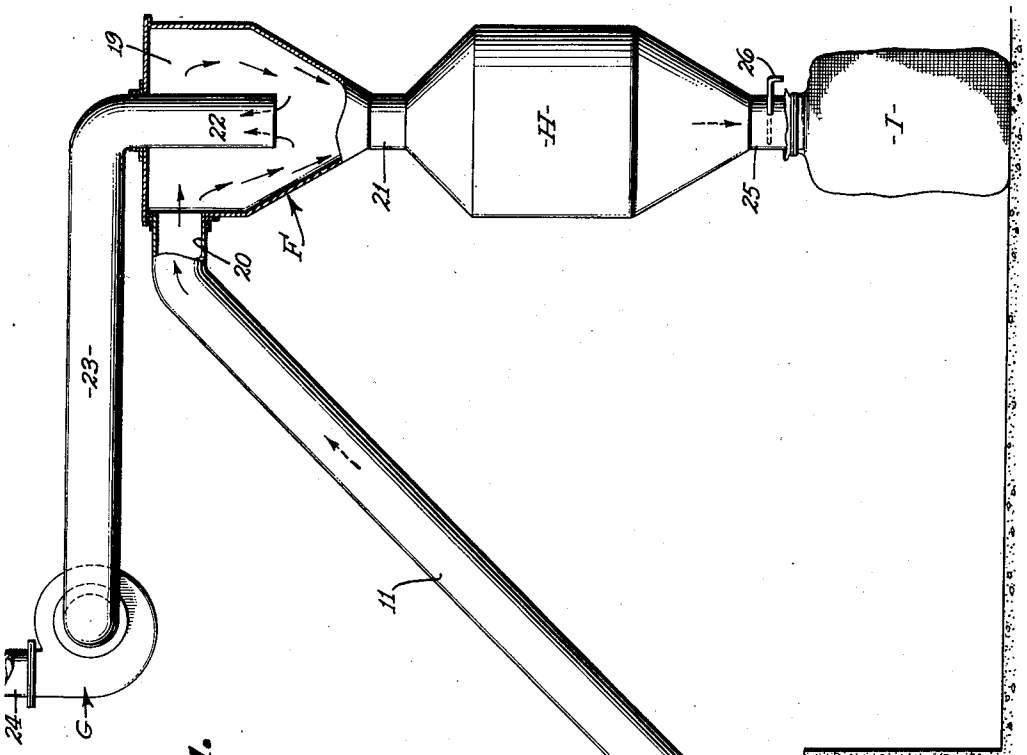


Fig. 1.

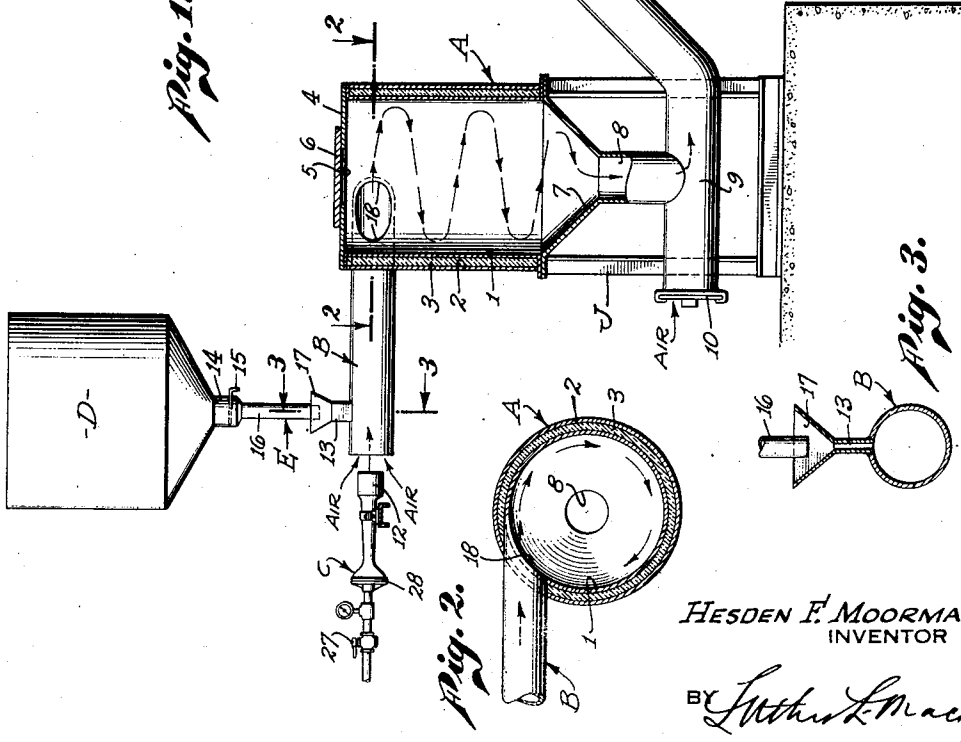


Fig. 2.

