126-77 CROSS REFERENCE SEARCH ROOM

Dec. 14, 1948. W. A. STUCKEY ET AL 2,456,570

SMOKELESS HEATER FOR BURNING COAL AND OTHER SOLID FUEL

Filed Oct. 21, 1946 3 Sheets-Sheet 1

Fig. 1

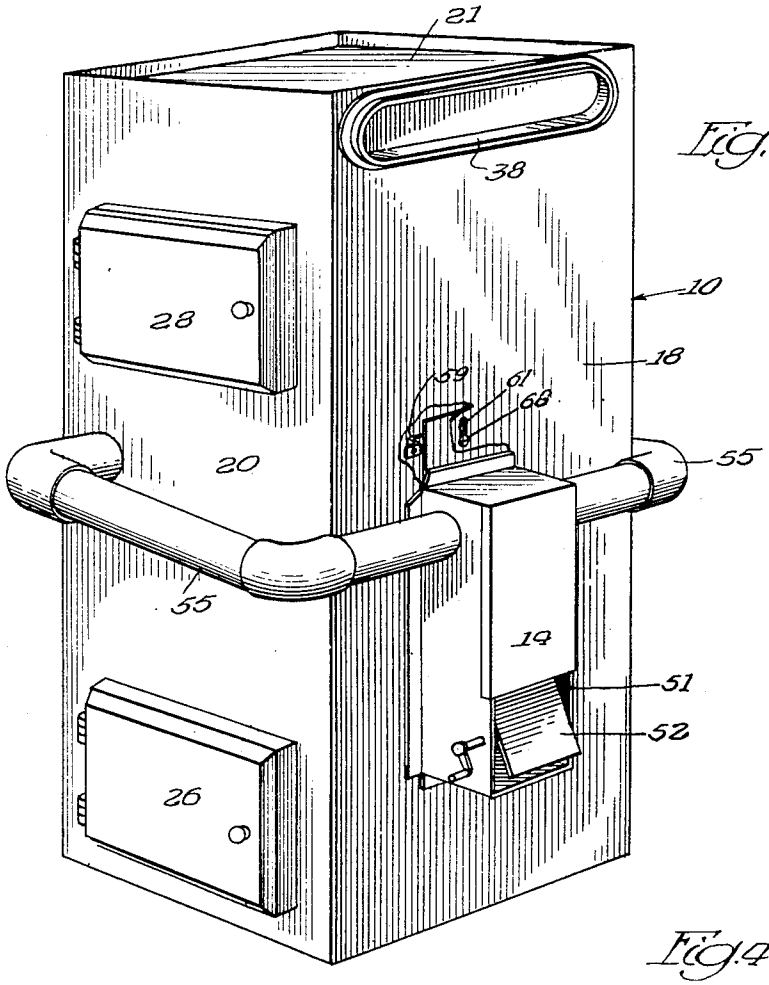
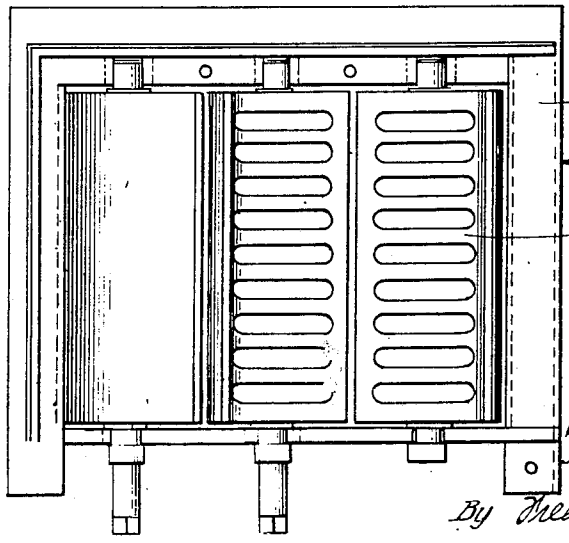


