

Feb. 27, 1962

W. T. S. MONTGOMERY

3,022,753

INCINERATOR

Filed Jan. 11, 1955

4 Sheets-Sheet 2

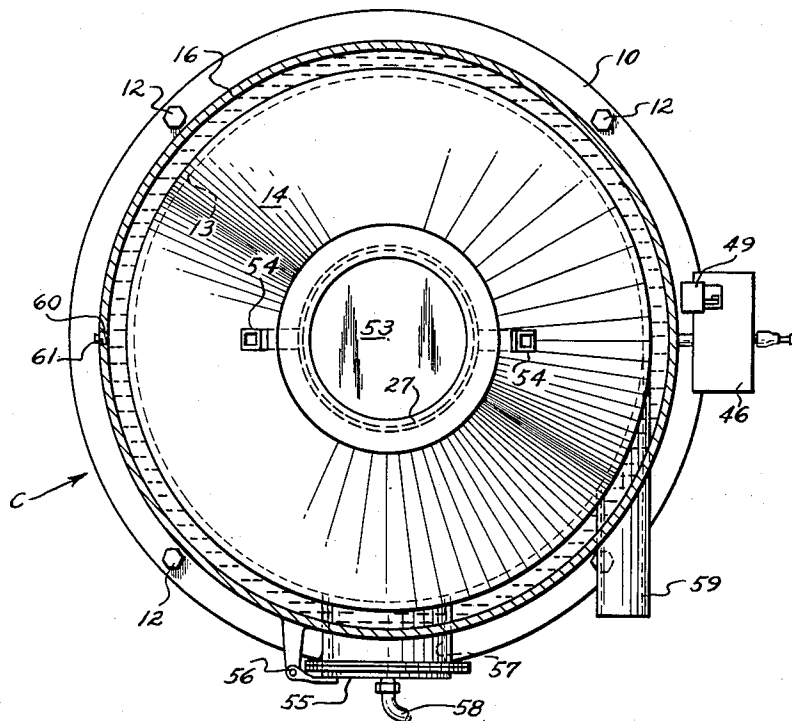


Fig. 2

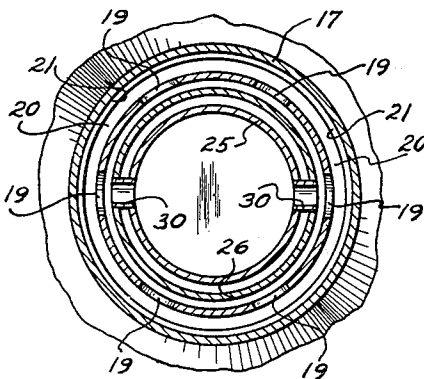


Fig. 3

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