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APPARATUS FOR OXIDATION OF FINELY SUBDIVIDED MATERIAL.

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[Diagram of apparatus for oxidation of finely subdivided material]
To all whom it may concern:

Be it known that I, William N. Best, a citizen of the United States, and resident of Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Apparatus for Oxidation of Finely-Subdivided Material, of which the following is a specification.

This invention relates to apparatus for the oxidation of pulverulent or other finely sub-divided material and has for its main object to more effectively bring the finely sub-divided material into intimate contact with a gaseous heating medium and a gaseous oxidizing agent.

This application is a division of my prior application Serial No. 275,682, filed Feb. 8, 1919, and in which the process is claimed.

So far as my improved apparatus is concerned, I do not wish to be limited to any particular finely sub-divided material nor to the character of the resultant product of the process employed. In carrying out my invention I use a burner or liquid fuel atomizer which will give a substantially flat spray of vapor of a liquid or semi-liquid fuel such as oil or tar, by means of an atomizing jet of compressed air or steam. Air for supporting the combustion of this liquid fuel is delivered preferably under comparatively low pressure adjacent to the spray so as to produce a substantially flat fan-shaped flame. The material which is to be oxidized is delivered mechanically as for instance, by gravity through a chute, trough, or conduit and in suitably regulated quantities. The point of delivery of the finely sub-divided solid material is directly above the flat fan-shaped flame so that said material falls into and through the flame and is highly heated by the latter and is oxidized by the current of air which is supplied not only for such oxidation but for the supporting of the combustion of the finely sub-divided liquid fuel.

One of the main objects of my invention is to more effectively utilize coal dust, culm, screenings, or other solid fuel existing in large quantities in a finely subdivided state. I am aware that such finely sub-divided solid fuel has been used in furnaces by blowing or spraying it into the combustion chamber in which a fluid fuel is also burned but so far as I am aware no one has heretofore proposed permitting such finely sub-divided solid material to fall through a fan-shaped flame of a liquid fuel atomized by a gaseous medium so that the solid fuel is both highly heated and the combustible portions completely oxidized. With this improved arrangement, the furnace may be first heated solely by the burning of the spray of liquid fuel and the additional fuel to produce the additional heat may be delivered either continuously or at such times as may be desired, to the fan-shaped flame.

A further object of my invention is to provide a simple, effective, and inexpensive apparatus for the oxidizing of such finely sub-divided materials as result in solid oxides rather than gaseous oxides like carbon-dioxide. My invention is particularly applicable for use in the producing of copper oxide from finely sub-divided copper. The finely sub-divided copper or other metal or material to be oxidized is delivered to and permitted to fall through the fan-shaped flame and the oxidizing air and is completely, thoroughly and uniformly oxidized at high temperature before it falls to and collects on the bottom of the furnace or in other suitable collection chambers.

Materials other than copper which produce solid oxides and materials other than coal dust which produce gaseous oxides, may be employed in my improved apparatus.

In the accompanying drawings I have illustrated certain essentials of an apparatus embodying my invention.

In these drawings:

Figure 1 is a central vertical section view of a portion of an apparatus showing the burner or liquid atomizer in one position, and Fig. 2 is a view similar to a portion of Fig. 1 but showing the burner or atomizer in an inverted position.

In these drawings, I have illustrated a portion of a furnace 10 having a combustion chamber 11. This furnace may be of any desired form, shape, or character, depending entirely upon the material to be heated by the heat of the furnace or the material to be oxidized in the flame. Opposite to the entrance to the combustion chamber I employ a burner or atomizer 12 having a delivery passage 13 for oil, tar, or other liquid or semi-liquid fuel and a passage 14 for steam, compressed air, or other gaseous or
fluid atomizing medium. The outlets from these passages are so juxtaposed that the escape of the atomizing medium delivers the liquid fuel in a substantially fan-shaped sheet or spray. The outlet from the passage 15 be connected up to suitable sources of supply of the two fluid mediums by pipes 16 and 17. The burner or liquid fuel atomizer may be constructed in accordance with any one of my various prior patents, as for instance, 708,458 of September 2, 1902, and 752,195 of February 16, 1904. Below the burner or atomizer is a nozzle 18 for delivering the low pressure combustion supporting gaseous medium, such as air.

