Jan. 6, 1970 G. B. DIXON ET AL 3,487,792

INCINERATOR FOR BURNING COMPACTED MATERIAL

Filed April 26, 1968

5 Sheets-Sheet 1

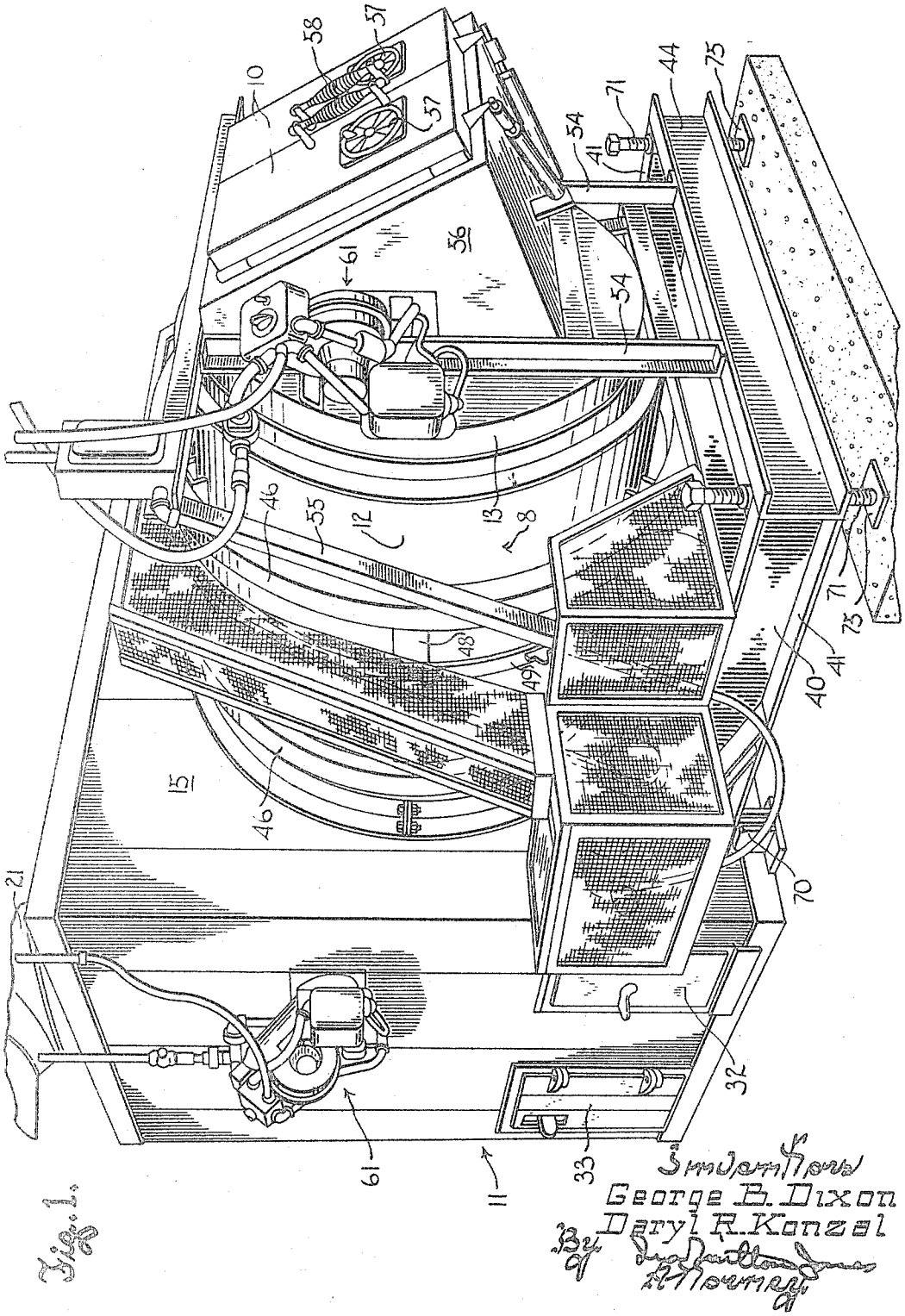

Fig. 1.

