

[54] **ROTARY KILN INCINERATOR**

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[58] Field of Search..... 110/8 R, 10, 14

[56] **References Cited**

UNITED STATES PATENTS

3,487,792 1/1970 Dixon et al. 110/14 X

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[57] **ABSTRACT**

An incinerator comprising a horizontally extending rotary kiln having a cooling water jacket between its inner and outer walls. An inner drum extends axially through the rotary kiln to define an annular combustion chamber therein, the inner drum including a water conduit in communication with the cooling water jacket and a plurality of air channels to supply air into the combustion chamber. On the circumference of the rotary kiln there are mounted a plurality of gear wheels respectively in mesh with pinions coupled to a motor for rotating the kiln. The kiln has a plurality of raised circular rims on its circumference each resting on a pair of rollers for further support.

8 Claims, 3 Drawing Figures

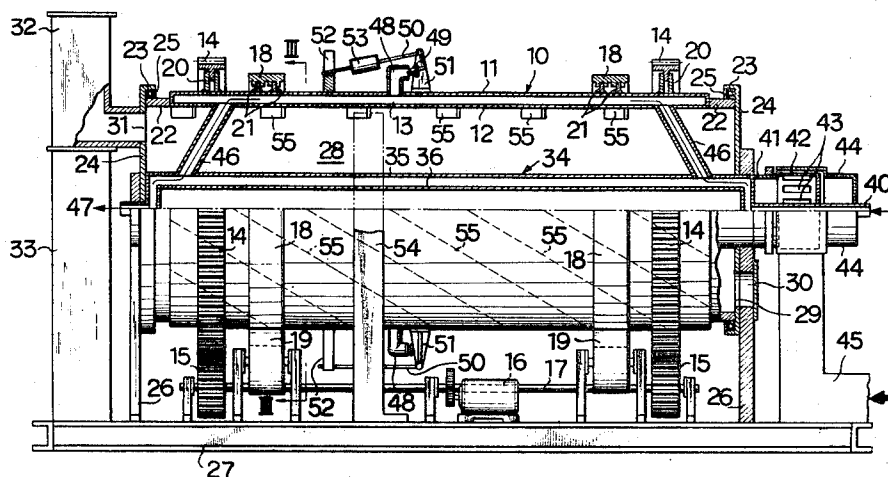


FIG - 1

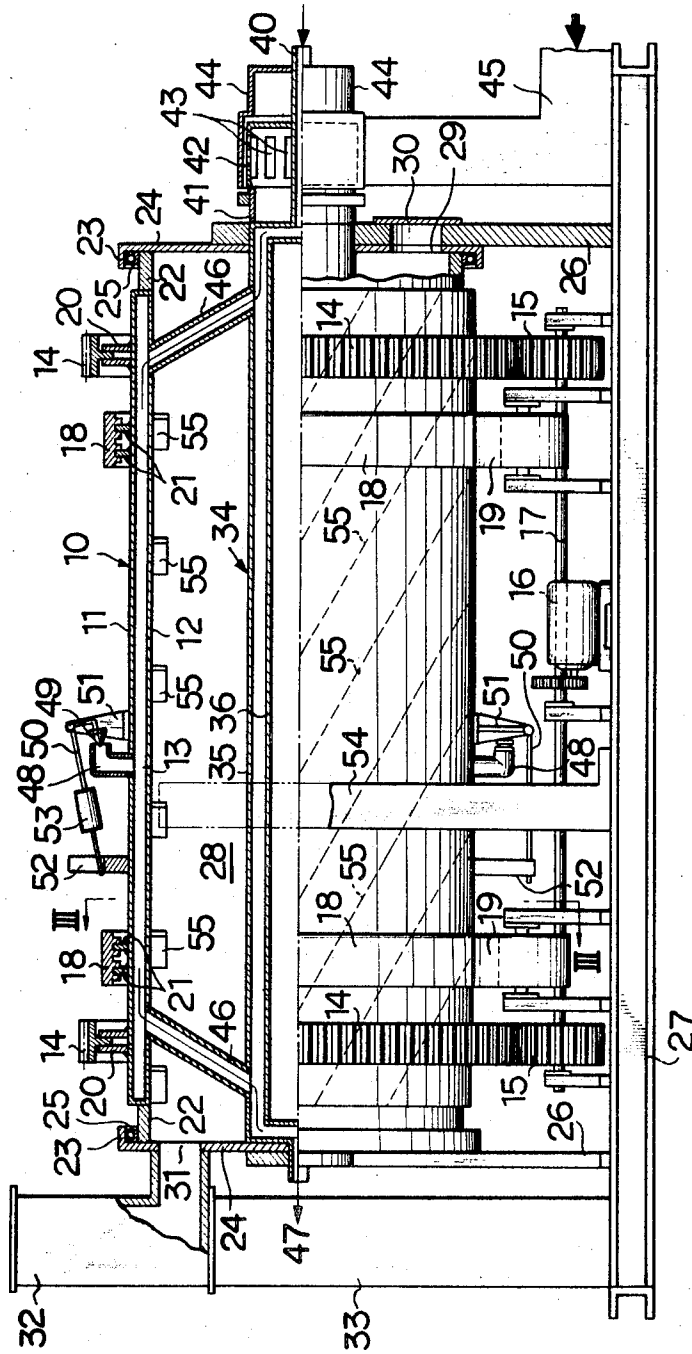


FIG - C

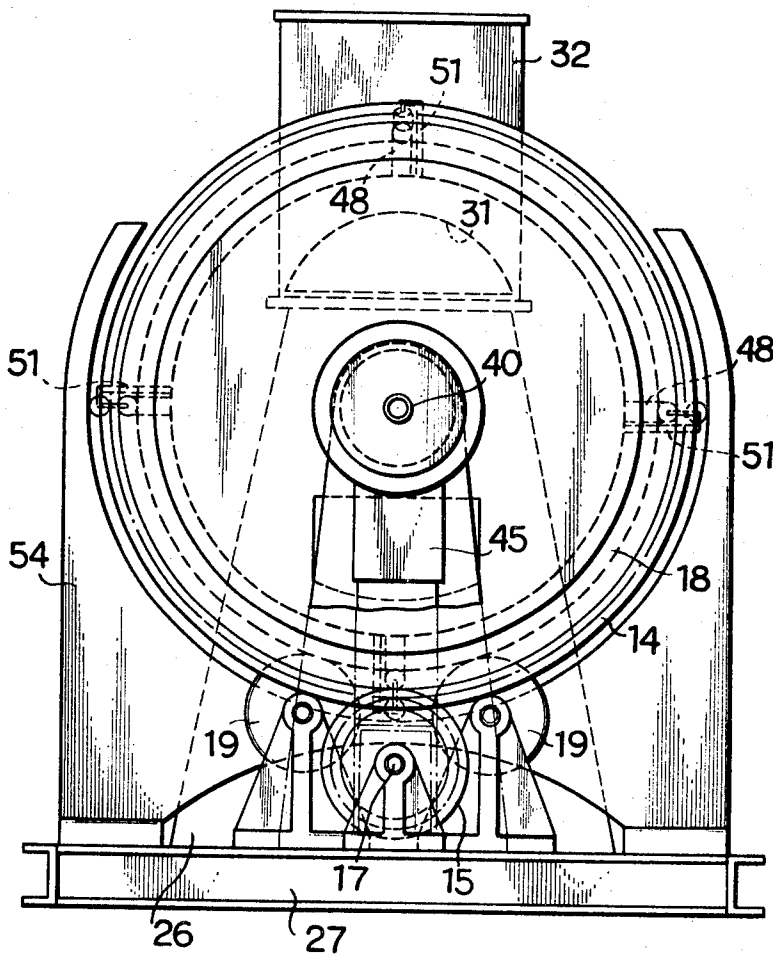
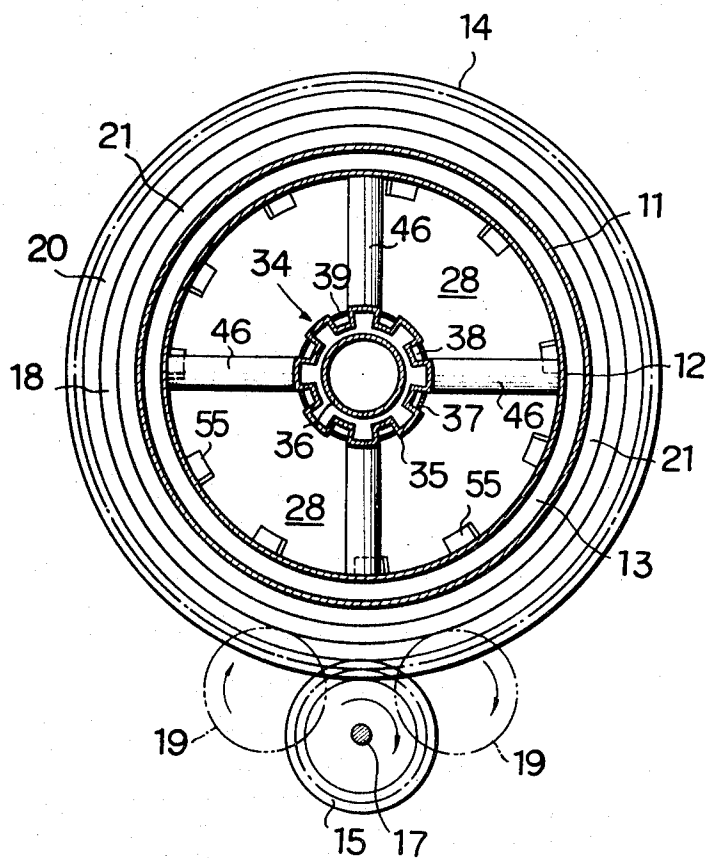


