Oct. 11, 1927. 1,644,693

H. M. ROBERTSON

APPARATUS FOR PRODUCING SMOKE

Filed July 10, 1923 3 Sheets-Sheet 1

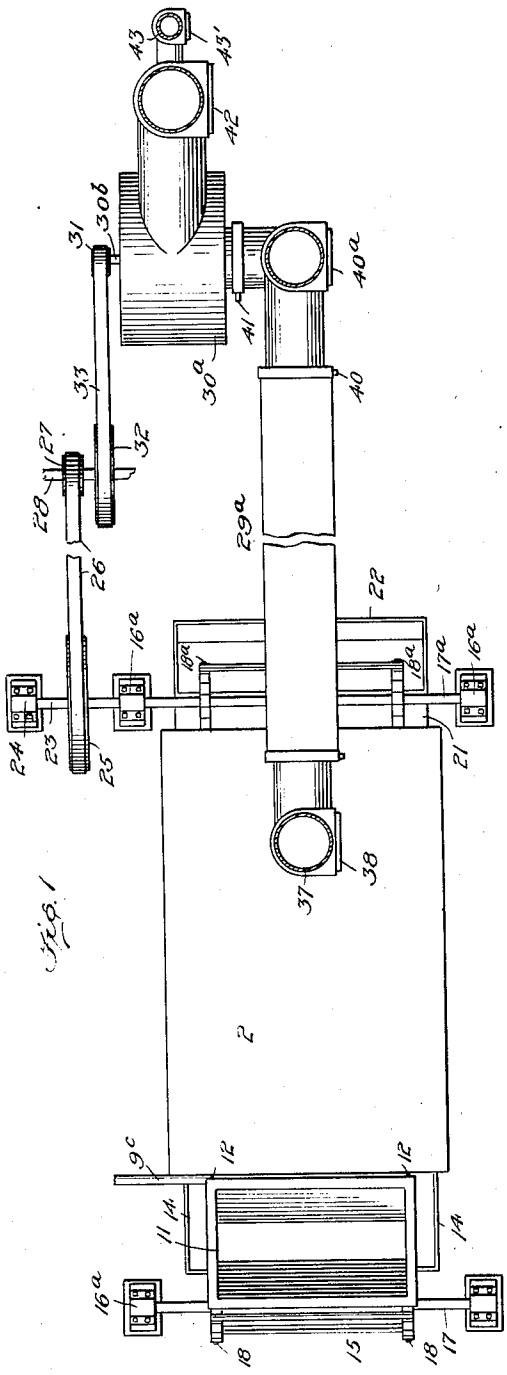


