Sept. 13, 1960 R. M. SHERMAN 2,952,226

INCINERATORS

Filed Feb. 23, 1956

3 Sheets-Sheet 2

Fig. 4.

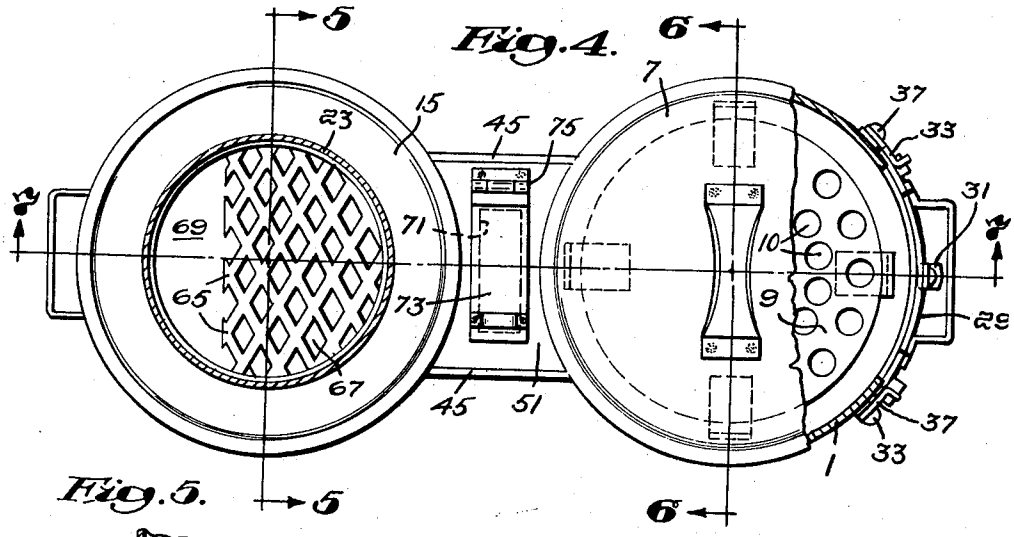


Fig. 5.

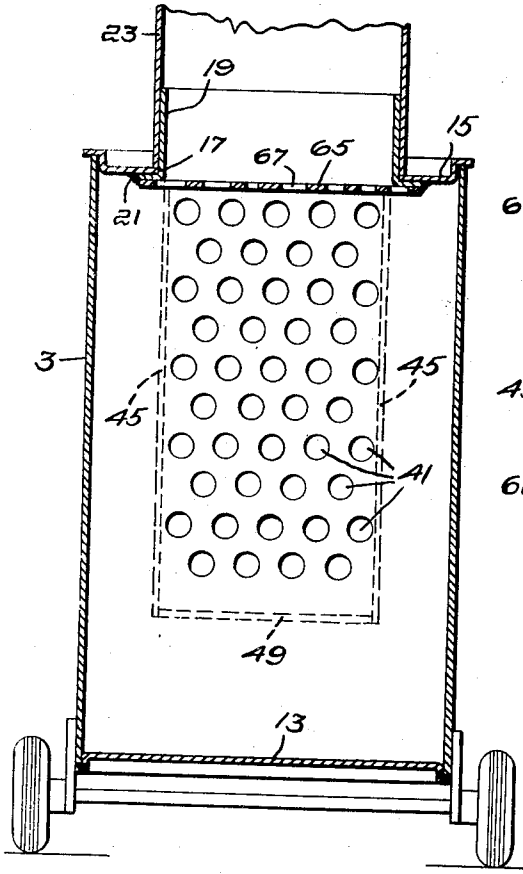
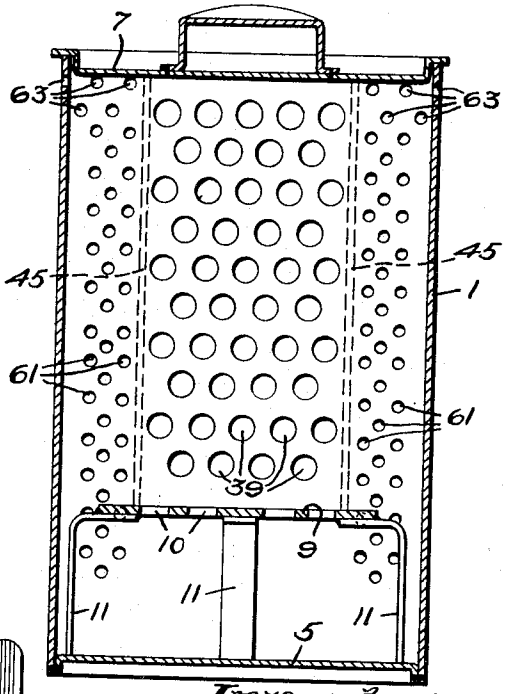


Fig. 6.



