

April 9, 1935.

W. L. McEVER

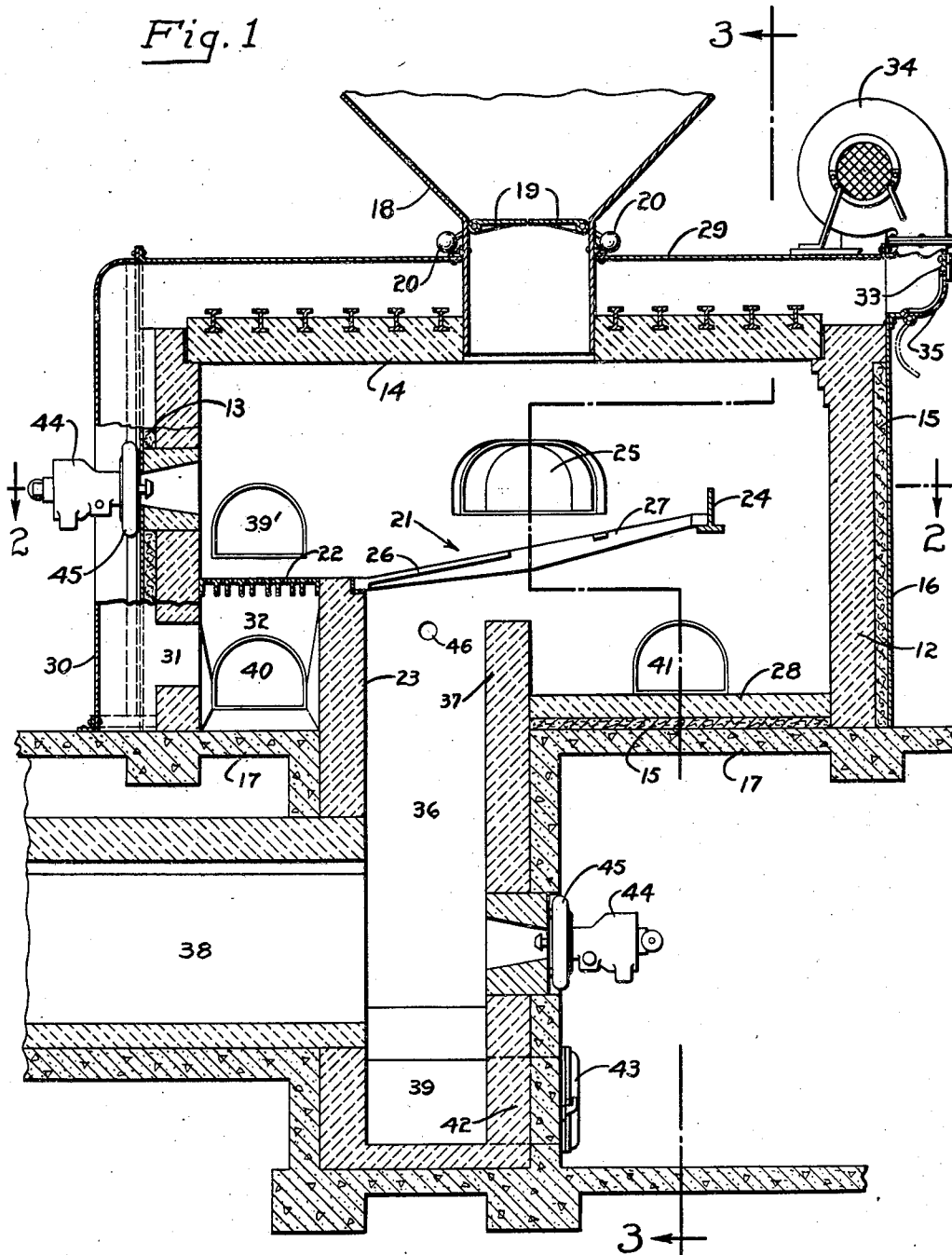
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INCINERATOR