Fig. 1

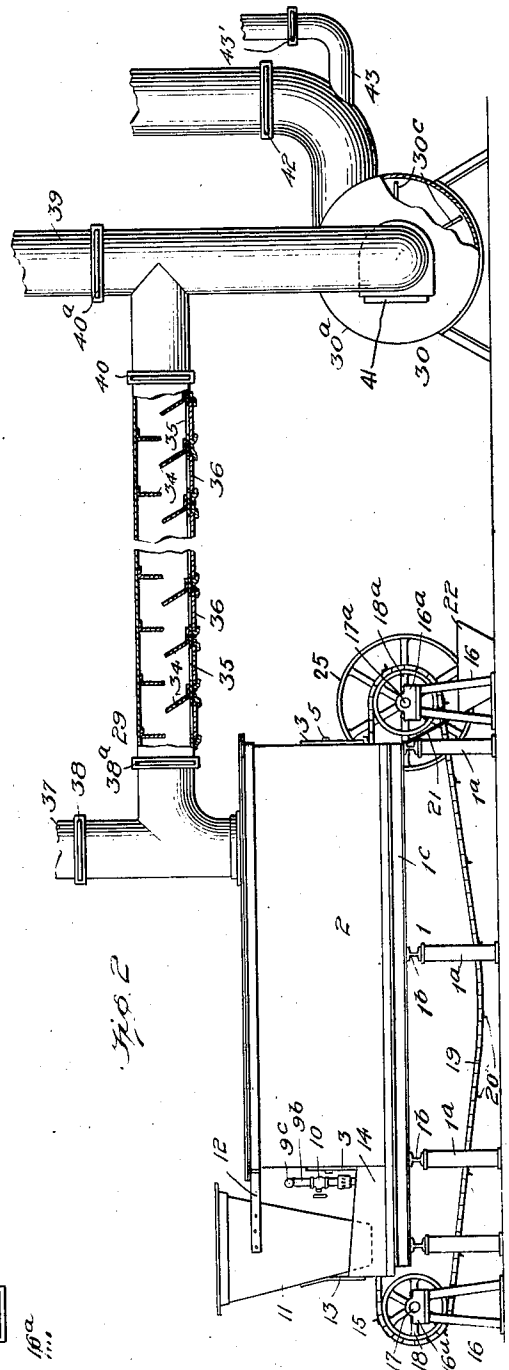


Fig. 2

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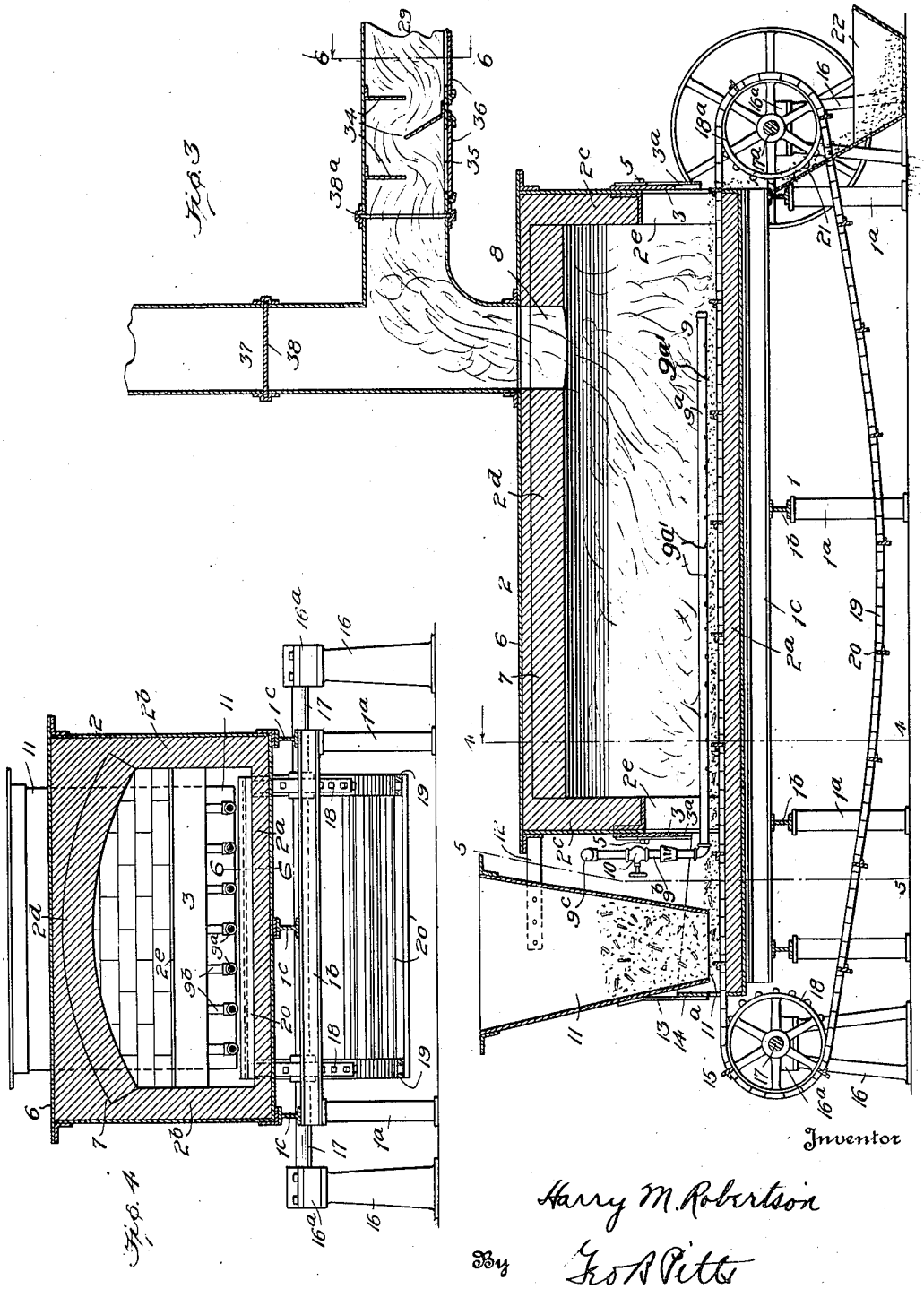


