

PATENT SPECIFICATION

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(54) IMPROVED METHOD AND APPARATUS FOR THE COMBUSTION OF CRUSHED SOLID FUELS

(71) We, CONCRETE INDUSTRIES (MONIER) LIMITED, a Company incorporated in New South Wales, carrying on business at 333 Epsom Avenue, Belmont, in the State of Western Australia, Commonwealth of Australia, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

This invention relates to an improved method for the combustion of crushed solid fuels and in particular it relates to the combustion of coal in kilns.

Hitherto the use of coal in the firing of brick kilns has been relatively limited with its major use residing in systems wherein the coal is trickle fed, hand fed, mechanical or air conveyed by systems such as Gibbons "Octopus" (Registered Trade Mark) and Impactopus, or introduced into the kiln in various other ways. The "Octopus" and Impactopus systems are developed by Gibbons Brothers Ltd of Lenches Bridge, Brierley Hill, West Midlands, England. The "Octopus" system resides in a system wherein milled coal is fed to a distribution point mounted on top of a kiln. The distribution point consists of a fan mounted horizontally on a small portable chassis. The fan has a circular casing with radial outlets spaced around its circumference. Flexible tubes connect these outlets to lances which inject the air/coal mixture into the kiln, where the coal burns in suspension. With this particular method and apparatus several disadvantages become apparent when the system is in use. The temperature within a kiln varies from one point to another and accordingly there must be some method of injecting extra fuel into the cooler areas of the kiln to raise the temperature. Similarly it would be advantageous to be able to completely control the rate of feed for each individual lance

and if necessary to be able to shut-off any particular lance.

The present invention may provide an improved method of supplying coal to a kiln wherein the above mentioned disadvantages are eliminated. In particular the invention will be described for use in continuous Hoffman type kilns, however, it will be appreciated that it can also be applied to car-tunnel kilns and periodic kilns.

The invention provides a method for the combustion of crushed solid fuel comprising crushing the fuel into a powder form, placing the crushed fuel into a storage bin and fluidising said fuel within said bin, advancing the fluidised fuel through a passage into a mixing chamber, passing compressed air through the mixing chamber so as to form a vena contracta in said mixing chamber so causing a mixture of fuel and compressed air to flow into a kiln or furnace.

Preferably the flow of compressed air is controlled by a solenoid valve operated by a pre-set controlling device.

Preferably every fuel inlet point on a kiln is fitted with a separate solenoid valve and pre-set control device.

The embodiments of the invention will be better understood by reference to the following description and accompanying drawings wherein;

Figure 1 is a schematic representation of one embodiment;

Figure 2 is a schematic representation of a further embodiment;

Figure 3 is a sectional side elevation of the burner on an enlarged scale; and

Figure 4 is a sectional side elevation of Figure 3 with a surrounding casing fitted to incorporate a secondary air flow.

In the embodiment shown in Figure 1 of the drawings solid fuel is crushed at 11 by any suitable means and then passed to a bin 12 for storage. Generally the bin 12 is provided with vertical walls with the entire base

being covered by an aerating pad 13. The pulverised fuel within bin 12 is continuously aerated and maintained in a fluid state. Dry air of approximately 1 p.s.i. is provided to the aeration pad to maintain the fluidised state of the solid fuel. One or more hoses 14 link the bin 12 with one or more mixing chambers or venturi burners 15. The hoses 14 must be a conductor of electricity such that no static electrical charge can build up. A carbon impregnated rubber, metallic tube or similar materials may be used. The diameter of hose 14 can obviously be varied to suit the specification of the burner 15 and the distance from bin 12 to the burner 15. The size of hose 14 which has been found most suitable during experimental runs has dimensions of 0.375 inch internal diameter and allows fuel to be conveyed to the burner over distances exceeding 30 feet. Fluidised fuel is passed from hoses 14 to fuel inlet 16 of burners 15. Compressed air is fed into the burner 15 through inlet 17 and forced through nozzle 18. Generally compressed air in the order of 20 p.s.i. to 100 p.s.i. has been found most satisfactory. The result is that fuel is caused to flow and mix with the compressed air as it passes through venturi 19 into blow pipe 20 and into the kiln. The flow of fuel may become erratic depending upon the length of hose 14 and the amount of aeration involved, especially if the compressed air pressure is allowed to fall below 20 p.s.i. A further method of control of the flow of fuel to the burner 15 may be achieved by bleeding air into the suction line/hose 14 so as to increase the air/fuel ratio being introduced into the burner. The flow of fuel through burner 15 is varied by means of pulsing the compressed air flow by use of an automatic electronic timer 21 operating through a solenoid valve 22 or similar such device or combination of devices. The electronic timer 21 may be set from 1 second to 3 minutes 'ON' with 1 second to 3 minutes 'OFF'. The 'ON-OFF' operation occurring alternatively and automatically. The compressed air pressure has little or no effect on the input of the fuel but rather the ejection path and flow characteristics of the fuel. Figure 4 of the drawings shows the burner 15 with an additional surrounding casing 23 incorporating a secondary air flow. In order to aid combustion, it may be necessary to introduce a secondary air flow into the kiln. This can be done by passing air in inlet 24, through chamber 25 which surrounds blow pipe 20 and then out into the kiln. The leading end of the burner 15 is provided with a protective cap 26 and mounting flange 27, flange 27 being provided to enable the burner to be fitted to a kiln.

In the second embodiment shown in Figure 2 of the drawings an additional flow

diagram has been included showing the passage of moist fuel before fluidisation. The raw fuel, if too wet to be fluidised, must be suitably dried by using a hollow flight screw conveyor or by under cover air drying or by rotary kiln or similar commercially available equipment. The dry solid fuel is then fed into a crusher 111 and the resultant crushed fuel passed through a sieve into storage bin 112. The crushed fuel generally used must be capable of passing through a size 14 B.S.S. mesh and is generally readily achieved by employing a hammer mill with screen bars set at 1/16 inch gap. Other types of mills that can be used quite satisfactorily include fine rolls, rod and ball mills, gyratory crushers, pan mills and the like. If obtainable, dry powdered fuel from separation processes such as wet washing, scrubbing, electrostatic precipitation, bag filters and cyclones may also be used. Generally the storage bin 112 is provided with vertical walls and has the entire base covered by an aerating pad 113. The pulverised fuel within the storage bin being continuously aerated and maintained in a fluid state. The storage bin 112 is linked by way of an air slide 114 and pneumatic gate control to a pressure pot 115. On receiving a signal from a level switch 116 situated in a fluidised distributor trough 117, the pressure pot 115 fills and charges a predetermined measure of fuel along discharge line 118 to an expansion hopper 119 located at the appropriate furnace or kiln. The discharge line 118 may be up to 1,000 feet or more in length and is dependent mainly on the pressure and volume of air used for propulsion. The expansion hopper 119 receives the charge of fuel, allows the air (i.e. conveying medium) to escape via a filter 120 of the continuous reverse air jet type or similar. The expansion hopper also allows the received fuel to feed into the distributor trough system 117. If necessary the expansion hopper may be fitted with gate valves, outlets, air bypass lines and/or such devices as are necessary to allow for multiple trough system to operate. Discharge from the expansion hopper occurs simultaneously with the charge entry of fuel into the expansion hopper from line 118. The fuel in the distributor trough 117 is maintained in a fluid state and at such a level to provide an upper air space uninterrupted throughout the trough system. A plurality of de-airing down pipes 121 are provided in the base of trough 117. The de-airing pipes allow partial compaction of the fuel prior to it entering hose 122 and burner 123. If the de-airing pipes are omitted and the hoses 122 connected directly to trough 117, where the trough is above the burner 123, then flow of pulverised fuel will occur down hoses 122 and through the burner 123 rendering the system inoperable. A venturi burner,

hose, electronic timer and solenoid valve are provided as described above with reference to Figure 1 of the drawings and operate in the same manner.

5 With this method of firing kilns large savings can be made in the actual cost of fuel consumed.

10 Whilst the invention has been described with reference to two specific embodiments it is not limited thereto as the system may also be fitted to tunnel kilns with either top or side firing, or to periodic kilns or to types of furnaces other than brick kilns.

WHAT WE CLAIM IS:-

15 1. A method for the combustion of crushed solid fuel comprising crushing the fuel into a powder form, placing the crushed fuel into a storage bin and fluidising said fuel within said bin, advancing the fluidised fuel through a passage into a mixing chamber, passing compressed air through the mixing chamber so as to form a vena contracta in said mixing chamber so causing a mixture of fuel and compressed air to flow into a kiln or furnace.

25 2. A method for the combustion of crushed solid fuel as claimed in Claim 1, wherein the flow of compressed air is controlled by a solenoid valve, said solenoid valve being operated by a pre-set controlling device.

30 3. A method for the combustion of

crushed solid fuel as claimed in Claim 1 or 2 comprising pulsing the flow of compressed air to said mixing chamber.

35 4. A method for the combustion of crushed solid fuel as claimed in Claim 1, wherein the compressed air is at 20 to 100 psi.

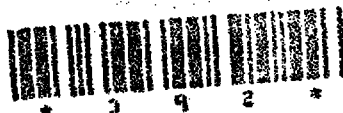
40 5. A method for the combustion of crushed solid fuel as claimed in Claim 1, wherein said compressed air is discharged into said mixing chamber through a nozzle and then into a venturi forming said vena contracta, the fuel being supplied to the compressed air at said vena contracta.

45 6. A method for the combustion of crushed solid fuel as claimed in any one of the preceding claims wherein the fuel is crushed to a size which is capable of passing through a 14 B.S.S. mesh or sieve.

50 7. A method for the combustion of crushed solid fuel substantially as herein described and as shown in Figure 1 of the drawings.

55 8. A method for the combustion of crushed solid fuel substantially as herein described and as shown in Figure 2 of the drawings.

60 MATTHEWS, HADDAN & CO.,
Chartered Patent Agents,
33 Elmfield Road,
Bromley, Kent.
For the Applicants.





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