March 1, 1966 W. H. BEST 3,237,622

HEATER

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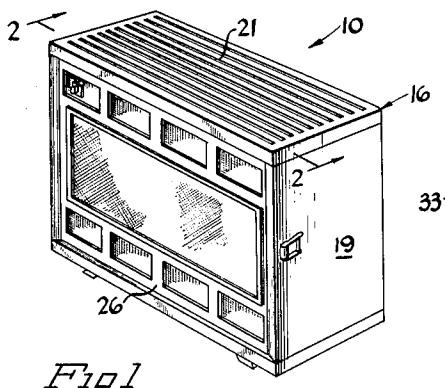
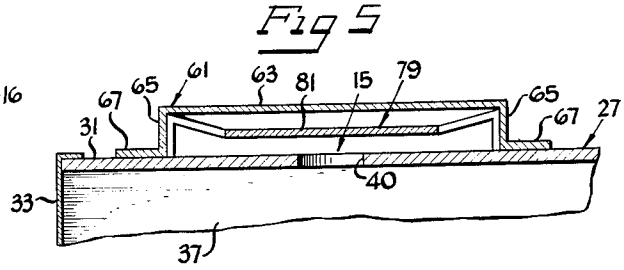


Fig 1



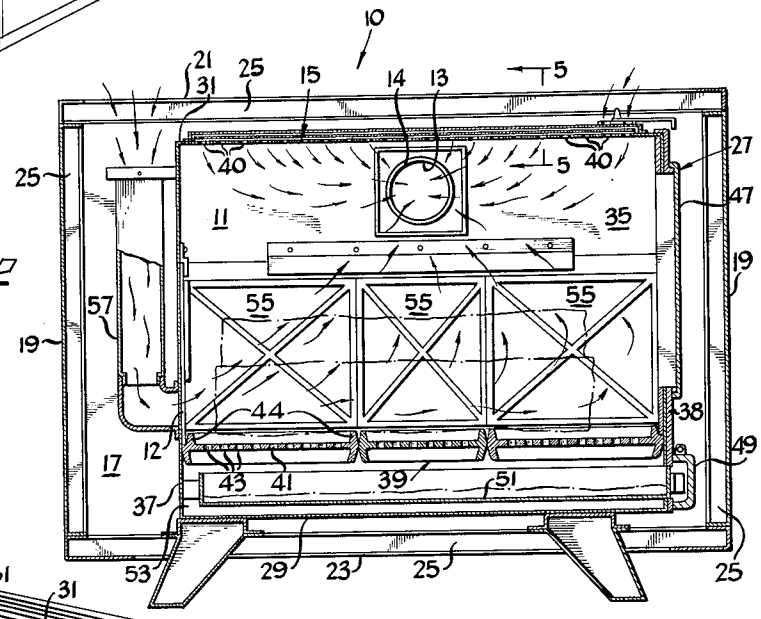
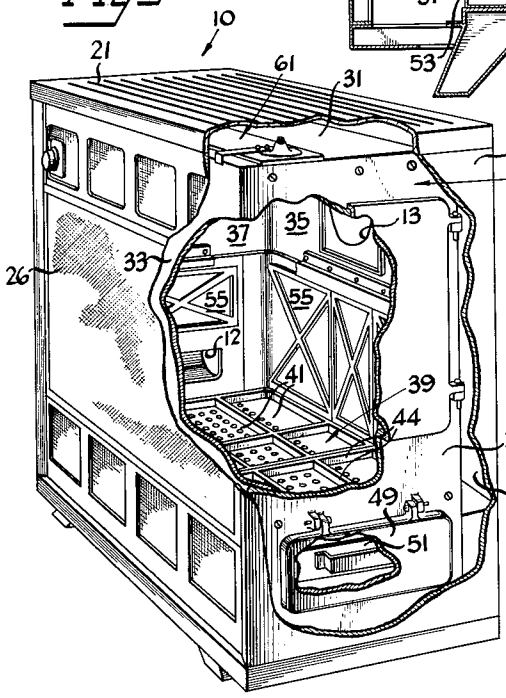
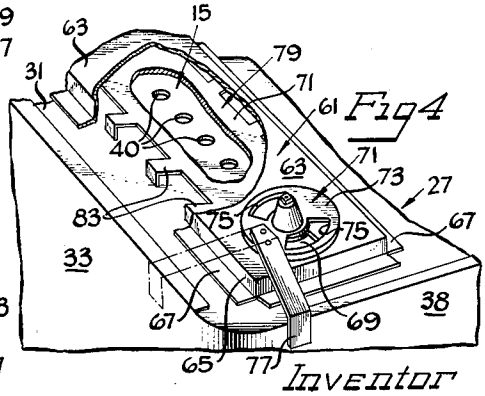


Fig 2





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HEATER

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The present invention relates generally to a heater construction and, more particularly, to an improved heater construction for burning a solid fuel such as wood in an efficient manner and so as to minimize accumulation or condensation of tar-like substances.