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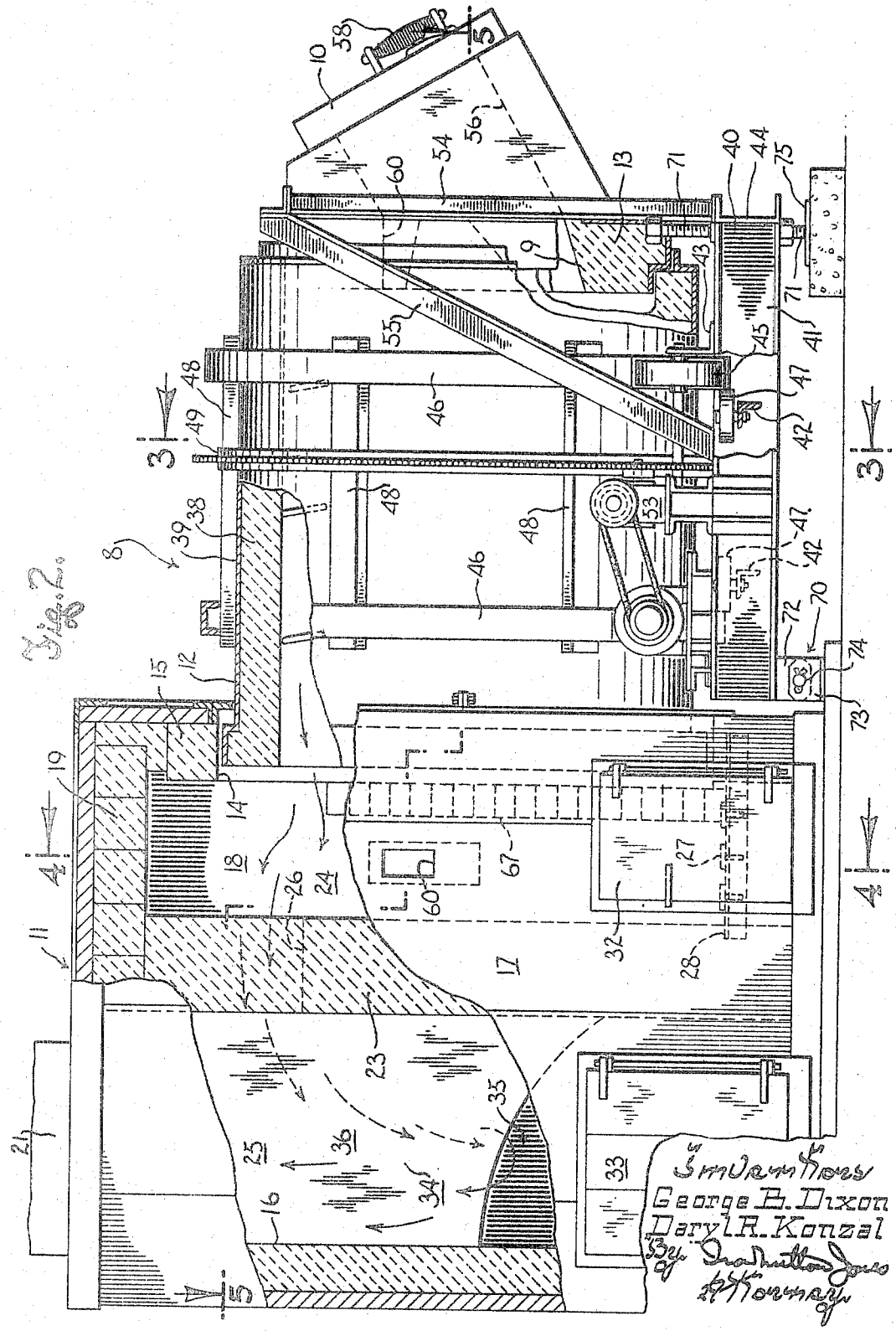