Fig. 4



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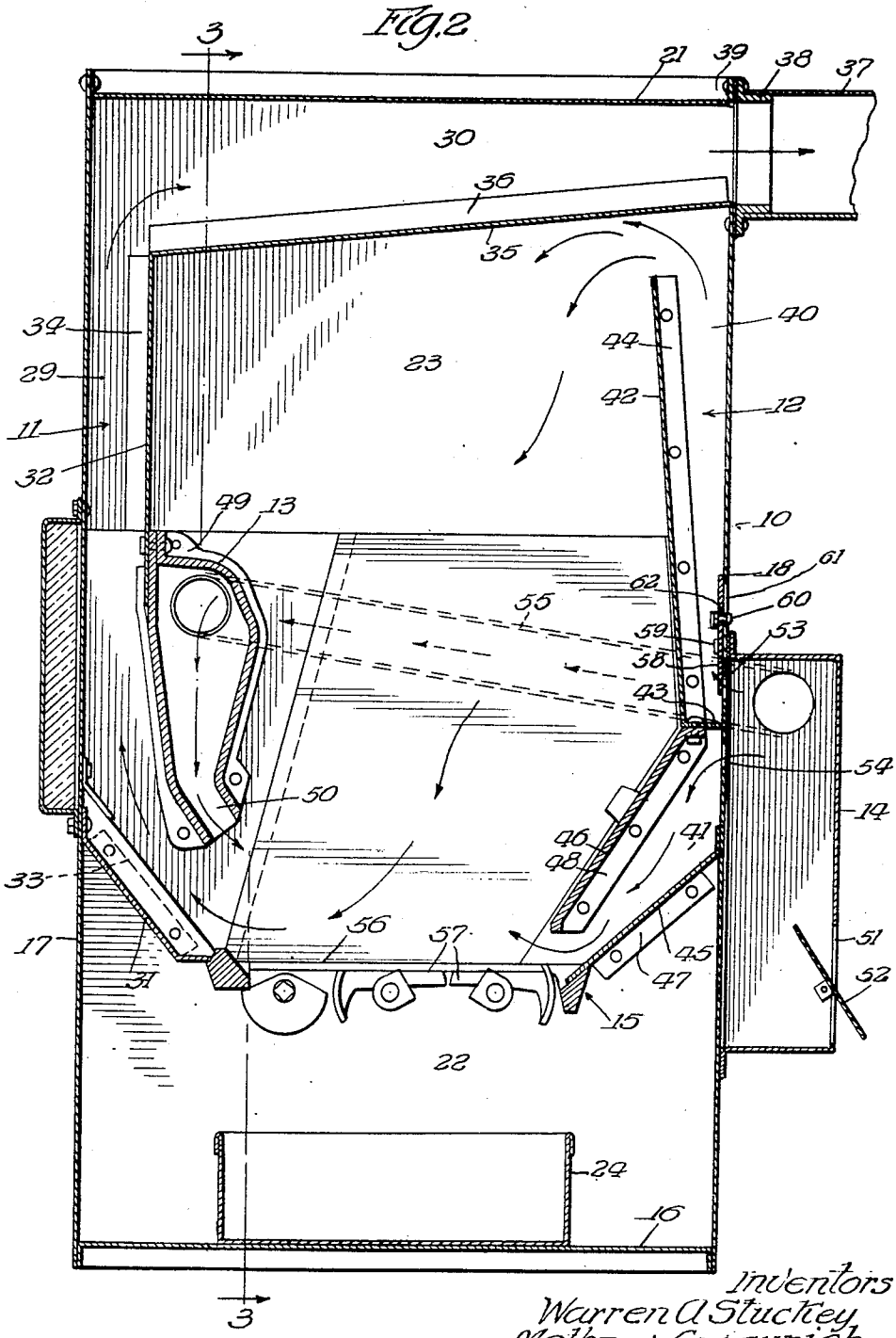
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SMOKELESS HEATER FOR BURNING COAL AND OTHER SOLID FUEL

