Jan. 15, 1952 E. C. WEBB 2,582,808

SECONDARY AIR SUPPLY SYSTEM AND NOZZLE FOR UNDERFEED STOKERS

Filed July 16, 1948

FIG. 1.

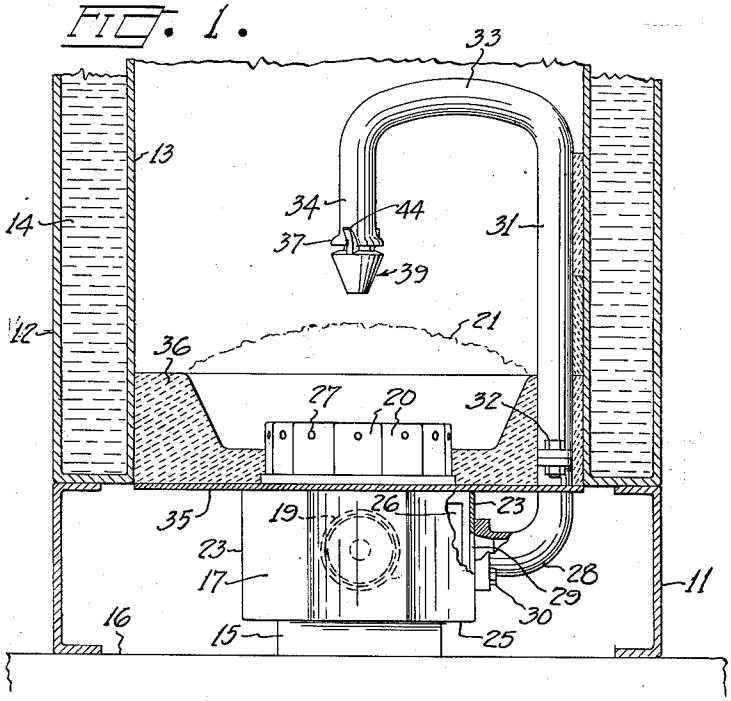


FIG. 3.

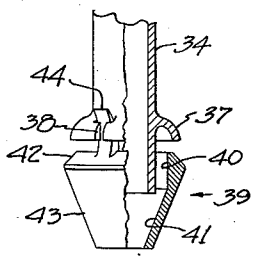
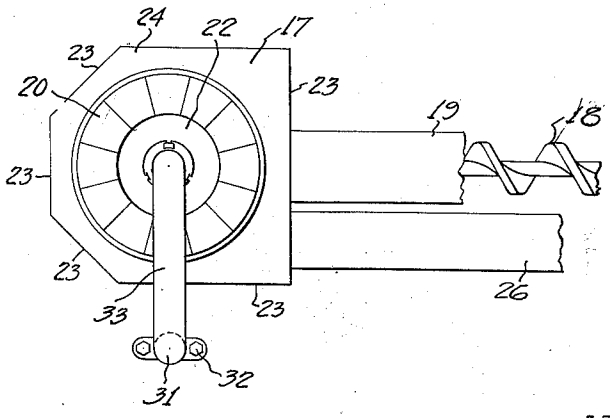


FIG. 2.



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SECONDARY AIR SUPPLY SYSTEM AND NOZZLE FOR UNDERFEED STOKERS

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4 Claims. (Cl. 110—75)

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In burning coking coal with a small single retort underfeed stoker, as is commonly used in connection with a residential heating boiler or warm air furnace, it has been the common experience that as the coal proceeds through the coal passage through the retort and tuyère block section of the stoker, the coal is warmed by conduction from the coal bed above and oozes tarry hydrocarbons to an extent that makes the coal particles adhere to each other. Under the pressure of the feed screw forcing the coal through this section of the stoker the coal tends to form into a column which becomes a more or less hard mass as the more volatile hydrocarbons are driven off and burned as the column progresses upwardly into the burning zone of the fuel bed. Although this coke column will vary in size and shape it resists orderly burning by presenting a much smaller total surface area to the incoming combustion air than would the individual small pieces of coal from which the column was formed. The result of the formation of these larger consolidations of coke in the fuel bed is to slow down the burning of the fuel until the fuel bed builds up to an undesirable height or the fire may even go out.

It is the general object of this invention to provide an auxiliary air system comprising both a means and a method of operation which will limit the height to which the fuel bed may rise without mechanical interference and at the same time to provide overfire air which has two ameliorating actions when the difficulties of burning coking coal are encountered. These two actions, are first, to lessen the tendency of the coal to coke in columnar form by reducing the necessary air required to be put through the fuel bed and thus to reduce the temperature in the lower part of the fuel bed and in the region of the retort and tuyères; and second, direct air at a considerable velocity down on to fuel bed from above and thus burn off the columnar coke formations from above as they occur.