Fig. 3

Fig. 4

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Fig. 5.

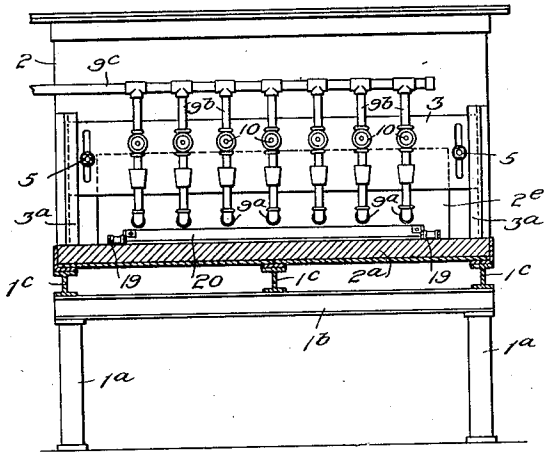


Fig. 7.

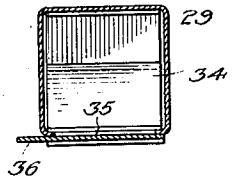


Fig. 6.

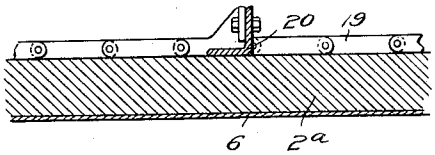


Fig. 8

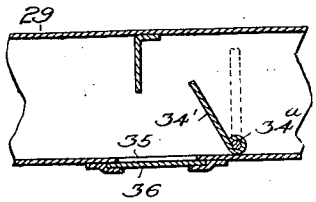
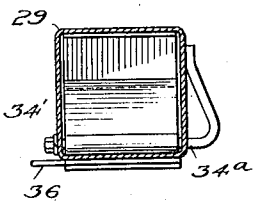


Fig. 9



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Patented Oct. 11, 1927. 1,644,693

UNITED STATES PATENT OFFICE.

HARRY M. ROBERTSON, OF LAKEWOOD, OHIO.

APPARATUS FOR PRODUCING SMOKE.

Application filed July 10, 1923. Serial No. 650,727.

This invention relates to an apparatus for producing smoke, more particularly smoke for use in curing and otherwise treating various substances, such as meats and other products. While the apparatus is intended to use such products as saw dust, corn-cobs and the like, it will be obvious that in the use of such terms, or either thereof, the invention is not to be limited thereto.

One object of the invention is to construct an apparatus of the character designated wherein combustion is maintained and smoke is rapidly and uniformly produced.

Another object of the invention is to construct a smoke producing apparatus in which the fuel is uniformly and substantially continuously agitated to effect complete oxidation and separation of the volatile constituents and the production of the maximum quantity of smoke without causing active combustion, to the end that the apparatus may be operated economically and without waste of fuel.

Another object of the invention is to produce a smoke producing apparatus of simple construction.

Another object of the invention is to provide an improved smoke producing apparatus in which the proper degree of combustion may be readily regulated.

