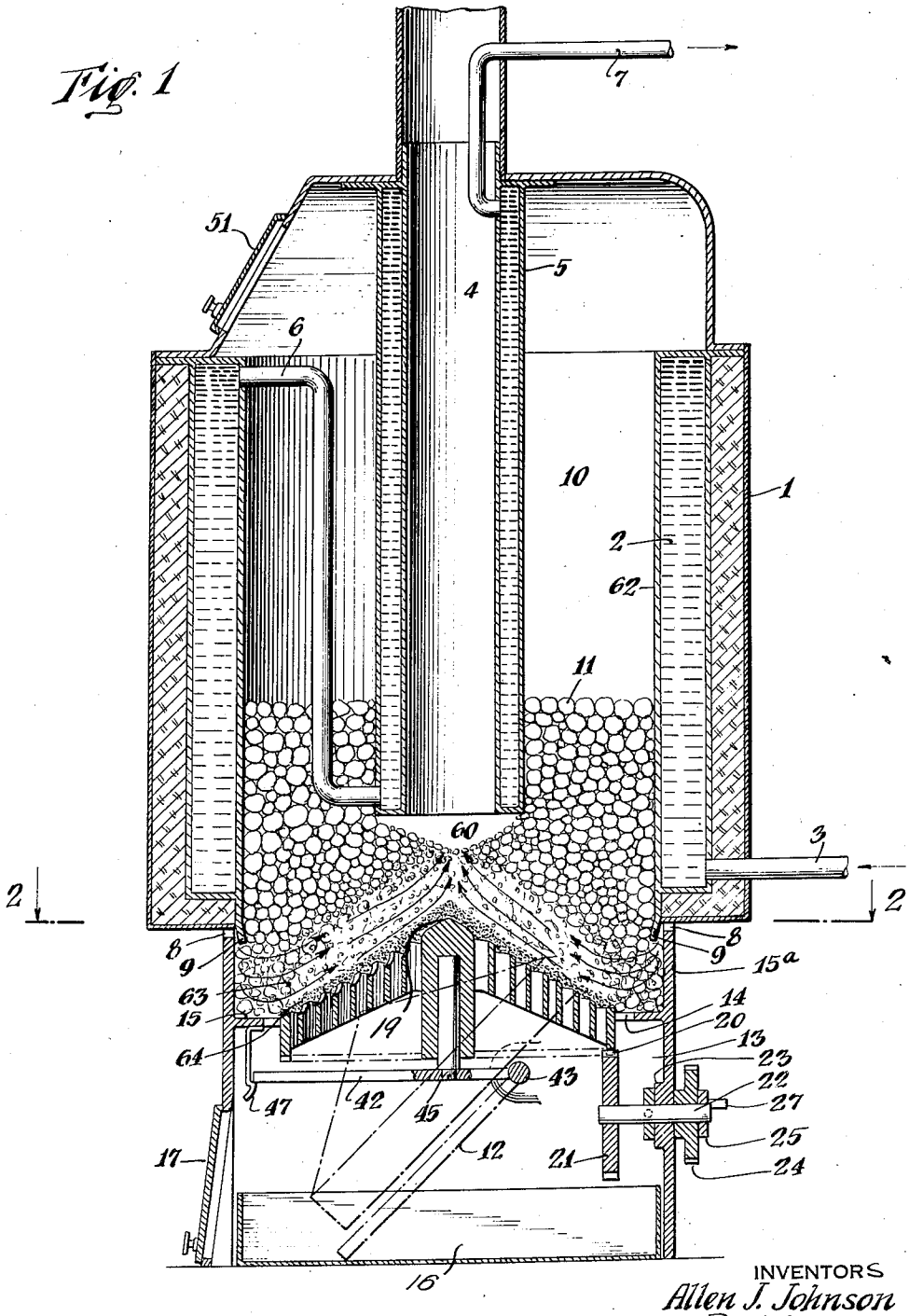
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COMBUSTION HEATER