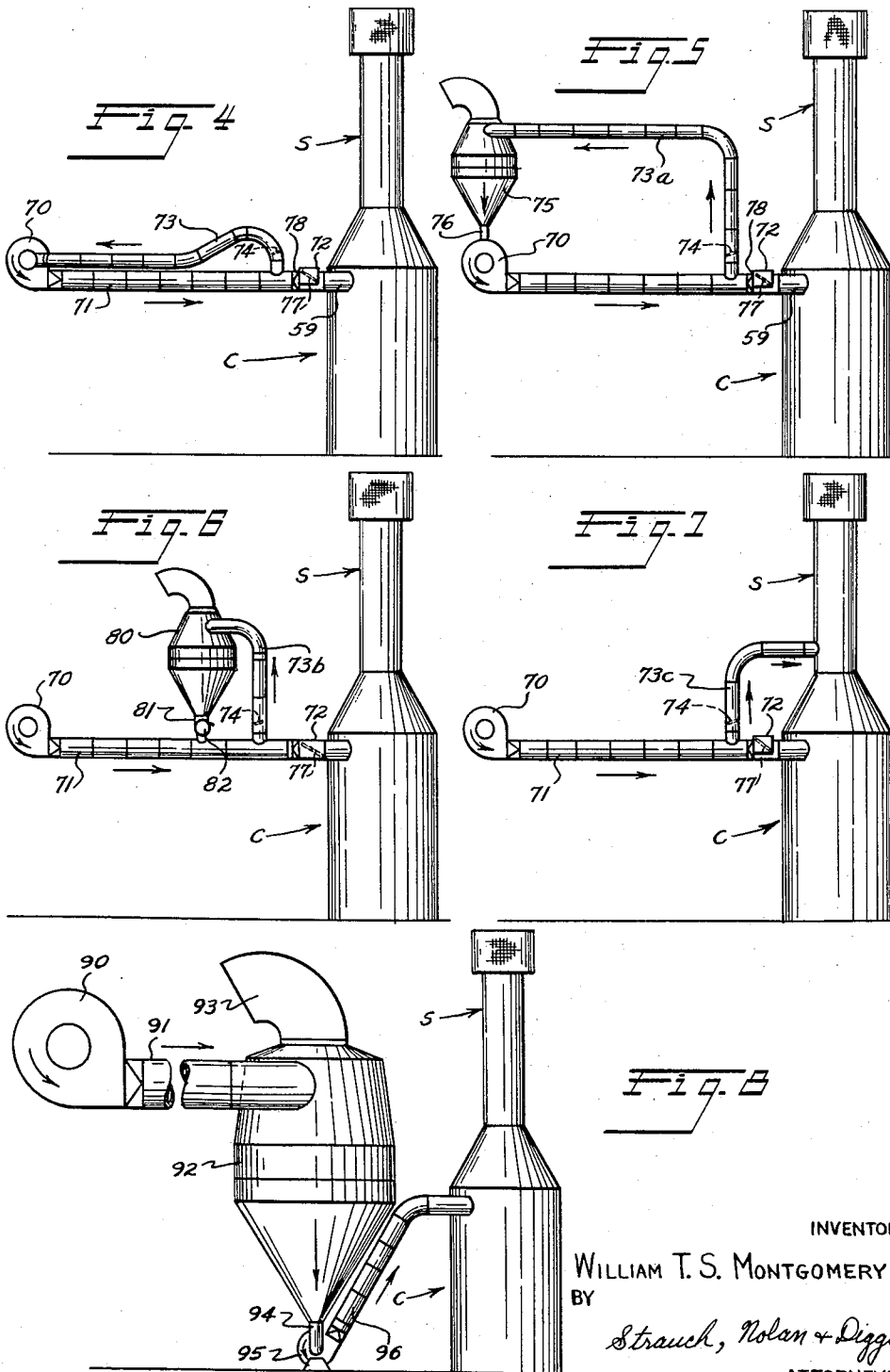
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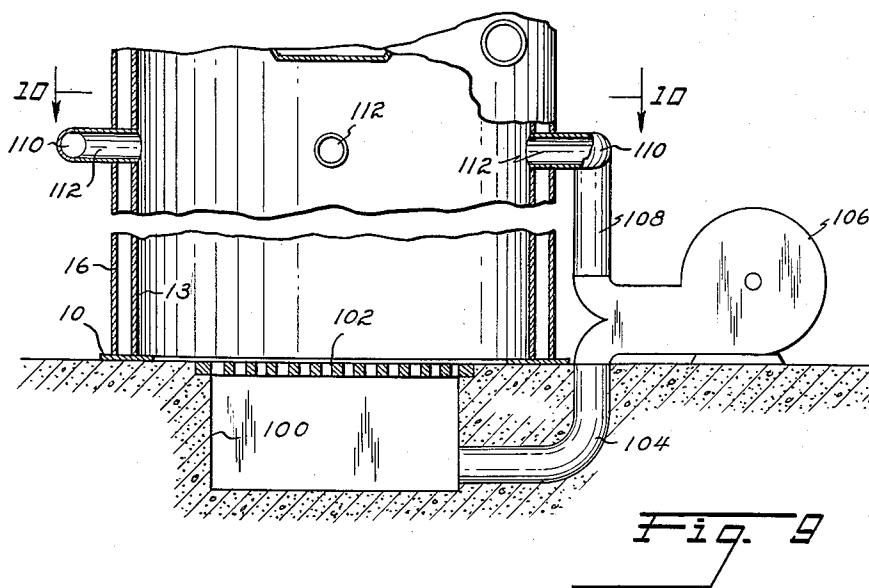
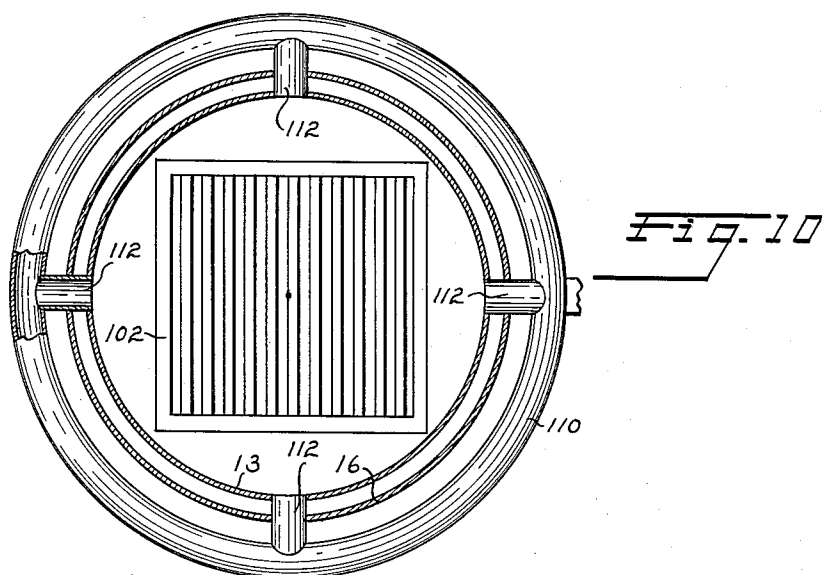
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4 Claims. (Cl. 110—7)

