

Dec. 25, 1962

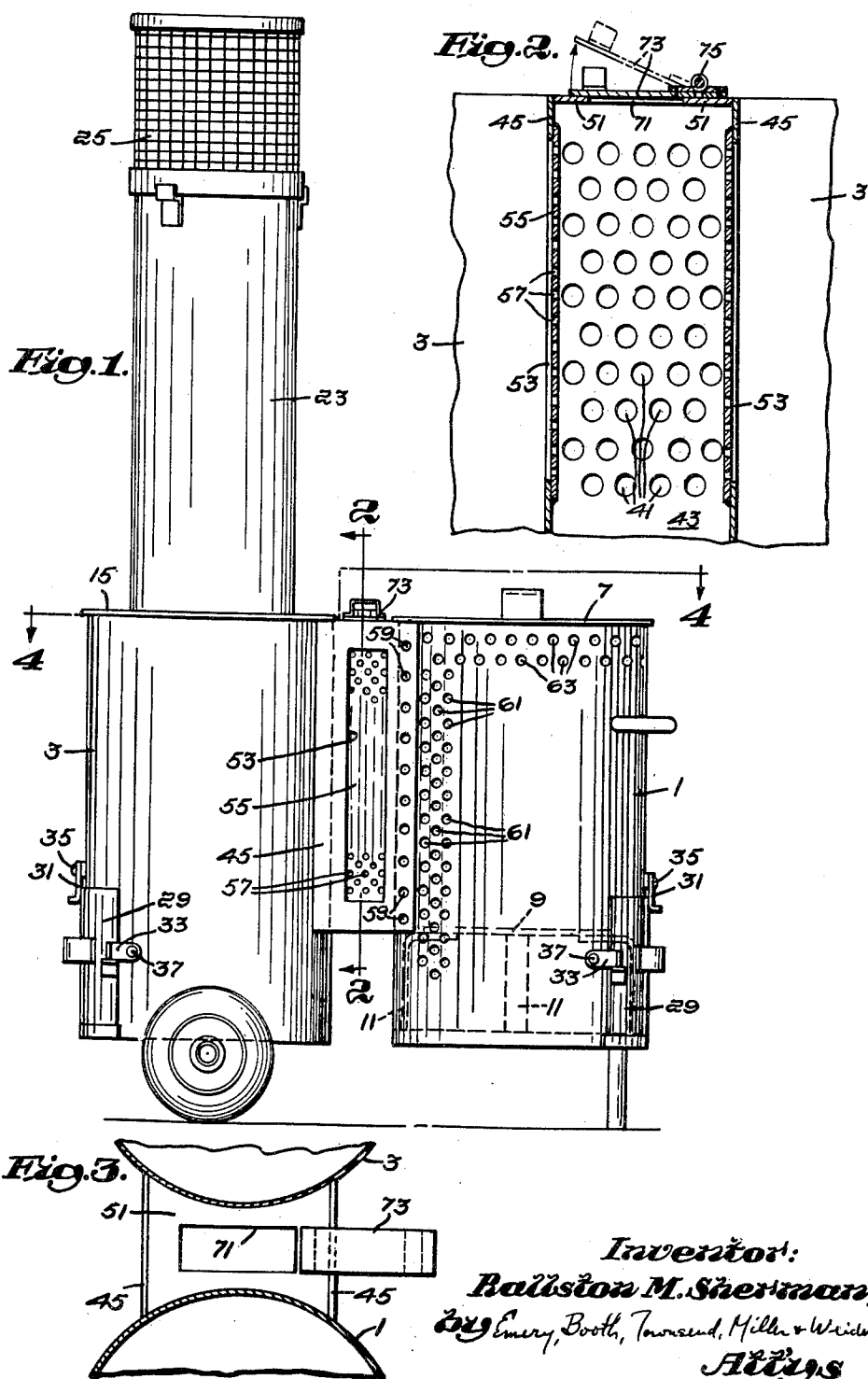
R. M. SHERMAN

3,070,047

INCINERATORS

Original Filed Feb. 23, 1956

3 Sheets-Sheet 1



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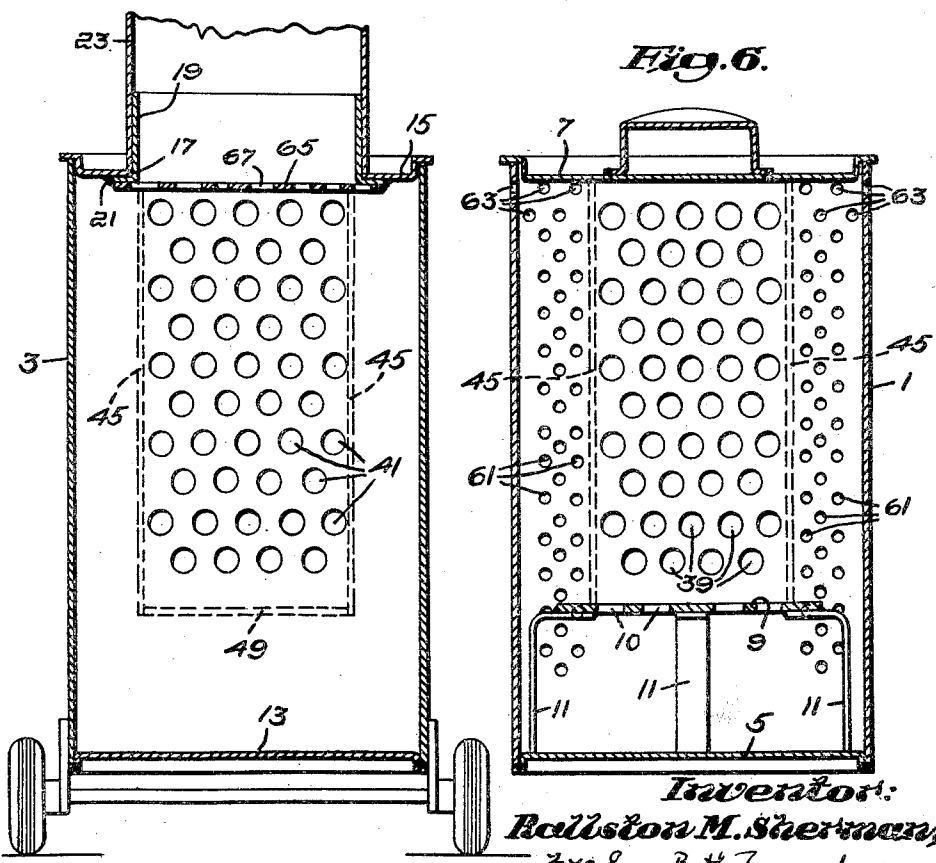