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3 Sheets-Sheet 2

Fig. 4.

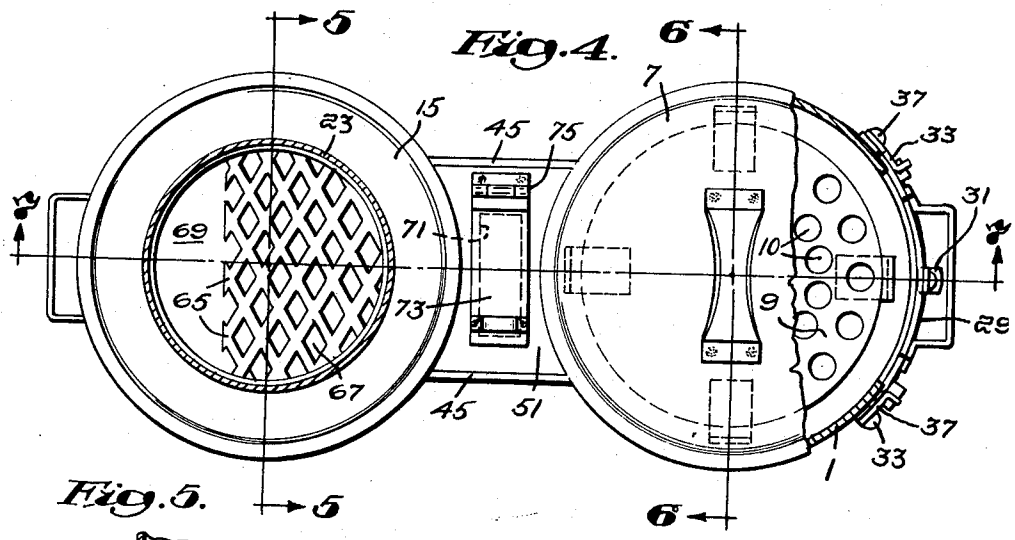


Fig. 5.

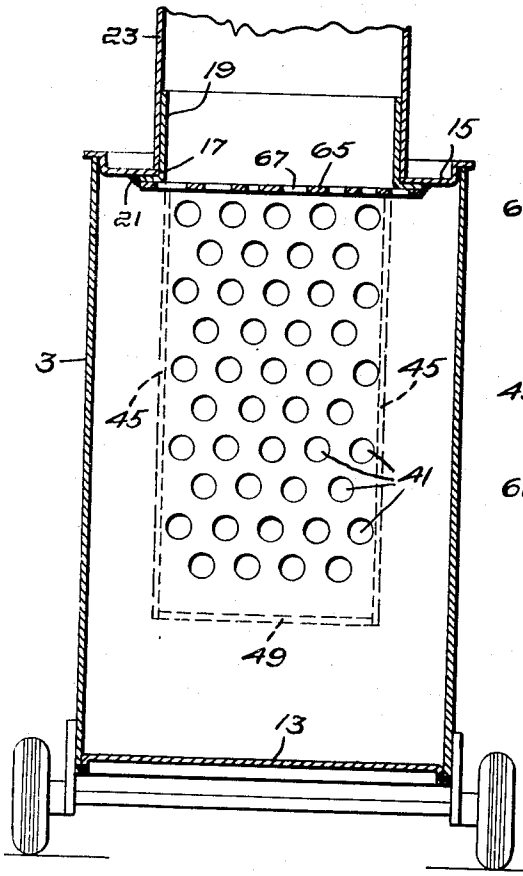
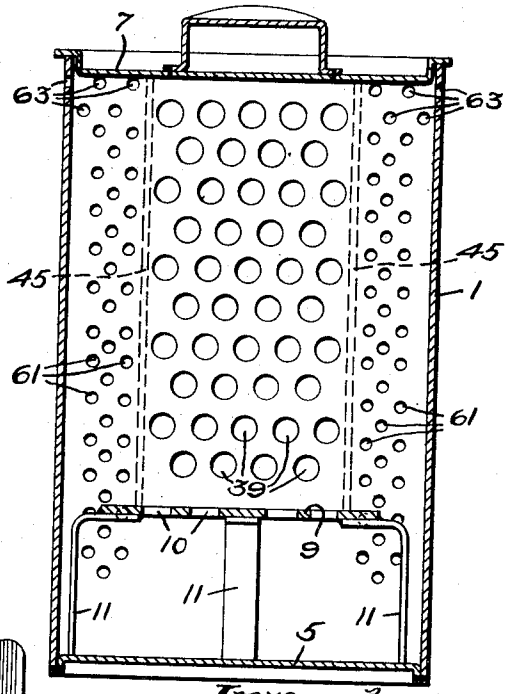


Fig. 6.