The present invention relates to a furnace and more particularly to a furnace for the burning of relatively small particles such as sawdust, wood shavings or the like. This application is a continuation-in-part of my application Serial No. 168,936, filed June 19, 1950, and which is now forfeited.

In mills and factories making products from wood there is inevitably a substantial amount of wood waste. The waste occurs in a variety of forms from saw dust to log butts and the different forms of waste occur at different places in the factory or mill. Heretofore, wood waste has been a serious and expensive nuisance and many wood mills have expended large sums in disposing of this waste by dumping it in the woods.

The first problem in disposing of this waste is to remove the waste from the point where the waste occurs and convey it to the point of disposal. Some forms of waste are difficult to handle especially when mixed with other forms and I have found it preferable to reduce the larger chunks and pieces of wood to small chips so that all of the waste may be conveniently handled and conveyed to the point of disposal by a blow pipe system. An efficient reduction and conveying apparatus is disclosed in my application Serial Number 52,380, filed October 1, 1948, for Wood Reduction and Handling which has now become abandoned.

The second problem, and that with which this application is concerned, is the actual disposal of the wood waste after it has been removed from the point where it occurs. Wood waste burns readily but heretofore there has been no incinerator or furnace in which the waste could be safely and efficiently burned. Hand feeding of wood waste to a furnace or incinerator is extremely dangerous because of the likelihood of flash-backs and automatic firing methods heretofore available have been either unsuitable for small chips and particles of wood, difficult and expensive to install, dangerous to operate or difficult to control so as to correlate the rate of burning with the rate at which the waste is formed.

In one common prior art system, wood chips and particles were conveyed on a stream of moving air to a dust collector and then fed by gravity to an incinerator. This system resulted in frequent and destructive fires in the dust collector. The heat generated by burning such small particles is very high so that even systems formed of refractory materials would not stand up.