In the operation of heaters utilizing a solid fuel such as wood, air is frequently admitted into the combustion chamber in a manner which causes combustion to occur at the bottom or lower portion of the fuel mass. The heat of combustion of this lower portion of the fuel raises the temperature of the remaining or upper portion sufficiently the cause various substances in the fuel to volatilize and be given off in the form of vapors. Although these vapors are combustible, they frequently do not burn because substantially all of the oxygen in the supply air has been consumed in the combustion of the fuel adjacent the air inlet and there is not sufficient oxygen remaining above the fuel to support combustion of the vapors. This is particularly true in heaters in which the output of the heater is regulated by controlling the amount of air supplied to the combustion chamber.

The failure of these vapors to undergo combustion is undesirable for many reasons. If they exit the heater in an unconsumed state along with the other products of combustion, their heat energy is lost and the operation of the heater becomes correspondingly less efficient. Also, if oxygen is suddenly admitted to the top of the heater due to a back draft down the chimney, the vapors may undergo substantially instantaneous combustion and a mild explosion may take place.

Frequently, however, these vapors do not pass out of the heater to the atmosphere but instead condense in the stove pipe or chimney and form a tar-like substance which then drains through openings or cracks in the pipe and causes damage to the interior of the room in which the heater is located. Such condensation will occur whenever the temperature of the exhaust pipe falls below the dew point of the vapors. This dew point can be lowered by lowering the vapor pressure of the vapor, which in turn can be accomplished by diluting the exhaust gases with fresh air. However, fresh air also lowers the temperature of the gases, further contributing to the problem of condensation. In addition, the introduction of air for the combustion of these vapors may tend to accelerate the burning rate of the fuel, thus creating more heat than is desired.

It is therefore an object of this invention to provide an improved heater construction for effectively burning a solid fuel such as wood.

An additional object of the invention is to provide such a heater which is particularly adapted to effect the combustion of combustible vapors within the heater.

It is also an object of this invention to provide an improved heater construction in which the combustion within the heater of combustible vapors produced by the burning and heating of the fuel is effected by the introduction of a supply of secondary air to the vapors.

It is another object of the invention to provide an improved heater construction of the type described herein which includes means for introducing prewarmed secondary air to the gases and vapors leaving the burning and heated fuel to effect combustion of the vapors and reduce condensation and accumulation of tar-like substances in the outlet flue and chimney of the heater.

A further object of this invention is the provision of an improved heater construction of the type in which the amount of heat produced is controlled by the amount of combustion air provided to the fuel, which heater construction includes means for introducing secondary air to the gases resulting from the burning and heating of the fuel without interfering with the controlled combustion of the fuel.

It is a further object of the invention to provide a heater construction which is simple, economical and durable.

Other objects and advantages of the present invention will become apparent from the following description and the drawings, wherein:

FIGURE 1 is a perspective view of a combustion air-controlled heater for burning fuel such as wood, and showing various of the features of the invention;

FIGURE 2 is an enlarged partially broken-away front sectional view taken along line 2—2 of FIGURE 1;

FIGURE 3 is an enlarged partially broken-away perspective view of the heater of FIGURE 1;

FIGURE 4 is an enlarged fragmentary partially broken-away perspective view of the secondary air inlet means of the heater of FIGURES 2 and 3; and

FIGURE 5 is an enlarged side sectional view taken generally along line 5—5 of FIGURE 2 and further illustrating the secondary air inlet means.

Briefly, a heater construction **10** showing various of the features of the invention is illustrated in the drawings and comprises a combustion chamber **11** which is adapted to receive a solid fuel of various types but particularly wood. The combustion chamber **11** has a primary air inlet **12** for supplying combustion air to the fuel and an exhaust outlet **13** spaced from the inlet and adapted to conduct gases flowing from the burning and heated fuel outwardly to the atmosphere, as through an outlet flue **14** and a chimney (not shown). Adjacent the outlet **13** but spaced a substantial distance generally upstream from the primary inlet **12** is a secondary air inlet **15** that provides combustion air which will mix with the exhaust gases before these gases reach the outlet **13**, thereby making it possible for the combustible elements in these gases to undergo combustion in the vicinity of the outlet flue **14**.