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Fig. 1



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Fig. 2

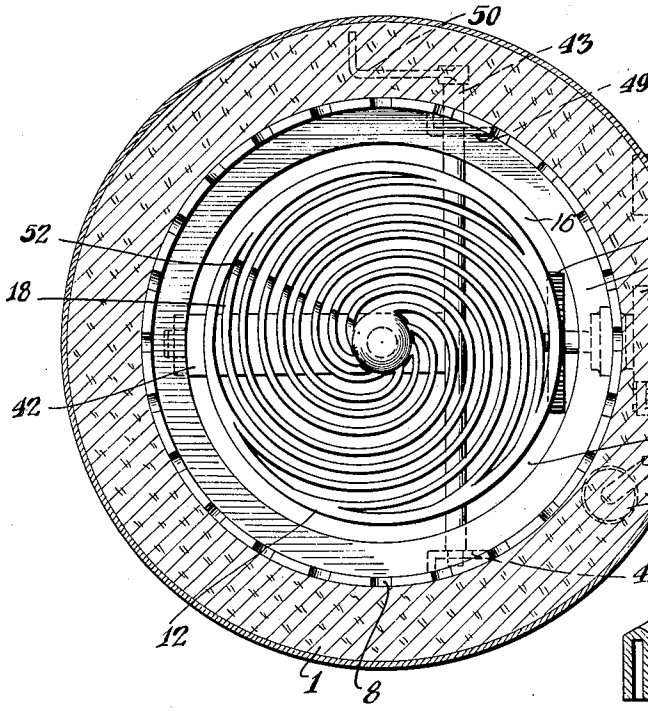


Fig. 4

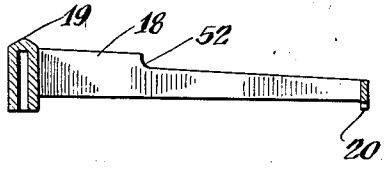
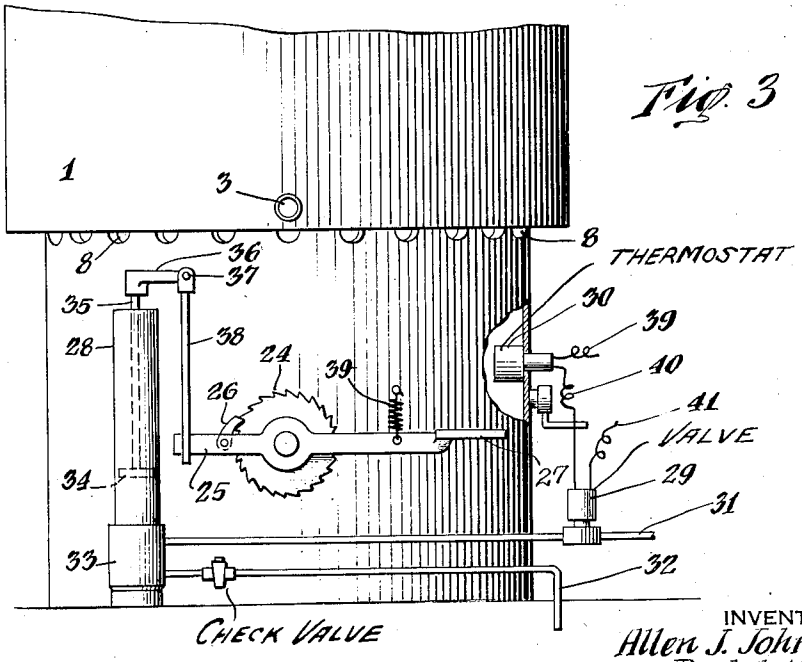


Fig. 3



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2,039,423

COMBUSTION HEATER

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Application March 25, 1935, Serial No. 12,850

4 Claims. (Cl. 110—29)

This invention relates in general to heaters and more particularly to an improved method and means for burning solid fuels.