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4 Sheets-Sheet 1

Fig. 1



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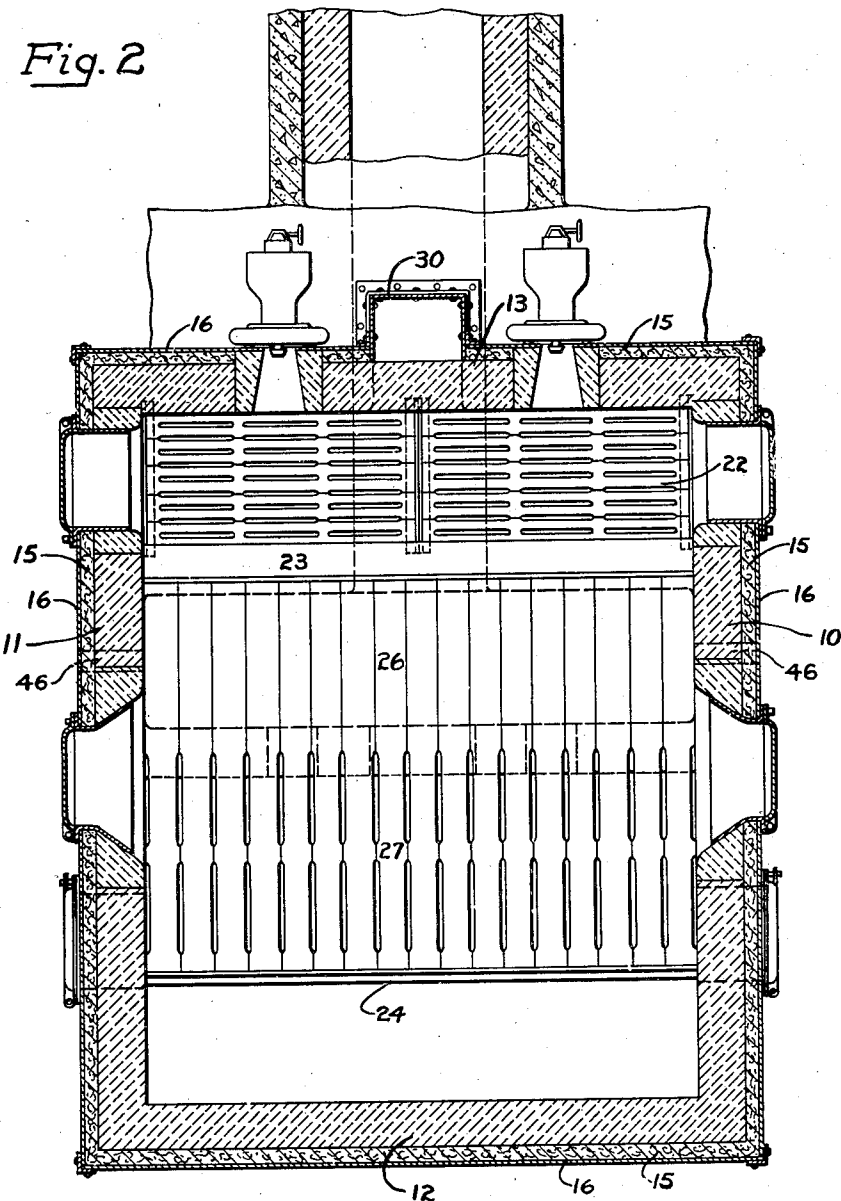
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INCINERATOR