Fig. 3.

HESDEN F. MOORMAN,
INVENTOR

BY Luther L. Mack
ATTORNEY.

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INTUMESCENT FURNACE

Hesden F. Moorman, Los Angeles, Calif.

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3 Claims. (Cl. 263—21)

This invention relates to and has for an object the provision of an improved means for intumescing or expanding certain minerals in the form of a light weight aggregate possessing a high insulation value, such as obsidian, perlite, pitchstone, pumice, pumicite and other volcanic deposits, by means of which the ores may be expanded for various uses efficiently and economically for commercial uses.

In the consideration of this invention it may be understood that I am aware of certain commercial forms of furnaces for exfoliating mica, vermiculite and other materials, but such furnaces are not effective for expanding materials which are desired to be treated by the means forming the subject matter of this application.

It is well known, for instance, that certain laminated materials such as mica and vermiculite are readily exfoliated by the mere application of heat, whereas such materials as perlite or other allied minerals, particularly of the obsidian family, are not effectively expanded for commercial usage by heat alone but require the direct application of fire for sustained periods in order that the material subsequent to my treatment may be capable of commercial use, as for instance, as an element of plaster applicable to walls of buildings, and as a component of a sound deadening or insulating material.

The invention, therefore, comprehends the provision of an improved means which includes a furnace in which the usual refractory lining is omitted, principally because the finest particles of material may adhere thereto and become fused, and into which a flame from a high pressure burner is directed tangentially for providing a maximum of turbulence and in which the flame traverses the interior of the furnace in a spiral or helical path. The material to be treated is introduced into the furnace through a firing tube into which the flame from the burner is also introduced and the material is adapted to be held in suspension within the furnace for sufficient periods of time to effect the complete intumescence of the particles before they are exhausted from the bottom of the furnace by suction to points of further treatment, such as for separating the materials from the gases, or ultimate disposition.

An object, therefore, is to provide a furnace having the characteristics herein named which may be effective either with or without the usual "cyclone" separating means common to other systems and is adapted for use in connection with a suitable means for collecting the treated particles and for dispensing them as required for use.

Other objects include: means for regulating the feed of the material to the firing tube; a primary means for regulating the volume of air admitted to the firing tube; auxiliary means for introducing air to the furnace outlet for regulating the output of the furnace; the provision of a suitable separator for the treated materials and the products of combustion; and means for the ultimate dispensing of the materials to suitable receptacles for use.

Other objects may appear as the description progresses.

I have shown a preferred form of apparatus in the accompanying drawing for carrying out the hereinabove named objects of my invention, subject to modification, within the scope of the appended claims, without departing from the spirit of my invention.

In said drawing:

Fig. 1 is a side elevation of an assembled apparatus, shown partly in section;

Fig. 2 is a sectional plan on line 2—2 of Fig. 1; and

Fig. 3 is a sectional elevation through the firing tube and the material feed hopper on line 3—3 of Fig. 1.

Briefly described, my invention includes: a furnace A to which is tangentially connected a firing tube B arranged for receiving a flame from a high pressure burner C, a feed hopper D for holding a substantial quantity of material to be treated, a material feeding means E for regulating the volume of material fed from hopper D to the furnace, a separator F for separating the treated material from the products of combustion, a fan G associated with the separator for exhausting the products of combustion, and a storage receptacle H into which the treated material is deposited from the separator and which is adapted to dispense the material into suitable bags, as at I, or other forms of collecting receptacles.

The furnace A is preferably of cylindrical form with an inner wall 1, an outer wall 2 and insulating material 3 between said walls, except preferably for a small area directly opposite the inlet from the firing tube B. Said furnace has a top 4 with an opening 5 therein which is adapted to be covered by a plate or lid 6 and which is removable for affording vision and access to the interior of the furnace at will. The bottom of the furnace, as at 7, is of the conical form and may be integral or separate from the furnace body, as shown in Fig. 1, with a vertical

outlet 8 connected with a horizontal section 9 of a discharge pipe carrying an air valve or damper 10 in its end and connected with a riser pipe 11 which leads to the separator F. The furnace is suitably supported upon a frame J.