Heretofore it has been a popularly accepted theory that in the burning of anthracite coal it must first be reduced by heat to gases and the gases then ignited to flame. This fallacious theory was presumably due to the general poor design of conventional heaters in which this transition actually took place because of the design of heater. We have, however, as a result of actual experience, experimentation and ingenious design devised a heater in which the anthracite coal may merely be brought to a glow without the necessity of first reducing it to a gas and igniting the gas. The importance of this advance in fuel combustion will be apparent after a further reading.

The present invention resulted in our design of a heater consisting in an inner and outer water jacket, an internally arranged stack and a fuel support, there being provided a space between the stack or inner jacket and the outer jacket for coal to be stored and fed by gravity to the combustion zone as the coal therein is consumed into ash. While the present invention is basic in connection with other types of heaters, such a heater will be fully described herein so as to demonstrate the application of our principle of combustion.

We are aware that it is an old expedient to provide a heater with inner and outer jackets, an internally located stack and grate supporting the ash, the burning coal, and the unburned coal in the storage chamber between the inner and outer jackets. These heaters have also been used for heating water as well as for other furnaces. The provision of an air supply to the combustion zone and the arrangement of and proportions of the combustion zone itself have, however, in the conventional design been made without an understanding of their influence on the combustion. There has been no scientific attempt to insure an adequate supply of air directly to the combustion zone for supporting the combustion. The admission of air to any other place is entirely useless and harmful as it tends to create an uneven combustion resulting in clinker formation and waste in consumption of fuel. For instance, in those heaters in which the air supply is through the grate from below the air is forced to travel through the ash deposit on the grate and it cannot be hoped that the zone of combustion will be supplied with air equally throughout. The consequence is uneven combustion, waste of fuel and formation of clinker.

Likewise those attempts to feed the air at a level above the grate to support combustion have fallen short of the desired result in that a full appreciation of the problem of combustion was not had; the entrance of and path of flow of air was not restricted to and through the zone of combustion. Because of this failure in design the air travel following the path of least resistance was through the green, or unburned coal rather than through the combustion zone and hence insufficient air was fed to the combustion zone with the attending results of uneven combustion, waste of fuel and formation of clinker.

To overcome these difficulties and other difficulties we arrange the grate, the stack and the storage chamber so that there need be no restriction in the cross section of the storage chamber between the bottom of the stack and the fuel support. Secondly, we virtually seal the ash pit below the fuel support and provide a series of air inlets around the periphery of the heater, and in such relation to the combustion zone as to insure direct admission to the burning fuel. The stack may be vertical throughout or its lower portion vertical and the remainder led out through the back. The bottom of the water jacketed stack is in proximity to the glowing coals and absorbs a high percentage of the radiant heat from the fuel bed, thus reducing the resultant fuel bed temperatures even at high rates of combustion. This prevents unduly high combustion temperatures and resulting clinker. The result of this arrangement is a very shallow combustion zone through which the air supply is directed. Thus in this relatively shallow zone of combustion lying between the completely consumed ash on the fuel support and the unignited coal above, the length of the air path through the active zone of combustion remains practically constant even though the level of the zone varies slightly as the fuel is consumed.

Therefore an object of the invention is to provide a heater including means for causing the solid fuel to burn in such a manner that regardless of the accumulation of ash, the combustion will proceed uniformly in all respects.

Another object is to provide a heater with means for absorbing a high percentage of radiant heat from the fuel bed so that the heater may operate on a low fuel bed temperature irrespective of the rate of combustion.

Another object is to provide a heater with means for causing the maximum completeness

of combustion of the fuel with the minimum of excess air.

Another object is to provide a heater which will be compact in nature and inherently designed for proper combustion at low resultant temperatures irrespective of the rate of combustion and without the necessity of regulating devices.