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Fig. 2



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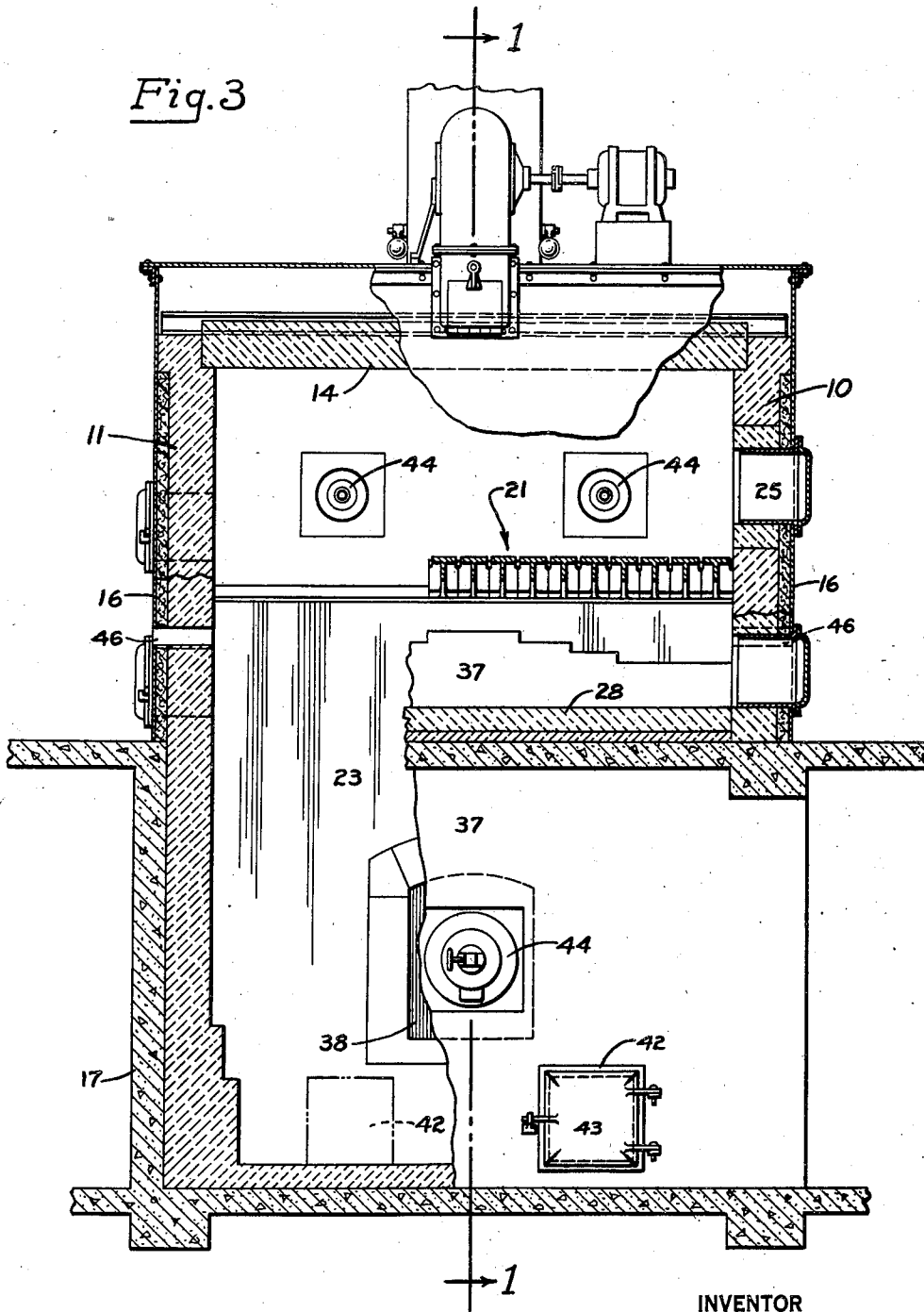
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Fig. 3