The combustion of unburned vapors in the exhaust gases tend to reduce condensation and the consequent accumulation of tar-like substances in the outlet flue **14** and chimney since much of the condensible material is removed from the exhaust gases. In addition, however, the secondary air dilutes the exhaust gases so as to lower the partial pressures of any vapors in the gases which fail to burn and, in turn, so as to lower the condensation or dew point temperature of these vapors. Still further, the combustion of the vapors adjacent the outlet flue **14** raises the temperatures of the flue and chimney, thereby also reducing the likelihood of condensation.

More specifically, the heater **10** comprises a housing or cabinet **16** which includes a rear wall **17**, a pair of end walls **19**, a top wall **21**, and a bottom wall **23**. Each of the walls is formed from a pair of spaced plates defining an inner compartment **25** (FIG. 2) within which an insulating material (not shown) may be placed if desired. A front or forward wall **26** of the cabinet is desirably of a construction which will facilitate the ready transfer of heat forwardly of the heater **10** and into the area to be heated. One of the end walls **19**, that end wall adjacent the right side of the cabinet when facing the forward wall **26**, is pivotally mounted to provide access to the interior of the cabinet, as for refueling and maintenance, and the upper or top wall **21** is vented by a plurality of end-to-end slits or openings for ready passage of air to

both the primary and secondary air inlets 12 and 15 respectively.

Disposed within the housing 16 is a firebox 27 which defines the combustion chamber 11 and which, like the housing 16, is of a generally rectangular construction. The firebox is preferably made from a strong and durable material such as heavy cast iron and includes a lower wall 29, an upper wall 31, a front wall 33, a rear wall 35, and a pair of end walls 37 and 38. A series of aligned apertures 40 is provided in the top wall 31 of the firebox and provides for the passage of secondary air into the combustion chamber 11 in a manner which will be described in greater detail shortly.

A horizontally disposed grate 39 extends fully across the firebox 27 a short distance above the lower wall 29 and defines a platform upon which the fuel may be placed. The grate 39 is comprised of generally rectangular grate sections 41 which include horizontal generally rectangular plate portions perforated by a plurality of apertures 43 and separated from one another by upstanding flanges 44 which support and maintain the solid fuel in a slightly elevated relationship to facilitate circulation of air around the fuel. The apparatus 43 in the grate are preferably sufficiently small to permit only "fluff" ash to fall through them incident to the burning of the fuel.

One end wall 38 of the firebox 27 adjacent the pivotally mounted end wall 19 of the heated housing, is provided with a fuel door 47 affording access to the area above the grate 39. This permits ready insertion of solid fuel, which may be wooden logs or pieces, pressed wood logs or other combustible solid fuel. The illustrated fuel door 47 is preferably constructed of precision ground cast iron packed with asbestos to render it airtight when the door is closed.

Below the fuel door 47 in the same end wall 38, an ash door 49 is provided for the periodic removal of ashes from below the grate 39 of the heater. This ash door affords access to a generally rectangular upwardly open ash pan 51 which is desirably constructed of a heavy gauge steel. The ash pan 51 is slidably supported in the firebox below the grate on guides 53 for easy withdrawal.

As noted above, the firebox 27 is desirably constructed of a material such as heavy cast iron to provide a durable long-lasting device and the interior walls thereof define the combustion chamber 11 of the heater. The lower portions of these internal walls, which portions are adjacent to the combustion of the fuel, are lined with floating cast iron liners or sections 55 which protect the internal wall above the grating platform 39 and adjacent to the position of the fuel while it is being burned, these areas being subjected to the more intense heat produced in the heater. The liners 55 are designed and supported to permit expansion and contraction incident to changes in temperature and eliminate the need for old-fashion firebricks that become brittle and tend to break.

The primary air inlet 12 for the illustrated heater 10 is located in the end wall 37 slightly above the grating platform 39 and adjacent to the area where the fuel is supported and burned. In the illustrated embodiment, the air inlet 12 is in the form of a generally rectangular aperture and extends substantially across the end wall 37. This location of the primary air inlet aids in burning wet wood. Further, clogged grates will not interfere with the flow of combustion air to the fuel.

