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COKE BURNING METHOD

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1 Claim. (Cl. 110—1)

This invention relates to the burning of coke, and particularly to the burning of coke in domestic furnaces such as are employed for heating purposes.

Coke has been found to be an excellent fuel for domestic heating purposes because of its comparative cleanliness as compared with many types of coal and because of its low cost as compared with fuel oil and the more expensive forms of coal. Coke, however, as compared with coal and fuel oil, has the disadvantage that it is difficult to operate a furnace automatically with it.

Because of its high ignition temperature, it is generally impractical to burn coke in the ordinary domestic type of underfeed stoker. Overfeed stokers have been constructed by means of which coke is automatically deposited on top of the fire bed as required, in simulation to hand firing, and stokers of this type, when used in connection with thermostatically controlled furnace dampers, have provided a practical semi-automatic way of firing domestic furnaces with coke. However, arrangements of this type have required daily attention to the fire in order to maintain proper draft conditions, and the variation in the temperature of the building being heated has been considerably greater than desirable because of the slowness of the response of the fire to the draft controls.

One of the principal objects of this invention is to provide a method of burning coke in domestic furnaces which will be almost completely automatic in operation and require the minimum of attention.

Another object of this invention is to provide a method for burning coke which will operate not only with lumps of coke having a maximum dimension of two or three inches but also with coke in much smaller pieces or particles such as are now considered unsuitable for use in domestic furnaces.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claim. My invention itself, however, both as to its organization and manner of construction, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing, in which:

Figure 1 is a side view, partly in elevation, partly in section, and partly diagrammatic, of one of the preferred arrangements of equipment for carrying out the invention; and

Figure 2 is a cross section on the line II—II of Figure 1.

While the invention may be carried out in practice in numerous different ways, I have shown, by way of illustration, a particular installation which comprises a conventional domestic boiler 10 having water spaces 11 surrounding the fire pot 12. The bottom of the fire pot is provided with a grate 13 which also forms the top of the ash pit 14 under the firepot. Access to the interior of the firepot 12 is provided by a door opening in the side, and access to the ash pit 14 is provided by an ash pit door opening 16. The grate 13, which is formed of separate grate bars arranged in a horizontal plane, may be provided with a supplementary conical grate 17 which is located in the center of the main grate 13. The conical grate 17 is formed of a heat-resisting iron casting and is provided with a plurality of apertures 18 therethrough for permitting the passage of air.

The boiler 10 is provided with a flue or pipe 19 for carrying the products of combustion to a chimney, and the pipe or flue 19 contains two butterfly dampers 20 and 21 spaced along its length and has a check damper 22 located on the side between the two butterfly dampers 20 and 21. As may be seen from Figure 2, the butterfly dampers 20 and 21, which are alike, are each formed with a central aperture 23, so that they will not entirely close off the flue 19 even when they are in their fully closed positions.

A stoker 24 of the overfeed type is provided for automatically feeding the coke, which is used as fuel, to the fire. The stoker 24 may be any stoker of the type which feeds fuel to the top of the fire and which will maintain the top of the fire bed at a predetermined level. The particular stoker shown in the drawing for the purpose of illustration is a Murray stoker, Model No. 40, and comprises a stand 25 mounted upon wheels 26 so that the entire stoker 24 can be readily moved away from the boiler 10 when desired. The stand 25 supports a hopper 27 containing the coke 28 to be burned, and also supports, below the hopper, a mechanism 29 for introducing the coke into the furnace.

The coke-feeding mechanism 29 projects through the door opening 15 of the boiler and is provided with a plate 30 which closes the opening 15, the door for the opening 15 either being removed or swung out of the way.

The coke-feeding mechanism 29 includes a heavy fire-resistant control member 31, which normally rests upon the top of the fire and

which is arranged to set the feeding mechanism into operation whenever the fire burns down and allows the member 31 to drop below a predetermined level. When this occurs, the control member 31 is lifted up out of the way, the shovel portion 32 of the mechanism moves in to the center of the fire pot, and an ejector forces fuel out of the extended shovel 32 onto the top of the fire. The parts then return to their former positions until the top of the fire bed again drops below the predetermined level.

Means are provided for supplying a forced draft to the boiler, and for automatically controlling the draft in accordance with the heating requirements. These means comprise a blower 34, which may be of the centrifugal type as shown, driven by a suitable electric motor 35, and mounted upon a plate 36 covering the ash pit door opening 16. The inlet 37 to the blower 34 is provided with a shutter 38 by means of which the effective area of the inlet opening 37 may be varied as desired in order to adjust the capacity of the blower 34.

The blower motor 35 is provided with electric power through a set of controls which includes a thermostat 39 placed in the space which is being heated by the boiler 10, a limit control or switch 40, which is responsive to the temperature of the water or steam by means of which the heat is transferred from the boiler 10 to the space to be heated, and a time switch 41 connected to each other and to the motor 35 and to a source of power by wires 42, 43, 44, and 45. The thermostat 39 is arranged to allow the blower motor 35 to be energized whenever the temperature in the space to be heated drops below a predetermined temperature, such as 70 degrees Fahrenheit. The limit control 40 is arranged to cut off the power to the blower motor 35 whenever the temperature of the water or the pressure of the steam rises above a predetermined safe point, irrespective of whether the thermostat 39 is calling for more heat or not. The time switch 41 contains a clockwork or other time-keeping mechanism and is arranged to energize the blower motor 35 for a few minutes at comparative long intervals of time, such as every hour. If desired, the time switch may be of the type that operates in conjunction with the thermostat so that a full interval of time, such as one hour, will intervene between the shutting off of the blower motor 35 by the thermostat and its energization by the time switch.