FIG. 3



ROTARY KILN INCINERATOR

This invention relates generally to incinerators, and in particular, to a novel rotary kiln incinerator for facilitating complete combustion of solid wastes or refuse.

One of the present inventors has recently proposed in U. S. Pat. No. 3,534,693 an incinerator capable of complete combustion of rubber, leather, chemical fibers and like substances which would produce a great deal of smoke and/or poisonous gases if burnt incompletely. While this incinerator has gathered the attention of the specialists because of its capability of complete combustion of such substances which now occupy a considerable percentage of community refuse, there were some problems left unsolved.

One of the problems resides in how to send a charge of refuse to an actual point of combustion in a combustion chamber. With most conventional incinerator plants of the "floor dump" (meaning that the refuse is first dumped on a charging floor and then pushed into a combustion chamber), the operator has had to practically hurl the refuse with all his might into the charging opening in order to send it as close as possible to such an actual area of combustion, which usually is located some distance from the charging opening. Alternatively, another solution has been to provide mechanical conveyor means which render the overall incinerator plant unnecessarily complex and expensive.

Another problem concerns the difficulties involved in removal of the hardened residue of incompletely burnt rubbish. Performed during periodically forced rests of the incinerator, the removal of residue which has firmly stuck to the combustion chamber walls has been an undue burden which has slowed down operation of incinerators and required burdensome labor.

No matter how efficiently built an incinerator itself may be, its effective operation for disposal by burning will not be necessarily high unless the operator is relieved of the heavy labor heretofore required through solution of the above problems.

Accordingly, it is an object of the present invention to provide a novel rotary kiln incinerator which overcomes these problems without sacrificing performance, and which incinerator is capable of complete and rapid combustion of almost any substances contained in ordinary community refuse.

Another object of the invention is to provide a rotary kiln incinerator wherein the kiln automatically rotates at controlled speed thereby agitating and facilitating the combustion of the refuse charged into its combustion chamber.

Another object of the invention is to provide a rotary kiln incinerator wherein fins are arranged helically on the inner surface of the cylindrical rotary kiln defining a combustion chamber therein whereby, as the kiln rotates, the refuse charged from one end thereof is gradually fed toward the other end while being smoothly burnt out. Hence no hardened residue of the refuse will remain adhered to the combustion chamber wall.