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INCINERATOR

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Fig. 4

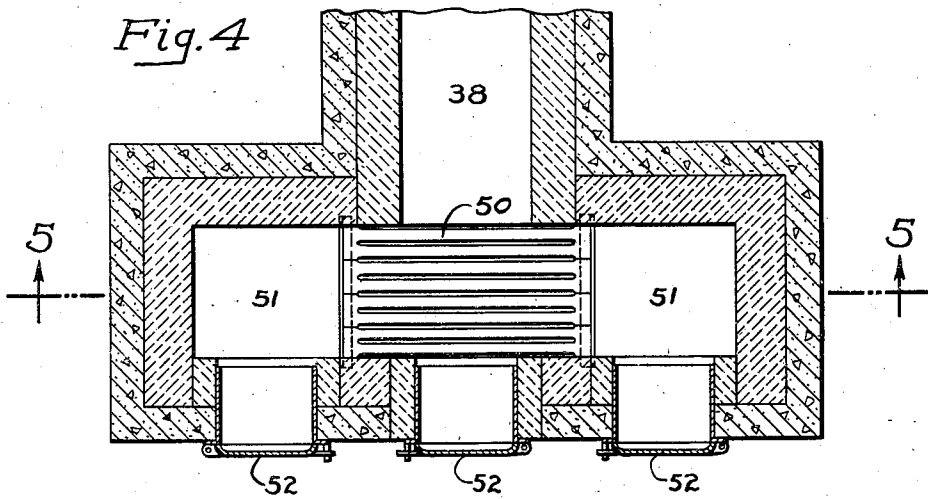
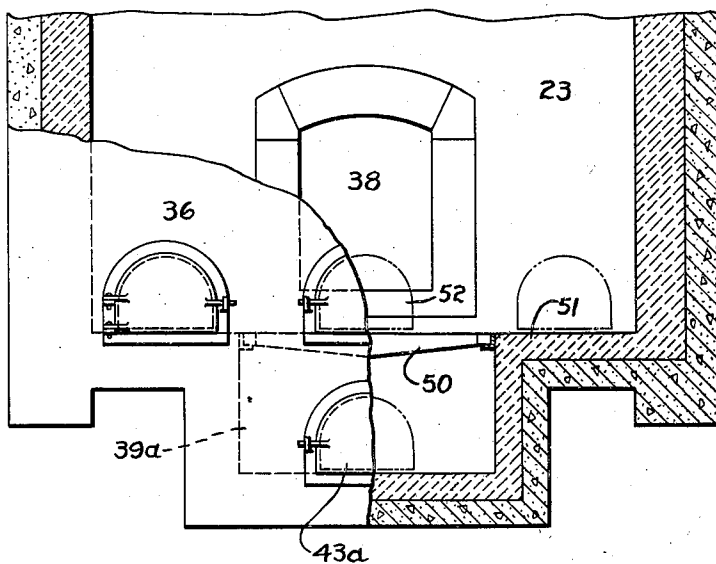


Fig 5



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UNITED STATES PATENT OFFICE

1,997,306

INCINERATOR

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Application January 7, 1933, Serial No. 650,682

5 Claims. (Cl. 110—12)

My invention relates to incineration and more particularly to apparatus and methods for the disposal or burning of sewage sludge, sewage screenings, rubbish, garbage and other material containing a large percentage of moisture.

An important object of the invention is to provide new and advantageous methods for burning material of the general class specified. Another important object of the invention is to provide new and advantageous apparatus for the general purpose specified. A further important object of the invention is to utilize to the fullest extent heat resulting from combustion of material in the furnace or incinerator.

In materials such as referred to, there is usually sufficient moisture to necessitate the use of auxiliary fuel to obtain complete and efficient disposal, and it is therefore an important object of the invention to utilize to the fullest extent the heat resulting from the combustion of both the material to be disposed of and the auxiliary fuel. It is also an object of the invention to provide positive control over the gases produced. A further object of the invention is to render all of the gases discharged from the apparatus clean and odorless at all times, irrespective of variation in quantity or quality of the material being destroyed.

An important feature of the invention involves the passage of the gaseous products of combustion along both upper and lower faces or sides of a drying support. A more specific feature involves the passage of the gaseous products of combustion—first along one face and then along the other of the faces of the drying support.

Another feature relates to the use of a drying support having, in addition to an imperforate portion or hearth, a perforated part, or grate, whereby a portion of the gaseous products of combustion may be passed therethrough, thus producing in effect a short-circuiting of the flow of gaseous products of combustion.

Other features involve the passing of the gaseous products of combustion along the top of a drying support in a combustion chamber or high temperature zone, back at the lower side of said support and through that portion of the high temperature zone, and then to a discharge flue preferably leading to a stack.

According to a preferred form of carrying out the invention, provision is made of a refractory lined structure having an upper part which is preferably rectangular in shape and receives the material to be burned through means including a central charging hopper in the top, which

top may be flat and suspended from metal cross members, such as I-beams, spanning the distance between the side walls. Beneath the charging device is a drying support preferably inclined downwardly toward a partition wall which serves as a support for one end of the drying hearth, the other end being supported in a suitable manner as by a bearer bar. The drying hearth should be of heat-conducting material and preferably is made of high-heat-resisting metal or the like and while solid near the partition wall is perforated in the part remote from the partition wall, thus in effect providing a secondary grate.