I have found that wood waste can be efficiently burned and safely fed to an incinerator or furnace on a moving stream of air so that the incinerator serves also as a dust collector. Often the volume and speed of the air stream necessary to convey the wood waste is so great that combustion would be too rapid but I have found that the amount of air entering the furnace or incinerator with the wood waste can be controlled independently of the amount of air required to convey the wood. By controlling the amount of air entering the incinerator, the rate of combustion can be controlled. By controlling the rate of combustion, the operation of the incinerator or furnace can be correlated to the production of waste or the demand for steam so that the fire will not burn out when waste is produced at a low rate nor will rapid production of waste create a storage problem or fire hazard.

In an incinerator for burning small chips the fire will sometimes smother and the chips will give off gas. When

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fire is introduced in the presence of this gas, destructive explosions can occur. I have found that the burning can be controlled so as to prevent such smothering and insure complete combustion of all of the wood particles.

In its broadest aspect, the present invention contemplates the elimination of a costly waste disposal problem and the utilization of that waste as a valuable fuel. For simplicity, the invention is described in terms of an incinerator which also serves to provide a source of hot water. It is to be understood however, that the invention is equally applicable to a furnace for producing steam or heat.

One of the objects of the present invention is to provide a simple and efficient furnace or incinerator.

Another object is to provide a combined incinerator and cyclone.

Another object is to provide a method of and apparatus for safely and efficiently burning small particles of combustible material.

Another object is to provide a method of and apparatus for safely and efficiently feeding small particles of combustible material to an incinerator or furnace.

Another object is to provide a method of and apparatus for controlling the rate of combustion in an incinerator or furnace for burning small particles of combustible material.

Another object is to provide an incinerator for small particles of wood in which the particles are always subjected to moving air and are maintained in a turbulent condition during combustion.

These and other objects and advantages reside in novel features of construction, arrangement and combination of parts and in steps and processes as will hereinafter be more fully set forth and pointed out in the appended claims.

Referring to the drawing:

FIGURE 1 is a vertical section of my incinerator with parts in elevation.

FIGURE 2 is a section taken on line 2—2 of FIGURE 1.

FIGURE 3 is a section taken on line 3—3 of FIGURE 1.

FIGURE 4 is a side elevation of an incinerator system showing one form of feed and air control.

FIGURES 5, 6, 7 and 8 are side elevations of my incinerator systems showing other forms of feed and air control.

FIGURE 9 is a fragmentary vertical section of a modified form of incinerator.

FIGURE 10 is a section taken on line 10—10 of FIGURE 9.

One form of incinerator according to my invention is illustrated in FIGURES 1 to 3 of the drawing wherein 10 indicates a base plate which is firmly secured on a suitable foundation 11 by suitable means such as the nuts 12. The combustion chamber indicated generally at C, formed by a wall 13 secured to the base plate 10 is preferably cylindrical and an annular plate 14 secured at the upper end of the wall 13 carries a vertical sleeve 15.

Wood chips and shavings burn at a high temperature and I prefer to surround the wall 13 with a second wall 16. The top of the wall 16 is connected to the top of the sleeve 15 by a conical wall 17, the space between wall 13, plate 14 and sleeve 15 and walls 16 and 17 constituting a water jacket. Above the water level indicated at 18, the sleeve 15 has vent openings 19 to permit the escape of steam and suitable baffles 20 and 21 may be secured to the sleeve 15 and conical wall 17 below the vents 19.

The stack indicated generally at S, consists of two concentric cylindrical pipes 25 and 26, the outer pipe 26 being smaller than the sleeve 15 so that there is a space between them. The pipes 25 and 26 are connected at

their lower ends by an annular plate 27 which extends outward from the pipe 26 to engage the inner surface of the sleeve 15. An annular plate 28 secured on top of the sleeve 15 and conical wall 17 engages the outer surface of the pipe 26 enclosing the space between the sleeve 15 and pipe 26. Short horizontal tubes 30 extend through and are suitably secured in the pipes 25 and 26 as for example by welding, and connect the space between sleeve 15 and pipe 26 to the interior of the stack so that steam from the water between walls 13 and 16 may escape through vents 19 and tubes 30 into the stack.