Another object of the invention is to provide a rotary kiln incinerator of such construction that the operator may simply drop a charge of refuse into its combustion chamber from a charging gate at one end thereof, the refuse then being fed toward the other end by the rotary kiln itself.

Another object of the invention is to provide a rotary kiln incinerator wherein the rotary kiln has an inner

wall and outer wall provided with a cooling water jacket therebetween to prevent the same from overheating.

Another object of the invention is to provide a rotary kiln incinerator wherein an inner drum extends axially through the cylindrical rotary kiln, the inner drum including a water conduit in communication with the cooling water jacket and a plurality of air channels to supply air into the combustion chamber.

A further object of the invention is to provide a rotary kiln incinerator wherein the water conduit of the inner drum has portions exposed to the combustion chamber, so that only appropriately pre-heated water is supplied to the cooling water jacket to prevent damage to the incinerator because of thermal expansion and contraction of parts.

A further yet object of the invention is to provide a rotary kiln incinerator wherein the cooling water jacket of the kiln is provided with a plurality of exhaust pipes which are opened only above the predetermined level of the cooling water in the kiln to permit the egress of steam produced therein.

A still further object of the invention is to provide a rotary kiln incinerator wherein the kiln is provided with a plurality of raised circular rims on its circumference each resting on a pair of rollers in order to ensure its stabilized rotation.

The novel features that are considered characteristic of the present invention are set forth in the appended claims. The invention itself, however, with its additional objects and advantages, will be best understood from the following description when read in conjunction with the accompanying drawings which illustrate, by way of example only, a preferred embodiment thereof, and wherein:

FIG. 1 is a side elevational view of a rotary kiln incinerator constructed in accordance with the concepts of the present invention, with parts thereof being broken away to show other parts in detail;

FIG. 2 is an explanatory front elevational view of the rotary kiln incinerator of FIG. 1, with parts thereof being shown broken away; and

FIG. 3 is a vertical sectional view taken along the plane of line III — III in FIG. 1.

Referring now to the drawings, and more particularly to FIG. 1 thereof, a cylindrical kiln 10 has an outer wall 11 and an inner wall 12 defining a cooling water jacket 13 therebetween, the jacket 13 having a desired amount of water flowing therethrough during the operation of the incinerator in a manner described hereinafter. A drive mechanism adapted for rotation of this kiln 10 includes a pair of gear wheels 14 secured on the circumference of the outer wall 11 and respectively meshing with a pair of pinions 15. The pinions 15 are both driven by means of a motor 16 via a shaft 17. Stable rotation of the kiln 10 is ensured by means of a pair of raised rims 18 extending circumferentially on the outer wall 11 and each resting on a pair of rollers 19 (refer also to FIG. 2). Since the aforesaid gear wheels 14 and rims 18 will be susceptible to too much heat conduction from the kiln 10 if they were to be secured directly to its outer wall 11, they are mounted upon flanges 20 and 21, respectively, which project outwardly therefrom.

Connected at each closed end of the outer and inner walls 11 and 12 there is a short cylindrical member 22. Each end of the kiln 10 thus formed by the member 22

is closed with a faceplate 24 having flanges 23 thereon. A ring 25 is in effective slidable contact with the inside surface of each of the flanges 23 and the cylindrical member 22. The face plates are supported by means of brackets 26 secured on a base or floor 27. Hence a substantially completely closed annular combustion chamber 28 is formed. A charging gate 29, complete with an openable door 30, is formed through the forwardmost bracket 26 and the faceplate 24 which are located on the right hand side as viewed in FIG. 1. The other faceplate 24, on the left hand side in FIG. 1, is formed with an exhaust opening 31 which leads to a smokestack 32 standing upward on a support 33. Extending axially through the kiln 10, an inner drum 34 is adapted both to supply cooling water to the jacket 13 and to provide air within the combustion chamber 28 in accordance with the concepts of the present invention.