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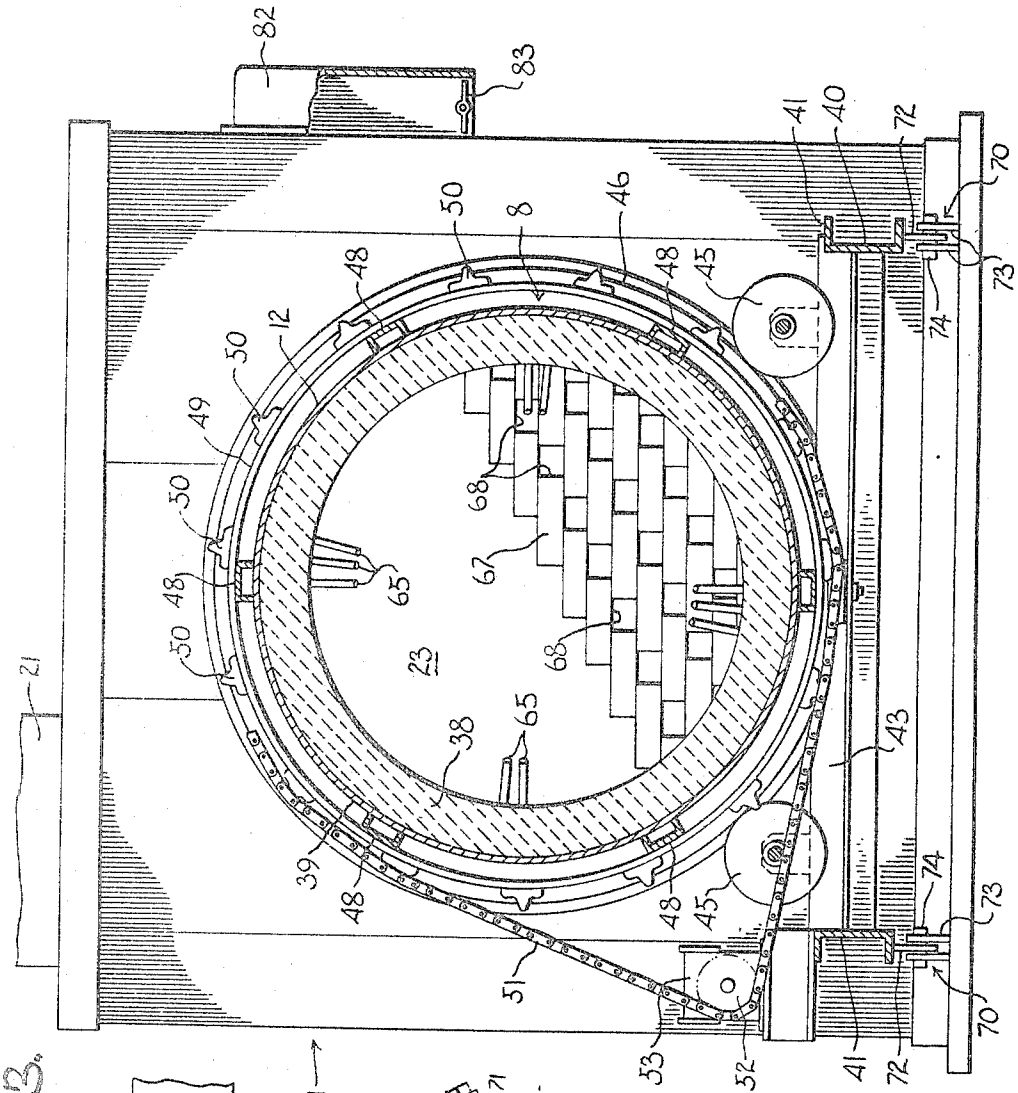

Fig. 3.

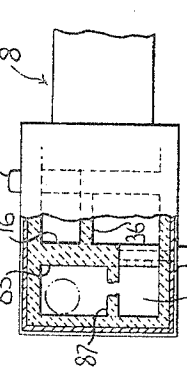

Fig. 7.

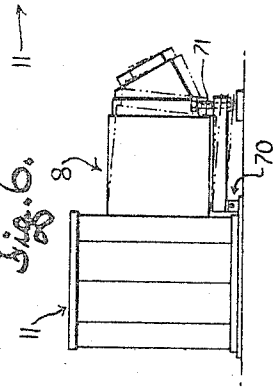

Fig. 6.