Filed Oct. 21, 1946 3 Sheets-Sheet 2

Fig. 2



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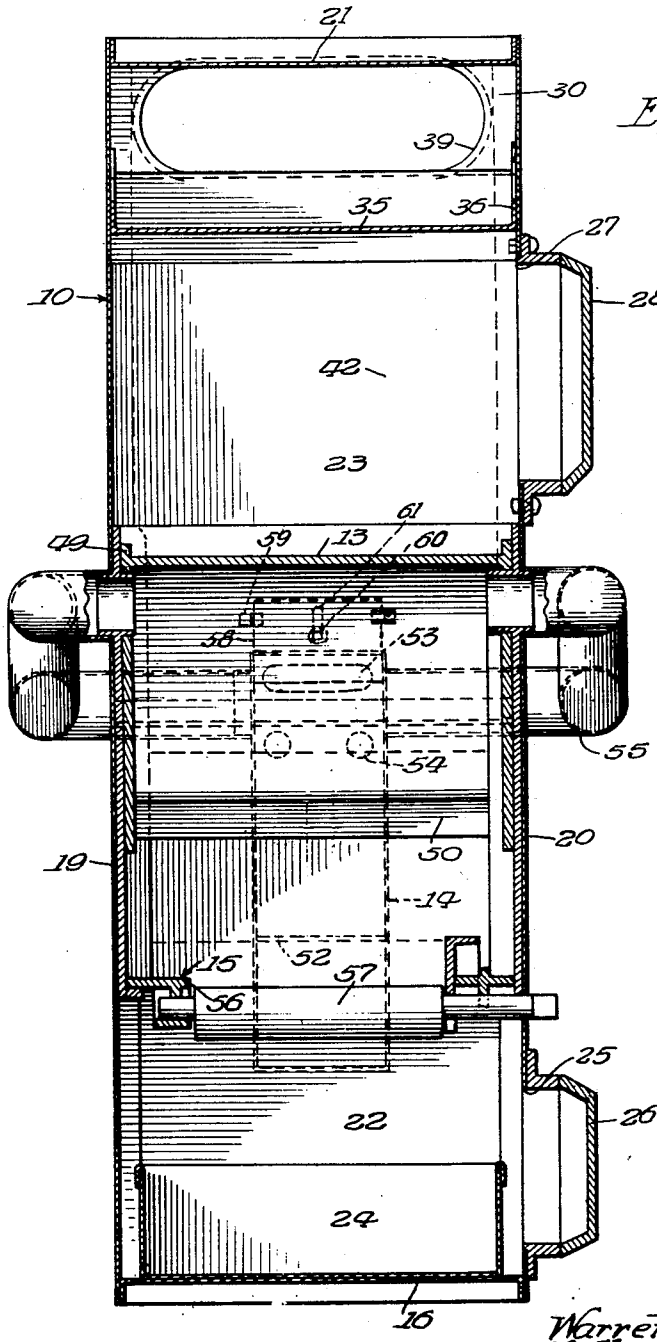


Fig. 3

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2,456,570

UNITED STATES PATENT OFFICE

2,456,570

SMOKELESS HEATER FOR BURNING COAL AND OTHER SOLID FUEL

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Application October 21, 1946, Serial No. 704,586

4 Claims. (Cl. 126—77)

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The present invention relates generally to heaters for burning coal and other solid fuel. More particularly the invention relates to that type of heater which is known in the art as a smokeless heater, serves as a space heating medium or instrumentality and as its component parts comprises: (1) a vertically elongated box-like shell having an ash chamber in the lower portion thereof, a combination fuel and combustion chamber in its central portion, and a grate between the two chambers; (2) an outlet duct for the products of combustion leading upwards from a point directly above the grate to a flue adjacent the top wall of the shell; (3) a duct arrangement opposite the outlet duct for admitting outside primary air into the upper part of the combination fuel and combustion chamber and outside primary air into the lower part of such chamber; and (4) a horizontally extending conduit which is located directly inwards of the lower or inlet end of the outlet duct and is connected and arranged to deliver outside secondary air into the lower part of the combination fuel and combustion chamber.

One object of the invention is to provide a heater of this type which is generally an improvement upon, and has certain advantages over, previously designed smokeless coal heaters of the same general character and is characterized by the fact that it is highly efficient in operation, embodies simple and novel means for controlling the supply of primary air and secondary air and is so designed and constructed that puffing in connection with operation of the heater is effectively eliminated.

Another object of the invention is to provide a smokeless heater of the last mentioned character in which the means for controlling the supply of primary air and secondary air comprises a single air distribution box which is mounted on, and disposed exteriorly of, the shell, embodies a damper controlled air inlet and has the interior thereof connected to the duct arrangement for the primary air and the conduit for the secondary air.

Another object of the invention is to provide a smokeless heater of the aforementioned type and character in which the air distribution box is mounted on the portion of the shell that is adjacent the duct arrangement and the connection for establishing communication between the interior of the box and the branch of the duct arrangement that serves to supply the upper primary air into the upper part of the combination fuel and combustion chamber is in the form

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of a hole which is formed in the aforesaid portion of the shell and is controlled by a slidably mounted shutter plate in order that the proportion or amount of upper primary air may be varied to take care of the burning of low, medium or high volatile coal or other solid fuel in the heater.

A further object of the invention is to provide a smokeless heater of the type and character under consideration in which the lower end of the outlet duct and the lower end of the branch of the duct arrangement that serves to supply the lower primary air are downwardly and inwardly inclined to the end that there is a restriction between the ash and combustion chambers and it is hence possible so to reduce the size of the grate that undesirable air currents tending to produce puffing are eliminated.

A still further object of the invention is to provide a smokeless heater which is generally of new and improved construction and is so designed that it is highly efficient in operation and may be produced or fabricated at a comparatively low cost.

Other objects of the invention and the various advantages and characteristics of the present smokeless heater will be apparent from a consideration of the following detailed description.

The invention consists in the several novel features which are hereinafter set forth and are more particularly defined by claims at the conclusion hereof.