With the foregoing and other objects in view the invention resides in the combination of parts and in the details of construction hereinafter set forth in the following specification and appended claims, certain embodiments thereof being illustrated in the accompanying drawings, in which:

Figure 1 is a view in vertical section taken through the heating unit;

Figure 2 is a view in horizontal section taken along line 2—2 of Figure 1 and looking in the direction of the arrows;

Figure 3 is a fragmentary view in front elevation of the actuating mechanism for the movable fuel support;

Figure 4 is a detailed view partly in section and partly in elevation of one of the ribs of the spiral fuel support.

Referring more particularly to the drawings, the heating unit comprises an outer insulated case 1, inside of which is mounted coaxially a water jacket 2, having an inlet 3 for cold water near its lower extremity. The heating unit is further provided with a centrally located stack 4 which is surrounded by a water jacket 5. As shown in Figure 1 the stack may extend vertically upwardly past the upper extremity of the heating unit. It is of importance, however, only that the lower end of the stack shall be vertical. The remainder of the stack may be otherwise disposed and extended out through the back of the heater. In the water heating and circulating system shown merely as an example the water enters the water jacket 2 through the pipe 3 and leaves the water jacket near the top thereof through pipe 6 which extends downwardly so as to communicate with the inner jacket 5 near its lower end. There is also provided a water outlet pipe 7 that carries off water from the water jacket 5 at a point near the upper end thereof and on to any desired point for service purposes.

The space 10 between the water jacket 2 and the water jacket 5 provides a storage space for a liberal supply of coal or other solid fuel indicated at 11. Beneath the stack and centrally located with respect to the inner and outer jackets is arranged an inverted conically shaped fuel support. This fuel support is rotatable about its axis. The fuel bed thus rests upon the rotatable fuel support and partly upon an interior circular rib 15 carried on a circular stationary base 15a. The fuel support besides constituting a support for the ash, the burning coal and the reserve coal above it also provides a means by which the ashes may be shaken down from the fire into the ash container 16. The fuel support is concentric with and smaller in diameter than the circular base 15a and is spaced from the rib 15, so that an annular space 13 is left between the outer jacket and the fuel support through which the ash may drop. The fuel support resembles a grate except that the air for combustion does not pass through it. To avoid this the ash pit is virtually sealed against the admission of air so none may pass upwardly through the grate or fuel support.

As shown in the drawings, the fuel support is conical in shape and composed of a series of spiral bars 18. The fuel support is so constructed that when it is rotated or otherwise moved the ash bed above it is agitated in such a manner that the ashes directly above the fuel support either drop through the bars of the fuel support or are impelled toward the edge thereof and allowed to drop through the space 14 and into the space 13 and finally into the ash container 16, which may be withdrawn through an opening normally closed by a door 17. As a preferred embodiment shown in the drawings the fuel support comprises a series of bars 18 that are preferably dished and sloped as shown in Figures 1 and 4. These spiral shaped bars extend spirally from a central hub 19 and extend to a rim which is toothed on the under-side at 20. The spiral bars are preferably so formed as to give uniform space between the adjacent bars. Due to the spiral shape of the bars the fuel support when rotated forces a large part of the ash toward the rim of the fuel support and thence into the ash pit. A shoulder 52 is formed in the upper edge of each bar, these offsets lying in a common radius of the fuel support. The function of these offsets is to break and loosen the arches formed by the compression of the ash and cause it to be discharged uniformly over the entire area of the fuel bed without churning or otherwise mixing the ash with the partially burned coal.