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INCINERATOR FOR BURNING COMPACTED MATERIAL

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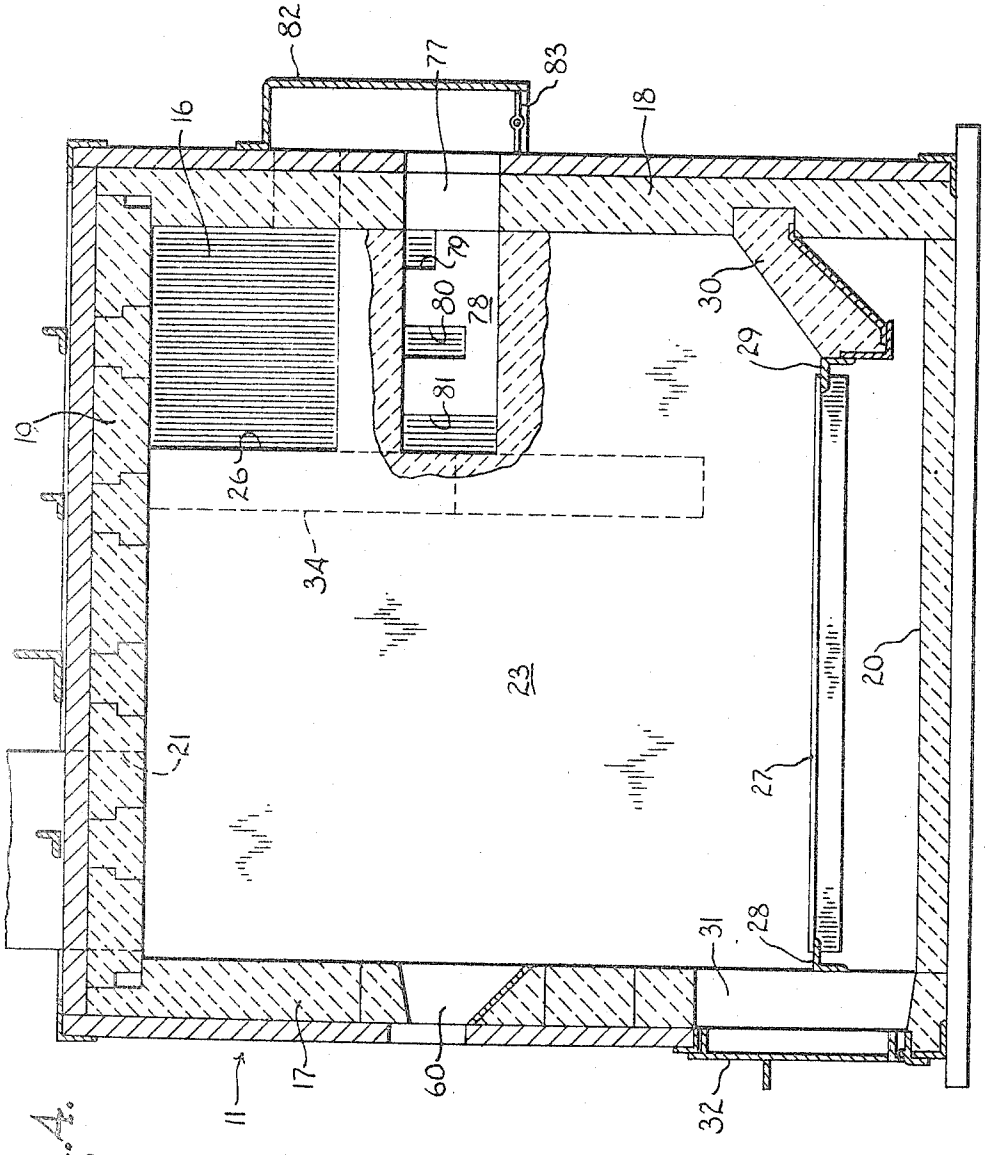

Fig. 4.