In the drawings which accompany and form a part of this specification or disclosure and in which like numerals of reference denote corresponding parts throughout the several views:

Figure 1 is a rear perspective view of a smokeless heater embodying the invention, certain portions of the shell of the heater being broken away in order to disclose the construction and arrangement of the slidably mounted shutter plate for controlling the effective or operative size of the hole that establishes communication between the interior of the air distribution box and the branch of the duct arrangement that serves to introduce primary air into the upper part of the combination fuel and combustion chamber;

Figure 2 is a vertical longitudinal section illustrating in detail the construction, design and arrangement of the outlet duct, the primary air duct arrangement, the secondary air conduit, and the common air distribution box;

Figure 3 is a vertical transverse section taken on the line 3—3 of Figure 2 and showing in detail the manner in which the air distribution box is

connected to the conduit for the secondary air; and

Figure 4 is a plan view of the grate of the heater.

The heater which is shown in the drawings constitutes the preferred form or embodiment of the invention. It is essentially designed for use as a space or room heater and may be fired with bituminous coal, coke, anthracite coal or any other type of solid fuel. As its principal components or parts the heater comprises a shell 10, an outlet duct 11 for the products of combustion, a duct arrangement 12 for introducing primary air, a conduit 13 for introducing secondary air, an air distribution box 14 for supplying primary air to the duct arrangement 12 and secondary air to the manifold 13, and a grate 15.

The shell 10 is vertically elongated and has a box-like contour or configuration. It is preferably formed of plate or heavy sheet metal and consists of a bottom wall 16, a front wall 17, a back wall 18, a pair of side walls 19 and 20 and a top wall 21. The bottom wall 16 embodies a down turned marginal flange and is adapted to rest on the floor of the space or room to be heated. The front wall 17 and the back wall 18 are arranged in opposed relation and have the lower margins thereof welded or otherwise fixedly secured to the front and rear portions of the down turned marginal flange of the bottom wall 16. The side walls 19 and 20 extend between and at right angles to the front and back walls 17 and 18 and have the side margins thereof suitably connected to the side margins of the last mentioned walls. They are disposed in opposed and parallel relation and have the lower margins thereof suitably secured to the side portions of the down turned marginal flange of the bottom wall 16. As shown in the drawings the shell 10 is deeper than it is wide. In other words, the shell is horizontally elongated from front to back. The top wall 21 has an upturned marginal flange and this is suitably secured to the upper marginal portions of the front, back and side walls of the shell. The lower portion of the shell interior constitutes an ash chamber 22 and the central interior portion of the shell constitutes a combination fuel and combustion chamber 23. These two chambers are separated by way of the grate 15. The upper portion of the chamber 23 constitutes a fuel space and the lower portion of the chamber is a combustion space. A receptacle 24 for receiving and collecting ashes may, if desired, be positioned in the ash chamber 22 beneath the grate 15. Access to the ash chamber 22 is provided by way of an opening 25 on the lower portion of the shell side wall 20. This opening is normally closed by way of a hinged door 26 and is sufficiently wide to permit the receptacle 24 to be inserted into and removed from the ash chamber 22. Access to the upper portion of the chamber 23, i. e., the fuel space, is provided by way or means of an opening 27 in the shell side wall 20. This opening is located an appreciable distance above the door-closed opening 25 in the lower portion of the shell side wall 20 and is normally closed by way of a hinged door 28. When the latter is opened coal may be introduced into the chamber 23 via the opening 27.

