Feb. 6, 1940. J. G. BRUSH 2,189,194

APPARATUS FOR HEAT TREATMENT

Original Filed Dec. 28, 1936 3 Sheets-Sheet 1

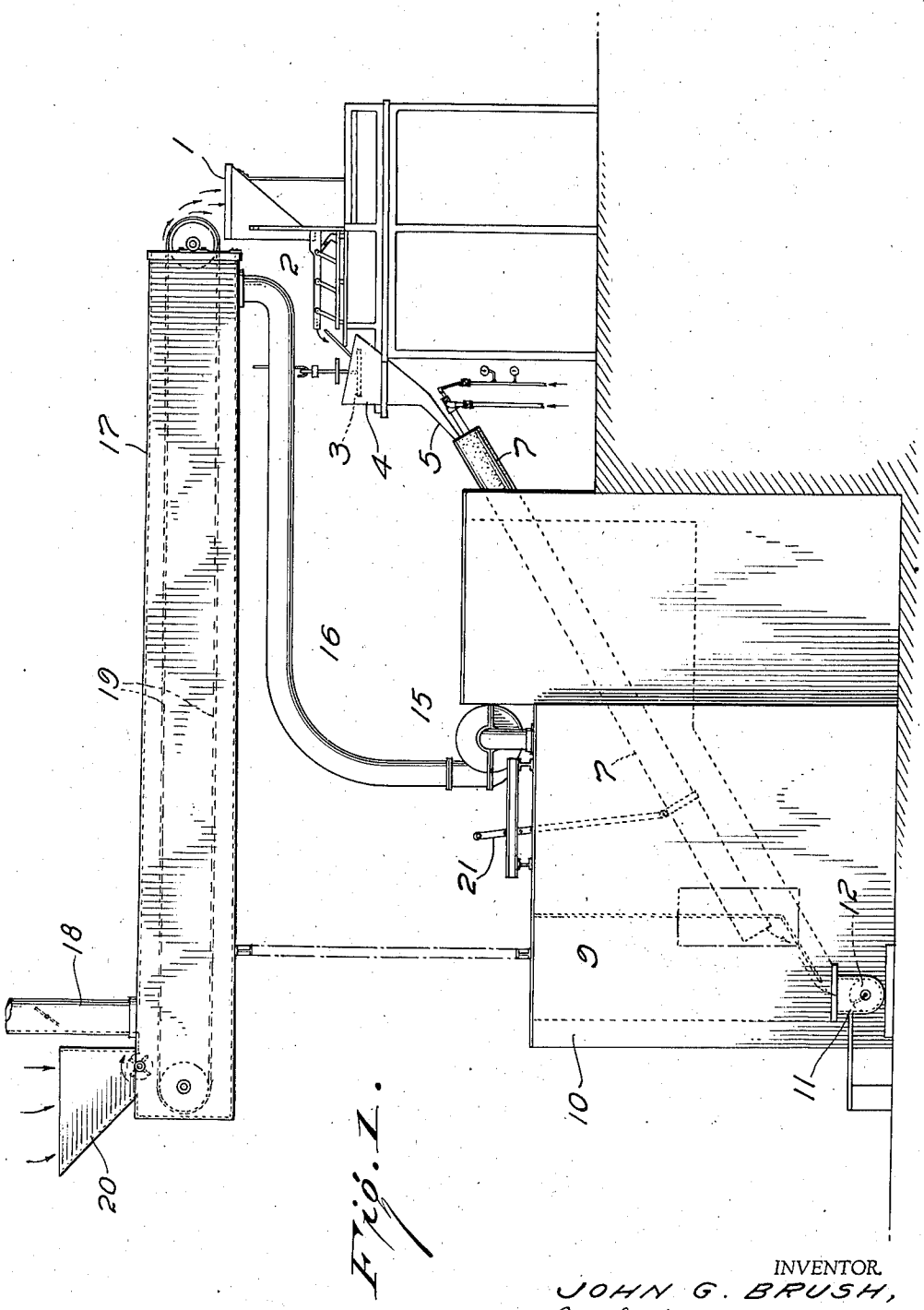


Fig. 1.