Extending from the partition wall to the side of the chamber is a fire grate or set of grates on which the material dried on the drying support is burned. Beneath the fire grate is an ash pit through which is introduced a hot draft to aid combustion. The air for the hot draft may enter through a duct having a flat portion overlying the top of the furnace chamber and a portion of smaller cross section extending downwardly to a point where it may communicate with the ash pit.

The passage of air over the top of the furnace serves not only to preheat the air for draft and combustion purposes but also to cool the I-beams which if they become too hot might have a tendency to sag. The circulation of air over the roof and into the ash pit is preferably effected by means of a forced draft fan located at the inlet of the duct.

Hot gases from the fire grate pass over the top of the drying support or hearth and, in general, around the farther edge of the support. However, due to the perforated character of this part of the drying support, the gases may pass downwardly therethrough, although partially obstructed by material thereon.

Beneath the drying support is a part of the combustion chamber and the gases are turned back to pass therethrough and along the lower side of the drying hearth to a down well or passage which may be included between the partition wall, serving as a common support for the fire grate and the drying support, and a bridge wall which projects upwardly beneath the drying hearth near the middle thereof.

Preferably for proper regulation of the gas flow the bridge wall varies in height so that the distance between the drying support and the top of the bridge wall varies from a maximum at the side walls to a minimum at the center. The hot gases pass downwardly through the down well, which may serve as a downward extension of the com-

bustion chamber, until they reach the level of a flue connected with the stack and are drawn out at this point. Preferably there is a dust pit beneath the level of the flue.

After the material on the drying support has been sufficiently dried, it may be stoked downwardly to the fire grate or grates. The water content of the refuse material is usually so high that auxiliary fuel must be used, not only to start the drying and burning of the refuse material, but also during the normal operation of the incinerator. When use is made of either oil or gas as auxiliary fuel, burners may be located above the fire grate and also in line with the flue leading to the stack. If solid fuel be used, it may be burned on the fire grate and, if desired, on another grate located in the down well just below the level of the flue leading to the stack.

In starting the incinerator, there is no dried refuse material on the main grate and, if such auxiliary burners are used, there is no need for forced draft through the grate. Under these conditions, the fan may be left idle and, after a short preliminary heating, air may be admitted through a normally closed opening adjacent to the fan. After the incinerator has been thoroughly heated and combustion of material on the fire grate is assured, the opening adjacent to the fan is closed and forced draft is provided by the fan.

Other features and advantages will appear upon consideration of the following description and of the drawings, in which

Fig. 1 is a vertical section of a preferred embodiment of the invention, the section being taken along the line 1—1 of Fig. 3;

Fig. 2 is a vertical section taken along the line 2—2 of Fig. 1;

Fig. 3 is a section taken along the line 3—3 of Fig. 1;

Fig. 4 is a horizontal section of a modification taken at the junction between the down well and the flue leading to the stack, the burner shown in the first form being replaced by a grate; and

Fig. 5 is a view partly in section along the line 5—5 of Fig. 4.

Referring to the drawings, the main structure of the incinerator includes side walls 10 and 11, end walls 12 and 13 and a roof 14. The side and end walls are of refractory material at their inner surfaces and at their outer surfaces are preferably insulated by suitable material 15 and are encased in steel plate 16. Although the roof 14 may take other forms, it is preferably in the form of a flat arch of suitable heat-resisting material suspended from upright walls of the furnace by means of I-beams. The side and end walls may be supported in any suitable manner and as here shown are supported on a suitable concrete structure or foundation 17.

The sewage screenings or the like which are to be burned are introduced into the incinerator in any suitable manner, as for example, through suitable charging chutes 18 extending through the roof 14. Passage of screenings through the charging chutes may be controlled by means including automatic doors 19 normally held in closed position (Fig. 1) by weights 20. It will be evident that when screenings accumulate sufficiently upon the doors 19 the doors will open and discharge the screenings into the incinerator.