All of the air for supporting the combustion of the fuel enters through the peripheral openings 8 formed in the circular base 15a adjacent the combustion zone. It is to be understood that these air openings may be either in the form of peripheral slots or a series of apertures. In order to prevent these air holes from becoming clogged by reason of accumulation of ash the inner wall 62 of the outer water jacket 2 is provided with a downwardly depending flange or baffle 9, which may form a hood for the apertures. While this flange must necessarily be slightly inclined inwardly this inclination is not sufficient to materially affect the cross-sectional dimensions of the chamber for the reserve fuel. By reference to Figure 1, it will be seen that the cross-sectional dimensions of the space between the inner and outer water jackets is substantially uniform from the top of the heater unit down to the bottom of inner water jacket. It is of particular importance that this space shall not be restricted between the lower edge of the inner water jacket surrounding the stack and the fuel support. This arrangement has been found to be the means of producing highly efficient combustion and appreciably aids in the proper disposition and disposal of the ashes from combustion chamber into the ash pit beneath the fuel support. This arrangement also provides for a relatively small or negligible combustion space as indicated at 60. In other words, the water jacketed stack practically rests on, or is disposed slightly above the glowing bed of coal so as to directly absorb a high percentage of the radiant heat of the glowing fuel bed.

This absorption of heat reduces the temperature of the glowing bed of fuel even at high rates of combustion, making it possible to operate the heater at low resultant fuel bed temperatures, irrespective of the rate of combustion. With the combustion space thus defined at 60, the ash deposit on the fuel support is indicated at 64 while the zone of combustion is indicated at 63 between the ash deposit and the unburned coal in the reserve chamber. This relatively shallow zone of

combustion is the ideal condition for the burning of coal and makes it possible to bring the coal to a red glow directly rather than by reducing it by heat to a gas and then igniting the gas. This method of burning coal reduces it to a completely consumed ash condition without the formation of clinker in that it is gradually and thoroughly consumed rather than being subjected to an uneven and spasmodic combustion. Thus all the air that may enter the heating unit is definitely restricted to an entrance through the peripheral openings 8. Due to the arrangement of the stack the air flow must necessarily follow a relatively shallow path indicated by the arrows in Figure 1 or, in other words, the air must pass through the active combustion zone between the reserve fuel and the ash deposit on the fuel support. This path of air travel is substantially parallel to the inclined surfaces of the fuel support, until the air finally reaches the combustion space 60 and carries off the products of combustion through the stack. In other words, the air is admitted only into the restricted region where it is needed, i. e., through the combustion zone. This is an important feature in that it gives the heating unit a restricted condition of combustion predetermined by the inherent design of the heating unit rather than by the condition of the fuel bed itself. The apertures or slots 8 act as orifices that admit air in predetermined volume at all times. Inasmuch as combustion temperatures are directly proportionate to air supply the present invention affords at least two factors by which it is possible to keep the combustion temperature below the clinker temperature, namely, type and location of the air admission. The predeterminedly restricted admission of the air supply through the side apertures 8 prevents air from reaching the fire in sufficient amount to cause clinker. This is so because no matter how high the pull of the stack may be there is a very definite limit to the volume of air admitted. Thus the location of and the type of means for air admission to the combustion zone are two essential features in arriving at the desired type of combustion.

As stated before, the outer cylinder 2 is water jacketed to afford a maximum utilization of the heat produced, but more essentially to maintain minimum temperatures in the fuel bed and in the reserve fuel, in the former to prevent clinkering and in the latter to prevent premature ignition. The stack is also water jacketed and mounted so close to as to approximately rest on the live fuel bed so as to constitute the principal heat absorbing surface. The water jacket serves to keep the temperatures of the fuel bed and reserve fuel as low as possible irrespective of the rate of combustion.

The above described construction is suitable for practising the improved process of combustion. Due to the close proximity of the water-cooled surfaces of the burning fuel the maximum temperature attained seldom, if ever, exceeds 2000° F. and since no anthracite, and few if any other solid fuels will fuse at this temperature the resulting ash is a soft powder which is compressed into a dense mass by the weight of the fuel lying directly upon it. The ash is thereby made to occupy a minimum space and even after a fairly large quantity is accumulated the air entering the slot or openings 8 passes around the edge of flange 9 with little difficulty. The air travels through the combustion zone which lies immediately upon the compressed ash. From here it is drawn readily through the inter-spaces between the burning pieces of fuel to the combustion space 60 and thence outwardly through the stack.