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INCINERATOR FOR BURNING COMPACTED MATERIAL

Filed April 26, 1968 5 Sheets-Sheet 5

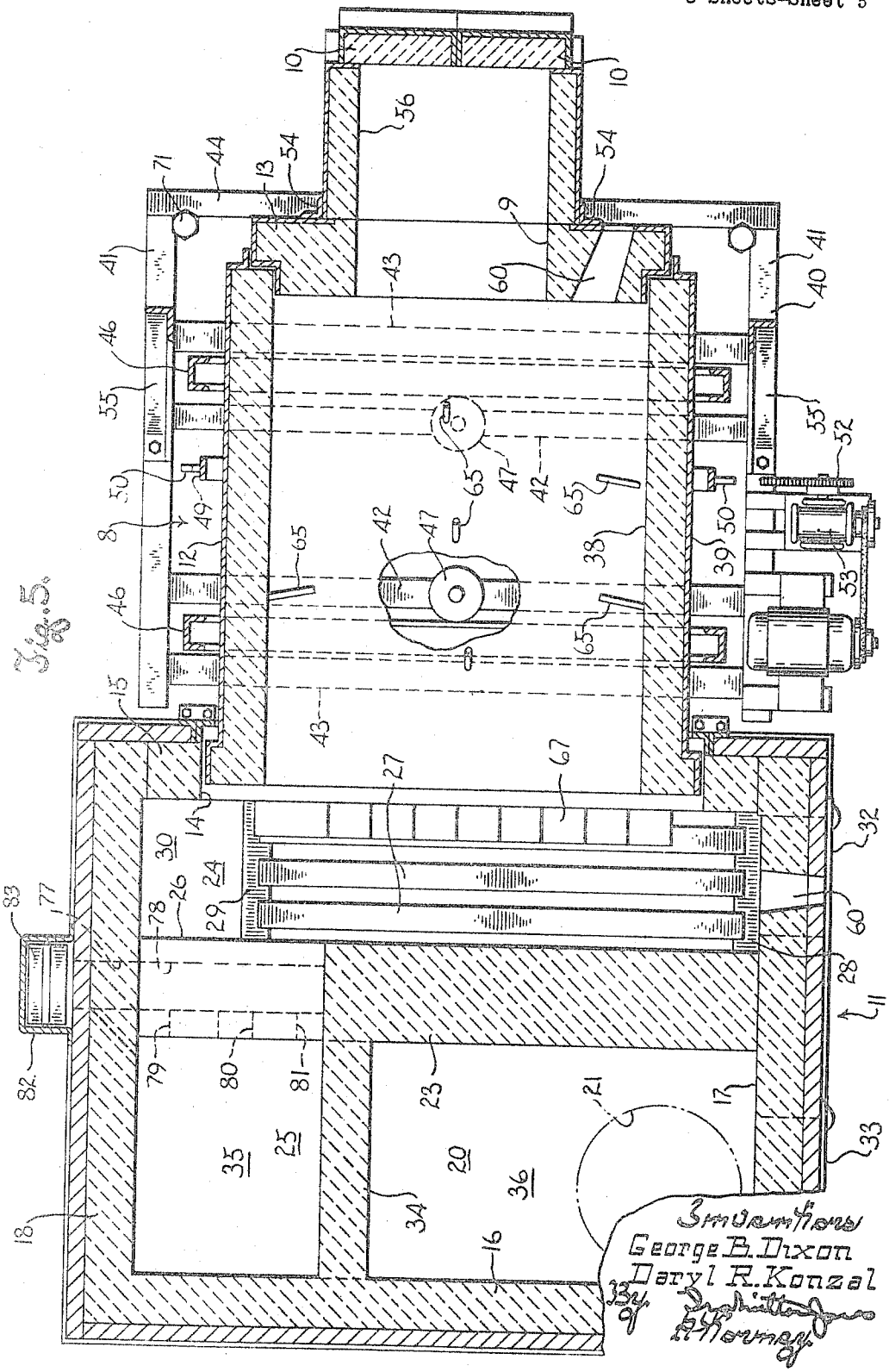

Fig. 5.

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United States Patent Office

3,487,792

Patented Jan. 6, 1970

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INCINERATOR FOR BURNING COMPACTED MATERIAL

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Int. Cl. F23b *1/32*; F23g *3/00*
U.S. Cl. 110—8 6 Claims

ABSTRACT OF THE DISCLOSURE

An incinerator having communicating primary and secondary combustion chambers in which the primary combustion chamber is a rotating drum and the secondary combustion chamber is defined by stationary walls, one of which has a round hole into which the open rear end of the drum projects. A partition wall behind the wall with the round hole divides the secondary combustion chamber into front and rear compartments that are communicated through a flame port in the partition wall. A stationary wall with a charging opening closes the front end of the drum. A perforate partition wall in the front compartment of the secondary combustion chamber extends across the open rear end of the drum to block direct passage of fly ash from the drum to the flame port. Inwardly directed projections on the wall of the drum tumble its contents as the drum rotates, and a tiltably mouted base on which the drum is rotatably supported is adjustable up and down to enable the drum to be disposed with its axis at an inclination to the horizontal.

This invention relates to incinerators and has as its purpose and object to provide an incinerator capable of completely ad quickly burning compacted material of all types, such as packed or stacked paper, magazines, I.B.M. cards and wet refuse.

Combustion of compacted material is extremely difficult, and complete combustion thereof within a reasonable time has been impossible with incinerators heretofore available, and could not be done at all in those incinerators except by constant manual stoking. But with the incinerator of this invention, even the most difficult to burn of these materials is easily handled without any manual attention, beyond throwing the material into the incinerator. To illustrate, an incinerator built in accordance with this invention and having overall dimensions of six feet in width and height, and ten feet in length, will burn two-hundred and thirty-five pounds of packed and cartoned I.B.M. cards in one hour, and in doing so will successfully and fully meet the most stringent air pollution abatement regulations.

The secret to the success of this invention lies in its provision of a slowly rotating drum which provides the primary combustion chamber of the incinerator, and which has inwardly projecting fingers to engage and tumble the material and work it away from the exit end of the drum and keep breaking it up to assure its combustion; and a novel arrangement of baffles in a stationary secondary combustion chamber which assures complete combustion of any and all material and combustible gases that are not consumed in the primary combustion chamber.

While it is not broadly new to combine a rotating retort with a stationary furnace chamber, none of the prior art adaptations of this combination has been capable of achieving the results accomplished with this invention. Examples of prior art that has been considered in this connection are the following patents: Duryee No. 652,670; Seelbach No. 1,232,724; Drew No. 1,835,147; Allen et al. No. 2,088,225 and Cates, Jr. et al. No. 3,173,389.