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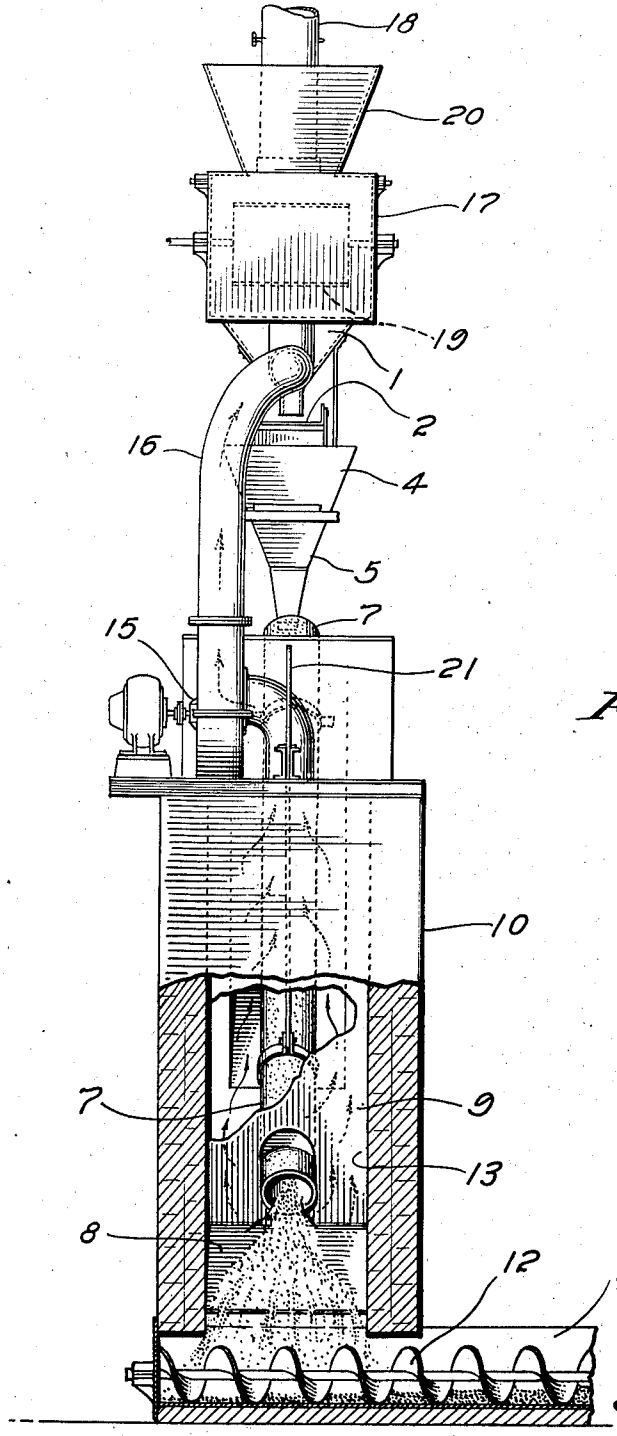


Fig. 2.