Another object of the invention is to provide, in an apparatus of this character, means for cleaning or clarifying the smoke of solid matter, such as soot, ash and bits of unconsumed fuel, as it is drawn from the furnace and conducted to the treating chamber.

Other objects of the invention will be apparent to those skilled in the art to which my invention relates from the following description taken in connection with the accompanying drawings, in which

Fig. 1 is a top plan view of an apparatus embodying my invention.

Fig. 2 is a side elevation, partly in section.

Fig. 3 is a longitudinal sectional view.

Fig. 4 is a transverse section on the line 4—4 of Fig. 3.

Fig. 5 is a fragmentary section on the line 5—5 of Fig. 3.

Fig. 6 is a fragmentary section, enlarged on the line 6—6 of Fig. 4.

Figs. 7, 8 and 9 are detail views showing a slight modification of the construction.

Referring to the drawings, 1 is a support which may be of any desired construction, but preferably comprising a plurality of standards 1^a, transverse beams 1^b supported at their opposite ends on the standards 1^a and longitudinal beams 1^c supported on the beams 1^b. The beams 1^b and 1^c may be secured to each other and the standards 1^a in any desired manner.

2 indicates as an entirety a furnace or fire chamber. The furnace 2 comprises a bed 2^a over which the fuel is conveyed in the manner to be later set forth, side walls 2^b, end walls 2^c and a top wall 2^d. For purposes which will later appear, the bed 2^a extends beyond the entrance end of the furnace, to receive the smoke producing material. 2^e indicates an opening formed in each end wall 2^c, each said opening being preferably provided with a door 3, whereby the size of the opening may be adjusted to regulate the intake of air into the furnace, and the combustion of the fuel. The openings 2^e preferably extend entirely across the furnace from side wall to side wall and permit the smoke producing material to be conveyed into the furnace and the resulting ash to be discharged therefrom in the manner to be later set forth. The opposite side edges of each door 3 may slidably engage guides 3^a, provided on the outer face of the adjacent end wall, to permit the raising and lowering of the door to the desired extent. Each door 3 may be fixed in its adjusted position by one or more suitable clamping devices 5. The furnace may be constructed in any desired manner. The construction shown for illustrative purposes comprises a casing of steel plates 6 suitably secured together and lined with fire brick 7 or other fire-resisting material. 8 indicates an outlet for the smoke, preferably formed in the top wall 2^d near the discharge end of the furnace.

9 indicates as an entirety a heat producing means disposed above and spaced from the bed 2^a and extending parallel thereto to heat, cause and maintain proper combustion of the fuel substantially uniform as it is conveyed through the furnace. The heat producing means 9 preferably comprise a plurality of pipes 9^a, to which gas is supplied, each having on its lower surface a plurality of uniformly spaced flame ports $9^{a'}$ which direct the ignited gas downwardly. The pipes 9^a preferably extend longitudinally of the bed 2^a and lead into the furnace 1 through the entrance opening 2^e, being connected outside the furnace to suitable supply

pipes 9^b. The supply of gas through each pipe 9^b is preferably controlled by a valve 10. The pipes 9^b are connected to a main supply pipe 9^c. In the preferred arrangement, the pipes 9^a extend parallel to each other, so that the supply of heat from the jets or ports $9^{a'}$ is substantially uniform over the bed 2^a.

11 indicates a supply means for the smoke producing fuel, such means preferably comprising a hopper having a discharge opening 11^a at its lower end. The lower end of the hopper may be spaced a predetermined distance above the receiving end or surface of the bed 2^a to permit of the discharge thereto of a relatively small quantity of the material. The feed or supply hopper is preferably disposed vertically to permit of the flow of the material to the discharge opening by gravity. The hopper 11 is preferably supported by a pair of brackets 12 extending laterally from the adjacent end wall 2^c. The lower end of the hopper may also be connected by a leg 13 to one wall of a guard 14 extending along the sides and end of the receiving portion of the bed 2^a. As shown, the guard 14 extends to a point above the lower end of the hopper 11 and thus serves to prevent any of the material from flowing laterally off the bed 2^a.