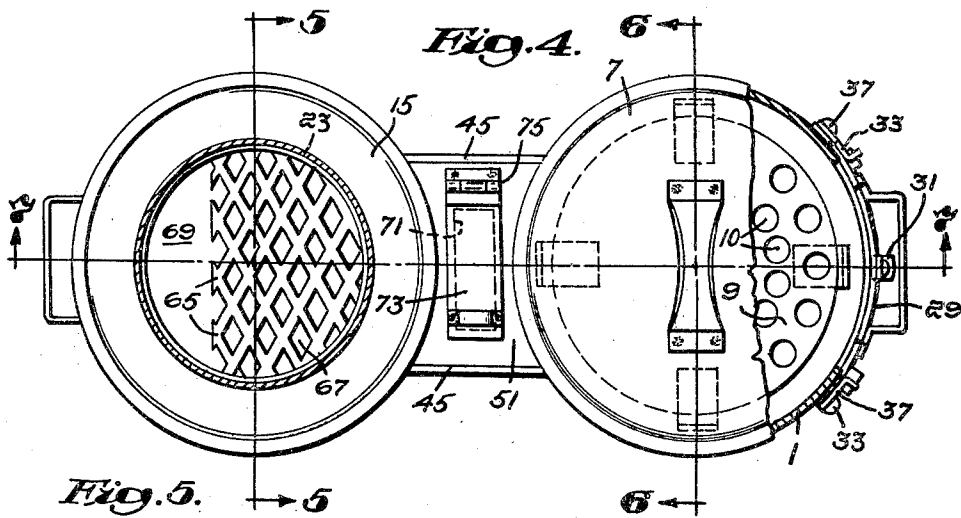
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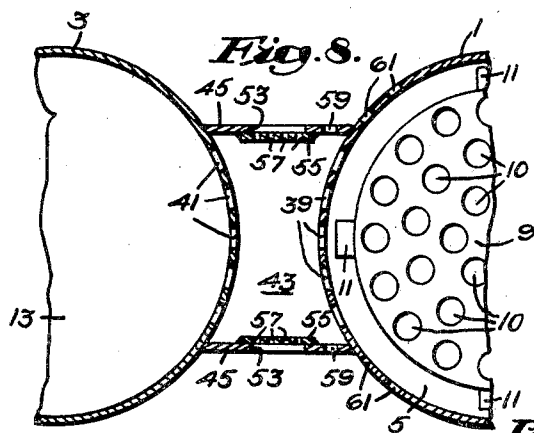
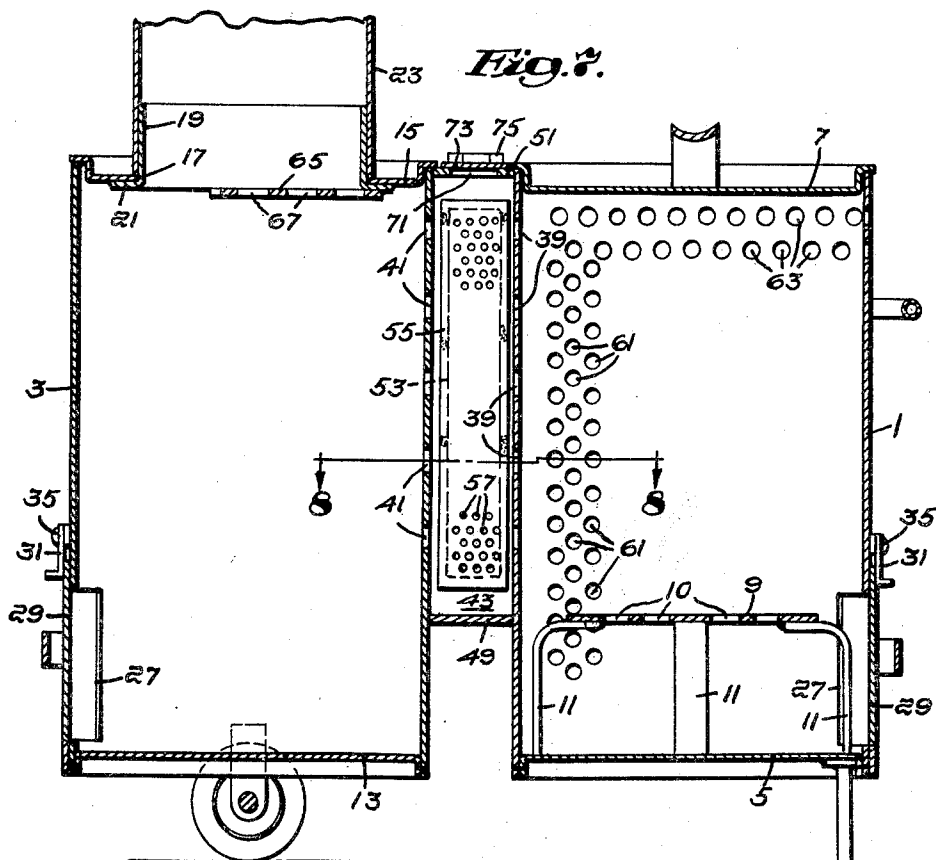
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3 Sheets-Sheet 3