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INCINERATORS

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Fig. 7.

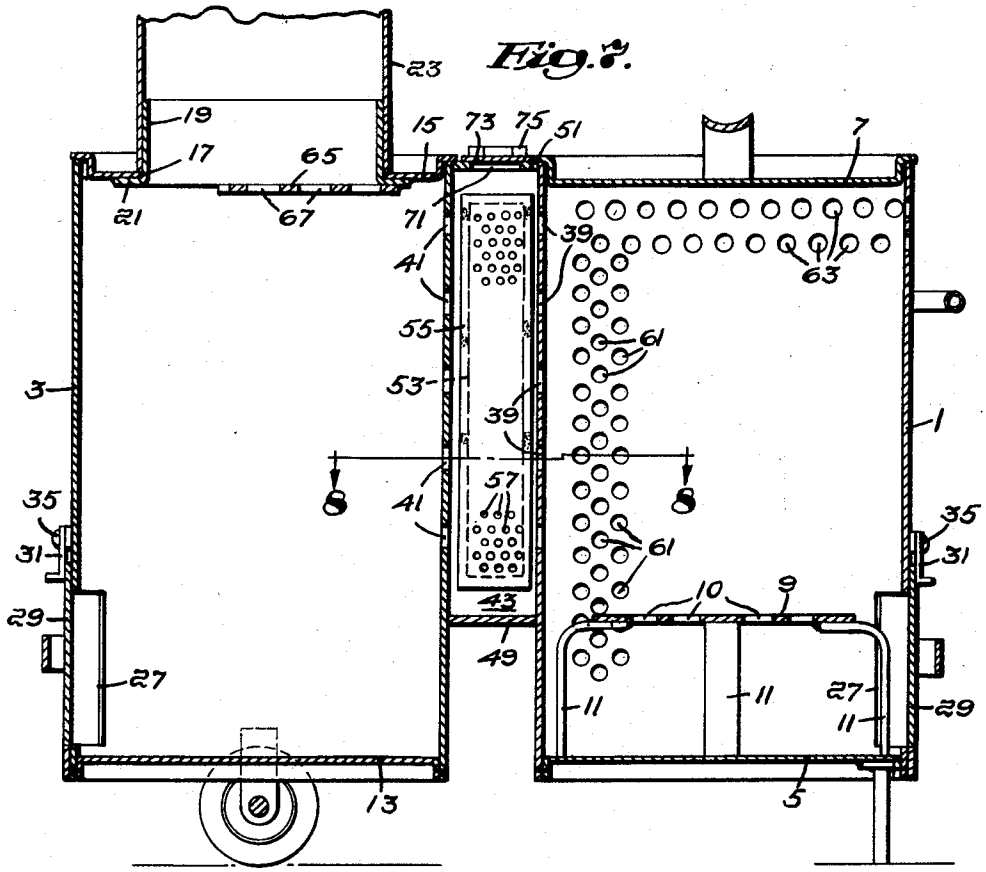
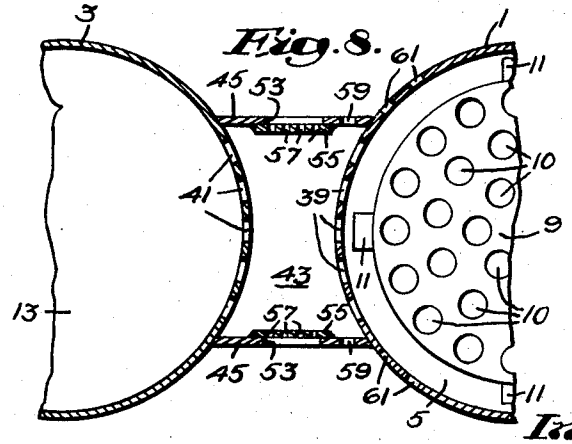


Fig. 8.



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2,952,226

INCINERATORS

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Filed Feb. 23, 1956, Ser. No. 567,167
10 Claims. (Cl. 110—18)

My invention relates to apparatus for disposing of trash and other material by incineration.

The invention has among its objects the incineration of material without production of smoke or objectionable odors.

Another object of the invention is an incinerator having provision for avoiding highly heating its walls to enable them to be formed of ordinary sheet mild steel and yet be durable, thus enabling the incinerator to be inexpensively constructed.