The screenings thus introduced fall upon a drying support 21 and when suitably dried thereon are transferred to fire grate 22 where the solid matter is consumed. The grate 22, as here shown, is supported at one side by the end wall 13 and

at the other side by a partition wall 23 of suitable refractory or fire-resisting material. The wall 23 may also be utilized to support the drying support 21 at one edge. Support for the opposite edge of the drying support may be effected by a bearer bar or beam 24 of suitable heat-resisting metal. Preferably the bearer bar 24 is somewhat higher than the top of the partition wall 23 so that the drying support 21 while forming substantially a continuation of the fire grate 22 is slightly inclined so as to facilitate transfer of the material, as by stoking through one or more openings 25 in the side walls, from the drying support to the fire grate.

The drying support 21 is substantially continuous near the partition wall 23 so that this part serves as a drying hearth 26, and is of open construction near the bearer bar 24 so as to provide a part serving as a drying grate 27. As shown in Figs. 2 and 3 the drying support 21 is preferably made up of a plurality of bars or members having flat tops and central reinforcing flanges projecting downward from said flat tops. As shown in Fig. 2 the flat portions of these members form substantially a continuous surface in the drying hearth portion of the support, and the grate portion of the drying support is provided by recesses in the edges of said flat tops.

Although there is no definite division in the interior of the incinerator the portion above the fire grate 22 may be considered as a burning chamber or zone and the portion of the said interior at the other sides of the partition wall 23 may be considered as a combustion chamber in which the gaseous products of combustion, from material burned on grate 22, are to a great extent completely burned. As indicated in Fig. 1, the combustion chamber extends beneath the open portion of the drying support 21 and is provided with a floor 28 of a refractory material, which is insulated from the concrete foundation or support by means of a layer of insulating material 15. The gaseous products of combustion pass over the drying hearth 26 and either around or through the drying grate 27 into the portion of the combustion chamber beneath the drying grate, are directed rearwardly beneath the drying support, and are withdrawn from the portion of combustion chamber beneath the drying hearth.

It will, therefore, be evident that material on the drying hearth will be subjected at its upper surface to the drying action of the gases of combustion passing over the same and that the material on the drying grate 27 will be exposed to the gaseous products of combustion not only above and below, but in the interior of the mass due to the fact that unless the mass is too thick and dense a portion of the gaseous products of combustion will be drawn through the drying grate. A great advantage arises from the use of a metallic drying support 21 in that it enables the use of long narrow slots, which would not be practicable to form in fire brick and similar construction, whereby the gases are permitted to pass through the support freely and all but very small particles of solid material are held on the grate.

To support combustion in the incinerator, it is necessary to supply a suitable amount of air, and, in order to increase the efficiency, the air introduced into the incinerator is preheated by using it to cool certain parts of the incinerator. If the roof 14 becomes too hot, the I-beams which support it will tend to sag. It is, therefore, desirable to cool said top and for this purpose said

top and is used as a bottom of a closed box 29 formed by a steel plate cover connected with the upper edges of the steel plates 16 enclosing the side and end walls of the incinerator. Near the wall 13, the box thus formed is connected by means of a downwardly extending duct 30 with a port or opening 31 connecting with the interior of ash pit 32 beneath the fire grate 22. Adjacent to the wall 12, the box is connected by means of an elbow 33 with a forced draft fan 34 mounted on the top of the box and the elbow is provided with a door 35 to supply air to the incinerator when it is working under natural draft.

As hereinbefore stated, the gaseous products of combustion after passing beneath the drying hearth 26 are withdrawn from the incinerator. This might be done by means of a flue extending from the position just below the drying hearth to a stack or other means of producing draft.

However, as illustrated, said gaseous products of combustion are directed downwardly through a down well 36 between the partition wall 23 and a bridge wall 37 of which the top is almost directly beneath the division between the drying hearth and the drying grate. As here shown, the down well 36 extends from side wall 10 to side wall 11. From the down well 36 the gaseous products of combustion may pass to a stack or other draft producing means, through a horizontal flue 38 connected with the down well 36 above its bottom so as to provide at the bottom of the down well a dust collecting chamber or pit 39.

