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FURNACE FOR BURNING PULVERIZED FUEL

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Fig. 1.

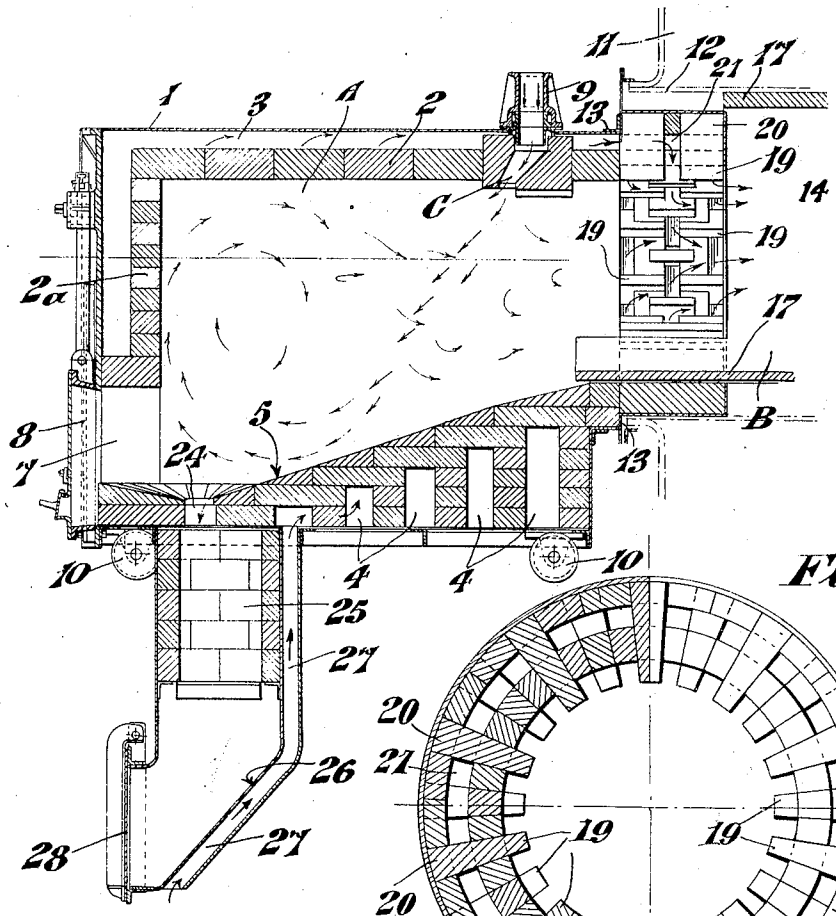


Fig. 2.

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FURNACE FOR BURNING PULVERIZED FUEL

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1 Claim. (Cl. 110—28)

This invention relates to apparatus for burning powdered fuel in furnaces. A known method of burning powdered fuel consists in partially gasifying the fuel by projecting the same into a primary combustion chamber together with or at the same time as a quantity of primary air insufficient to support complete combustion, causing the stream of fuel to strike a wall or surface within the combustion chamber in such manner that the stream is deflected and the fuel is both diffused within the primary air stream and retarded in its flow and, without the flame being extinguished, causing the mixture of gaseous and non-gasified fuel to pass, while still burning, out of the primary combustion chamber together with, or at the same time as, a quantity of secondary air sufficient to support complete combustion, into a secondary combustion chamber in which secondary combustion chamber the burning of the fuel is continued.

One of the objects of the present invention is to provide improved apparatus for burning powdered fuel by the aforesaid method, such apparatus enabling a very long path of travel of the fuel to be employed without increasing correspondingly the size of the generator or gasification chamber.

In the improved apparatus according to the present invention the fuel is projected into the interior of the gasification chamber through an inlet in one side wall thereof in a direction away from the outlet of such chamber and obliquely to the axis of the chamber so that it passes on to the opposite side wall of the gasification chamber from whence it is deflected onto the front end wall and so caused to return and flow towards the outlet through and around the incoming stream of fuel.

In thus striking the wall of the gasification chamber the stream of fuel is somewhat retarded in its flow but such retardation is also supplemented by other means such as restricting the size of the outlet and by the provision of suitable baffles. The size of the outlet must however not be restricted to such an extent as will cause the extinction of the flame, as it is intended that the partially gasified fuel shall pass into the secondary combustion chamber whilst it is still burning, the combustion within the secondary combustion chamber being then a continuance of the combustion initiated within the gasification or primary combustion chamber.

It will thus be seen that by admitting the fuel in the manner according to the present invention such fuel is caused to traverse a path which is in the form of a loop. There is thus avoided the baffling effect produced when the fuel is admitted coaxially and directed towards the opposite end wall which baffling effect results in the production of a somewhat quiescent region, in which the non-gasified particles of the fuel have a tendency to deposit.

In order that the invention may be clearly understood and carried into effect one construction of apparatus in accordance therewith will now be described by way of example by aid of the accompanying drawing in which:—

Figure 1 is a longitudinal vertical section through a combined primary and secondary combustion chamber showing the apparatus according to the invention applied to a steam generator of the "Lancashire" or "Cornish" type, and

Figure 2 shows, in the lefthand half, a transverse section and, in the righthand half, a front elevation of the outlet for effecting an intimate mixing of pre-heated secondary air with the products of partial combustion.