The above and other objects of the invention are secured by having the incinerator so constructed that, in among other things, it will predominantly burn the charge in such way as to distill combustible gases from it and burn those gases by hydroxylative combustion as distinguished from ordinary carbonic combustion.

Hydroxylative combustion, which is characterized by the production of a purplish flame, it has been found may be secured by so heating the charge as to distill a large volume of combustible gases from it and by causing those gases to burn as they flow away from the charge through a combustion zone in which the hydrocarbon molecules of the gases progressively absorb oxygen as they so flow. Such absorption of oxygen results in the progressive formation, along the path of flow, of hydroxyl (OH) groups, the intermediate products of the absorption being alcohols and aldehydes. These alcohols and aldehydes then under the influence of heat and temperature burn to carbon monoxide and hydrogen, and finally to carbon dioxide and water vapor. The purplish flame results from the formation of the aldehydes and then the burning of them. This purplish flame combustion takes place at a much lower temperature and more slowly than would be the case were the gases burned by so-called "carbonic combustion," which latter would heat the combustible gases to such high temperature as would crack the hydrocarbon molecules to liberate smoke forming carbon particles therefrom, all of which particles would not be consumed by the burning, the yellow flame which characterizes carbonic combustion resulting from the heating of such carbon particles to incandescence.

A still further object of the invention is an incinerator having provision for automatically reversing the draft under low temperature conditions resulting when the charge is almost consumed, so as to consume completely the remaining fractions of the charge and thus prevent such fractions from smoldering and producing smoke.

The above and other objects of the invention however will be best understood from the following description when read in the light of the accompanying drawings of a specific embodiment of the invention selected for illustrative purposes, while the scope of the invention will be more particularly pointed out in the appended claims.

In the drawings:

Fig. 1 is a side elevation of an incinerator according to the invention;

Fig. 2 is a section on the line 2—2 of Fig. 1;

Fig. 3 is a fragmentary plan of the incinerator according to Fig. 1 with parts in a different operative position;

Fig. 4 is a section on the line 4—4 of Fig. 1, with parts broken away;

Figs. 5, 6 and 7 are sections on the lines 5—5, 6—6 and 7—7, respectively, of Fig. 4; and

Fig. 8 is a section on the line 8—8 of Fig. 7.

Referring to the drawings, the incinerator illustrated comprises a pair of vertical, laterally spaced, cylindrical drums 1 and 3. The material to be incinerated is charged to the drum 1.

As shown, the drum 1 has a closed bottom wall 5 (Fig. 7), and a removable imperforate cover 7 constituting the top wall of the drum. Within the drum above its bottom wall 5 is positioned a horizontal foraminous plate 9 supported by the brackets 11. This plate 9 constitutes a grate-like structure on which the material charged to the drum may rest, access to the interior of the drum being afforded by removal of the cover 7 for permitting charging of the drum through its then open top.

The drum 3 similarly has a closed bottom wall 13. The top wall 15 of this drum is shown as provided with a large central opening 17 (Fig. 5) into which is fitted the lower end of an upwardly projecting sleeve 19, the sleeve having an outwardly projecting annular flange 21 at its lower end resting against and welded at its periphery to the under side of the top wall. Over this sleeve is fitted the lower end of a stack 23 which at its upper end, to comply with municipal ordinances of many communities, is shown as provided with a spark arresting screen 25.

As best shown in Figs. 1 and 7, the lateral wall of each drum adjacent its lower end is shown as provided with a cleanout opening 27. As shown, each of these openings is closed by a removable arcuate plate 29 normally held in position by the clips 31 and 33 pivotally mounted at 35 and 37, respectively, on the lateral walls of the drum.

As best shown in Figs. 2, 5, 6 and 8, that portion of the lateral wall of the drum 1 which faces the drum 3 is provided with a group of horizontally and vertically spaced perforations 39 communicating with that space in the drum which receives the charge, each such perforation for discharging in the form of a jet-like stream combustible gaseous products generated in such space in a manner hereinafter described. Best results in the performance of the apparatus, it has been found, are secured when this group of perforations is of fairly wide extent horizontally yet less than the semi-circumference of the drum and when the group extends downward from adjacent the top of the drum to about the level of the grate-like support 9 for the charge. That portion of the lateral wall of the drum 3 which faces the drum 1 is shown as similarly provided with a group of perforations 41 corresponding in position and size to the perforations 39 of the drum 1. Through these perforations 41 gaseous products discharge into the drum 3 in the form of divided streams of such products.