The bridge wall 37 serves to direct the hot gaseous products of combustion upwardly so as to contact with the lower face of the drying hearth. If the top of the bridge wall were horizontal from side wall 10 to side wall 11 there would be a tendency for the greater portion of the gases to pass through the central part of the passage so that the central part of the drying support would be heated more than the portions near the side edges, and the material on the drying support would not be dried uniformly. To this end the bridge wall 37 is made higher in the center and gradually decreases in height toward the side walls. As indicated in Fig. 3 this decrease in height is accomplished by giving the top of the wall a stepped formation.

In addition to stoke holes 25 for working the material from the drying support to the fire grate, provision may be made of stoke holes 39' for handling the material on grate 22, stoke holes 40 for removing ashes from the ash pit 32, stoke holes 41 for removing waste material from the floor 28 of the combustion chamber, and stoke holes 42 for removing dust from the dust chamber 39 at the bottom of the down well 36. Normally all of these stoke holes are closed and for this purpose are provided with doors 43.

This incinerator is intended particularly for burning wet screenings and the like and it is evident that it cannot be put into operation without the use of auxiliary fuel and that it may be necessary to use auxiliary fuel during normal operation. As illustrated on the drawings the auxiliary fuel to be used is oil introduced through suitable burners 44 of which two are shown acting through openings in wall 13 just above the fire grate and one is shown acting through the bridge wall 37 opposite the end of the flue 38. The burners illustrated include fans 45 by which air is mixed with the oil as desired, and as a matter of fact, excess air may be introduced to support combustion of solid matter on grate 22

and of combustible gases included in the gaseous products of combustion.

Oxygen to insure substantially complete combustion in the down well 36 and flue 38 may be supplied in any suitable manner, as from air entering through inlets 46 in the side walls 10 and 11 at the upper part of the down well, due to the pressures in the down well being below atmospheric pressure.

In starting with a cold incinerator, the operation may be substantially as follows:

The burners 44 at the wall 13 are put into service at substantially the same time, the burner 44 opposite flue 38 is also put into operation, and the fuel supplied by all of these burners is ignited. Gradually the refractory lining of the incinerator is heated sufficiently for satisfactory operation. At any suitable time during the heating operation, material may be introduced through the charging chutes 18 and counterbalanced doors 19, so as to fall on the drying support 21. As the material accumulates on the drying support it is stoked through the holes or openings 25 so as to spread it more or less uniformly over the drying support and thus subject as much of the material as possible to direct drying action of the hot gases produced by the combustion of the auxiliary.

It will be seen that the gaseous products of combustion pass above the material on the imperforate portion 26 of the drying support or hearth 21 to the upper side of the perforated section or drying grate 27 where a portion of the hot gases or gaseous products of combustion may pass downwardly through the material and the openings in this part of the drying support. The remaining products of combustion pass over the end of the drying support or hearth and the edge of the bearer bar 24 and then in a reverse direction of flow along the bottom of the drying support and through the corresponding portion of the combustion chamber. In this reverse flow the gaseous products of combustion pass over the bridge wall 37 with its top shaped to improve the uniformity of flow, and from the bridge wall pass downwardly through a down well 36 to the entrance of a flue 38 through which the hot gases may be discharged into a stack or other draft-producing means, not shown. In this way a maximum area of the material is exposed to the drying action of the hot gases, thus tending to reduce the amount of auxiliary fuel required for drying and combustion and to produce a dry product on the drying support or hearth.

When suitably dried on the drying support 21 the material is stoked onto the fire grate 22 where it burns, air containing the oxygen necessary for combustion being drawn in through and preheated in the box 29 at the top of the incinerator and being supplied at the lower side of the fire grate 22 through the ash pit 32. The non-combustible matter or ash formed on the grate 22 falls through the openings in this grate into the ash pit 32 from which it is removed through doors 40 and may be conveyed to a suitable place of final disposal. When the material has been dried on the drying support 21 and transferred, as by stoking, to the fire grate 22, it is burned on that grate and may be utilized for heating purposes as described for the auxiliary fuel. As soon as combustion of such dried material begins on grate 22, the amount of auxiliary fuel required is reduced in proportion to the amount of heat produced in this burning operation. All of the gaseous products of combustion must pass from the furnace 75

through the down well 36 and transverse flue 38, thus causing all such gaseous products of combustion to pass through the high temperature zone maintained by burner 44. In this manner, positive control over the temperature of the gases leaving the furnace can be obtained. Any solid particles suspended in the gases as they pass through the down well 36 will be caught in the dust pit 39 from which the solids may be removed through one or more cleanout doors 43.