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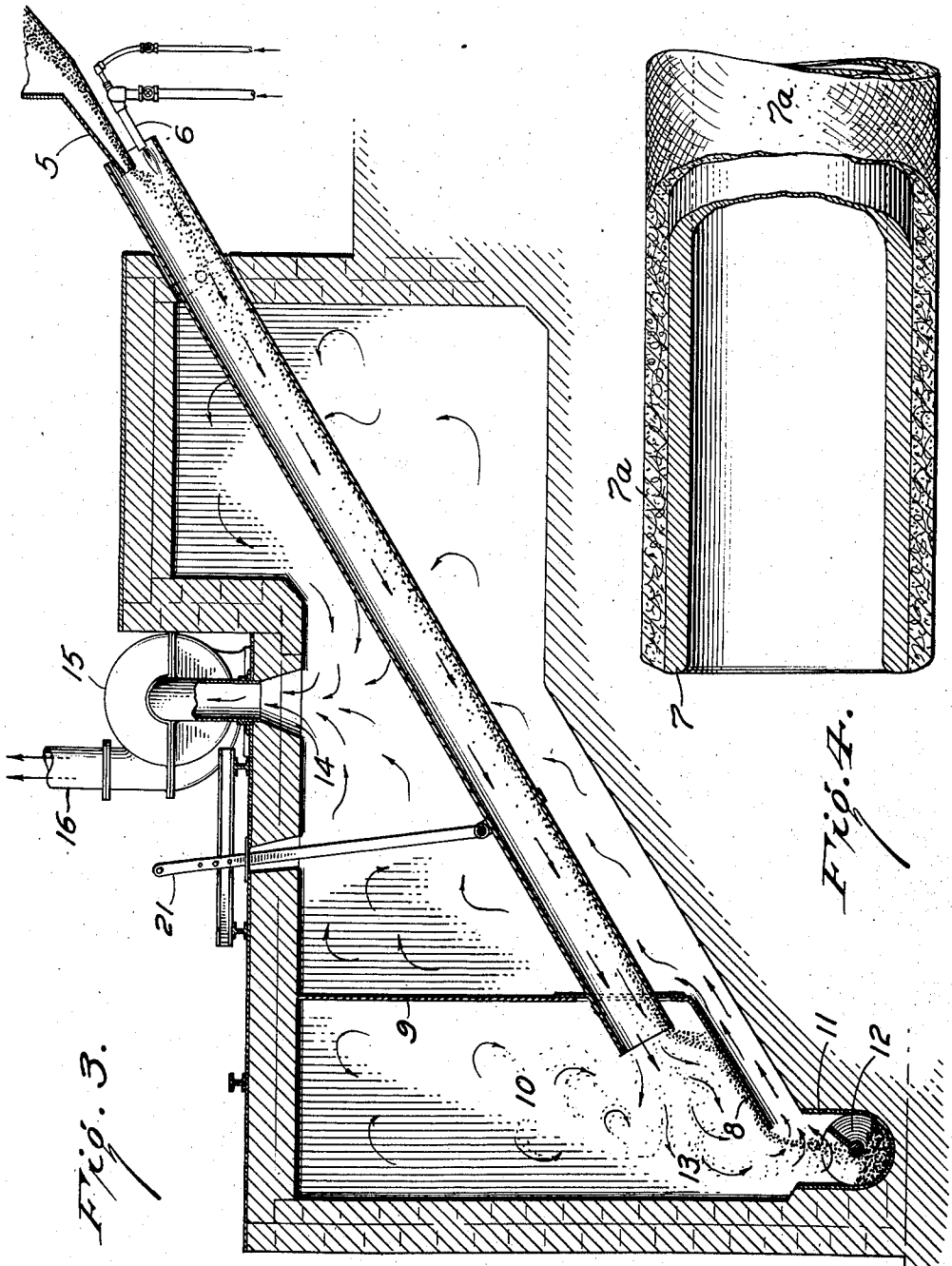


Fig. 3.

Fig. 4.

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UNITED STATES PATENT OFFICE

2,189,194

APPARATUS FOR HEAT TREATMENT

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Original application December 28, 1936, Serial No. 117,898. Divided and this application December 22, 1938, Serial No. 247,147

1 Claim. (Cl. 263—21)

The present invention relates to an apparatus for heat treating materials primarily for the purpose of removing water therefrom, whether free or combined and this case is a division of my copending application Serial No. 117,898, filed December 28, 1936. The invention has particular reference to the calcination of gypsum of either the natural or by-product type starting either with a dry material or material containing some free water.