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3,070,047

INCINERATORS

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Original application Feb. 23, 1956, Ser. No. 567,167, now Patent No. 2,952,226, dated Sept. 13, 1960. Divided and this application May 6, 1960, Ser. No. 27,383
1 Claim. (Cl. 110—18)

My invention relates to the disposing of trash and other material by incineration. It has among its objects the incineration of material without production of smoke or objectionable odors, also the avoidance of high heating of chamber walls, whereby the method may be carried out in chambers prefabricated of ordinary sheet mild steel over extensive use periods, thus enabling the employment of inexpensively constructed incinerator means.

The above and other objects of the invention methods are secured in such manner that among other things, the charge is predominantly so burned as to distill combustible gases from it and to burn those gases by hydroxylative combustion as distinguished from ordinary carbonic combustion.

This application is a division of my copending application Serial No. 567,167, filed February 23, 1956, now Patent No. 2,952,226, of September 13, 1960, disclosing and claiming exemplary apparatus suitable for the practice of the methods hereof.

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 turn 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 be consumed by the burning, the yellow flame which characterizes carbonic combustion resulting from the heating of such carbon particles to incandescence.

The method of the invention further contemplates 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 novel methods of the invention are herein explained with reference by way of example to incinerator means as disclosed in said parent application herein sufficiently described and shown in the accompanying drawings, the scope of the invention being more particularly pointed out in the appended claim.

In the drawings:

FIG. 1 is a side elevation of an incinerator illustrating one example of means for the practice of the invention;

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

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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 seen 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. The purposes of the method are promoted, 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 here exemplary of means for practicing the method or process of the invention 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, in the practice of the method it may be positioned at the level of the bottom walls of the drums. For use under the method these top and bottom walls may be 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.