As may be seen by reference to Figure 1, the length of the air path indicated by the arrows through the combustion zone remains practically constant regardless of the relative height of the combustion zone. This favorable condition would continue unless the gradual accumulation of ash were to fill the entire space between the fuel support and a horizontal plane through the stack opening. This could occur only after an unusually long time interval of combustion so that in practice it becomes necessary to discharge the ash by manipulation of the fuel support, at infrequent intervals.

As distinguished from known methods, the present arrangement provides for the maintenance of a substantially uniform length of air path through the burning fuel instead of a progressively shorter one as the ash accumulates. Also by properly proportioning the size of the fuel to the dimensions of the furnace, it is possible in the present arrangement to completely burn the fuel with a minimum excess of air.

As shown in Figures 2 and 3, the discharge of ash may be accomplished by the rotation of the fuel support by means of gears 20 and 21 and shaft 22. Gear 21 meshes with the teeth 20 on the under-side of the fuel support so that a rotation of gear 21 imparts a rotation of the fuel support. This gear is carried by a shaft 22 which is supported by bearings 23 in the outer jacket. Shaft 22 also carries a ratchet wheel 24 and a lever 25. This lever 25 also carries a pivotal pawl 26 which co-acts with ratchet wheel 24 so as to prevent rotation of the fuel support in a reverse direction. The lever 25 is also provided with a foot pedal 27 so that as the foot pedal is worked up and down intermittent rotation is imparted to the fuel support, causing the ash to be worked down into the ash receiver 16.

If it be desired to avoid the use of a mechanically operated foot pedal for shaking down the ashes, a motor may be employed such as the hydraulic piston type motor indicated at 28. This hydraulic motor may be regulated by an electrically operated valve 29 and either by an internally located thermostat 30 or a time switch of any conventional type or by means of a thermostat placed in the ash pit of the unit so that it may react to variance in temperature due to the presence of live coals or dead ash in the ash pit. If the hydraulic motor is used for this purpose, there may be provided a supply pipe 31 for bringing liquid under pressure and a drain pipe 32 for draining off the same from the cylinder 33. The hydraulic piston shown in dotted lines at 34 transmits motion to the piston stem 35 and thence to the bracket 36, to which is pivotally connected at 37 an operating rod 38 which is connected to the lever 25 for bringing about the same results accomplished by the operation of the foot pedal as previously described.

Referring to Figure 3, rotation of the lever about shaft 22 as a pivot is resisted by a tension spring 39 connected to the lever and to the casing. It is clear that a rotation of the lever in a clockwise direction, either as a result of a manual operation of the foot pedal downwardly or an upward pull on the other side of the lever by the operation of the hydraulic piston will cause the pawl 26 to engage ratchet wheel 24 so as to rotate the shaft 22 and impart this rotary

motion to the fuel support through the medium of gear 21 fixed to the shaft. The wires 39, 40 and 41 represent leads to a suitable supply of electric current.

In case the fire should become accidentally or purposely extinguished it will be necessary to empty the furnace of the contents in order to start a new fire. This is facilitated by the provision for tilting and lowering the fuel support to the dumping position shown in dotted lines in Figure 1. For this purpose the fuel support is pivoted upon a pin 45 which is secured to a bar 42. This bar is attached at one end of a cross shaft 43 and held at the other end by a spring catch 47. The shaft 43 turns in bearings 48 and 49 in the base. When the catch is released the fuel support may be swung down using a hand lever 50 if necessary, the ash and fuel falling into the ash pan.

Besides the door 17 for removal of ashes, there is also provided a door 51 for closing the opening provided for introducing the solid fuel into the storage chamber 10. Both of these doors are normally kept closed so as to seal the unit from admission of air therein. When starting a fire in the unit it is preferable to first put a bed of ashes on the fuel support and then put paper or charcoal on top of the ashes and ignite the same. A small amount of coal or other solid fuel is then added and as soon as this is ignited and burning well the unit may then be filled with fuel up to the top of the storage chamber 10.