The outlet duct 11 serves as a discharge medium for the products of combustion that result from burning of the fuel in the combustion space of the chamber 23. It embodies a vertically extending branch 29 along the central and upper portions of the front wall 17 of the shell and a horizontally extending branch 30 beneath the shell top wall 21. The vertically extending branch 29 of the duct 11 is defined by said central and upper portions of the shell front wall 17 together with the conduit 13, a plate 31 and a plate 32. The manifold 13 is spaced a comparatively small distance inwards from the central portion of the shell front wall 17 and extends between, and is secured to, the shell side walls 19 and 20, as hereinafter described more in detail. The plate 31 is located beneath the manifold 13 and extends downwards and inwards from the shell front wall 17. It defines with the conduit 13 the lower end of the vertically extending branch 29 and also the inlet for the outlet duct 11. The upper marginal portion of the plate 31 is welded, riveted or otherwise fixedly secured to the adjacent portion of the shell front wall 17. The side margins of the plate 31 are bent at right angles to form flanges 33 and these are secured to the adjacent portions of the shell side walls 19 and 20. The lower marginal portion of the plate 31 abuts against, and is secured to a portion of, the grate 15. The plate 32 is located for the most part above the manifold 13 and is disposed slightly inwards of, and in parallel relation with, the upper portion of the front wall 17 of the shell 10. The lower marginal portion of the plate 32 is suitably secured to the upper portion of the conduit 13 and the side margins of the plate 32 are bent at right angles to form flanges 34 which are suitably secured to the adjacent portions of the shell side walls 19 and 20. The plate 32 defines with the adjacent portion of the shell front wall the upper end of the vertically extending branch 29 of the outlet duct 11. The horizontally extending branch 30 of the outlet duct is defined by the shell top wall 21 and a subjacent plate 35. Said plate 35 is forwardly and downwardly inclined to a slight extent and defines the top of the combination fuel and combustion chamber 23. The front marginal portion of the plate 35 is secured to the upper marginal portion of the plate 32 and the side marginal portions of said plate 35 are bent upwardly at right angles to form flanges 36 which are suitably secured to the upper portions of the shell side walls 19 and 20. The rear end of the horizontally extending branch 30 of the outlet duct 11 is connected to a flue 37 by way of a tubular nipple 38. The latter is connected to the upper portion of the shell back wall 18 and communicates with the rear end of the horizontally extending branch 30 by way of an opening 39 in said upper portion of the shell back wall. When the heater is in operation the products of combustion flow into the lower end of the vertically extending branch 29 of the outlet duct, then flow upwards through said branch and then flow rearwards through the horizontally extending branch 30 into the flue 37. It is contemplated that the products of combustion will be discharged to outside atmosphere after travelling through the flue 37. As illustrated and hereinbefore indicated, the inlet end of the outlet duct 11 is downwardly and inwardly inclined and communicates with the chamber 23 at a point directly above the grate and beneath the lower portion of the manifold.

The duct arrangement 12 serves, as hereinafter described more in detail, to admit primary air into the upper part of the combination fuel and combustion chamber 23 and primary air into the lower part of said chamber. It is disposed directly inwards of the back wall 18 of the shell 10 and consists of an upwardly extending upper branch 40 and a downwardly and inwardly inclined lower

branch 41. The upper branch 40 of the duct arrangement 12 is defined by the upper portion of the shell back wall 18, a substantially vertically extending plate 42 and a horizontally extending partition-forming plate 43 and has the upper end thereof open and in communication with the upper part of the combination fuel and combustion chamber. The plate 42 is spaced inwards from the upper portion of the shell back wall and has its side margins bent at right angles to form flanges 44 which are fixedly secured to the adjacent portions of the shell side walls 19 and 20. The upper margin of the plate 42 is disposed a comparatively small distance below the plate 35 in order to effect communication between the upper end of the upper branch 40 of the duct 12 and the upper part of the chamber 23. The partition forming plate 43 is connected to, and extends outwards from, the lower marginal portion of the plate 42. It is connected to the adjacent portion of the shell back wall 18 and serves to divide or separate the upper and lower branches of the duct arrangement 12. The primary air for supply to the upper part of the chamber 23 enters the lower end of the upper branch 40 of the duct arrangement 12, as hereinafter described, then flows upwards through said upper branch and finally around the upper marginal portion of the plate 42 into the upper part or fuel space of the chamber 23. From the upper part of the combination fuel and combustion chamber the primary air flows downwards through the bed of coal in order to promote combustion of the coal that is being burned in the heater. The lower branch 41 of the duct arrangement 12 is defined or formed by a pair of spaced apart and downwardly and inwardly inclined plates 45 and 46. The plate 45 is located an appreciable distance beneath the partition forming plate 43 and extends downwards and inwards from the shell back wall 18. The side margins of the plate 45 are bent at right angles to form flanges 47 which are secured to the adjacent portions of the shell side walls 19 and 20. The lower marginal portion of the plate 45 is connected to a part of the grate 15, as described hereafter. The plate 46 overlies the plate 45 and extends downwards and inwards from the inner marginal portion of the partition forming plate 43. The side margins of the plate 46 are bent at right angles to form flanges 48 which are riveted or otherwise fixedly secured to the adjacent portions of the the shell side walls 19 and 20. The lower marginal portion of the plate 46 is spaced from the lower marginal portion of the plate 45 and defines therewith a primary air outlet for the lower branch 41 of the duct arrangement 12. Such outlet, as best shown in Figure 2, is disposed directly over the grate 15 with the result that the primary air which is introduced into the lower branch 41 of the duct arrangement, as described more in detail hereafter, sweeps horizontally over the grate in the direction of the inlet end of the vertically extending branch 29 of the outlet duct 11. The exposed portions of the partition forming plate 43 are imperforate to the end that none of the primary air that is supplied to or enters the lower branch 41 of the duct arrangement 12 flows into the upper branch 40.