As best illustrated by Figs. 4, 7 and 8, the apparatus is provided with a passage 43 into which discharge through the perforations 39 combustible gaseous products from the drum 1 and from which discharge through the perforations 41 gaseous products into the drum 3. This passage, as shown, has the vertical side walls 45 which at each vertical edge abuts and is welded to the lateral wall of the adjacent drum. The passage further has the imperforate bottom wall 49 and top wall 51, the bottom wall as shown being positioned at about the level of the grate-like plate 9 although, if desired, and without affecting the results secured by the apparatus, it may be positioned at the level of the bottom walls of the drums. These top and bottom walls are constituted by plates which at their edges conform to the side walls of the passage and those arcuate portions of the lateral walls

of the drums which lie between said side walls, in that way rigidly to reinforce those portions of the lateral walls of the drums which have the perforations **39** and **41**, which portions tend to be weakened and subject to warping because of the presence of those perforations.

As also shown, the side walls **45** of the passage **43** are each formed with a vertically elongated rectangular opening **53** which at its inner side is covered by a strip **55** welded at its edges to such wall. This strip is shown as provided over substantially its entire extent with a multitude of relatively small diameter and closely spaced perforations **57**. These perforations act to admit under normal conditions streams of combustion air into the passage for admixture with the jets or streams of combustible gases discharged into said passage through the perforations **39** from the interior of the drum **1**. It has been found that best results are commonly secured when provision is also made for admitting additional air into the combustible gases entering the passage, which may be done by providing each of the side walls **45** of the passage **43** with a vertical row of perforations **59** of larger size than the perforations **57** and positioned close to the lateral walls of the drum **1**. To the same end that lateral wall portion of the drum **1** which is adjacent the passage **43** is provided at each side of said passage with vertical rows of small perforations **61**. The rows of these perforations **61** preferably extend downward far enough to cause a few of them to lie at a level below the grate-like plate **9**, as shown in Figs. 1 and 7.

As further shown, the drum **1** adjacent its top is provided with horizontal rows of small perforations **63** extending about the drum from adjacent one side wall **45** of the passage **43** to adjacent the opposite side wall of said passage. Also, as shown, the opening from the top of the drum **3** communicating with the stack is partially closed by a foraminous plate or screen **65** having the apertures **67**, this plate, as best shown in Fig. 4, lying at the side of the opening nearest the drum **1** and extending across said opening for the major portion of its width so as to leave a relatively narrow passage **69** connecting the interior of the drum **3** with the stack at the side of the stack remote from the drum **1**.

As still further shown, the top wall **51** of the passage **43** is provided with a transversely extending rectangular opening **71** normally closed by a door **73** hingedly mounted, as indicated at **75**, at one end of the opening. This door may be swung from its closed position shown by Fig. 2 to its open position shown by Fig. 3 so as to permit access to the passage **43**.

The incinerator is intended for use outdoors. When made in smaller sizes it is particularly adapted for the incineration of domestic waste such as paper, cardboard, wood fragments, and the like. In its larger sizes it may be employed for incinerating like waste of mercantile establishments, factories, etc.

In the operation of the incinerator the cover **7** of the drum **1** may be removed and the waste charged to that drum so as to rest on the grate-like plate **9** and completely or partially fill the drum, whereupon the cover may be replaced. Best results are secured by not so tightly compacting the charge that air cannot reach its interior.

After the drum **1** is charged in the way above explained the door **73** associated with the opening **71** in the top wall **51** of the passage **43** may be swung to its open position shown by Fig. 3 to provide access to the opening **71** in said top wall. The charge in the drum **1** may then be ignited through the perforations **39** which place the passage in communication with the interior of the drum, which ignition conveniently may be accomplished by loosely twisting up several sheets of paper, say of newspaper size, one end of which when ignited forms a torch, and then inserting such torch with its ignited end pointed downward through the opening **71** and closing the opening by means of the door **73**. As the torch is consumed it will ignite the charge through the perforations **39** for a considerable extent of the height of the charge. This ignition of the charge at points adjacent these perforations is preferable to igniting the upper surface portions of the charge when the cover **7** of the drum is removed, as it has been found it avoids possibility of discharge of smoke from the stack.

Combustion of the charge after it is ignited in the way above described is maintained by air admitted through the perforations **63** above the charge. The amount of air so admitted is insufficient to support complete combustion of the charge yet sufficient to generate enough heat to distill from the charge combustible hydrocarbon gases, which gases will discharge through the perforations **39** into the passage **43** in the form of divided streams or jets as above described. The residual air admitted through the perforations **63** of the drum **1**, much augmented by the streams of air which enter that drum through the perforations **61** adjacent the discharge point of the gases from the drum, causes these jets of combustible gases to enter the passage **43** in ignited condition. The streams of air entering the passage through the vertical row of perforations **59** in its side walls, and the finely divided streams of air entering the passage through the small perforations **57** in said walls, mix with the jets of combustible gases discharged into the passage to supply them with sufficient air for complete combustion. The discharge of gaseous products into the drum **3** through the perforations **41** in the walls of that drum in the form of streams or jets permits such gases to be completely consumed in the drum **3** during the normal part of the operation in case they are not completely consumed within the passage **43**. In this operation because combustion air enters the drum **1** through the perforations **61** and enters the passage **43** through the perforations **59** and **57** in each instance in the form of divided streams, and the gases enter the passage **43** likewise in the form of divided streams, the air and gases intimately mix.