Referring to Figure 1 the primary combustion chamber A comprises an outer shell 1 of metal and an inner liner 2 of refractory bricks or other refractory material which liner is spaced from the shell 1 to provide a space 3 for the circulation and consequent preheating of the secondary air which enters such space through the openings 4. The bottom 5 of this chamber is sloped downwards from the neck or outlet 6 to the front end wall 2^a and at such lower end an opening 7, normally closed by a door 8, is provided. Pulverized fuel together with primary air are conveyed to the inlet C by way of a feed pipe 9 either directly from a suitable pulverizer or from a storage and, in consequence of the shape and inclination of such inlet, this fuel is projected towards the inclined bottom 5 obliquely to the axis of the chamber. From this inclined surface it is deflected onto the end wall 2^a from which it is again deflected and caused to travel through the chamber, through and around the incoming fuel and finally out through the outlet 6 into the secondary combustion chamber B. The fuel is thus caused to travel approximately the path indicated by the arrows and by so doing is caused to remain within the primary chamber a length of time sufficient for the desired partial gasification to take place. By returning past the incoming fuel the partially gasified fuel is caused to ignite the incoming fuel practically at the moment of its first entry. This feature although not novel per se is thus decidedly advantageous as it results in reaction taking place throughout

practically the whole distance travelled by the fuel within the primary combustion chamber.

As the period during which the fuel is subjected to the heat within the primary combustion chamber is also a factor of great importance and as the maintenance of this heat is dependent upon such period being adequate, provision is made to ensure that the velocity of the burning fuel in its path through the primary combustion chamber shall be sufficiently retarded. This retarding effect is produced on one hand by the particular path the stream of fuel is caused to take and on the other hand by making the outlet 6 of an area smaller than the area of the front end of the combustion chamber.

In the example of apparatus illustrated, which is expressly designed for use in connection with large fire-tube boilers of the "Lancashire" and "Cornish" types, the primary combustion chamber is mounted upon wheels or rollers 10 whereby the same may be wheeled up to the front end of the boiler 11 and its outlet detachably coupled to the existing flanged end of the fire-tube 12 in the manner indicated generally at 13.

By this means the products of partial combustion are caused to pass directly into the secondary combustion chamber B without the flame being extinguished. The pre-heated secondary air is caused to mix with these products of partial combustion within the opening 14 constituting the inlet to the secondary combustion chamber such pre-heated air entering such opening through an extension between the outlet end of the primary combustion chamber and the rear face of the inlet opening 14, this extension serving to insure efficient mixing of the pre-heated secondary air with the burning products of partial combustion, as will be more fully described below. As the temperature within the secondary combustion chamber is comparatively high the interior of the portion of the boiler fire-tube 12 which constitutes the secondary combustion chamber, is lined with refractory material which lining is indicated generally at 17.

In lieu of induced draught for the secondary air such air may be supplied under pressure and admitted into the pre-heating space either through the openings 4 or through another opening in the front wall 2^a of the combustion chamber which may also be constructed so as to provide in its thickness a space for this air. By this means the whole or the greater part of the refractory lining of the primary combustion chamber will be efficiently air-cooled.

The lower end of the sloping bottom 5 is arranged to discharge its accumulation of molten slag or clinker into a pit or down a chute to a place convenient for its removal in a manner hereafter to be described.

So as to ensure efficient mixing of the pre-heated secondary air with the burning products of partial combustion the extension between the outlet end of the primary combustion chamber and the opening 14 is provided with a series of inwardly and radially extending projections 19, see Figure 2. These projections in the example illustrated are formed by using specially long wedge-shaped refractory bricks 20, which extend across the secondary air space indicated at 21, and into the passage through which the gases pass to the opening 14.

One of the difficulties met with in the use of apparatus for burning pulverized fuel is that of removing and handling the slag. The apparatus according to this invention is provided with a means whereby the slag may be easily and successfully removed from the primary combustion chamber and subsequently handled. Such means comprise a comparatively small drain 24 located at the lower end of the inclined base 5 and extending through the floor of the combustion chamber. Through this drain the molten slag is permitted to fall down a chute 25 and onto a stoping and artificially cooled surface 26.

This surface 26 is cooled by the secondary air which is conducted through a space 27 on the underside of this surface 26, the space 27 being connected to the openings 4 so that the secondary air heated by contact with the underside of surface 26 passes to the space 21 adjacent to the outlet 14. By this means the molten slag within the combustion chamber is converted into small solid particles in which condition it is collected within the bottom of the chute 25 and removed at intervals through the opening 28. It is important that the drain 24 be kept as small as possible so as to shield the surface 26 and the interior of the chute from as much as possible of the radiant heat from the interior of the primary combustion chamber. If desired the surface 26 may be water cooled.

In starting up the apparatus when using pulverized fuel sufficient air for complete combustion is admitted with the fuel and it has been found that more rapid heating up is attained if during this period the fuel is ground to the finest possible powder form. When the primary combustion chamber has been sufficiently heated the air supply is reduced and fuel ground to the usual specification may be used.

I claim:

In an apparatus for burning pulverized fuels the combination of a combustion chamber, an ash pit, said chamber provided with a restricted discharge neck and a base inclined downwardly away from said neck, and provided further with an opening arranged to discharge slag from the lower end of said base into the ash pit, means adjacent said neck for discharging a mixture of fuel and primary air, sufficient only for the partial combustion of the fuel, into the combustion chamber through the upper wall thereof in a direction away from said neck and towards the base, an outer shell surrounding said neck and separated from a part thereof by a space through which secondary air passes, a main furnace chamber with which said neck communicates in which the complete combustion of the partially burnt products discharged from said neck takes place, means for connecting the shell to the main chamber so that the air discharged from the shell passes into said main chamber, and a tubular extension between the neck and the main chamber provided with openings and with radial partitions between said openings, said partitions extending into the stream of the discharged products for mixing the secondary air discharged from the space between the neck and the shell with the products discharged from the neck.

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