As noted above, the fuel 12 is supported as illustrated in FIGURE 2 so that there is space for combustion air to circulate around and below the fuel, causing the fuel to burn from the bottom upwardly. An intake conduit 57 extends vertically upward from the air inlet aperture 12 externally of the firebox 27, and is secured to the outer surface of the end wall 37 of the firebox. The upper end of the conduit 57 is open and is located in a position adjacent the vented upper wall 21 of the housing 16 for receiving a supply of fresh air for the combustion of the fuel in the heater.

The heat output level for the heater 10 is preferably automatically controlled by a primary air control means (not shown) that regulates or controls the amount of primary combustion air to the fuel and provides effective maintenance and control of the desired heat level. However, as noted above, in prior devices it contributed to a condition resulting in the formation and accumulation of tar-like substances because it caused a deficiency of oxygen in the upper portion of the combustion chamber which made it difficult for the volatilized vapors and condensible material given off by the fuel to undergo combustion. As already noted, this problem is effectively resolved by the illustrated structure including the secondary air inlet means, hereinafter described.

The exhaust outlet 13 of the heater 10 is in the form of an aperture provided in the rear wall 35 of the firebox 27 and communicates with the outlet flue or stove pipe 14 as previously set forth. The illustrated outlet 13 is located in the upper portion of the wall 35 substantially above the level of the primary air inlet 12 and generally equally distant from each of the end walls 37 and 38 of the firebox. As illustrated by the arrows in FIGURE 2, the gases resulting from the burning or combustion of the fuel, as well as from the heating of the fuel, are drawn toward the outlet 13 by the updraft provided by the chimney or outlet flue and by the tendency of the hot gases to rise. The exhaust gases resulting from the combustion and heating of the fuel include the products of combustion, the used air from which the oxygen has been expended by combustion of the fuel in the lower part of the combustion chamber, and the vapors or other materials which have been volatilized by the heating of the portion of the fuel that has not as yet undergone combustion.

The secondary air inlet 15 of the illustrated heater 10 serves to provide a supply of fresh oxygen-containing air to the exhaust gases traveling from the area of combustion upwardly and toward the exhaust outlet 13. As already noted, the introduction of the fresh secondary air permits additional or secondary combustion of combustible material in the gases which has not as yet been burned and, in particular, permits the combustion of volatilized vapors and material coming from the unburned but heated portion of the fuel. This additional combustion reduces the tendency for condensation to form in the outlet pipe or chimney in several ways: since the combustion takes place adjacent the mouth of the exhaust pipe 14, it heats the exhaust gases immediately before they enter the pipe and thus raises the temperature of the pipe appreciably above the dew point of the condensible vapors; also, the aforesaid secondary combustion consumes some of the vapors which would otherwise condense; still further, the mixing of the incoming secondary air with the vapors reduces the partial pressure of the condensible vapor in the exhaust gases, thereby lowering the dew point or condensation temperature to which the hot exhaust gases need be lowered before condensation of the vapors will result. As will become apparent shortly, the incoming secondary air is heated before entering the combustion chamber and, hence, does not lower the temperature of the exhaust gases. Thus, more effective and efficient operation of the heater is achieved, together with a reduction in the tendency for tar-like substances to form in the outlet or chimney associated with the heater.

Referring more specifically to the illustrated heater construction as seen best in FIGURES 3, 4, and 5, an elongated, generally rectangular, inverted channel 61 having a top wall 63 and side walls 65 overlies the row of aligned apertures 40 of upper wall 31 of the firebox 27 to form a manifold or distributor which extends substantially from end to end of the firebox and adjacent the front edge thereof. The lower portions of the side walls 65 are turned outwardly to provide marginal or peripheral flanges 67

which are secured to the upper wall 31 of the firebox. The channel 61 thus combines with the upper wall of the firebox to provide the elongated manifold in an upper portion of the combustion chamber 11 which will convey secondary air to the apertures 40.

Secondary air enters the manifold through a pair of circumferentially spaced vent openings 69 provided in the top wall 63 adjacent one end thereof. In order to permit regulation of the amount of secondary air passing through the vent openings 69, and hence, through the apertures 40, a flow regulating mechanism 71 is provided and comprises a disc 73 rotatably mounted atop the wall 63 in overlying relation to the vent openings 69. The disc 73 is provided with a pair of apertures 75 which generally match the vent openings 69 when the disc is rotatably positioned in the "open" or intake position. By rotating the disc 73, the apertures 75 and vent openings 69 are placed in greater or lesser alignment to increase or decrease the size of the inlet, respectively, or to close the inlet. The disc 73 is provided with a control handle 77 to facilitate rotation thereof. FIGURE 4 illustrates a partially opened position of the flow regulating mechanism 71 while another position for the handle 77 is shown in phantom in that figure.