With these observations and objects in mind, the manner in which the invention achieves its purpose will be appreciated from the following description and the accompanying drawings. This disclosure is intended merely to exemplify the invention. The invention is not limited to the particular structure disclosed, and changes can be made therein which lie within the scope of the appended claims without departing from the invention.

The drawings illustrate one complete example of the physical embodiment of the invention constructed according to the best mode so far devised for the practical application of the principles thereof, and in which:

FIGURE 1 is a perspective view of an incinerator constructed in accordance with this invention, showing the same completely installed and operative so that the burners which direct flame into its primary and secondary combustion chambers with their fuel and electrical supply conduits, as well as guards for the drive mechanism, are shown in this view, those details being omitted from the other views for sake of clarity;

FIGURE 2 is a side view of the incinerator with parts broken away and in section;

FIGURE 3 is a cross sectional view through FIGURE 2 on the plane of the line 3—3;

FIGURE 4 is a cross sectional view through FIGURE 2 on the plane of the line 4—4;

FIGURE 5 is a horizontal sectional view through FIGURE 2 on the planes delineated by the line 5—5;

FIGURE 6 is a side view of the incinerator at a reduced scale to illustrate the adjustability of its primary combustion chamber; and

FIGURE 7 is a top view at the same reduced scale employed for FIGURE 6, illustrating the simplicity with which another stage can be added to the secondary combustion chamber, if desired.

Referring to the drawings in which like numerals designate like parts, the numeral **8** designates generally the primary combustion chamber of the incinerator, into which the materials to be burned are deposited through a charging or feed opening **9** provided with doors **10**; and from which any unconsumed material and combustible gases, as well as the products of combustion, pass into a secondary combustion chamber designated generally by the numeral **11**.

The primary combustion chamber consists essentially of a rotating drum **12** and a stationary wall **13** which closes the front end of the drum and has the charging opening located therein. The rear end of the drum opens to the secondary combustion chamber **11** through a round hole **14** in its front wall **15**, into which the rear end portion of the drum projects.

The secondary combustion chamber is preferably of modular or sectional construction, as in the Naulin Patent No. 2,805,633; but in any event it comprises—in addition to the front wall **15**—an upright rear wall **16**, side walls **17** and **18**, a roof **19** and a floor or bottom wall **20**.

A flue gas outlet **21** in the rear portion of the roof provides means for connecting the secondary combustion chamber with a chimney or stack.

The secondary combustion chamber is divided into two compartments by a partition wall **23** which is normally referred to in the industry as a bridge wall. This wall extends from side wall to side wall and from floor to ceiling between the front and rear walls of the secondary combustion chamber. Hence, one of the two compartments thus formed can be designated a front compartment **24** and the other a rear compartment **25**. These compartments are communicated with one another through an opening **26** in the partition or bridge wall, generally called a flame port.

In the bottom of the front compartment **24** at a level

slightly below the lower edge of the round hole **14**, is a grate **27**. This grate may consist of a number of parallel T-bars resting at one end upon a ledge **28** secured to the inner face of the side wall **17**, and supported at their opposite ends on a similar ledge **29** which is fixed to the lower edge portion of a downwardly sloping wall **30** supported by the side wall **18**, the front wall **15** and the partition wall **23**.

A clean-out opening **31** provided with a door **32**—as shown in FIGURE 4—extends above and below the grate **27**. A similar clean-out opening with a door **33** is provided for the rear compartment **25**.

The rear compartment **25** has a partition wall **34** extending fore and aft between the partition wall **23** and the rear wall **16**, and downwardly from the roof **9** to an elevation spaced above the bottom or floor. As shown in FIGURE 5, the partition wall **34**, which is generally referred to as a drop wall, forms a continuation of the side of the flame port which is in the partition wall **23** and, being so located, divides the rear compartment **25** into a throat **35** and an expansion chamber **36**, the latter having the flue gas outlet **21** in its roof.

The lower edge of the drop wall **34** is curved, as shown in FIGURE 2, to assure uniform distribution of the gases across the expansion chamber as they leave the throat and flow towards the flue gas outlet.

As is customary, all of the walls of the secondary combustion chamber are constructed of refractory material suitably reinforced and jacketed. The drum **12** likewise consists of a refractory cylinder **38** within a metal shell **39**. The drum is rotatably supported on a base **40** constructed of structural members including side rails **41** and cros members **42**, **43** and **44**, the latter being at the front end of the base.