In connection with this mechanism, I employ a receptacle 19 which may be in the form of a hopper or of any desired shape, size, or form and from which a conduit 20 extends to a delivery nozzle or outlet 21. This is positioned slightly above the plane of the fan-shaped flame, said plane being indicated approximately by the line A in Figs. 1 and 2, and it is spaced a short distance from the outlet for the expansive medium which delivers and distributes the liquid fuel. In order to secure a substantially continuous delivery of the finely sub-divided material, such as coal dust, metallic copper, or other oxidizable material, to break up any large chunks in the receptacle, and to keep the conduit from clogging up, I provide some suitable form of mechanical agitating and feeding means. Merely as an example of such means, I have shown a reciprocating plunger rod 22 connected to an eccentric strap 23 of an eccentric 24, which latter is secured to and rotated by a shaft 25 above the hopper. The lower end of the rod 22 may be roughened or recessed or provided with pockets or other surface irregularities and terminates within the portion 26 of the conduit 20 connected to the hopper.

The rotation of the eccentric gives the rod both a reciprocating motion within the conduit and a slight lateral movement so as to effectively deliver material from the hopper to the conduit. The rate of delivery may be controlled not only by varying the speed of the shaft 25 but also by controlling the inlet opening to the pipe 20. I have shown a pair of closure sections 26—26 slidably mounted on the bottom of the hopper upon opposite sides of the rod 22, and extending part way across the inlet end of the conduit 20. These closure sections may be adjusted toward and from each other in the following manner, for instance, by screw threaded engagement with shaft sections 27 having operating handles or cranks 28 and held against longitudinal movement by nuts upon opposite sides of supporting brackets 29.

The relative positions of the burner and the delivery nozzle for the solid material may be varied dependent upon the character of the furnace and the character of the liquid and solid materials oxidized therein. In Fig. 4 I have shown a construction involving the same structural elements as in Fig. 1 but have shown the burner or atomizer inverted so that the atomizing gaseous medium is delivered across the open upper end rather than the open lower end of the liquid fuel delivery passage. In many respects this is the preferable positioning of a burner of this character.

Materials of various different states of sub-division may be employed, the fineness of the material or the regularity and size of the particles being dependent to a certain extent upon the nature of the material. If the solid material is to be oxidized in order to produce heat, I preferably pulverize it or screen it to pass through a 100, 150, or 200 mesh but coarser or finer material may be employed.

Although I have shown the solid material delivered to the flame or liquid fuel spray solely by the action of gravity, it will of course be understood that other delivering means might be employed. Although under ordinary circumstances the combustion supporting gaseous medium is air under comparatively low pressure, as for instance, from a blower, yet it will of course be understood that other means for supplying such combustion supporting medium might be employed or that the fan-shaped flame might be so positioned that a sufficient amount of combustion supporting air would be automatically taken directly from the atmosphere without the necessity for the delivery nozzle 18. Under some special circumstances I might employ oxygen of any desired purity instead of ordinary air.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. An apparatus of the character described, including a burner or atomizer for delivering a substantially flat fan-shaped spray of liquid fuel in substantially horizontal direction, means for delivering combustion supporting air beneath said spray, and means for delivering a finely sub-divided solid material above said spray and permitting it to drop substantially vertically into the flame.

2. In combination, a combustion chamber, an atomizing nozzle for delivering a substantially flat fan-shaped spray of liquid fuel into said chamber, a solid fuel receptacle, a conduit leading from said receptacle and through which the solid material may move by gravity and be delivered at a point above said spray, an agitator and feeder movable vertically within the upper part of
said conduit, and means for varying the effective size of the inlet to said conduit around said agitator and feeder.

3. In combination, a combustion chamber, an atomizing nozzle for delivering a substantially flat fan-shaped spray of liquid fuel into said chamber, a receptacle for finely sub-divided solid material disposed above said nozzle, a conduit extending downwardly from said receptacle and terminating in advance of said nozzle, whereby said solid material may fall by gravity into said spray, and reciprocating means operating within said conduit for feeding material therethrough.


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