15 indicates as an entirety means for conveying the smoke producing material over the bed 2^a relative to the heating means 9 through the furnace and for agitating the material during such movement. Of the conveying and agitating means, 16 indicates pairs of supporting members provided with suitable bearing or journal boxes 16^a to rotatably support the opposite ends of a pair of shafts 17, 17^a. The supporting members 16 are arranged to support the shafts 17, 17^a, transversely of and beyond the opposite ends of the bed 2^a. 18, 18^a, indicate pairs of sprockets fixed to the shafts 17, 17^a, respectively. 19 indicates endless chains running over the sprockets 18, 18^a, and connected by transverse bars, for example, angle bars, 20. As shown, the upper run of the conveyor chains and bars engage and slide on the upper surface of the bed 2^a and move in a plane below the gas pipes 9^b and between them and the bed 2^a. The transverse bars 20 serve as flights to push or propel the smoke producing material over the bed 2^a toward its discharge end and in so doing agitate it sufficiently to expose all portions of the material to the flame jets $9^{a'}$ of the gas pipes. As shown, the discharge opening 11^a of the feed hopper is above the path of movement of the propelling flights 20, so that the latter operate to effect a discharge of a relatively small quantity of material from the hopper 11 as each flight moves past it. As the flights move forwardly over the bed, portions of the material will be carried along thereby while other portions of the material will ride over the upper edges of the flights onto the bed into the path of movement of the succeeding flight or flights which in turn will propel such portions forwardly on the bed. As a result of the movement of the flights along the bed, all portions of the material will be agitated and exposed to the gas jets so that the latter may effect sufficient combustion of the material to generate or produce smoke therefrom. The residue or unconsumed portions of the material is advanced by the conveyor beyond the discharge end of the bed, through the exit opening 2^e, where it drops by gravity onto a chute 21 leading to a receiver 22 or other suitable container.

One of the shafts 17, 17^a, is driven, for example, the shaft 17^a. For this purpose, one end of the shaft 17^a is extended, as shown at 23, and has support at its outer end in a bearing 24. Between the bearing 24 and the adjacent bearing 16^a the extension 23 carries a belt wheel 25 around which runs a belt 26. The belt 26 runs around a pulley 27 which is fixed to a driven shaft 28, driven in any desired manner by means not shown. The driving means may be provided with suitable devices of a well known character to regulate the speed of the shaft and through it the speed of the conveyor chains and bars.

29 indicates a conduit connected to the smoke outlet 8 and leading therefrom to the inlet of the smoke house or chamber (not shown), but which forms the subject-matter of a separate application. Interposed in the conduit 29 is a fan 30, the purpose of which is to draw the smoke from the furnace chamber and force it to the smoke house, such operation serving to permit proper regulation of the combustion in the furnace 1 and insuring a proper and continuous supply of smoke to the smoke house. The fan 30 comprises a casing 30^a having an inlet at one side axially and an outlet in its side wall and a shaft 30^b carrying the fan blades 30^c. The fan shaft 30^b is extended beyond the casing at that side opposite to the inlet and is provided with a pulley 31 over which and a pulley 32 fixed to the shaft 28, runs a belt 33. Suitable devices may be employed to drive the fan shaft at different speeds.

34 indicates as an entirety cleaning devices, preferably interposed in the conduit 29 between the furnace outlet 8 and the fan 30 and arranged to clean the smoke of ashes, bits of unconsumed material and other solid matter which may be sucked out of the furnace chamber with the smoke. The cleaning devices 34 comprise a plurality of spaced plates or baffles extending from opposite sides of the conduit 29 alternately arranged and of a length so that their free ends overlap to form a circuitous passage to retard and arrest and collect the materials and residue referred to. To insure the most efficient ar-