Each of the two cross members **43** has two rollers **45** mounted thereon to supportingly engage one of two circular tires or tracks **46** which are fixed to and encircle the drum. The drum is held against shifting axially from its position in which the circular tracks **46** ride the rollers **45**, by a pair of guide rolls **47** rotatably mounted on the cross members **42** and engaging the inner edges of the circular tracks. Preferably the tires or tracks **46** are lengths of channel iron rolled to proper shape and size, with their webs outermost and their flanges facing inwardly to engage and be secured to longitudinally extending structural reinforcing members **48**, suitably secured to the metal shell **39**.

Between the tracks **46**, a ring **49** encircles the drum and, like the tracks **46**, is secured to the longitudinally extending members **48**. At peripherally spaced intervals—see FIGURE 3—the ring **49** has tooth-forming projections **50** fixed thereto to be engaged by a sprocket chain **51** which encircles the ring **49** and is trained over a drive sprocket **52**. The sprocket **52** constitutes the output of an electric motor driven gear reduction unit **53**.

As indicated hereinbefore, the front end of the drum is closed by the wall **13** which, like the other walls of the incinerator, is essentially formed of refractory material but, of course, suitably reinforced. It is fixedly supported on the front end portion of the base **40** by uprights **54** and diagonal braces **55**. The charging opening **9** in the wall **13** is at the lower end of a downwardly sloping chute **56** which projects from the front of the wall **13** and has the doors **10** hingedly mounted thereon. The doors preferably have shuttered inlet openings **57** and, of course, handles **58**.

The front wall **13** of the primary combustion chamber and the side wall **17** of the secondary combustion chamber are each provided with a burner port **60** through which flame is projected from a gas or oil fired burner **61**. The burners are, of course, suitably supported and have the necessary fuel supply lines and electrical control lines leading thereto, as shown in FIGURE 1, but omitted from the other figures of the drawings.

The primary combustion chamber burner directs its flame rearwardly and toward the axis of the drum, and the secondary combustion chamber burner projects its flame into the front compartment at a downward angle, so that in each case the flame is most effectively located.

Fingers **65** projects inwardly from the wall of the drum to engage, tumble and break up the material deposited in the drum through the charging opening. These fingers are inclined toward the front end of the drum, so that as the material slides off of them, it tends to move toward the front of the drum and away from its rear end which opens to the secondary combustion chamber. Premature passage of the material from the primary combustion chamber is thus fairly well prevented.

Toward the same objective, the secondary combustion chamber has a perforate partition wall **67** extending partially across the round hole **14** and hence across the open rear end of the drum. This partition wall is built up of refractory brick arranged in "checkerboard" fashion so as to leave openings **68** through the wall. The wall rests upon one of the bars of the grate **27** and hence extends from a level beneath the lower edge of the hole **14**. The upper edge of this perforate partition wall, as best seen in FIGURE 3, is disposed at an angle to the horizontal so that it is higher at one side of the hole **14** than at the other. Since the wall **67** is highest at the side of the hole nearest the flame port **26**, it lies athwart the shortest path from the drum to the flame port, and thereby forces fly ash and the like leaving the primary combustion chamber to take a circuitous path up and over the wall, or through the openings **68** in the wall. In either event, large pieces of fly ash are broken up before they reach the flame port.

Although the forwardly inclined disposition of the fingers **65** fairly well retains the material in the rotating drum until it is almost completely combusted, this result can be further assured by having the drum slope downwardly towards its front end, and to permit such disposition of the drum, the base **40** upon which it is rotatably supported is pivotally mounted at its rear end, as at **70**, and adjustably supported at its front end by jack screws **71**.

The pivotal support **70** comprises a web **72** welded to the underside of each side rail **41** and received between a pair of upstanding ears **73** to which the webs are connected by pins **74**. The jack screws **71** are threaded in nut members, not shown, fixed to the front end portion of the base and have their lower ends bearing upon pads **75**. Thus, as illustrated by the dotted line position of the primary combustion chamber in FIGURE 6, the axis of the drum may be adjusted to slope downwardly toward the front.

As best seen in FIGURE 4, secondary combustion air enters the throat of the secondary combustion chamber through an air admission port **77** in the side wall adjacent to the flame port. This air admission port opens to a passage or chase **78** in the partition wall **23** and communicates with the throat through progressively larger outlet ports **79**, **80** and **81**. The air admission port **77** is covered by a hood **82** which opens downwardly and has an adjustable damper **83** across its mouth to control the volume of air passing through the port **77**.

If additional secondary combustion is needed, a second stage secondary combustion chamber can be easily added as shown in FIGURE 7. To do so simply involves converting the rear wall **16** into a partition or bridge wall **85** and increasing the size of the secondary combustion chamber to provide a duplicate second rear compartment **86**, which then, in fact, becomes a third compartment in the secondary combustion chamber.