In the above described operation the air is admitted to the combustible gases progressively at points along the direction of their flow, namely, through the several vertical rows of perforations **61**, through the perforations **59** spaced from said perforations **61** in the direction of the flow of said gases, and then through the several vertical rows of perforations **57** spaced from said perforations **59** in the same direction. This causes the relatively slow hydroxylative combustion of such gases as hereinbefore mentioned, with total absence of discharge of smoke from the stack, and reduces to a minimum smoke forming carbonic combustion of the charge and the gaseous products distilled from it, the smoke forming particles caused by such small amounts of carbonic combustion as may occur in the drum **1** being entirely consumed by the hydroxylative combustion of the gases in the passage **43**.

The gaseous combustion products are normally discharged from the drum **3** into the stack through the opening **69** at the left of the foraminous plate **65** as viewed in Fig. 4, and not through the apertures **67** in said plate, by reason of the known phenomena of hot gases refusing to discharge through small openings under a moderate pressure differential between opposite ends of such openings if they can otherwise discharge. However, under high flame conditions in the incinerator necessitating an untoward amount of combustion products to be discharged from the drum **3**, the concomitant higher pressure in the drum **3** will be relieved by the gases then forced to flow through the apertures **67**. The normal flow of the gases in a horizontal direction from the drum **1** through the passage **43**, and the forcing of the gases flowing through the drum **3** to discharge from that drum into the stack at a point remote from the passage, result in the gases traveling generally horizontally through a

long enough path to permit any fly-ash which may be present in the gases to fall to the bottom of said passage and bottom of said drum 3 so that no fly-ash will be discharged from the stack.

When desired fresh material may be added to the drum 1 by temporarily removing its cover while the original charge is being burned. When combustion of the contents of the drum causes such sufficient consumption of those contents that not enough hot gases are discharged into the drum 3 to maintain the draft in the stack the draft through the drum 1 will automatically reverse itself and cause the drum 1 to act itself as a stack. When the drum 1 so acts air will be drawn into it through the lowermost perforations 61, 59 and 57 to burn the remaining fractions of the charge, the gaseous products of combustion resulting from such burning discharging from the drum 1 through the perforations 63 and uppermost perforations 61. The last residual fractions of the charge will be consumed by reason of air admitted to the drum through those perforations 61 which lie at a level below the grate-like plate 9, such air passing through the perforations of that plate to supply the necessary combustion air for burning those fractions. As hereinbefore indicated, were the residual fractions of the charge not burned under sufficient supply of combustion air they would smolder and produce objectionable amounts of smoke which would discharge from the incinerator.

It will be observed that in the construction described all combustion air admitted to the incinerator takes place through perforations in the lateral walls of the drum 1 and side walls of the passage 43. Such air so entering acts to keep such walls cool, and also acts to keep the flame out of contact with them which also acts to keep them cool. Such keeping of said walls, which normally would be the hottest walls of the incinerator, at a low temperature increases the durability of the incinerator and enables it to be fabricated wholly of inexpensive ordinary sheet mild steel.