The conduit 13 which, as heretofore pointed out, assists in defining the lower end of the vertically extending branch of the outlet duct 11, extends between the shell side walls 19 and 20 and is preferably in the form of a two-piece metal casting. It is vertically elongated, as shown in

Figure 2, and has at its ends right angle flanges 49 which are secured to the adjacent portions of the shell side walls. The lower portion of the conduit 13 is shaped to form a full length downwardly and inwardly inclined slot-like discharge opening 50. The latter is located an appreciable distance above the outlet end of the lower branch 41 of the primary air duct arrangement 12, and is inclined downwards and inwards at substantially the same angle as the plate 31 which, together with the lower portion of the conduit 13, defines the inlet end of the vertically extending branch 29 of the outlet duct 11 for the products of combustion. When secondary air is supplied to the conduit 13, as hereinafter described, it flows downwards and then is discharged into the bed of coal on the grate 15 via the discharge opening 50. As shown in the drawings the secondary air conduit 13 has its interior closed against communication with the chamber 23 except for the discharge opening 50.

The air distribution box 14 serves as or constitutes single or common means for controlling the supply of primary air to the duct arrangement 12 and secondary air to the conduit 13. It is vertically elongated, as shown in the drawings and is disposed externally of, and is suitably fixedly secured to, the central portion of the shell back wall 18. The lower end of the box 14 embodies a single inlet 51 whereby outside of ambient air is permitted to enter the interior of the box. A pivotally mounted damper 52 serves to control the flow of air through the inlet 51. This damper may be controlled manually or, if desired, thermostatically, and serves to control or vary the amount of air entering the box 14 via the inlet 51. The upper end of the interior of the box 14 communicates with the lower end of the upper branch 40 of the duct arrangement 12 by way of a hole 53 in the shell back wall 18, communicates with the upper end of the lower branch 41 of said duct arrangement 12 by way of holes 54 in said shell back wall and communicates with the upper portion of the interior of the conduit 13 by way of a pair of pipes 55. The hole 53 is horizontally elongated as shown in Figure 3. It is formed in the back wall 18 of the shell 10 at a point directly above the partition forming plate 43 and permits a portion of the air that enters the box 14 to flow into the upper branch 40 of the duct arrangement 12 as primary air. The holes 54 are formed in the shell back wall 18 at a point directly beneath said partition forming plate 43 and permit a portion of the air that enters the box 14 to flow into the lower branch 41 of the duct arrangement 12 as primary air. The central portions of the pipes 55 are disposed outwards of, and in parallel relation with, the central portions of the shell side walls 19 and 20 and the rear or receiving ends of the pipes 55 extend inwards at right angles and are connected to, and communicate with the interior of, the upper end of the air distribution box 14. The front or discharge ends of the pipes 55 extend inwards from, and at right angles to, the central portions of the pipes, extend through registering holes in the central portions of the shell side walls 19 and 20 and the ends of the conduit 13 and communicate with the upper end portions of the interior of said conduit. When the damper 52 is open while the heater is in operation a portion of the air that goes into the box 14 via the air inlet 51 flows into the conduit 13 via the pipes 55 as secondary air, as hereinbefore pointed out. The damper 52 serves to control the amount of air

entering the box 14 which, in turn, supplies the primary air to the duct arrangement 12 and the secondary air to the conduit 13. The size of the holes 53 and 54 and the pipes 55 determine the amount or proportion of air that enters the upper branch 40 of the duct arrangement 12 as primary air, the amount or proportion of the air that enters the lower branch 41 as primary air and the amount or proportion of the air that enters the conduit 13 as secondary air. By employing the air distribution box 14 with its damper controlled single air inlet 51 the design or construction of the heater as a whole is materially simplified and the control of both primary air and secondary air is readily effected. When it is desired to effect rapid burning of the fuel in the chamber 23 the damper 52 is opened and when it is desired to curtail burning of the fuel the damper is swung into a partially closed position.

The grate 15 is disposed between the ash chamber 22 and the chamber 23 and consists of a rectangular frame 56 and a plurality of side by side grate bars 57. The front portion of the frame is suitably secured to the lower marginal portion of the plate 31 and the side portions of the frame are suitably secured to the adjacent portions of the shell side walls 19 and 20. The rear portion of the grate frame 56 is secured in any suitable manner to the lower marginal portion of the plate 45, which, as heretofore pointed out, defines with the plate 46 the lower branch 41 of the primary air duct arrangement 12. The grate bars 57 are preferably three in number and have trunnions at their ends whereby they are pivotally connected to the side portions of the frame 56 of the grate. Certain of the trunnions extend or project through holes or apertures in the shell side wall 20 and have polygonal outer extremities whereby the bars may be rocked by a suitable tool in order to effect discharge of ashes into the receptacle 24 in the ash chamber 22. By having the inlet end of the outlet duct 11 and the lower branch 41 of the duct arrangement 12 downwardly and inwardly inclined it is possible so to reduce the size of the grate as a whole that undesirable air currents tending to produce puffing in connection with operation of the heater are effectively eliminated.