The set of controls which has been illustrated is of the so-called high voltage type, each control making or breaking the circuit for the blower motor 35. If desired, however, other suitable means may be provided for making and breaking the circuit, for the blower motor 35, without departing from the spirit and scope of the present invention.

In carrying out the teachings of the novel method, a bed of ashes 47, which is preferably from three to five inches in depth, is first formed on top of the grates 13 and 17. The ashes may be secured from an external source and spread over the grates to the desired depth, or a fire may be built in the boiler in the conventional manner and allowed to burn down to ashes if no convenient supply of ashes is at hand. A coke fire is then built on top of the ashes 47 and, when this forms a layer of burning coke 48, it is covered by a layer of fresh coke 49. There is thus formed a fire bed composed of a layer of ashes 47, a layer of burning coke 48, and a layer

of unburned coke 49 arranged one above the other. After the fire bed has been formed in this manner, the two butterfly dampers 20 and 21 in the furnace flue 19 are placed in their closed position, as shown in the drawing, and the check damper 22 is opened. Thus there is substantially no natural draft acting on the fire.

Because of the almost complete absence of natural draft, the fire burns very slowly when the blower 34 is not operating and consumes very little coke. When the blower 34 is set into operation by the thermostat 39 or the time switch 41, a substantial amount of air is forced through the fire bed and the layer of burning coke 48 burns briskly. Under these conditions of operation, that is, alternate quiescence and brisk combustion, a large porous clinker 50 is formed between the bed of ashes 47 and the layer of burning coke 48, the clinker being formed from the incombustible residue of the burnt coke. The clinker 50 is annular in shape, this shape apparently being caused by the radially outward movement of the burning coke 48 above the conical grate 17.

As the system continues in operation, the thickness of the clinker 50 increases and the area of its central opening decreases, and both of these changes increase the resistance to the flow of air through the fire bed. The shutter 38 on the blower is therefore adjusted from time to time in order to maintain the desired flow of air and rate of combustion. Eventually, the clinker 50 so obstructs the flow of air that the desired rate of combustion cannot be maintained even when the shutter 38 on the blower is fully opened. It is then necessary to break up and remove the clinker 50, which is readily done by means of a poker inserted through the door opening 15, the stoker 24 being rolled back out of the way while this operation is being performed. After the clinker 50 has been removed, combustion proceeds as before and another clinker 50 starts to form.

It has been found, by actual operation of the above-described system over a period of months, that breaking up and removal of the clinker 50 is necessary only at intervals of once or twice a week depending on the rate of combustion. It is thus practical to allow the system to function unattended in moderately cold weather, except for supplying coke 28 to the hopper 27 and adjusting the blower shutter 38, over intervals of a week, and an even temperature of the space being heated will be automatically maintained. Because of the almost complete stopping of combustion when the blower 34 is not operating, the system generates very little heat after the thermostat ceases to call for heat, and a very even temperature is maintained in the space being heated. It has been found, for example, that the temperature of a heated space will vary less than one degree from the desired temperature as long as the system is kept in operation.

It has been found that the above-described system for burning coke will operate satisfactorily with coke in much smaller pieces than is ordinarily used for domestic heating purposes, and that the system will even operate with powdered coke known as "coke breeze." Because the coke is fed onto the top of the fire bed, the layer of unburned coke 49 forms, as it were, a filter which holds down whatever small particles of burning coke may be present and prevents any such particles or particles of ash from being blown up out of the fire bed by the draft. Thus,

not only is the system capable of operating with coke in the form of small particles but it operates without the production of any fly ash.

Another advantage of the system of burning coke which has been described above is the almost complete elimination of the problem of ash removal. While the system is in operation, additional ash is formed at such a slow rate that it is not necessary to shake the grate 13 more than once or twice a year in order to keep the bed of ashes 47 at the desired thickness. The incombustible matter in the coke accumulates in the clinker 50, as previously mentioned, and the clinker 50 can be withdrawn from the fire and disposed of without the creation of any dust, as contrasted to the removal of ashes produced by conventional systems of burning coke.

While I have shown only one arrangement of apparatus for carrying out my invention, it will, of course, be clear that numerous modifications and changes may be made. Other forms of blowers than the one shown may be used, as long as the blower is capable of maintaining a static pressure that reaches a maximum of one-quarter of an inch of water in the ash pit when the clinker 50 is at its maximum permissible thickness. The conical grate 17 may be omitted, but I have found it preferable to employ this grate because it results in the formation of an annular

clinker, which is more easily removed than the disc clinker which would otherwise be formed. Other forms of stokers may be used as long as they are of the same general type, and the firing of the coke may even be done by hand although the latter procedure is at the expense of some of the chief advantages of my system. The furnace 10 may be a boiler, as shown, or may be a hot-air or other form of furnace, and the controls may obviously be varied somewhat from those shown. I therefore do not intend to limit the patent granted hereon to the specific method which I have shown and described, but it is to be clearly understood that it embraces all methods falling within the terms of the following claim.

I claim as my invention:

A method of burning coke in a furnace which comprises forming a fire bed having a layer of ashes and a layer of burning coke above the ashes and a layer of unburned coke above the burning coke, and alternately maintaining a low draft and a high draft through said fire bed, said low draft being scarcely sufficient to maintain combustion of said coke and said high draft being sufficient to maintain combustion of said coke at a temperature above the clinker-forming temperature.

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