rangement of the plates 34, the section of the conduit in which they are mounted is disposed horizontally, as shown at 29ª, and the lower plates are inclined toward the inlet end of this section. As the smoke flows through the conduit section 29ª, the ashes and bits of solid materials will engage the plates 34 and be arrested thereby and fall by gravity onto the lower wall of the conduit section. The conduit section 29ª is of sufficient length to provide a requisite number of cleaning plates to entirely clarify the smoke of solid materials. For the purpose of cleaning out the conduit section 29ª from time to time, the lower wall thereof is formed between the lower series of plates 34 with openings 35 which are closed by doors 36 slidably supported on the section in any desired manner. If desired, certain or all of the cleaning devices 34 may be made adjustable. As illustrating this form of construction, reference is made to Figs. 7, 8 and 9. In these views I have shown alternate devices 34′ secured to rock shafts 34ª, which are mounted in the side walls of the conduit section 29ª so that they may be adjusted from a vertical position to any angle desired. As a means for holding the devices 34′ in their adjusted positions, each shaft 34ª is formed of resilient material and its free end is bent upwardly so as to yieldingly engage the adjacent side wall of the conduit section as shown in Fig. 9. All of the devices 34′ may be adjusted to the same angle or at different angles.

37 indicates a branch conduit preferably connected to the conduit 29 between the outlet 8 and the cleaning devices 34 and leading to the atmosphere. 38, 38ª, indicate valves or shut-offs in the branch conduit and conduit section 29ª, respectively, to control the flow of smoke through one or the other as desired. 39 indicates a return conduit leading from the smoke house to the fan 30. 40, 40ª, indicate valves or shut-offs provided in the conduit section 29ª and return conduit 39, respectively, to control the flow of the smoke therethrough. 41 indicates a valve for controlling the inlet of smoke into the fan casing and 42 indicates a valve for regulating or shutting off the flow of smoke through the conduit section to which the outlet end of the fan 30 is connected. 43 indicates a discharge pipe connected to the conduit 29 beyond the fan 30 and leading to the atmosphere for well known purposes. The flow of smoke through the pipe 43 is controlled by a suitable valve 43′.

From the foregoing description it will be seen that the apparatus operates to produce or generate smoke automatically and continuously so long as the hopper 11 is supplied with materials. Furthermore, since the discharge opening 11ª from the hopper has a fixed relationship to the receiving portion of the bed 2ª and the conveyor and agitating means may, by suitable speed control or regulating means (not shown), be caused to move at any predetermined speed, the materials may be substantially continuously delivered to the furnace, so that by the proper adjustment of the doors 3 to admit the requisite amount of oxygen, in relation to the suction effect of the fan 30, the necessary heating by the heating means 9 and combustion of the materials may be effected to produce smoke therefrom without causing a flaming or active combustion of the materials. By operating the valves 10, the heat from the heating means may be controlled or regulated. In my construction the bed over which the saw-dust, corn-cobs, or a mixture thereof, or other material, moves is solid and results in preventing air from flowing up through the material and causing active combustion thereof; on the other hand, the heating means being arranged above the material, only the exposed surface thereof is heated. As a result of this construction and arrangement and the agitation of the smoke producing material as it moves over the bed, I am enabled to produce a maximum amount of smoke from all portions of the material as it passes through the furnace.

To those skilled in the art to which my invention relates, many changes and modifications in the construction disclosed and applications of the invention and widely differing embodiments thereof will suggest themselves without departing from its spirit and scope. My disclosures and the description herein are purely illustrative and are not intended to be in any sense limiting.

What I claim is:

1. In apparatus of the class described, the combination of a furnace chamber having a bed, means for conveying smoke producing material over said bed from end to end of said chamber, and means disposed above the material for heating it as the material moves over said bed.

2. An apparatus as claimed in claim 1 in which the conveying means comprises devices that operate to periodically move and agitate the material.

3. In apparatus of the class described, the combination of a furnace chamber provided with a bed for smoke producing material and having inlet and exit openings in its opposite walls and an outlet for smoke, means passing through said openings for conveying smoke producing material over the surface of said bed from end to end of said chamber, means above said bed for heating the material as it moves thereover, a conduit for smoke leading from said outlet, and suction means in said conduit.