In order to vary the effective size of the hole 53 and thus control the proportion or amount of upper primary air that is delivered into the upper part or fuel space of the chamber 23 by way of the branch 40 of the duct arrangement 12 a shutter plate 58 is provided. This shutter plate serves as a valve and fits flatly against the inner face of the shell back wall 18 at a point adjacent the hole 53. It is mounted for vertical sliding movement by way of a pair of opposed L-shaped lugs 59 and is secured in its various adjusted positions by way of a bolt 60, the shank of which extends through a vertical slot 61 in the shell back wall 18 and into an internally threaded hole 62 in the upper end of the shutter plate 58. When the bolt is loosened the plate may be raised or lowered so as to increase or decrease the effective area of the hole 53. Tightening of the bolt results in the shutter plate being locked in place. The lower end of the shutter plate extends across the hole 53, as best shown in Figure 3 of the drawings. The upper end of the plate is extended so that it serves at all times to close the slot 61 regardless of the position of the plate. When low volatile solid fuel is burned in the heater the shutter plate is adjusted downwards so as to close off a major portion of the hole 53. When fuel of

medium volatility is being burned in the heater the shutter plate is adjusted into an intermediate position wherein it serves to expose approximately fifty percent of the area of the hole 53. When high volatile fuel is being burned in the heater the shutter plate is upwardly adjusted so as to expose substantially the entire area of the hole 53. It is contemplated that but one type of fuel will be burned in the heater and that the shutter plate 58 will be adjusted for such type of fuel and then locked in place by the bolt 60.

The herein described solid fuel burning heater is highly efficient in operation and may be produced at a comparatively low cost. In addition it is capable of being readily controlled and this is directly attributable to the fact that it includes a single air distribution box 14 which serves to supply the primary air to the duct arrangement 12 and the secondary air to the conduit 13. The air distribution box 14 forms, in effect, a vertically elongated duct, the upper end of which is in communication with the branches 40 and 41 of the duct arrangement 12 and the lower end of which is open to outside or ambient air. Because of the length and shape of the upper branch 12 and the length of the duct that is formed by the air distribution box 14 such resistance is provided as to preclude backfire or puffing in the event of ignition of combustible gases in the upper portion of the chamber 23. In other words, should combustible gases collect in the upper portion of the chamber 23 and become ignited the products of combustion resulting from ignition of the gases will flow downwards through the fuel in the chamber 23 instead of to atmosphere via the branch 40 and the air distribution box 14.

The invention is not to be understood as restricted to the details set forth since these may be modified within the scope of the appended claims without departing from the spirit and scope of the invention.

Having thus described the invention what we claim as new and desire to secure by Letters Patent is:

1. A smokeless solid fuel burning heater comprising an upstanding shell having an ash chamber in its lower portion, a combination fuel and combustion chamber above the ash chamber, and a horizontal grate between the two chambers, means within the shell forming an outlet duct for the products of combustion leading upwards from a point a small distance above the grate and located at one side of the second mentioned chamber, a primary air duct arrangement disposed within the shell in spaced relation with the outlet duct and at the opposite side of the second mentioned chamber and embodying an upwardly extending upper branch having the upper end thereof communicating with the upper part of the second mentioned chamber and adapted to deliver primary air thereto, and a separate or independent downwardly extending lower branch having its lower end communicating with the lower part of said second mentioned chamber and facing downwards and inwards in order to deliver primary air in such manner that it flows over the grate towards the lower end of the outlet duct, said primary air duct arrangement being provided between the two branches thereof with an imperforate cross plate whereby said branches are rendered separate and independent of one another, a secondary air conduit disposed in the shell directly above and inwards of the lower end of the outlet duct, provided in the bottom thereof with a downwardly and inwardly facing opening

for delivering secondary air downwards and inwards into the lower part of said combination fuel and combustion chamber, and having the interior thereof closed against communication with the last mentioned chamber except for said opening, common means operative to supply outside air in controlled quantity to the two branches of the primary air duct arrangement and to the secondary air conduit and embodying an air distribution box disposed exteriorly of the shell, provided with a damper controlled inlet for outside air and having its interior connected to, and in communication with, said two branches and the ends of said conduit, and valve means adjustable from the outside of the shell and operative to control the amount of air that is delivered from the interior of the air distribution box into one of the branches.