The top of the pipe 25 has an enlarged portion 31 and the top of the pipe 26 an enlarged portion 32 concentric with the portion 31. The spaced pipes 25 and 26 and portions 31 and 32 form a water jacket and the enlarged portion 31 is provided with internal vents 33 above the level of the water as indicated at 34, to permit the escape of steam. Baffles 35 and 36 may be secured to the enlarged portions 31 and 32 respectively between the top of the water and the vents 33 and the space between portions 31 and 32 is closed at the top by an annular ring 37.

A spark arrester indicated generally at 40, which may be of conventional, well-known type is secured on top of the ring 37 as by bolts 41. The spark arrester 40 has a hinged top 42 which may be opened by a rod or cable 43.

Water is introduced into the water jacket formed by walls 13 and 16 through a pipe 45 and the water is maintained at a predetermined level 18 from a reservoir 46 containing a conventional float valve 47 such as is well known in the plumbing trade. The reservoir 46 may be supplied from a suitable supply not shown. A glass gauge 48 may be provided on the side of the reservoir 46 and a switch 49, controlled by a float 50 in the reservoir 46, actuates a signal, not shown, when the water level 18 falls below a predetermined limit. A substantially identical reservoir, float valve, gauge and switch assembly indicated generally at 51, is provided to maintain the water level in the jacket formed by pipes 25 and 26.

The bottom of the incinerator is preferably filled to a substantial depth with sand 52 and a water cooled baffle 53 is secured in the combustion chamber beneath the stack by pipes 54 which communicate with the water in the jacket surrounding on the combustion chamber. A water jacketed door 55 is hinged at 56 on the wall 16 and closes an opening 57 in the lower part of the combustion chamber through which the chamber may be cleaned, the fire ignited or the like. Water for the door 55 is circulated through pipes 58 from a source not shown.

The chips and particles of wood are introduced into the incinerator on a stream of moving air which enters the combustion chamber C through a tangential conduit 59 adjacent the top of the chamber. If there were no fire, my incinerator would function as a simple dust collector, the chips and particles settling to the bottom of the chamber C and the air leaving through the stack S. When a fire is present in the chamber C, the chips and particles burn as they are carried around the chamber on the stream of air and most if not all of the chips are fully burned by the time they reach the bottom of the chamber C. Excess air not needed for combustion, is expelled with the products of combustion through the stack S as in a conventional dust collector.

To ignite my incinerator, the air stream is started and chips and particles fed into the incinerator until a pile is built up on the floor 52 of the chamber C. The air is then cut off, the door 55 opened, the pile of chips and particles soaked with oil, kerosene or gasoline and ignited, the door 55 closed and the air and chips restarted through the conduit 59. Regardless of the amount of air required to carry the chips and particles, the amount

of the air entering the incinerator is controlled to maintain proper combustion.

While my invention is shown as applied to an incinerator for the disposal of waste, the invention is also applicable to a furnace for burning fuel of small particle size for heat or power. The embodiment shown in FIGURES 1 to 3 may also be used as a source of hot water and openings 60 are provided in the wall 16 for hot water connections. These openings 60 may be closed with plugs 61. Suitable drain plugs 62 are provided for draining the water jackets.

It is apparent that wood chips and particles could be picked up at the points where they occur, carried to my incinerator and blown by a fan or blower into the chamber C through the conduit 59 from a hopper or storage bin. However, such handling of the wood waste is expensive and hazardous and it is preferable to convey the wood waste from the point of origin to the incinerator on a moving stream of air in a blow pipe system. As pointed out above, the amount of air required to convey the chips and particles is often too great for efficient continuous combustion, especially if long distances are involved, so that it is necessary to control the air entering the incinerator independently of the air used to convey the particles. Various systems for accomplishing this control are shown in FIGURES 4 to 8 inclusive.