To accomplish this general object in a practical way the particular object of this invention is to provide a nozzle or auxiliary air conduit end arrangement which makes this type of operation feasible by preventing the destruction of the nozzle or conduit end, and by the design of the nozzle or auxiliary air conduit end arrangement to determine or provide a method of operation of the auxiliary air system which will preclude the destruction of the equipment.

That these objects are accomplished by the equipment and method of operation of the invention will become apparent on reference to the following specifications as illustrated in the accompanying drawing in which:

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Fig. 1 is a conventionalized drawing in vertical section of a fragment of a residential size heating boiler having installed therein the burning head of a residential size underfeed stoker including the auxiliary air equipment of this invention.

Fig. 2 is a plan view of the burning head of the stoker shown in Fig. 1, showing the location in plan of the auxiliary air equipment of this invention.

Fig. 3 is an elevation in partial section of the auxiliary air conduit terminal equipment of this invention.

Like numbers of reference refer to the same or similar parts throughout the several views.

Referring now to the drawing, there is shown a fragmental section through the combustion chamber of a residential size heating boiler having a base 11 on which is resting a boiler having an outer shell 12 and an inner shell 13 with the space between the shells filled with water 14. Within the base 11 and resting on a fire brick or other support 15 on a floor 16 is shown the windbox 17 of an underfeed stoker of conventional design. It is understood that the driving motor, the electrical controls, the coal storage hopper, the speed reduction gearing, the air fan, and other parts of the stoker which are usually arranged exterior to the boiler are omitted from the drawings for the purpose of confining attention to the novel parts and arrangement of the invention. However, there is shown a stoker coal feed screw 18 which feeds coal through a conveyor housing 19 and through an elbow or retort 22 within the windbox 17 and from which the coal rises within the ring of tuyère blocks 20 to form a fuel bed the ideal upper limit of which is indicated by the broken line 21 of Fig. 1.

The windbox 17 having outer walls 23, top closure 24, bottom closure 25 and inner wall formed by curved retort or coal conveyor elbow 22, communicates through opening (not shown) in top closure 24 with hollow tuyère blocks 20 and through an opening in outer wall 23 with air duct 26. The stoker fan mentioned above but not shown is understood to supply combustion air through air duct 26 to windbox 17 from where the air is delivered to the underside of the fuel bed through tuyère blocks 20 having openings 27 therein as required.

Air for combustion is also supplied to the fuel bed from above by the auxiliary air system of

this invention comprising a flanged air conduit elbow 28 secured to windbox outer wall 23 by cap screws 30 and communicating with windbox 17 through opening 29 in outer wall 23. Auxiliary air conduit 31 is secured to elbow 28 by flange bolts 32 and continues upwardly into a reverse bend 33 from which its discharge end 34 depends to discharge air downwardly and approximately axially of the upwardly forming fuel bed. It is understood that the location of opening 29 in any side 23 of windbox 17 is a matter of choice for the particular installation and that the horizontal offset of the axis of conduit end 34 from the vertical axis of the ring of tuyère blocks 20 is a matter of choice to obtain best results for the particular design and arrangement of windbox, retort, tuyère blocks, etc.

Shown resting on top closure 24 of windbox 17 is hearth support plate 35 upon which is supported the molded refractory ceramic hearth 36 formed as desired for best combustion results and to protect from thermal destruction the inner shell 13 of the boiler or furnace as well as the flanged connection between conduit elbow 28 and air conduit 31.

Formed on air conduit 31 near its outlet end 34 is downwardly diverging conical flange on skirt 37 having slots 38 formed therein.

In axial alignment with air conduit end 34 is a second conduit or nozzle shown generally as 39 having an upper interior cylindrical surface 40 of greater diameter than the outer diameter of conduit end 34 and a downwardly converging conical interior surface 41 ending with an outlet diameter less than the inside diameter of conduit end 34. At its upper end nozzle 39 has a downwardly diverging outer surface 42 and at its lower end a downwardly converging conical surface 43. Malleable lugs 44 formed on the upper edge of nozzle 39 are sized for insertion through slots 38 of skirt 37 on conduit end 34. Formed on conduit end 34 and nozzle 39 are raised surfaces (not shown) which in assembly coact to maintain nozzle 39 in co-axial relation with conduit end 34 and to space nozzle 39 from skirt 37 to maintain an air discharge opening between them. In assembly nozzle 39 is telescoped over conduit end 34 with lugs 44 inserted through slots 38 up to the limit allowed by the spacing surfaces and lugs 44 are bent by tapping their upper ends outward with a hammer to fix nozzle 39 in position.