4. In apparatus of the class described, the combination of a furnace chamber provided

with a bed and having inlet and exit openings in its opposite walls and an outlet for smoke, means passing through said openings for conveying smoke producing material over said bed from end to end of said chamber, means for heating the material as it moves over said bed, a conduit connected with said outlet, suction means in said conduit, and means for regulating the size of one of said openings.

5. In apparatus of the class described, the combination of a furnace chamber provided with a bed and having inlet and exit openings in its opposite walls and an outlet for smoke, means passing through said openings for conveying smoke producing material over said bed from end to end of said chamber, means for heating the material as it moves over said bed, a conduit connected with said outlet, suction means in said conduit, and means in said conduit between said outlet and the suction means for cleaning the smoke of solid materials.

6. In apparatus of the class described, the combination of a furnace chamber provided with a bed and having inlet and exit openings in its opposite side walls and an outlet for smoke, means passing through said openings for conveying smoke producing material over said bed from end to end of said chamber, means for heating the material as it moves over said bed, a conduit connected with said outlet, suction means in said conduit, and means in said conduit between said outlet and the suction means for cleaning the smoke of solid materials, said cleaning means comprising a plurality of spaced plates extending inwardly from the inner wall of the conduit to intercept such materials therethrough.

7. In apparatus of the class described, the combination of a furnace chamber provided with a bed for smoke producing material extending from end to end thereof, means for conveying the smoke producing material over the surface of said bed and agitating it during such movement, said means comprising a pair of endless chains and spaced transverse bars slidable on said bed and means for supporting and driving said chains, and means for heating said material as it moves over said bed.

8. In apparatus of the class described, the combination of a furnace chamber provided with a bed extending from end to end thereof, means for conveying smoke producing material over said bed and agitating it during such movement, said means comprising a pair of endless chains and spaced transverse bars slidable on said bed and means for supporting and driving said chains, and means for heating the material as it moves over said bed, said heating means being disposed above the material.

9. In apparatus of the class described, the combination of a furnace having an outlet for smoke, means for conveying smoke producing material through said furnace, means for heating the material as it moves through said furnace to cause combustion thereof to produce smoke, a conduit leading from said outlet, and means in said conduit for cleaning the smoke of solid materials as it passes therethrough, said cleaning means comprising a plurality of spaced plates extending from opposite inner walls of said conduit and alternately arranged to form a circuitous passage.

10. In apparatus of the class described, the combination of a furnace having an outlet for smoke, means for conveying smoke producing material through said furnace, means for heating the material as it moves through said furnace to cause combustion thereof to produce smoke, a conduit leading from said outlet, and means in said conduit for cleaning the smoke of solid materials as it passes therethrough, said cleaning means comprising a plurality of spaced plates extending from opposite inner walls of said conduit and alternately arranged to form a circuitous passage, certain of said plates being adjustable.

11. In apparatus of the class described, the combination of a furnace having inlet and exit openings in its end walls and an outlet connected with a conduit for smoke, means passing through said openings for conveying smoke producing material through said furnace, means for heating the material as it passes through said furnace, means in said conduit for creating a suction effect therein, and means for regulating the size of said inlet and exit openings.

12. In apparatus of the class described, the combination of a furnace having inlet and exit openings in its end walls and an outlet connected with a conduit for smoke, means passing through said openings for conveying smoke producing material through said furnace, means for heating the material as it passes through said furnace, means in said conduit for creating a suction effect therein, and means for regulating the size of one of said openings.

13. In apparatus of the class described, the combination of a furnace having inlet and exit openings in its end walls and an outlet connected with a conduit for smoke, means passing through said openings for conveying smoke producing material through said furnace, means for heating the material as it passes through said furnace, means in said conduit for creating a suction effect therein, means for regulating the size of one of said openings, and means for regulating and controlling said heating means.

In testimony whereof, I have hereunto subscribed my name.

HARRY M. ROBERTSON.