In the embodiment shown in FIGURE 4, the wood particles may be drawn into the inlet side of a fan or blower 70 and blown to the incinerator C through a conduit 71. The volume of air necessary to convey the particles is too great to maintain combustion and a throttle valve indicated at 72 is located in the conduit 71 adjacent the conduit 59 which is connected to the incinerator C. This throttle valve 72 may be of a variety of forms but I prefer to use a flat plate 77 hinged adjacent the top of a rectangular conduit section 78 and prefer that this plate be longer than the height of the conduit section so that its free end is always inclined toward the incinerator. If desired, stops can be provided to hold the flat plate 77 in selected angular position.

The plate 77 may be adjusted to reduce the air entering the incinerator C to the amount required for the proper rate of combustion but ordinarily it would also reduce the flow in conduit 71 to a rate insufficient to convey the particles.

I have found that by connecting a bleeder conduit 73 to the conduit 71 adjacent the valve 72 on the side opposite the incinerator C, excess air may be bled off from the conduit 71. Thus, the section of conduit 71 between the fan or blower 70 and the bleeder conduit 73 carries enough air to convey the particles efficiently while the valve 72 passes the wood particles and only enough air for efficient combustion. In this embodiment, I prefer to connect the bleeder conduit 73 to the intake side of the fan or blower 70 and a butterfly damper 74 may be inserted in the bleeder conduit 73 to balance the air flow through conduit 73 and valve 72.

Sometimes it is undesirable to introduce the full flow of air from the bleeder conduit 73 into the intake of the fan or blower 70 and in such cases the bleeder conduit 73a is connected to a dust collector 75 which is, in turn, connected to the intake side of the fan 70 through a pipe 76 as shown in FIGURE 5. In such a construction, the wood particles may be introduced into the incinerator system by a separate blow pipe system not shown through the dust collector 75 or may be sucked into the incinerator system through a conduit, not shown, connected to the intake side of the fan or blower 70.

The systems shown in FIGURES 4 and 5 are primarily applicable to installations in which the distance between the incinerator C and fan or blower 70 is relatively short. When relatively long distances are involved it is uneconomical to extend a bleeder conduit 73 back over the entire distance to the fan or blower. FIGURES 6 and 7 show systems particularly adapted for installations in

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which the wood particles travel a long distance from the point of origin to the incinerator.

In the embodiments shown in FIGURES 6 and 7 the main fan or blower 70, main conduit 71, throttle valve 72, bleeder conduit and damper 74 are all substantially identical to those in FIGURES 4 and 5. The principal difference between the embodiments of FIGURES 6 and 7 and those of FIGURES 4 and 5 being the connections of the exhaust ends of the bleeder conduits.

Referring to FIGURE 6, the bleeder conduit 73b is connected to a dust collector 80 which is connected to the conduit 71 by a pipe 81. An air lock 82 is preferably located in the pipe 81. In this embodiment, any wood particles passing into the bleeder conduit 73b are reintroduced into the system from the dust collector 80 through the pipe 81 and air lock 82 until it finally passes through the valve 72 into the incinerator C and is burned.

When only fine particles or dust enter the bleeder conduit, the system shown in FIGURE 7 may be used and the bleeder conduit 73c connected to the incinerator stack S. The excess air is thus exhausted with the combustion gases and the heat in the stack is sufficient to consume the fine particles.

FIGURE 8 shows a modification in which a huge volume of air is used to convey the wood particles from the fan 90 through a large conduit 91. In this system the conduit 91 is connected to a dust collector 92 located adjacent the incinerator C. The air used to convey the particles is exhausted from the dust collector 92 through the vent 93 and the wood particles drop to the bottom of the dust collector 92.