With the stoker in operation part of the combustion air enters the fuel bed from below through tuyères 27 and part of the air is discharged downwardly onto the fuel bed through nozzle 39.

Should the coking tendency of the coke being burned be so extreme that the fuel bed height or coke column continues to increase it may finally push against the lower outlet opening of nozzle 39 which will from there on break up the coke column mechanically. But if this pressure of coke against the lower opening of nozzle 39 were allowed to stop the flow of air through conduit 31 the high temperature conditions in the combustion space and fuel bed would lead to the thermal destruction of the nozzle and air conduit.

However, in the auxiliary air system of this invention it is seen that this could not occur for under the condition of stoppage of air flow through the lower opening of nozzle 39 the air would continue to flow from the end of conduit 34 into the interior of nozzle 39 where it would be reversed in direction and flow upwardly in the annular space between conduit end 34 and nozzle 39 and impinge against the lower side of skirt 37 when it would again be reversed in direction and be discharged downwardly onto the fuel bed outside the nozzle. This continued flow of air will not only continue the combustion over the top of the fuel bed but will also continue to cool both the air conduit and the nozzle and prevent their destruction from overheating.

From the above description and by reference to the drawings, the design and operation of the auxiliary air system of this invention will be plain. It will also be apparent that modifications of the specific form of the invention shown may be constructed to operate in the same manner and attain the objects of the invention.

While it is known that many previous arrangements have been tried, some of which has attained a limited commercial success, no previous device has accomplished all of the desired results. I have no desire to claim any of the previous art but I do desire to preserve for myself the critical features of the design and method of operation of my auxiliary air system as herewith set forth.

I claim:

1. An auxiliary air system for use with a stoker burning coking coal, comprising a source of air under pressure, a nozzle, an air supply pipe for conducting air from said source to said nozzle, and co-operating means formed on said pipe and said nozzle for attaching said nozzle to the outlet end of said pipe, said nozzle having a frusto-conical exterior surface converging in the direction of air flow from said pipe and an interior surface cylindrical at its inlet end and frusto-conical at its outlet end, said nozzle interior being of larger diameter over its cylindrical length than the outer diameter of said pipe and of smaller diameter at its outlet end than the interior diameter of said pipe, said co-operating means including means for locating said nozzle both axially and longitudinally of said pipe whereby when said said nozzle is attached to said pipe said pipe is telescoped within the cylindrical portion of said nozzle and spaced therefrom, said pipe having formed thereon a conical skirt axially spaced from and diverging in the direction of said nozzle whereby when air is flowing through said pipe and said nozzle the major portion of the air will be discharged from the vertex outlet of said nozzle if said outlet is open but should said outlet be clogged said air will be discharged from said pipe into the conical interior of said nozzle from where it will flow in a reverse direction in the cylindrical interior of said nozzle but outside said pipe and on leaving said nozzle will impinge on said skirt and thereby be deflected to discharge in a hollow conical stream diverging in the direction of air flow in said pipe.

2. In combination, a furnace, a source of air under pressure, a first conduit for conducting air from said source to the interior of said furnace, a second conduit surrounding the discharge end of said first conduit and spaced therefrom, said second conduit extending beyond the end of said first conduit to form a nozzle therefore, a flange surrounding said first conduit and spaced from said second conduit, whereby should the outer end of said second conduit become clogged the said air will be conducted from the end of said first conduit to the space between said conduits and ejected from said second conduit in a reverse direction against said flange thereby again reversing the direction of said air to cause said

air to discharge approximately in its original direction of flow.

3. A pipe having a downwardly pointing vertical portion at one end and a downwardly diverging conical flange surrounding said vertical portion near said end, together with a nozzle member in axial alignment with said pipe at said end, said nozzle member being open at both ends and having an upper cylindrical part of larger diameter than said pipe and a lower portion converging to a smaller diameter than said pipe, said pipe end being telescoped into said nozzle for the cylindrical part of its length, and means for holding said nozzle in radial spaced relation to said pipe and in axially spaced relation to said flange.

4. An auxiliary air system for use with an underfeed stoker for burning coking coal, comprising a downwardly discharging secondary air pipe, a funnel shaped nozzle disposed under the lower end of said pipe and spaced around the tip thereof and a skirt spaced from the upper edge of said nozzle and surrounding said pipe, said skirt covering the space between said pipe and

nozzle whereby air passing downwardly from said pipe through said funnel shaped nozzle will entrain air beneath said skirt for the purpose of cooling said nozzle and raising the temperature of the secondary air issuing therefrom.

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