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G. SZIKLA ET AL

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FUEL DUST FURNACE

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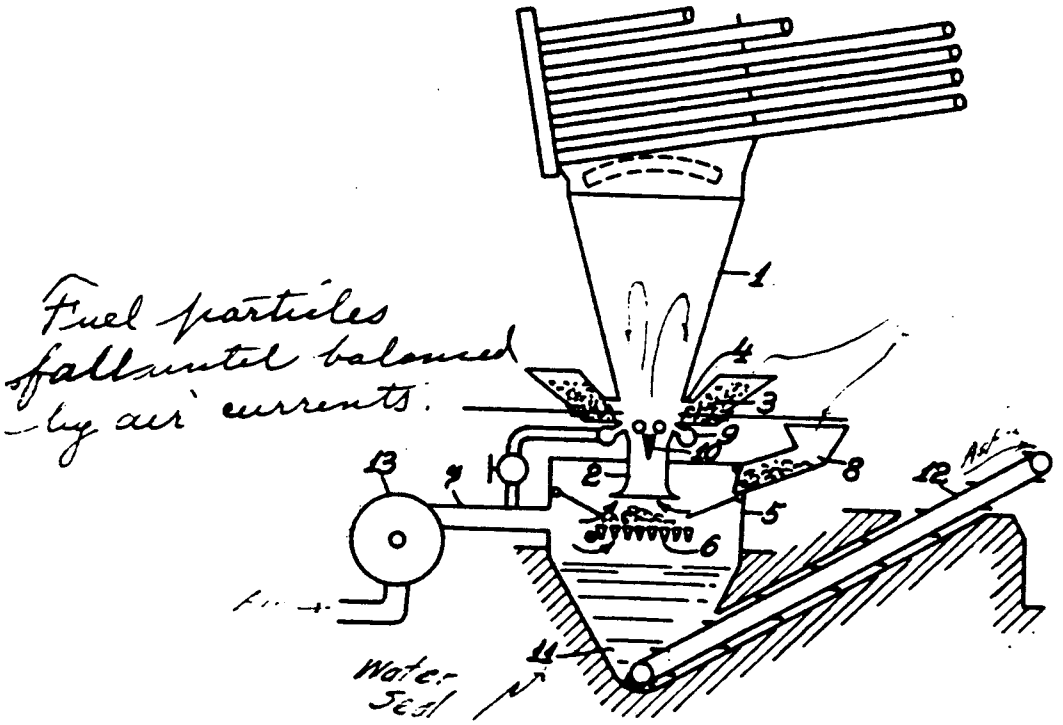

Inventors
G. Szikla
A. Rozinek
by Lanyon, Parry, Kerr & Lanyon
Attys.

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UNITED STATES PATENT OFFICE.

GÉZA SZIKLA AND ARTHUR ROZINEK, OF BUDAPEST, HUNGARY.

FUEL-DUST FURNACE.

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It has been proposed to burn powdered fuel comprising finer and coarser particles by causing the pulverized fuel to fall in the form of a shower in a rising air current within a combustion chamber, the cross sectional area of which diminishes downward in order to decrease the falling travel of the fuel and the depth of the chamber required to allow the complete combustion of the fuel before reaching the bottom of the chamber. As, however, the fuel particles owing to their fall attain a certain vertical velocity and their fall is only more or less impeded by the rising air current, the height of the furnace shaft is, in spite of its tapered shape, a considerable one. Moreover the fuel introduced at the top of the furnace shaft will not be distributed uniformly throughout the whole cross sectional area of the shaft.

It has been further proposed to introduce the pulverized fuel and the blast of the air of combustion together at the bottom of a funnel shaped combustion shaft, so that the fuel particles may be driven upward by the air blast until the velocity of the air current has decreased in the upper wider levels of the shaft so far as to allow the coarser particles to drop back. Owing to the fact that the fuel enters the combustion shaft with the velocity of the air current, the height of the shaft required to ensure a complete combustion within the shaft is comparatively great, while with the fuel and the air rushing with a considerable velocity in the same direction, the conditions for ignition and combustion are as unfavorable as in the usual coal dust furnaces. The ignition and the combustion of the fuel is partly unreliable and partly slow, while the starting and regulation of, and the removal of the slag from such furnaces, as well as the securing of the complete utilization of the fuel is difficult.