From the dust collector 92 the particles are drawn through a pipe 94 by a relatively small fan or blower 95 and are blown into the incinerator through a relatively small conduit 96 connected to the incinerator conduit 59. An air lock not shown, may be provided in the pipe 94 if desired. The size of the fan or blower 95 and conduit 96 are such that combustion in the incinerator will be maintained and it is apparent that the amount of air entering the incinerator through conduit 96 is entirely independent of the air in conduit 91.

Under some circumstances, the fire in the incinerator shown in FIGURES 1 to 3 can smother and chips can pile up and smolder on the sand floor 52. Gases may be formed and if a flame is introduced into this gas, an explosion may occur. FIGURES 9 and 10 show an embodiment in which smothering of the fire is prevented.

In the embodiment shown in FIGURES 9 and 10, the bottom of the incinerator is formed of fireclay or heat resistant cement and recessed as indicated at 100. A grate 102 or a plurality of separate grate bars are placed over the recess and a conduit 104 connected to a fan or blower 106 is also connected to the recess 100. Air coming from the blower 106 through the conduit 104 enters the recess 100 and blows upward through the grate 102. This causes a forced draft through any chips which come to rest on the grate and prevents smothering of the fire. The recess may be substantially the same size as the incinerator or may be smaller as shown so long as there is no substantial area on which the chips can come to rest away from the air coming through the grate.

I have found that it is also desirable to keep the chips turbulent during burning to prevent any piling up which might have a smothering effect on the fire. To keep the chips agitated, a second conduit 108 is connected to the blower 106 and is connected to a conduit 110 which encircles the incinerator above the grate 102 and below the inlet 59. A plurality of short conduits 112 connected to the conduit 110 extend through the wall of the incinerator.

When the wood chips enter the incinerator through the conduit 59 they tend to circle around the inner wall of the incinerator and gradually drop to the bottom. Air entering through the short conduits 112 breaks up this smooth flow of chips and moves the chips in a turbulent

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fashion during burning. This prevents any substantial piling during operation. These short conduits may be directed radially inward or may be inclined either horizontally or vertically. Suitable control valves or dampers not shown, may be provided in conduits 104 and 110 to regulate the flow of air.

The incinerator shown in FIGURES 9 and 10 may be otherwise substantially identical with that shown in FIGURES 1 to 3.

From the foregoing it will be apparent that I have attained the objects of my invention and have provided a new, safe and efficient furnace for burning small particles of inflammable material. I have also provided an efficient system for conveying the particles and introducing them into the furnace while controlling the amount of air to maintain efficient, continuous combustion. I have also provided a furnace for burning small particles of fuel while preventing smothering of the fire.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

1. A furnace for burning small particles of combustible material comprising an inner side wall shaped to form a substantially vertical combustion chamber of substantially circular horizontal cross-section, means for introducing the particles and the air for combustion adjacent the top of said inner side wall and substantially tangentially thereof, a top wall for said chamber having a vent therein substantially concentric with said side wall, a substantially vertical sleeve secured to said top wall surrounding said vent and extending upward therefrom, an outer wall encircling said inner side wall and said sleeve and secured at its upper end to the upper end of said sleeve, said outer wall being spaced from said inner wall and sleeve to form a water jacket, a stack mounted in said sleeve, and vent openings in said sleeve and said stack whereby steam generated in said water jacket is exhausted through said stack.

2. A furnace as defined in claim 1 including a water cell forming a baffle within the combustion chamber beneath and in alignment with the vent in said top wall, pipe means connecting said cell to the water jacket space formed by the outer wall and means for maintaining water in said water jacket space at a predetermined level.

3. A furnace as defined in claim 1 in which the stack comprises two spaced concentric walls forming a second water jacket, a vent in the inner stack wall adjacent the upper end thereof whereby steam generated in said second water jacket will be exhausted through said stack and means for maintaining water between said stack walls at a predetermined level.

4. A furnace as defined in claim 1 including grate means at the bottom of the combustion chamber and means for directing a stream of air upward through said grate means.

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