With reference now to both FIGS. 1 and 3, in order to describe the makeup of this inner drum 34, a conduit 35 for carrying cooling water is provided concentrically with a center cylinder 36. This water conduit is formed with a plurality of annularly spaced rectangular projections extending in parallel relationship with one another throughout the length thereof. The spacings between these projections are closed by members 37 to define air channels 38 therein, each of the members 37 having bores 39 of adequately small diameter arranged longitudinally at prescribed intervals. Hence a sufficient amount of air for combustion is to be supplied uniformly to all parts of the combustion chamber 28.

FIG. 1 best illustrates the various means adapted to feed air and water to the inner drum 34. The water conduit 35 is in communication with a feed pipe 40 located axially of the inner drum 34 and connected to a source of water supply. Concentrically with this feed pipe 40 there is provided a short pipe or cylindrical member 41, which may be of the same diameter as the water conduit 35 inclusive of its projections. A cap or cover 42 is secured to the short pipe 41. A plurality of longitudinal slots 43 are formed in the cover 42. A cylindrical casing or enclosure 44 loosely encloses the cover 42 with clearance therebetween at one end of an air duct 45 which is connected at the other end of a blower (not shown). The air required for combustion is thus supplied from the duct 45 to the fixed enclosure 44 and thence to the air channels 38 via the longitudinal slots 43 of the cover 42 irrespective of the rotation of the inner drum 34 together with the kiln 10.

The cooling water supplied from the feed pipe 40 flows toward the left, as viewed in FIG. 1, through the conduit 35 with its projections. Thereafter, the cooling water is appropriately preheated in the conduit 35 and flows through the jacket 15 via pipes 46 intercommunicating conduit 35 and jacket 13. The cooling water which has completed its circulation within the kiln 10 will flow therefrom via a discharge pipe 47 which extends through the center of the left hand faceplate 24 and which is in direct communication with the conduit 35.

Inasmuch as dangerously high pressure will be built up within the jacket 13, the conduit 35 and so forth by the steam produced therein, such steam has to be adequately exhausted. To this end a plurality of short exhaust pipes 48 are provided at equal circumferential intervals on the kiln 10 in direct communication with the jacket 13. The exhaust pipes 48, as shown in FIG. 1, each has its open end furnished with a cap 49 which

may be made of heat resisting rubber. This cap 49 is secured at one end of a lever 50 which pivots on a fulcrum 51 guided by a radially projecting member 52 and which is fixedly provided with a weight 53. A guide 54 (refer also to FIG. 2) is adapted to keep the open end of each exhaust pipe 48 closed with the cap 49 by properly supporting the weight 53 when it has been moved below the level of the cooling water within the kiln 10 as determined by the discharge pipe 47. Above the cooling water level, the weight 53 acts to open the exhaust 48 thereby permitting the egress of the steam. Thus loss of water is prevented while the steam is adequately vented.

As illustrated in FIGS. 1 and 3, fins 55 are fixed to the inner surface of the inner wall 12. Arranged helically, these fins 55 serve both to agitate and feed the refuse, as well as the burnt ashes and residue of the refuse, within the annular combustion chamber 28 from one end toward the other.

Proceeding now to a description of a mode of operation of the incinerator constructed as set forth hereinbefore, cooling water is supplied from the feed pipe 40 until it attains its level in the rotary kiln 10 predetermined by the location of the discharge pipe 47. With the door 30 opened, a suitable amount of refuse (which may include rubber, leather, chemical fibers, plastics and so forth) is charged into the combustion chamber 28 from the gate 29, followed by paper, wood and like materials that will readily catch fire. Shortly after ignition, when black smoke starts rising from the smokestack 32, the charging gate 29 is closed with its door 30 and the blower (not shown) is put into operation. The motor 16 is actuated to initiate the rotation of the kiln 10 when the refuse within its combustion chamber 28 has completely caught fire. The air fed from the blower is uniformly supplied to all parts of the combustion chamber 28 out of the bores 39 of the air channels 38 after being appropriately heated therein, thereby accelerating the combustion process and completely oxidizing the combustion gases before they reach the exhaust opening 31. The combustion process is further promoted by the rotary kiln 10 itself, which rotates at a rate of, say, from five to ten revolutions per minute to provide greater agitation and more intimate mixing of the refuse with the air supplied as above. Furthermore, as the kiln 10 rotates, the helically arranged fins within the combustion chamber 28 gradually feed the charged refuse toward the other end of the chamber for still more efficient combustion.