As also shown in the illustrative means suitable for the method hereof, 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. Best results for the method are commonly secured by admitting additional air into the combustible gases entering the passage, which may be done for example 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 of 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.

Incineration in accordance with the method hereof may be accomplished out doors on a relatively large scale, and on a smaller scale is particularly adapted for the incineration of domestic waste such as paper, cardboard, wood fragments, and the like. In larger scale use the method may be employed for incinerating like waste of mercantile establishments, factories, etc.

In the practice of the method 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 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 procedure 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 procedure 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

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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 travelling 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 wall 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 about 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 6 1/2 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 1 3/4 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 14 1/2 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 1/4 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 1/4 inch in diameter with their centers spaced apart 1 1/2 inches and 1/2 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 1/4 inch in diameter with the center lines of the horizontal rows thereof spaced apart 1 1/4 inches and the centers of the perforations in said rows spaced apart a like distance. The perforations 61 of the drum 1 were likewise 1/4 inch in diameter with the center lines of the

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vertical rows thereof spaced apart 1 3/4 inches and the centers of the perforations in said rows spaced apart 1 1/4 inches, the center line of the vertical row nearest each side wall 45 of the passage 43 being spaced 1 1/4 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 9 1/4 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 1 3/4 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 1/4 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 2 1/2 inches and 1/2 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 1 1/4 inches and the centers of the perforations in said rows spaced apart 1 1/4 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 2 1/2 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 1/2 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.

From the foregoing it is apparent that the method of the invention, for the practice of which illustrative means is herein shown and/or described sufficiently for an understanding of the novel incineration procedure involved, provides for the avoidance of smoke in the incineration of waste material and accomplishes such incineration under low combustion temperature conditions consonant with the use of prefabricated sheet-metal chambers. To this end the method comprises the novelly correlated steps of presenting in a chamber the material as a charge having upper and lower surfaces, and igniting and slowly burning such charge or body, accomplishing this by flowing limited combustion air in contact with the body from one toward the other surface thereof and in so doing heating the body and distilling combustible gases from it dominantly of hydrocarbon molecules and in such quantity as to be beyond the capacity of the limited air to cause complete burning thereof. Further the method comprises effecting the discharge of such gases at spaced points from the chamber, and into associated confined space as ignited jet-like flowing streams, together with admitting into such space additional combustion air in a plurality of jets, and causing the gases to continue burning through hydroxylative combustion by subjecting the flowing ignited jet-like gas streams to contact transversely by the combustion air jets and progressively along

the direction of flow of the gas streams so as to be extensively and progressively intimately mixed with the combustion air jets additionally entering the confined space.

It will be understood that in the practice of the method of the invention there may be employed incinerator means other than with horizontally associated chambers as in the illustrative means example and that the gas generating, carburetting and settling chambers utilized may be variously constructed and operatively disposed otherwise than laterally side by side, the method of the invention being not limited in these and other respects to the examples herein illustrated or described, and I set forth its scope in my following claim.

I claim:

The method of incinerating waste-material in a plural-chambered incinerator having prefabricated sheet-metal supporting walls, and effecting the same with avoidance of smoke and under low combustion temperature conditions which comprises

charging such material to a chamber of such incinerator and in so charging also forming and erecting the material into a body having upper and lower surfaces,

initially igniting said body at a region spaced above the lower surface and substantially throughout a localized area at the outside of such body and which is thereafter extended over substantially the height thereof,

slowly burning said body by flowing combustion air in contact with it from one of said surfaces thereof toward an opposite of said surfaces while limiting the amount of the combustion air so flowed and thereby heating said body and distilling from

it combustible and in large part hydro-carbon gases in amount beyond the capacity thereof to be burned in the presence of such air limitation,

discharging such distilled gases from such chamber at points above the bottom surface and distributed over an area of the chamber laterally opposite such ignition area by jet-flowing ignited streams of such gases into confined space of such incinerator, admitting jets of additional combustion air into upper space in the chamber and that between said ignition and discharge areas which is formed by gradual consumption of the ignited waste material body,

and while such distilled gases are flowing through said confined space contacting them transversely of the flow direction and progressively along their direction of flow with combustion air jets in a manner extensively and progressively intimately to mix such gases and the additionally admitted air and thereby continuing by hydroxylative combustion and burning of such gases.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,070,047

December 25, 1962

Rallston M. Sherman

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 8, line 21, for "and" read -- the --.

Signed and sealed this 28th day of May 1963.

(SEAL)

Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents