Sept. 18, 1956 E. C. MILLER 2,763,221

FUEL BURNING SYSTEM

Filed Jan. 19, 1952 2 Sheets-Sheet 1

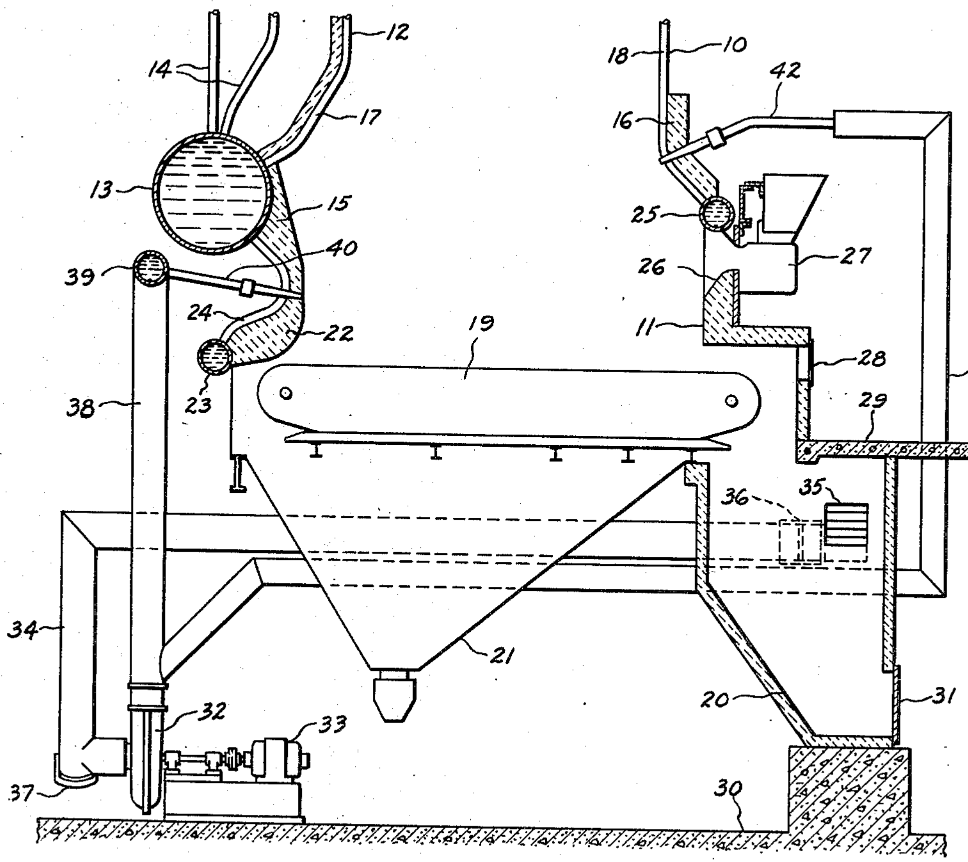

Fig. 1

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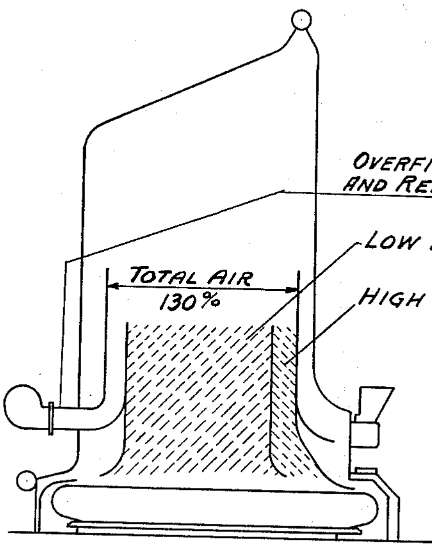

Fig. 2

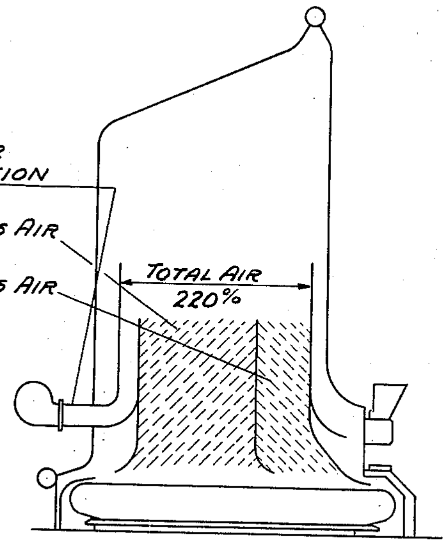

Fig. 3

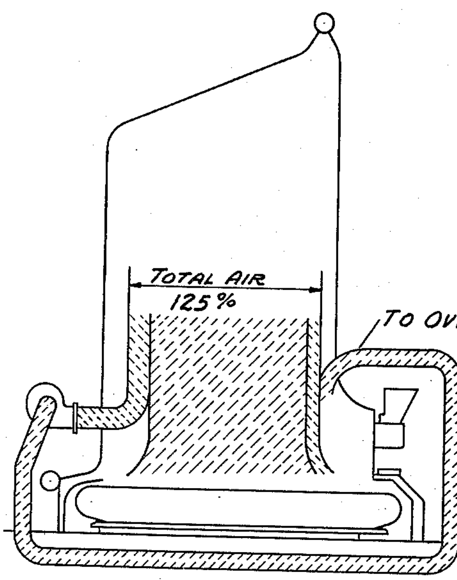

Fig. 4

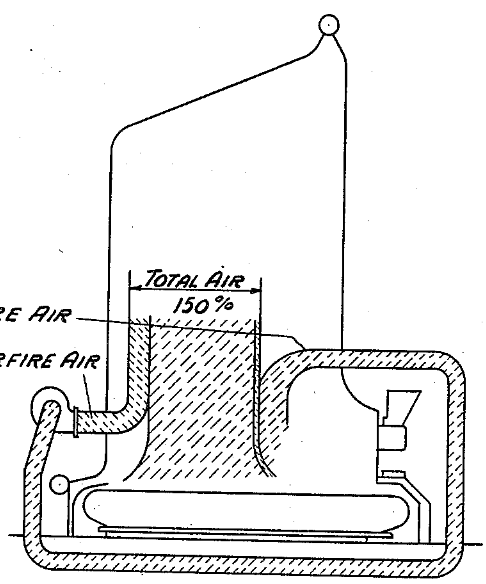

Fig. 5

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FUEL BURNING SYSTEM

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1 Claim. (Cl. 110—52)

This invention relates generally to fuel burning systems and more particularly to an apparatus for introducing overfire air to a furnace.

The performance of spreader stokers at low loads is the most serious handicap in this type of firing. Smoke and high excess air at low loads are the two most important complaints of modern spreader stoker installations. While it is true that refractory furnaces and special coals can eliminate smoke, it must be assumed that the modern steam generating units will have water walls and will be fired by the most economical fuel. The problem is one of improving the spreader stoker to overcome the weakness of smoke and high excess air, rather than using refractory furnaces and special fuel to overcome these difficulties. The present invention obviates the difficulties experienced in previously-known installations in a novel manner.

It is therefore an outstanding object of the present invention to provide an apparatus for firing fuel in conjunction with a spreader stoker whereby objectionable smoke and excess air are eliminated even at low load operation.

Furthermore, it is object of the invention to provide an apparatus for increasing the turbulence in a spreader stoker fired furnace.

It is a further object of this invention to provide for the operation of a spreader stoker fired furnace at higher temperatures than were possible within the prior art.

Although the novel features which are believed to be characteristic of this invention will be particularly pointed out in the claim appended hereto, the invention itself, as to its objects and advantages, the mode of its operation, and the manner of its organization may be better understood by referring to the following description taken in connection with the accompanying drawings forming a part thereof, in which:

Fig. 1 is a vertical longitudinal section of a furnace embodying the principles of the instant invention;

Figs. 2, 3, 4 and 5 are generally schematic views of furnaces operating under various conditions of load and overfire air.

In general, the present invention can be said to consist in employing the lean gases of a furnace for turbulence and flyash reinjection. It is known that the discharge end of the grate operates with a high excess air to assure a burned out ash. This low temperature gas of high oxygen content is pulled out of the furnace gas stream and diverted into the furnace turbulence system. The reduction in total flow through the furnace is equal to the overfire air requirement. A reduction of 25% in gas flow through the furnace at low loads has been obtained and the resulting increase in furnace temperature is greater than that gained from 50% increase in load.

Referring to Fig. 1, wherein is shown a specific embodiment of the invention, the apparatus, generally designated by the reference character **10**, is shown as comprising a furnace **11** and a boiler **12**. The lower portion only of the boiler is shown and it consists of a lower water drum

13 with downcomer tubes **14** extending therefrom. The furnace is provided with a rear wall **15** and a front wall **16** over which water wall tubes **17** and **18**, respectively, extend. A traveling grate **19** extends across the bottom of the furnace and is shown as discharging at the front of the furnace into an ashpit **20**. A windbox **21** is provided under the grate for control of air under the grate and zoning, not shown, is provided for. The lower portion of the rear wall **15** of the furnace is provided with a small arch **22** extending over the rear of the furnace and this arch has a header **23** at the rear, lower edge thereof with tubes **24** extending upwardly therefrom to the drum **13**.