The drop wall **87** of this third compartment is near the side wall opposite that at which the drop wall **36** is located, and of course the flue gas outlet leads from the third compartment rather than the second.

OPERATION

In operating the incinerator, the motor driven drive for the drum **12** and burners **60** are, of course, first activated, and then the material to be combusted is charged into the rotating drum. Here it is continually tumbled and broken up by the inwardly directed fingers **65** which work the material towards the front of the drum and keep it from leaving the drum until it is practically entirely combusted. That part of the material which is not fully combusted in the drum which constitutes the primary combustion chamber of the incinerator—and, of course, all combustible gaseous constituents released from the material and the uncombustible products of combustion—pass on into the first compartment **24** of the secondary combustion chamber.

To reach the secondary combustion chamber, the material must flow over the perforate partition wall **67** or through the apertures therein so that all large pieces of fly ash will be broken up and prevented from traveling directly to the flame port **26**.

In the compartment **24** of the secondary combustion chamber, the combustion continues so that by the time the second compartment **25** which provide an expansion chamber is reached, very little uncombusted materials remains. In any event, the flue gases that leave the expansion chamber through the flue gas outlet **21** are completely devoid of combustible gases, fly ash, or any other air pollutants.

What is claimed as our invention is:

1. An incinerator for burning compacted material, comprising:

(A) structure defining primary and secondary combustion chambers in open communication with one another,

the structure defining the primary combustion chamber comprising stationary upright wall means having a charging opening through which material to be burned is introduced into the incinerator, and a rotatable drum with its axis substantially horizontal and one of its ends contiguous to said upright wall means to be closed thereby, the structure defining the secondary combustion chamber comprising fixed exterior walls, certain of which are upright, one of said upright walls having a round role in which the opposite end of the drum is received, another of said exterior walls having an outlet opening through which flue gases leave the incinerator, and internal baffle walls between said round hole and the flue gas outlet opening;

(B) means mounting the drum for rotation about its axis;

(C) power means connected with the drum for rotating the same;

(D) spaced inward projections on the wall of the drum to engage and tumble the contents of the drum as it rotates;

(E) burner means arranged to direct flame into the primary combustion chamber;

(F) burner means arranged to direct flame into the secondary combustion chamber, and

the incinerator being characterized in that one of the baffle walls of the secondary combustion chamber extends across the secondary combustion chamber in spaced relation to said exterior upright wall in which the round hole

is located, and laterally beyond the side edges of said hole, to divide the secondary combustion chamber into a front compartment which communicates with the interior of the drum and extends beyond the side edges of the round hole, and rear compartment from which the flue gas outlet leads,

said baffle wall having a flame port to communicate the front and rear compartments, said flame port being in an upper portion of the partition wall which lies laterally beyond one side edge of the round hole.

2. The incinerator of claim **1**, further characterized by a perforate baffle wall in the front compartment of the secondary combustion chamber extending partially across said round hole and the adjacent open end of the drum.

3. The incinerator of claim **2**, wherein said perforate baffle wall extends upwardly from a level beneath the lower edge of said round hole to a height sufficient to cover substantially one-half of said round hole,

the upper edge of said perforate baffle wall being inclined to the horizontal so that said baffle wall is higher at one side of the round hole than at the other side thereof,

the higher portion of the baffle wall being at the side of the hole which is nearest the flame port.

4. The incinerator of claim **1**, wherein the means for rotatably mounting the drum comprises a base on which the drum is rotatably seated,

and means supporting the base for limited up and down tilting adjustment about a horizontal axis parallel to and near the bottom of the upright exterior wall in which the round hole is located,

whereby the drum may be disposed with its axis tilted from horizontal.

5. The incinerator of claim **4**, wherein the base has a part thereof adjacent to each end of the drum and wherein the means for tiltably supporting the base comprises fulcrum means at the part of the base which is at the rear end of the drum, and

adjustable support means engaging another part of the base to support the front end of the drum.

6. The incinerator of claim **1**, wherein one of the exterior walls of the secondary combustion chamber constitutes a roof for said chamber and others of said exterior walls are side walls thereof, wherein said baffle wall identified in claim **1** extends from side wall to side wall and to the roof, and

wherein the flame port is adjacent to the roof and one of said side walls, and

further characterized by an air admission port in said side wall and a passageway in said baffle wall beneath the flame port, to which said air inlet port opens and from which air outlet openings lead to debouche into the rear compartment.

References Cited

UNITED STATES PATENTS

3,306,237	2/1967	Ransom	110—14
3,173,389	3/1965	Cates et al.	110—14

KENNETH W. SPRAGUE, Primary Examiner

U.S. Cl. X.R.

110—14