Gypsum is ordinarily calcined by two general methods, the older being to place the gypsum into a vertically arranged kettle equipped with stirrers, heat being applied to the bottom thereof, suitable heat flues extending up into the body of gypsum being treated. The material is heated in the kettles until its temperature is about 400° F., at which time the desired degree of water removal or calcination is effected. At that time, the kettle is discharged. The chief disadvantages of the kettle process are that, first, it is discontinuous in operation; second, the power costs are high; and, third, maintenance costs are high owing to wear on the agitators and cracking of the kettle bottoms due to heat.

A second common method of calcining gypsum is to feed the material into an interiorly fired rotating inclined tube provided with baffles and the like, the material tumbling on itself until discharged at the proper degree of calcination. The disadvantages of such a process are that the power costs are high, maintenance costs are high due to wear and tear on the parts and a rather inefficient contact of the heated gas with the material to be calcined is obtained.

The principal object of the present invention, therefore, is to devise an apparatus which may be used to heat treat materials even to the point of calcination having a minimum number of moving parts, which will entail an efficient heat transfer relationship, which will require a minimum number of workmen to operate, which will be more or less automatic in its action and which will be provided with readily replaceable parts in case of failure, making unnecessary the shutting down of the equipment for long periods of time during such repair or replacement.

With this and other objects in view, the invention comprises in its broadest aspect apparatus for the feeding of the material to be heat treated in a thin curtain through a flame, followed by movement through an elongated heating zone either under the action of gravity or under the impulse of the flame and/or the hot gases therefrom. During the passage of the material through this elongated chamber, the material will, of course, be subjected to contact with the hot walls thereof which will materially assist in such treatment. It is proposed to discharge the material from the elongated heating zone also as a curtain through which the hot gases from the reaction zone pass. The thus treated materials then pass into an area from which they may be mechanically removed for use. The invention also contemplates apparatus for the pretreatment of material to be treated by means of the exhaust gases from the calcining apparatus using the sensible heat to pre-condition the material to be treated prior to its entrance into the elongated heating chamber.

The invention further consists in the novel arrangement, combination and construction of parts more fully hereinafter described and shown in the accompanying drawings.

In the drawings:

Fig. 1 is a side elevation of an assembly embodying the invention;

Fig. 2 is a front view partly in section of the assembly of Fig. 1;

Fig. 3 is a sectional elevation through the heating chamber and associated parts;

Fig. 4 is an enlarged detail partly in section showing the construction of the heating chamber.

The invention may be described with reference to the embodiments shown in the drawings which are particularly adapted for the treatment of gypsum to produce therefrom calcium sulfate hemihydrate or plaster of Paris.

In these drawings, a feed hopper is shown at 1 into which the gypsum to be treated is fed and discharged onto a distributor 2. This distributor may be preferably of a vibratory type so as to tend to break up any loose agglomerates and feed the material uniformly to a vibrating screen 3 where the material is further broken up and evenly distributed as near as possible as individual crystals into feed funnel 4. The lower end of the funnel 4 is arranged with a flat portion 5 so located as to permit the material to drop therefrom as a thin curtain having a substantial lateral dimension.

A burner 6 is arranged to project its flame through the curtain spilling from the chute 5 into the upper end of an elongated heating chamber 7. It has been found satisfactory to use for this purpose a cast iron pipe, for instance, 8 inches in diameter and 16 feet long with a pitch of 7½ inches per foot. Means are also provided to raise or lower one end of the pipe and, hence, its pitch

is adjustable. It is also preferable to insulate the pipe, such for instance, as with one inch of 85% magnesia shown at 7a.

The fuel for the burner 6 may be gas admixed with compressed air as this has been found to give a good system of control, although obviously an oil or other burner may supply the necessary heat.

The material being treated is discharged from the lower end of the pipe 7 onto the inclined bottom portion 8 of the baffle 9 inside a dust chamber 10. The material spills off of the edge of the baffle 8 in a thin curtain into a trough 11 equipped with a screw conveyor 12 which removes the finished material from the treatment zone for use. The hot gases issuing from the end of the pipe 7 after being relieved of the major portion of any entrained dust in the settling chamber 13, passes downwardly, around and under the lower edge of the baffle 8 and through the curtain of falling material and finally upwardly and out through exhaust port 14. An exhaust fan 15 may be used to assist the removal of the gas.