In the above connections it is mentioned that satisfactory results have been secured with small size incinerators, constructed as herein illustrated and described, with the drums 1 and 3 each 15 inches in diameter and 24 inches high and spaced axially apart 18 inches, the stack being 10 inches in diameter and, neglecting the spark arrester, being 24 inches high measured from the top of the drum 3. In this specific instance of the incinerator the side walls 45 of the passage 43 were spaced apart 9 inches with the bottom wall 49 of said passage 6½ inches above the bottom wall of the drum 1 and with the grate-like plate 9 at about the same level. The perforations 39 and 41 connecting opposite ends of this passage 43 with the interiors of the drums 1 and 3, respectively, were 1 inch in diameter with the center lines of the vertical rows thereof spaced apart 1¾ inches and the centers of the perforations in said rows spaced apart 2 inches. The rectangular openings 53 in the side walls 45 of the passage 43 were 3 inches wide and 14½ inches high, and the perforations 57 of the strips 55 covering such openings were 0.08 inch in diameter with the center lines of the horizontal rows thereof spaced apart ¼ inch and the centers of the perforations in said rows spaced apart a like distance. The perforations 59 of the vertical row thereof in each side wall 45 of the passage 43 for admitting air to that passage were ¼ inch in diameter with their centers spaced apart 1½ inches and ½ inch from the adjacent vertical edge of said side wall. The perforations 63 for admitting air to the top portion of the drum 1 were also ¼ inch in diameter with the center lines of the horizontal rows thereof spaced apart 1¼ inches and the centers of the perforations in said rows spaced apart a like distance. The perforations 61 of the drum 1 were likewise ¼ inch in diameter with the center lines of the vertical rows thereof spaced apart 1⅝ inches and the centers of the perforations in said rows spaced apart 1¼ inches, the center line of the vertical row nearest each side wall 45 of the passage 43 being spaced 1¼ inches from the adjacent vertical edge of that side wall. These vertical rows of perforations 61 extended downward far enough to cause six of them to lie below the level of the grate-like plate 9.

Satisfactory results have been secured with a similarly constructed larger size incinerator having the drums 1 and 3 each 22 inches in diameter and 36 inches high and spaced axially apart 28 inches, the stack being 15 inches in diameter and, neglecting the spark arrester, being 24 inches high measured from the top of the drum 3. In this specific instance of the incinerator the side walls 45 of the passage 43 were spaced apart 9¼ inches with the bottom wall 49 of said passage 8 inches above the bottom wall of the drum 1 and with the grate-like plate 9 at about the same level. The perforations 39 and 41 connecting opposite ends of this passage 43 with the interiors of the drums 1 and 3, respectively, were 1 inch in diameter with the center lines of the vertical rows thereof spaced apart 1¾ inches and the centers of the perforations in said rows spaced apart 2 inches. The rectangular openings 53 in the side walls 45 of the passage 43 were 9 inches wide and 25 inches high, and the perforations 57 of the strips 55 covering such openings were 0.08 inch in diameter with the center lines of the horizontal rows thereof spaced apart ¼ inch and the centers of the perforations in said rows spaced apart a like distance. The perforations 59 of the vertical row thereof in each side wall 45 of the passage 43 for admitting air to that passage were 5/16 inch in diameter with their centers spaced apart 2½ inches and ½ inch from the adjacent vertical edge of said side wall. There were four horizontal rows of perforations 63 for admitting air to the top portion of the drum 1, which perforations were also 5/16 inch in diameter with the center lines of the horizontal rows thereof spaced apart 1¼ inches and the centers of the perforations in said rows spaced apart 1¼ inches. There were four vertical rows of the perforations 61 of the drum 1, which perforations were likewise 5/16 inch in diameter with the center lines of said vertical rows spaced apart 2½ inches and the centers of the perforations in said rows spaced apart a like distance, the center line of the vertical row nearest each side wall 45 of the passage 43 being spaced ½ inch from the adjacent vertical edge of that side wall. These vertical rows of perforations 61 extended downward far enough to cause six of them to lie below the level of the grate-like plate 9.

It will be understood that within the scope of the appended claims wide deviations may be made from the form of the invention described without departing from the spirit of the invention.

I claim:

1. A prefabricated waste-material incinerator, comprising upwardly extending walls and a bottom wall forming a chamber; means in said chamber forming a charge supporting grate dividing said chamber into a charge receiving space above said grate and an ashpit below said grate; said chamber having a top opening, provided with a normally closed cover, for entering the charge into said charge receiving space; other upwardly extending walls and a bottom wall forming a fly-ash settling chamber spaced from the first mentioned chamber; means, comprising horizontally spaced upwardly extending walls extending horizontally from an upwardly extending wall portion of one of said chambers to an upwardly extending wall portion of the other of said chambers together with vertically spaced horizontal walls, forming a passage extending from one of said chambers to the other, which passage, vertically considered, extends downward from adjacent the top of said charge receiving space to at least adjacent the level of said grate; means for admitting air in limited amount to the upper portion of said charge receiving space for downward flow in respect to such charge to cause said charge when initially ignited to burn

slowly and be heated for distilling from it combustible gases to be ignited; the upwardly extending wall of the chamber having said charge receiving space being formed for substantially the height of such space with a series of spaced openings formed and positioned to discharge said combustible gases into said passage in the form of separate ignited jet-like streams; the upwardly extending walls of the fly-ash settling chamber being formed to permit gaseous products to discharge into such chamber from said passage, which fly-ash setting chamber is formed with an upper discharge opening; a stack with which the last mentioned opening communicates to provide a draft whereby said jet-like streams are caused to flow in said passage toward said fly-ash settling chamber; said horizontally spaced walls of said passage being formed with spaced openings for discharging into said passage streams of combustion air for contact with said streams of combustible gases and progressive admixture therewith whereby to continue the burning of said gases in said passage by hydroxylative combustion.