Thereafter, refuse may be charged into the combustion chamber 28 at suitable time intervals, and the inevitable burnt ashes (not the hardened residue) of the refuse may have to be removed only at greatly extended intervals when the incinerator is at rest.

According to the present invention the possible damage to the walls of the combustion chamber 28 due to the high temperature of complete combustion (approximately 2,000° C in the case of plastics) is prevented by virtue of a sufficient amount of appropriately preheated cooling water supplied thereto. The hot water thus obtained from the discharge pipe 47 may be utilized for various purposes.

While it will be apparent that the various explicitly stated and implicitly suggested objects of the present invention are fully accomplished by the rotary kiln incinerator herein disclosed, it will also be appreciated that the invention itself is susceptible to many modifi-

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cations, substitutions and change without departing from the proper scope or fair meaning of the appended claims.

A latitude of modification, change and substitution is intended in the foregoing disclosure, and in some instances, some features of the invention will be employed without a corresponding use of other features. What is claimed is:

1. An incinerator comprising a horizontally extending cylindrical kiln having a cooling water jacket defined by an inner wall and outer wall spaced from said inner wall, a pair of fixed faceplates, said cylindrical kiln having its ends closed by said faceplates forming a combustion chamber, a plurality of gear wheels on said cylindrical kiln, a plurality of pinions in mesh with said gear wheels, a motor means connected to said pinions for rotating said cylindrical kiln relative to said faceplates, a plurality of raised rims, roller means engaged by said cylindrical kiln, each of said raised rims for rotatably supporting said cylindrical kiln, a charging gate formed through one of said faceplates, and an exhaust opening formed through the other of said faceplates.

2. An incinerator according to claim 1, further comprising an inner drum extending axially through said cylindrical kiln and having a portion projecting outward from one of said faceplates, said inner drum including a water conduit in communication with said cooling water jacket, said inner drum having a plurality of air channels for supplying air into said combustion chamber.

3. An incinerator according to claim 2, wherein said water conduit includes a plurality of annularly spaced projections of substantially rectangular cross section extending in parallel with one another throughout the length thereof and defining spacings therebetween, and a plurality of bored members closing said spacings to define said air channels.

4. An incinerator according to claim 2, wherein said air channels communicate with said portion projecting

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outward from one of said faceplates, said projecting portion having slots, an air duct, a fixed cylindrical enclosure at one end of said air duct, said projecting portion being received with substantial clearance in said enclosure.

5. An incinerator according to claim 2, including a feed pipe extending axially through said projecting portion, said feed pipe being connected to a source of water supply, a discharge pipe extending outward through the center of said other faceplate, said water conduit having its ends connected to said feed pipe and said discharged pipe.

6. An incinerator according to claim 5, wherein means are provided for exhausting the steam produced in said water conduit and said cooling jacket, said means comprising a plurality of short exhaust pipes provided at circumferential intervals on said cylindrical kiln in direct communication with said cooling water jacket, each of said exhaust pipes having an open end provided with a displaceable cap which is secured at one end of a lever supported on a fulcrum, said lever having a weight on the opposite side of said fulcrum, thereby to keep said cap off the open end of the exhaust pipe while the same is above the level of the cooling water within said cylindrical kiln, and guide means for supporting said weight so as to keep the open end of the exhaust pipe securely closed with said cap at and below the cooling water level.

7. An incinerator according to claim 1, further comprising fins arranged helically on the inner surface of said inner wall of said cylindrical kiln for feeding refuse charged from said gate toward said other faceplate at the opposite end.

8. An incinerator according to claim 1, including flange means for mounting said gear wheels and said raised rims on said cylindrical kiln for preventing too much heat conduction from said kiln.

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