In cases where there is still a quantity of usable heat in the exhaust gases and such gas is not completely saturated with moisture, they may be conveniently led into an inlet 16 in a predrying chamber 17 and exhausted through the stack 18. This predrying unit may conveniently be provided with an endless belt 19 receiving the material to be preheated from the hopper 20 and discharging it at the other end of the conveyor 19 into hopper 1.

The predrying unit has been found to be particularly effective when calcining by-product gypsum inasmuch as this material is usually delivered to the calciner in a moist condition and containing usually from 8 to 15% of free water. It has been found that under such circumstances, if the moist material containing the higher percentages of water is first passed through the predrier, the free moisture content may be reduced to from 10 to 12% or even lower and that with this range of free moisture, it is then most suitable to be moved uniformly into the upper end of the heating zone 7 with efficient results. It has been found that with more than 12% moisture the material entering the upper end of the chamber 7 requires either a higher temperature or a longer interval of time in the heating zone to accomplish the result obtainable by treating a material containing less moisture. The degree of heat secured may be readily adjusted through manipulation of the burner 6 or reducing the amount of material delivered from the distributor 2. The interval of time to which the material is subjected to heat may be varied by adjusting the inclination of the pipe 7 through adjustable rod 21.

It is to be noted that a flash removal of a large part of the water contained in the material being treated is first obtained as the material passes through the flame issuing from the burner 6. This has been found to be a very efficient method for quickly raising the temperature of the material being treated to the desired point. As the material slides down the pipe 7 either under the action of gravity or under the impetus of the flame or the gases therefrom or both, it is additionally heated both by the gases themselves and by contact with the walls of the hot pipe. A further intimate contact of the hot gases with the material being treated is obtained at the end 8 of the baffle 9 where the gases pass through or in contact with the curtain of falling material. Any dust entrained in the exhaust gases prior to removal of the gases from the chamber 10 finds its way into the compartment 11 by reason of the inclined bottom walls of the chamber.

It has been found that the best results on the calcination of gypsum are obtained where the particle size of the material being treated is such that approximately 90% will pass a 100 mesh sieve. Of course, the dryer the material entering the upper end of the pipe 7, the more efficient the calcining operation will be, with minimum fuel requirements.

Typical data on a semi-commercial plant run as follows:

Rate of feed--pounds per minute--	9 to 10
Production rate ----------do----	7
Fuel gas rate cubic feet per minute--	12 to 13
Rate of flow of flue products (including vaporized moisture) at stack temperature cubic feet per minute--	1100 to 1300
Equivalent flue gas, velocity of, passed through a pipe of 8 inches diameter feet per minute--	380 to 448
Temperature of stack gas----° F.--	400
Temperature of outgoing product----------° F.--	330 to 360

One of the real advantages of the above equipment is that it may be operated in batteries of any number of tubes to step up the production to any desired point. The tubes or pipes are subjected to minimum wear and tear but in case of a desired replacement, this may be done with ease and speed by merely shutting down the burner for that particular pipe and making the replacement without disturbing the rest of the battery.

While the invention has been described with particular reference to the calcination of gypsum, yet obviously it is not to be restricted thereto but the invention is to be construed as applicable to any situation where these steps and apparatus described will be found useful.

I claim:

In a continuous heat treating apparatus, a stationary elongated heating chamber inclined at an angle sufficient to cause material being treated to slide through the same, means to feed material to be treated to the upper end thereof in a curtain, means to project a flame through the curtain of falling material, a dust chamber surrounding the lower end of the heating chamber provided with a baffle arranged to receive the material being treated and to spill it therefrom as a curtain, and an exit port for gases from the dust chamber so arranged as to force the exhaust gases to flow through the curtain of discharging material and beneath the baffle, and a chamber for receiving treated material, the bottom wall of the dust chamber being inclined to convey dust depositing thereon into the chamber for finished material.

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