2. An incinerator according to claim 1 in which the means for admitting the limited amount of air into the charge receiving space comprises a substantially horizontal series of spaced openings in the upper portion of the upwardly extending wall of such space whereby such air is distributed horizontally over the upper surface of the charge in such space.

3. An incinerator according to claim 1 in which the upwardly extending wall of the charge receiving space is formed, adjacent the outer sides of the horizontally spaced walls connecting the two chambers, with a series, extending substantially the height of the charge receiving space, of spaced air admission openings.

4. An incinerator according to claim 1 in which the horizontally spaced side walls of the passage into which the jet-like streams of combustible gases are discharged are formed with an area, extending in the direction of flow of such streams, of small closely spaced openings for discharging combustion air into said passage in the form of finely divided streams for contact with said jet-like streams and admixture with the gases of such streams.

5. Apparatus according to claim 1 in which a wall of the passage connecting the two chambers is provided with means for giving temporary access to said passage for initially igniting the charge through the openings which normally discharge the combustible gases into said passage.

6. An incinerator according to claim 1 in which means are provided for admitting a small amount of air into the ashpit for causing, upon secession under low fire condition of the draft normally produced by the stack, air to flow upward from the ashpit through the grate into the charge receiving space and discharge from the latter through the openings which normally admit air to the upper portion of said space, whereby to burn the residual fractions of the charge remaining on said grate.

7. An incinerator according to claim 1 in which the chamber having the charge receiving space and the fly-ash settling chamber are in the form of cylindrical sheet metal drums.

8. An incinerator according to claim 1 in which the gaseous products are discharged from the passage connecting the two chambers through spaced openings in the upwardly extending wall of the fly-ash settling chamber so as to enter the latter in the form of a plurality of horizontally directed streams, the main discharge opening from said fly-ash settling chamber to the stack being positioned adjacent the side of such chamber opposite said openings through which said streams enter that chamber whereby to increase the length of the path of flow of the gaseous products through such chamber for facilitating the falling of fly-ash from them.

9. An incinerator according to claim 1 in which the gaseous products are discharged from the passage connecting the two chambers through spaced openings in the upwardly extending wall of the fly-ash settling chamber so as to enter the latter in the form of a plurality of horizontally directed streams, the main discharge opening from said fly-ash settling chamber to the stack being positioned adjacent the side of such chamber opposite said openings through which said streams enter that chamber whereby to increase the length of the path of flow of the gaseous products through such chamber for facilitating the falling of fly-ash from them, there being a perforated baffle associated with said discharge opening to the stack partially extending over such opening from its side nearest said passage to leave an unobstructed portion of said opening to said stack at its side farthest from said passage for normal discharge of the products into said stack, and for discharge of products into said stack through said unobstructed portion of said opening and the perforations of said baffle under high flame conditions that may under untoward conditions exist in said fly-ash settling chamber.

10. A prefabricated waste-material incinerator, comprising upwardly extending walls and a bottom wall forming a chamber; means in said chamber forming a charge supporting grate dividing said chamber into a charge receiving space above said grate and an ashpit below said grate; said chamber being formed at the top level of the charge-receiving space to provide an opening having a normally closed cover for entering the charge into said space; other upwardly extending walls forming a fly-ash settling chamber spaced from the first mentioned chamber in such wise as to cause upwardly extending wall portions of one to be opposed to upwardly extending wall portions of the other in spaced relation; means forming a passage comprising upwardly extending opposite side walls extending from one of said opposite side wall portions of one chamber to the opposite side wall portions of the other chamber, together with vertically spaced horizontal walls which passage, vertically considered, extends downward from adjacent the top of said charge receiving space to at least adjacent the level of said grate; the upwardly extending wall of said charge receiving space having a series of spaced openings adjacent the side walls of said passage at the exterior of the latter for entrance of combustion air into such space, and having a series of spaced openings between said side walls of said passage for discharge of gaseous products from said space into said passage in the form of separate jet-like streams, all of which series extend for substantially the height of said space; said side walls of said passage being formed with spaced openings for admission thereinto of combustion air; the wall of said space adjacent its top having openings for admitting further combustion air to said space; the upwardly extending wall of said fly-ash settling chamber being formed with one or more openings for discharge into such chamber of products from said passage; and means providing a discharge opening at the upper portion of said fly-ash settling chamber.

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