One object of this invention is to avoid some of the said drawbacks by introducing the slack fuel or pulverized fuel into the rising gas current in the upright furnace shaft having an upward increasing cross sectional area, at the proximity of the smallest cross section and at a higher level than the entrance of the said gas current.

Another object is to avoid some of the above mentioned drawbacks by providing below the bottom opening of the tapered furnace shaft a chamber of greater cross sectional area than the said bottom opening provided with gas or air inlet channels and with a grate receiving the particles falling through the bottom opening of the shaft.

If the rising gas current is produced by an air or gas blast, the widened grate chamber is joined gas-tightly to the shaft and the blast entering the said grate chamber passes over or through the said grate. Preferably an ash pit provided with a water seal receiving a conveyor for the removal of the ashes is arranged below the said grate.

By introducing the fuel in the vicinity of the smallest cross sectional area of the shaft, the fuel may be easily distributed uniformly over the whole cross sectional area and the fuel meets the rising gas current at the place, where it has its greatest or nearly its greatest velocity, while the fuel has practically no velocity at all in the direction of the flow of the gas current. Hence, even if the combustion shaft is shaped like a diffuser allowing the eddyless decrease of the velocity of the air current, the fuel may be held during its complete combustion in a substantially stationary floating suspension in a shaft of comparatively small height, while the air of combustion flows along the substantially stationary fuel particles. The newly introduced fuel traverses the burning fuel layers floating in equilibrium until different particles of the newly introduced fuel reach their state of equilibrium at the levels of the shaft in which the velocity of the air current balances the weight of the fuel particles. The ignition and combustion or gasification or distillation of the fuel can be performed in this manner in a regular process.

Another object is to allow the removal of the unburned or incombustible parts even if the fuel is treated in a substantially stationary floating suspension. For this object the suspending gas current introduced at the bottom of the shaft and practically forming an impenetrable wall, will be periodically choked or interrupted to allow the particles to be removed to drop from the zone of action of the rising gas current. Simultaneously with the choking or interrupting of the gas current, the introduction of fuel may be periodically diminished or interrupted.

The accompanying drawing shows diagrammatically, a sectional elevation of an example of a furnace, according to this invention.

In the drawing 1 is an upright shaft having an upward increasing cross sectional area. Adjoining the lower end of the shaft is provided a part 2 of uniform or downward increasing cross section. The fuel dust is supplied into the shaft 1 at one or more points 4 by means of mechanical feeding devices, as for example screw conveyors 3. According to the example shown in the drawing, the air necessary for combustion and eventually the gases of combustion enter the funnel shaped shaft 1 through channels 7 near or at the bottom of the shaft, for example through the opening 2 in its lower end, so that the introduced air keeps the fuel which is admitted at 4 in floating suspension.

The weight of the fuel particles is balanced by the lifting power of the air current at a velocity of the current depending from the shapes, dimensions and the weights of the said particles and from the relative weight of the air. Owing to the upward increasing cross sectional area of the shaft, the velocity of the gas decreases upwards. The fuel particles rise according to their weight with the air current to a level, at which their weight is balanced by the air current. The fuel introduced at 4 into the shaft 1 will be arranged according to the sizes of the particles at different levels in which they will float without being driven in the direction of the air current. Even the coarser particles have plenty of time to be completely burnt or in case of a reduced air supply, to be completely gasified.

If the fuel and the air be introduced in the above described manner, the furnace operates similarly to a usual hand supplied grate furnace, except that the air takes the place of the iron grate, as a supporter of the fuel. The new furnace differs also in principle from all known coal dust furnaces and is similar to the grate furnaces in that the newly introduced fuel comes into contact with the burning fuel since it has to traverse the floating layers already burning, before coming to a stationary state in the level corresponding to its size. This peculiarity of the furnace greatly facilitates the ignition. The advantage of the concentrated combustion of the grate furnaces is attained without the drawbacks of such grates viz, the large costs of installation and of maintenance and the difficulties caused by the use of caking and slagging coal.

As the velocity of the air current reaches its maximum value in the axis of the shaft and decreases toward the walls, in order to obtain a more favorable distribution of the velocity, it is advisable to arrange choking or distributing members 10, for example in the shape of a core arranged in the center of the shaft in the vicinity of its narrowest cross section.