The water wall tubes **18** on the front wall **16** of the furnace end in a lower header **25** just above an aperture **26** in the wall. A spreader stoker **27**, of a well-known type, is mounted on the outside of the furnace to project the fuel into the furnace through the aperture **26**. A fire door **28** is also provided in the front wall. A floor **29** is shown in the usual relationship to the grate level. The entire apparatus is shown as mounted on a base structure **30**. The ashpit **20** is provided with an access door **31** in the lower part thereof for removal of ash.

A fan **32** driven by a motor **33** is mounted on the base structure **30**. A suction conduit **34** extends from the intake opening of the fan to the area adjacent the discharge end of the grate and has access to the furnace through an opening such as the louver **35** in the side of the ashpit **20**. A sleeve **36** is provided in the conduit **34** for purposes of adjustment and expansion, while a trap **37** is provided to remove fines from the gas passing through the conduit to the fan. A conduit **38** extends from the discharge side of the fan **32** and is connected with a header **39** extending transversely of the furnace. The header **39** discharges into the furnace through a series of nozzles **40** extending through the rear wall of the furnace between the grate and the drum **13**. The nozzles are aligned in the direction of grate motion and are inclined slightly downwardly. A conduit **41** extends from the discharge side of the fan **32** and discharges into the furnace through a nozzle **42** which passes through the front wall of the furnace above the header **25** and the stoker **27**.

The operation of the apparatus is as follows: the fan **32** sucks gases from the discharge end of the grate; most of this gas will be from the portion of the furnace which is immediately over the discharge end of the grate and which is relatively lean. In the preferred embodiment, the gas will flow downwardly past the end of the grate into the ashpit **20** and through the louver **35** into the conduit **34**. The fan **32** then discharges the gases into the furnace through the nozzles **40** and **42**. This flow of gases into the furnace produces turbulence with its attendant advantages.

It is to be realized that the portions of the furnace into which the gases are projected will depend upon the particular situation and will be dependent on any number of factors. Also, the point where the gases are withdrawn will be selected in view of the particular situation, the important factor being that the withdrawal must be affected so that lean gases will be withdrawn from the discharge end of the grate.

The advantages of the present invention can best be understood by reference to the diagrammatic showings of Figs. 2, 3, 4 and 5. Fig. 2 shows a traveling grate spreader stoker operating at full load with overfire air and flyash reinjection, the air being obtained from an external source such as the space outside the furnace. It can be seen from the diagram that there is a considerable segregated stream of gas containing a high excess of air adjacent the discharge end of the grate; in addition a considerable body of cold air is introduced into the furnace in the form of overfire air for turbulence or for flyash reinjection. Not only is the furnace required to heat this cold air, but the gas flow through the furnace is increased. Preheating the overfire air does not solve the problem, since the heat for such a preheat must come from the overall system, thus lowering its efficiency and, of course, the increase of load; it can be seen that the difficulties are multiplied at low loads. The cold overfire air, when used in sufficient volume to produce turbulence, chills the low load furnace gases and thus decreases the effectiveness of the air turbulence.

Figs. 4 and 5 show the air flow through a furnace having a traveling grate spreader stoker with overfire air introduced in accordance with the present invention at full load and one-quarter load, respectively. The fact that gases are removed from over the discharge end of the grate means that the segregated stream of lean gas is diminished considerably, especially at low load; at the same time the total weight of gases passing through the furnace is not increased. Reducing the total flow of gases means that velocities will be lower, which results in less flyash, and the furnace temperature will be higher, since a smaller body of gases is heated by a given heat release. In these diagrams the overfire air does not flow through the furnace in a segregated stream, as the drawing would seem to indicate, but is projected transversely to gas flow to give good mixing with resultant improved combustion. It is also to be realized that the gases for turbulence may be used to reinject flyash and, thus, serve a dual function.

While certain novel features of the invention have been shown and described and are pointed out in the annexed claim, it will be understood that various omissions, substitutions and changes in the forms and details of the device illustrated and in its operation may be made by

those skilled in the art without departing from the spirit of the invention.

The invention having been thus described, what is claimed as new and desired to secure by Letters Patent is:

An apparatus for improving the performance of a furnace, comprising a furnace wall defining a combustion chamber having a gas outlet in its upper portion, a traveling grate within the combustion chamber, a spreader stoker in the lower portion of the combustion chamber for feeding fuel onto the grate, an ash pit at the discharge end of the grate, a conduit having one end opening in the ash pit adjacent the discharge end of the grate, a fan having an inlet and an outlet opening, said conduit being connected at its other end to the inlet opening of said fan, a second conduit connected at one end to the outlet opening of the fan, at least one nozzle projecting through the furnace wall into the combustion chamber in a direction generally perpendicular to the main flow of combustion gases and connected at the outer end to the other end of the second conduit.

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