2. A smokeless solid fuel burning heater comprising an upstanding shell having a normally closed ash chamber in its lower portion, a normally closed combination fuel and combustion chamber above the ash chamber, and a grate between the two chambers, means within the shell forming an outlet duct for the products of combustion leading upwards from a point a small distance above the grate and located at one side of the second mentioned chamber, a primary air duct arrangement disposed within the shell in spaced relation with the outlet duct and at the opposite side of the second mentioned chamber and embodying an upwardly extending upper branch with an open upper end for delivering primary air into the upper part of the second mentioned chamber, and a downwardly extending lower branch having its lower end communicating with the lower part of said second mentioned chamber and facing downwards and inwards in order to deliver primary air in such manner that it flows over the grate towards the lower end of the outlet duct, a horizontally elongated secondary air conduit disposed in the shell directly above and inwards of the lower end of the outlet duct, provided at the bottom portion thereof with a downwardly and inwardly facing full length slot-like opening for delivering secondary air downwards and inwards into said lower part of said combination fuel and combustion chamber, and having the interior thereof closed against communication with the last mentioned chamber except for said opening, and common means for supplying outside air in controlled quantity to the two branches of the primary air duct arrangement and to the secondary air conduit, embodying an exteriorly disposed air distribution box mounted on the portion of the shell that is adjacent said duct arrangement, provided with a single damper controlled air inlet, and having its interior connected to, and in communication with, said two branches and also connected to, and in communication with, the conduit by way of a pair of substantially horizontal pipes extending around opposite side portions of the shell and having certain ends thereof attached to the box and their other ends leading to said side portions of the shell and connected to the ends of said conduit.

3. A smokeless solid fuel burning heater comprising an upstanding shell having an ash chamber in its lower portion, a combination fuel and combustion chamber above the ash chamber, and a horizontal grate between the two chambers, means within the shell forming an outlet duct for the products of combustion, leading upwards from a point a small distance above the grate and located at one side of the second mentioned chamber, a primary air duct arrangement disposed within the shell in spaced relation with the outlet duct and at the opposite side of the second mentioned chamber and embodying an upwardly extending upper branch with an open upper end for delivering primary air into the upper part of the second mentioned chamber, and a separate or independent downwardly extending lower branch having its lower end communicating with the lower part of said second mentioned chamber and facing downwards and inwards in order to deliver primary air in such manner that it flows over the grate towards the lower end of the outlet duct, a horizontally elongated secondary air conduit disposed in the shell directly above and inwards of the lower end of the outlet duct, provided in the bottom portion thereof with a downwardly and inwardly facing opening for delivering secondary air downwards and inwards into the lower part of said combination fuel and combustion chamber and having the interior thereof closed against communication with the last mentioned chamber except for said opening, common means operative to supply outside air in controlled quantity to the primary air duct arrangement and the secondary air conduit, embodying an exteriorly disposed air distribution box mounted on the portion of the shell that is adjacent the lower end of the upper branch and the upper end of the lower branch, provided with a single damper controlled air inlet, and having its interior connected to, and communicating with, the last mentioned ends of the two branches by holes in said portion of the shell and also connected to, and in communication with, said conduit, and valve controlled means for controlling the effective size or area of the hole that establishes communication between the interior of the air distribution box and the upper branch of said primary air duct arrangement.

4. A smokeless solid fuel burning heater comprising an upstanding shell having a normally closed ash chamber in its lower portion, a normally closed combination fuel and combustion chamber above the ash chamber, and a horizontal grate between the two chambers, means within the shell forming a comparatively wide outlet duct for the products of combustion leading upwards from a point a small distance above the grate and located at one side of the second mentioned chamber, a comparatively wide primary air duct arrangement disposed within the shell in spaced relation with the outlet duct and at the opposite side of the second mentioned chamber and embodying an upwardly extending upper branch having at the upper end thereof a substantially full width discharge opening for delivering primary air into the upper part of the second mentioned chamber and a separate and independent downwardly extending lower branch having at its lower end a downwardly and inwardly facing discharge opening for delivering primary air across the lower part of said second mentioned chamber in the direction of the lower end of the outlet duct, a horizontally elongated conduit disposed in the shell directly above and inwards of the lower end of the outlet duct, connected to receive outside air as secondary air, and having in the bottom thereof a longitudinal substantially full length downwardly and inwardly facing slot-like opening for delivering secondary air downwards and inwards into said lower part of the combination fuel and combus-

tion chamber, means disposed outside of the shell forming a single comparatively long vertical duct having the lower end thereof open to outside air and terminating adjacent the ash chamber and its upper end in communication with the two branches, said last mentioned duct and the upper branch of the primary air duct arrangement being of such combined length as to prevent backfiring or puffing in the event of ignition of combustible gases in the upper part of said combination fuel and combustion chamber, and valve means adjustable from the outside of the shell and operative to control the amount of air that is delivered from the upper end of said duct into one of the branches of the duct arrangement.

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MATTHEW GREGURICH.

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