Uniform distribution of the secondary air to the apertures 40 is enhanced by a generally horizontally disposed elongated baffle 79 which includes a top plate 81 disposed within the secondary air conduit midway between the top wall 63 of the inverted channel 61 and the top wall 31 of the firebox 27 and maintained in such position by a series of spaced-apart outwardly and downwardly extending arms or projections 83 that are spaced along each longitudinal edge of the plate 81. The arms 83 define there between gaps or openings through which air can pass from above the plate 81 to beneath the plate and through the apertures 40. The baffle serves to distribute the air over the apertures and insures that the secondary air will enter the combustion chamber over substantially the entire upper end thereof. More specifically, the secondary air enters through the vent openings 69 in the upper wall 63 of the secondary air conduit and moves longitudinally of the conduit in the area above the baffle 79. Some of this air is drawn around the longitudinal edges of the baffle plate 81 into the various apertures 40 leading to the combustion chamber 11. The baffle 79 thus serves to improve the circulation of the air within the conduit. Also, since the conduit is defined by one wall of the firebox 27, the air is prewarmed as it travels through the conduit and accordingly, will not appreciably lower the temperature of the exhaust gases with which it combines.

The operation of the structure may now be readily understood. The control means is set for the temperature desired in the area to be heated and regulates the amount of primary air entering the combustion chamber 11 through the primary inlet 12. As indicated by the arrows in FIGURE 2, the primary air passes through the venting provided by the upper wall 21 of the cabinet or housing 16 and into the intake flue or conduit 57. This air circulates around the fuel, tending to support its combustion from the bottom upwardly by providing the oxygen for this combustion. The hot exhaust gases including the vapor, unburned material, and combustion air from which the oxygen has been used, travels upwardly in the combustion chamber 11 and also rearwardly toward the exhaust outlet 13.

As also indicated by arrows in FIGURE 2, the secondary air is introduced from above across substantially the entire width of the heater and combines with the exhaust gases adjacent the exhaust outlet 13. The presence of the secondary air in the air conduit and its circulation and mixing within that conduit (which is facilitated by the baffle 79) provides a pre-warmed or heated supply of secondary air which will not substantially lower the temperature of the gases passing toward the outlet 13. The addition of this secondary air across substantially the entire width of the heater provides for more thorough and effective mixing and dilution of the exhaust gases and for effective combustion of whatever unburned materials are in the gases This combustion occurs in the vicinity of the exhaust pipe 14 and heats the same so as to further lessen the possibility of condensation.

The supply of secondary air may be adjusted for the most effective operation of the heater for a desired heat level and for the particular fuel being burned by the flow regulating mechanism 71. The movement of the secondary air is generally confined to the upper portion of the combustion. Thus, the introduction of the secondary air does not interfere with the controlled rate of combustion of the fuel by the primary air.

Thus, a simple, durable, and efficient heater 10 is provided which requires very little attention and supervision and which is capable of burning solid fuels such as wood with a controlled supply of primary combustion air but with a reduced amount of accumulation of tar-like substances and without interfering with the desired regulated rate of direct combustion.

Various modifications and changes may be made in the illustrated structure without departing from the spirit and scope of the present invention.

Various features of the present invention are set forth in the following claims.

What is claimed is:

1. A heater construction comprising
(1) a fire box with top, bottom and side walls,
(2) a primary air inlet adjacent the bottom of said fire box,
(3) an exhaust outlet adjacent the top wall of said fire box,
(4) a secondary air inlet comprising a plurality of apertures in the top wall of said fire box and extending across substantially the length of said top wall,
(5) means defining a conduit extending along said top wall of said fire box for conducting air to said apertures, and
(6) a horizontal baffle positioned in said conduit above said apertures, said baffle having gaps in its longitudinal edges through which air passes to enter the apertures.

2. A heater construction comprising
(1) a fire box with top, bottom and side walls,
(2) a primary air inlet adjacent the bottom of said fire box,
(3) an exhaust outlet adjacent the top wall of said fire box,
(4) a secondary air inlet comprising a plurality of apertures in the top wall of said fire box and extending across substantially the length of said top wall,
(5) a channel member positioned on the top wall of said fire box over said apertures to provide a secondary air chamber for conducting air to said apertures and,
(6) a baffle horizontally positioned in said secondary air chamber above said apertures for uniform distribution of secondary air to said apertures.

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