Under some conditions it may be desirable to use solid fuel on the grate 22 to start the furnace and to heat the outgoing gases by fuel on a grate 50 immediately above the dustpit at the bottom of the down well, as shown in Figs. 4 and 5. With this arrangement it may be necessary in starting the apparatus to admit air through a door 40 in the side of the ash pit 32 beneath the fire grate 22, and to admit air to the lower part of the down well through a cleanout door 43a connected with the dust pit 39a, which in this form is narrow and is flanked at its top by section 51 of a floor for the down well, and/or through one or more doors 52 at or above the level of said grate and floor section 51. In this form, dust may collect on the floor sections 51 and may be removed through the doors 52. Material may be supplied to the grate 50 through a central door 52 which may also be used when it is desired to stoke material on the grate 50.

It should be understood that various changes may be made in construction and arrangement and that certain features may be used without others without departing from the true spirit and scope of the invention.

Having thus described my invention, I claim:

1. In an incinerator, the combination with a burning chamber and a fire grate therefor, of a combustion chamber, a drying hearth in said combustion chamber and having one edge adjacent to said fire grate, a drying grate adjacent to the opposite edge of said drying hearth, a down well constituting a combustion chamber outlet beneath said hearth, a bridge wall beneath the adjacent edges of the drying hearth and drying grate and having its top spaced therefrom to provide a passage, said top of the wall being so shaped with reference to the top of the passage that the height of the passage at the middle is less than at the sides to limit the flow of gases at the middle and thereby increase the flow at the sides and render the flow more uniform across the passage, a laterally extending flue connecting with said down well and a burner jet in said down well opposite the end of said flue.

2. In an incinerator, the combination with a burning chamber and a fire grate therefor, of a combustion chamber receiving gaseous products of combustion from the burning chamber, a drying support in said combustion chamber, a combustion chamber outlet, said drying support and said outlet being so arranged that said gaseous products pass in one direction over the upper

face of the support and in the opposite direction beneath the lower face of the support, and means for restraining the flow along the middle of said lower face and thereby rendering the flow of gaseous products at the lower face substantially uniform throughout the width of the support.

3. In an incinerator, the combination with a burning chamber and a fire grate therefore, of a combustion chamber receiving gaseous products of combustion from the burning chamber, a drying support in said combustion chamber, a combustion chamber outlet, said drying support and said outlet being so arranged that said gaseous products pass in one direction over the upper face of the support and in the opposite direction beneath the lower face of the support, said lower face being substantially flat across the width of said support, and means including a wall higher at its middle and lower at its ends to render the flow of gaseous products in said opposite direction substantially uniform across the width of said support.

4. In an incinerator, the combination with a burning chamber and a fire grate therefor, of a combustion chamber at one side of said burning chamber, a drying support in said combustion chamber inclined downwardly to one edge of said fire grate, and a down well positioned beneath the portion of said drying support adjacent to the fire grate whereby the gases of combustion from the fire grate will pass along the upper side of said support and back along the lower side thereof, said support being formed of heat-resisting metal with an imperforate portion near the fire grate and another portion further from the fire grate provided with long narrow slots permitting gases to pass through but retaining most of the solids of which some disposition must be made.

5. In an incinerator, the combination with a burning chamber and a fire grate therefor, of a combustion chamber at one side of said burning chamber, a drying support in said combustion chamber inclined upwardly from one edge of the fire grate to a position spaced from the wall of the combustion chamber to form a passage through which combustion gases from the fire grate may be passed, and a down well beneath the drying support adjacent to the fire grate so that combustion gases will be drawn along the top of the drying support and backward beneath the drying support to said downwell constituting an outlet, said drying support comprising a substantially imperforate part near the fire grate and a perforate portion remote therefrom and being formed of a series of metal members fitting closely together adjacent to said fire grate and providing at the remote portion substantially long narrow slots to pass gases therethrough while retaining solids of appreciable size, said slots being formed of recesses provided at the edges of said metal members.

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