The burner C is a high pressure type and adapted for use with either gas or oil and arranged for regulation of the volume of air for mixture with the fuel at a suitable point for providing a maximum heat and efficiency, the burner not being a part of my invention. As shown in Fig. 1 the jet 12 of the burner is adjacent to the inlet of the firing tube B and said tube is, as shown in Fig. 2, disposed at a tangent to the inner wall of the furnace A so that when the flame from the burner is introduced into the furnace a substantial turbulence will be caused by the whirling of the flame while it is traversing the circular inner wall of the furnace so that when material to be treated is fed through an inlet 13 into the firing tube the material will be held in suspension within the furnace for sustained periods of time in a disseminated state.

Feed hopper D is adapted to hold a substantial quantity of the material which flows by gravity through an outlet 14 capable of being controlled by a suitable valve 15, and thence downwardly into and through a tube 16 into a smaller hopper 17 attached to the upper end of inlet 13, from which latter point the material is drawn into the furnace through firing tube B in accordance with requirements, as may be determined by the capacity of the furnace.

As illustrated in Fig. 1, the flame and material to be treated is introduced into the furnace through an orifice 18 and while the flame traverses a spiral downward path within the furnace as shown by the lines and arrows, the turbulence in the furnace tends to hold the particles, large and small, of the material in suspension for long enough periods to effect the complete intumescence of every particle, after which the particles are drawn downwardly by reason of the induced draft in the pipe 11 caused by fan G.

Fan G creates suction in chamber 19 of separator F which is communicated to pipe 11, section 9 and the interior of the furnace so that the tendency of the apparatus is to move the suspended particles through the furnace, pipes 9 and 11 and separator F, but the turbulence in the furnace is sufficient to hold the particles suspended in the furnace for sufficient periods of time to effect their intumescence before they are exhausted into section 9 and from said point to the separator F through pipe 11.

The relative pressure from the flame of the burner and the suction created by fan G is regulated either by the usual air valve on the burner or by the regulator 10 on section 9 of the outlet pipe, or by both of such instrumentalities.

The material enters chamber 19 of the separator at a tangent through an orifice 20 and falls by gravity into the storage receptacle H through a neck 21 while the products of combustion are discharged upwardly through an outlet 22 leading to a pipe 23 from which the gases are delivered to an axial opening in the fan G and are discharged from the fan through an outlet 24. In this connection it may be noted that the section of the apparatus shown in Fig. 2 is also typical of the connection of pipe 11 with the separator F, and in some cases the burner C and firing tube B may be applied to the separator directly, or, the fan G may be applied to the top of the furnace A and the outlet 21 be formed on or attached to section 9 of the discharge means in lieu of the combined use of the two elements described. In the form shown, receptacle H has a dispensing outlet 25 with a suitable valve 26 therein for regulating the dispensing of the treated material from the receptacle into a bag as at L or otherwise as may be convenient and desirable.

In connection with the furnace it is notable that when fire brick is employed, as in some types of furnaces, the finest particles of material are prone to cling to the refractory lining and fuse, hence I have ascertained that a stainless steel lining is most adaptable to prevent such results.

In the operation of the furnace I have discovered that the kinds of material hereinbefore mentioned and which are granular or cellular and are not laminated are capable of intumescense at a temperature of approximately 1750 degrees Fahrenheit when the flame from the burner is directly applied to the granules, and I have also discovered that the same temperature is ineffective for producing the desired results when merely heat of said temperature is applied to the material. While the same temperature, more or less, may be effective for exfoliating mica, vermiculite and other laminated material, it requires more than mere heat and an actual application of flame to the particles of material, large or small, for accomplishing the results of this invention. To this end, therefore, I have ascertained from experimentation, that an extreme turbulence must be maintained within the furnace, into which the particles of materials are introduced in sufficient volume, and the flame must be under a high pressure in order to hold the particles in suspension for periods of time requisite for effecting their complete intumescence.