It has been found in actual practice that the ashes need be shaken down only once about approximately every 48 hours. The coal supply may be replenished when the coal chamber is about one-half empty.

We claim:

1. In a combustion device for solid fuel, a vertical annular jacket, a fuel support having an inwardly and upwardly inclined surface extending into the lower portion thereof, a fuel storage chamber above said support provided by said jacket, a base surrounding said fuel support extending approximately to the level of the top thereof and supporting said jacket, said base having circumferentially arranged restricted air inlets in substantially the same plane at a level above and in proximity to the adjacent outer edge of said fuel support, a draft inducing stack mounted in said jacket above said air inlets and above the inclined surface of said fuel support, said base being substantially sealed from admission of air below said fuel support, whereby the volume of admitted air is predetermined and its flow above the compressed ash is restricted to follow a path substantially parallel to the upper surface of said fuel support to provide a resulting relatively shallow zone of combustion defined by the ash deposit and the reserve fuel and the combustion zone is maintained substantially constant in depth in the direction of the air flow from the inlets to the stack.

2. In a combustion device for solid fuel, a vertical annular jacket, a fuel support having an inwardly and upwardly inclined surface extending into the lower portion thereof, a fuel storage chamber above said support provided by said jacket, a base surrounding said fuel support extending approximately to the level of the top thereof and supporting said jacket, said base having circumferentially arranged restricted air inlets constituting the sole means of air supply and arranged at a level above and in proximity to the adjacent outer edge of said fuel support, a draft inducing stack mounted in said jacket above the level of said air inlets and above and in close proximity to the fuel bed therebeneath and also substantially directly above the level of the inclined surface of said fuel support, said base being substantially sealed from admission of air below said fuel support, whereby the volume of admitted air is predetermined and its flow above the compressed ash is restricted to follow a path substantially parallel to the upper surface of said fuel support to provide a resulting relatively shallow zone of combustion defined by the ash deposit and the reserve fuel and the combustion zone is maintained substantially constant in depth in the direction of the air flow.

3. In a combustion device for solid fuel, a vertical annular jacket, a fuel support having an inwardly and upwardly inclined surface extending into the lower portion thereof, a fuel storage chamber above said support provided by said jacket, a base surrounding said fuel support extending approximately to the level of the top thereof and supporting said jacket, said base having circumferentially arranged restricted air inlets constituting the sole means of air supply and arranged at a level above and in proximity to the adjacent outer edge of said fuel support, a draft inducing stack, the lower portion of which is vertical and mounted in said jacket above the level of said air inlets and above and in close proximity to the fuel bed therebeneath and also substantially directly above the level of the inclined surface of said fuel support, said base being substantially sealed from admission of air below said fuel support, whereby the volume of admitted air is predetermined and its flow above the compressed ash is restricted to follow a path substantially parallel to the upper surface of said fuel support to provide a resulting relatively shallow zone of combustion defined by the ash deposit and the reserve fuel and the combustion zone is maintained substantially constant in depth in the direction of the air flow.

4. In a combustion device for solid fuel, a vertical annular jacket, a fuel support having an inwardly and upwardly inclined surface extending into the lower portion thereof, a fuel storage chamber above said support provided by said jacket, a base surrounding said fuel support extending approximately to the level of the top thereof and supporting said jacket, said base having circumferentially arranged restricted air inlets constituting the sole means of air supply and arranged at a level above and in proximity to the adjacent outer edge of said fuel support, a draft inducing stack, the lower portion of which is vertical and mounted in said jacket above the level of said air inlets and above and in close proximity to the fuel bed therebeneath and also substantially directly above the level of the inclined surface of said fuel support, said base being substantially sealed from admission of air below said fuel support.

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