In order to secure the drop or the removal of the incombustible particles, the gas current and preferably also the introduction of the fuel dust, can be periodically choked or interrupted or altered. For example the admission of air through the channel 7 may be periodically interrupted in order to allow the ashes to drop, and at the same time the introduction of the air through the nozzles 9 may be choked or totally interrupted.

The periodic alteration of the quantity of air blown into the shaft may be effectuated also by altering the quantity of air only in the lower levels of the furnace, while it remains substantially constant in the upper levels. This can be easily effected, if the blast channels are arranged at different levels, so that, for example, during the choking of the introduction of the air at the lowest channels 7, a correspondingly greater quantity of air is admitted through the nozzles 9.

As coarser fuel particles may drop from the furnace shaft, more especially when the air blast is interrupted for the purpose of removal of the ashes, a comparatively wide chamber 5 is arranged below the narrowest part of the shaft and provided with a grate 6, on which the fuel falling from the shaft will burn out, and at the same time preheat the air before it enters the shaft. The preheating may be aided by the introduction of fuel directly to the grate 6 through channel 8. The air may be introduced totally or partly through chamber 5 and part of the air can be conducted through the grate 6. The bottom of the grate chamber 5 may form a water seal 11 receiving the ashes dropped from the grate 6. A suitable conveyor 12 entering the said water seal allows a continuous removal of the ashes.

The grate 6 facilitates the starting and the regulation of the furnace. It is sufficient to kindle and to maintain a small fire on the grate. As soon as air and fuel dust are introduced, instant ignition takes place without the necessity of prior heating of the shaft. For purposes of regulation the introduction of fuel may be interrupted for shorter or longer periods, as the fuel is ignited directly upon its renewed introduction.

The described furnace may be used not only for powdered or crushed solid fuels but also for atomized liquid fuels with high boiling temperature, for example tar or residues of mineral oil distillation.

The furnace may be used not only for combustion, but also for the gasification of fuels with reduced air admission, to obtain a gas mixture with high carbon monoxide per-

centage. For the production of combustible gases steam or atomized water may be introduced into the furnace shaft.

The fuel floated within the shaft must however not be completely gasified but it can be treated by heat in such a manner that only the volatile constituents are driven out, that is to say, so that the fuel is only distilled. If the distillation is to be performed at low temperatures in order to obtain primary tar, the gases floating the fuel are heated before their introduction to the distillation temperature. The operation of the furnace may be interrupted periodically in order to permit the coke- or semi-coke dust to drop and to be removed.

Having now fully described and ascertained the nature of the said invention and the manner in which it is to be performed, we declare, that what we claim is:—

1. A furnace for utilizing powdered fuel and the like, in a rising current of gaseous fluid, comprising, an upright shaft having an open lower end and of upwardly increasing cross sectional area, a chamber positioned below the lower end of the shaft and having a cross sectional area greater than that of the open lower end, a grate in the chamber positioned to receive material falling through the lower end of the shaft, and an inlet for gaseous fluid in the chamber.

2. A furnace for utilizing powdered fuel and the like, in a rising current of gaseous fluid comprising, an upright shaft having an open lower end and of upwardly increasing cross sectional area, a chamber positioned below the lower end of the shaft and having a cross sectional area greater than that of the open lower end, a grate in the chamber positioned to receive material falling through the lower end of the shaft, and an inlet for gaseous fluid in the chamber, the chamber having an air-tight connection with the shaft.

3. A furnace for utilizing powdered fuel and the like, in a rising current of gaseous fluid comprising, an upright shaft having an open lower end and of upwardly increasing cross sectional area, a chamber positioned below the lower end of the shaft and having a cross sectional area greater than that of the open lower end, a grate in the chamber positioned to receive material falling through the lower end of the shaft, and an inlet for gaseous fluid in the chamber, an ash pit at the bottom of the chamber, a water seal for the chamber bottom, and a conveyor entering the chamber.

4. A furnace for utilizing powdered fuel and the like, in a rising gas current, comprising, an upright shaft having an open lower end and of upwardly increasing cross sectional area, a chamber positioned below the lower end of the shaft and having a cross sectional area greater than that of the open lower end, a grate in the chamber positioned to receive material falling through the lower end of the shaft, and an inlet for gaseous fluid in the chamber and a fuel feed opening in the chamber for directly supplying the grate.

In testimony whereof we affix our signatures.

GÉZA SZIKLA.
ARTHUR ROZINEK.