My system must also, and does provide means for the quick expulsion from the fire zone of the particles so that they may not become overhot and useless commercially, i. e., they may become viscid and fusible which may also render them at times incapable of discharge from the fire zone. The material when treated in my apparatus is maintained in a closed circuit from its point of entry to its point of ultimate disposition, and the deposition of a regulated volume of material into the firing tube and its conduct therethrough to the fire zone in which there is provided a maximum of cyclonic turbulence, assures the suspension of the particles throughout a sustained period sufficient to effect complete intumescence and a resultant uniformity of the commercial product.

The several points of regulation render the apparatus capable of adaptation to variations as between different materials, size of the furnace and its capacity, altitude and other atmospheric conditions and other circumstances which may affect the product of the apparatus. For instance, the burner C has the usual fuel control valve 27 and air control 28; the air regulator 10 applied to section 9 of pipe 11 for regulating admission of air to pipe 11, and the fan G which may be adjusted to vary the suction which effects the removal of the treated material from the furnace and its separation from the products of combustion.

An apparatus of the character herein described lends itself readily to economy and efficiency in operation in that several of the units may be attended by a single operator and the output will depend upon the particular character and mesh

of the material treated, after the apparatus has been once set for operation on a given kind of material.

The fan G which is operatively associated with the separator F and the furnace A creates sufficient draft through the furnace for effecting proper combustion and also for withdrawing the treated material and products of combustion from the furnace and for conveying the material and products of combustion to the separator, at which point the treated material is separated from the products of combustion and the latter are withdrawn from the separator while the material is deposited in the receptacle H.

It is to be particularly noted that not only is the material held in suspension in the furnace during a continuous state of turbulence, but the material is at all times disseminated during the period of its suspension, thereby permitting the direct attack on the separate particles by the flame and from all sides and directions simultaneously.

Hence, the means herein shown and described accomplishes the following results, viz., the provision of a continuous flow of air through the apparatus necessary for affecting proper combustion; the creation of a cyclonic turbulence which serves as a medium for supporting the material in disseminated suspension during treatment thereof; the continuous removal of the material from the zone of treatment by reason of the draft; the utilization of the draft thus created for conveying the treated mterial and the products of combustion to a suitable separating apparatus; and finally, the separation of the treated material from the products of combustion and the deposit thereof in a suitable storage bin or receptacle. Moreover, the cyclonic turbulence in the fire zone is not only occasioned by the pressure applied to the flame from the burner C, but also from the suction created in the apparatus by fan G, and these two forces are relatively adjustable as to intensity and volume for retarding or speeding up the flow of the materials through the furnace and the consequent regulation of the length of the treating periods.

What I claim is:

1. An intumescent furnace comprising: a cylindrical furnace, a firing tube tangentially connected therewith at the top of the furnace, a burner for projecting a flame at high pressure into said tube and furnace so as to effect a spiral traverse of the furnace by the flame, means for feeding finely divided intumescible material into said tube at a point intermediate the burner and the inlet to the furnace so that the particles thereof will be held in suspension while under the direct attack of said flame, and means for discharging the treated material and the products of combustion.

2. An intumescent furnace comprising: a furnace having a cylindrical body, a firing tube tangentially extended from the top thereof, a burner for projecting a flame at high pressure into said tube and furnace so as to effect a spiral traverse of the furnace by the flame, means connected with said tube and disposed between the burner and the furnace for feeding finely divided intumescible material into said tube and thence to the furnace so that the particles thereof will be held in suspension while under the direct attack of said flame, said furnace having a conical bottom, and an outlet in said bottom for discharging the treated material and the products of combustion, said outlet arranged for connection with a source of suction to effect the discharge of the treated materials, and means for varying the discharge of the materials to correspond to requirements of different materials.

3. An intumescent furnace comprising: a furnace, having a cylindrical body, a firing tube tangentially extended from the top thereof, a burner for projecting a flame at high pressure into said tube and furnace so as to effect a spiral traverse of the furnace by the flame, means connected with said tube and disposed between the burner and the furnace for feeding finely divided intumescible material into said tube and thence to the furnace so that the particles thereof will be held in suspension while under the direct attack of said flame, said furnace having a conical bottom and an outlet in said bottom for discharging the treated material and the products of combustion, said outlet arranged for connection with a source of suction to effect the discharge of the treated materials, and means for varying the discharge of the materials to correspond to requirements of different materials, said last mentioned means including a pipe connected with the outlet of said furnace and arranged for connection with a source of suction, and a damper in said pipe for regulating air admitted thereto from the atmosphere, as described.

HESDEN F. MOORMAN.