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B. E. ELDRED.

PROCESS OF BLAST COMBUSTION.

APPLICATION FILED APR. 8, 1905.

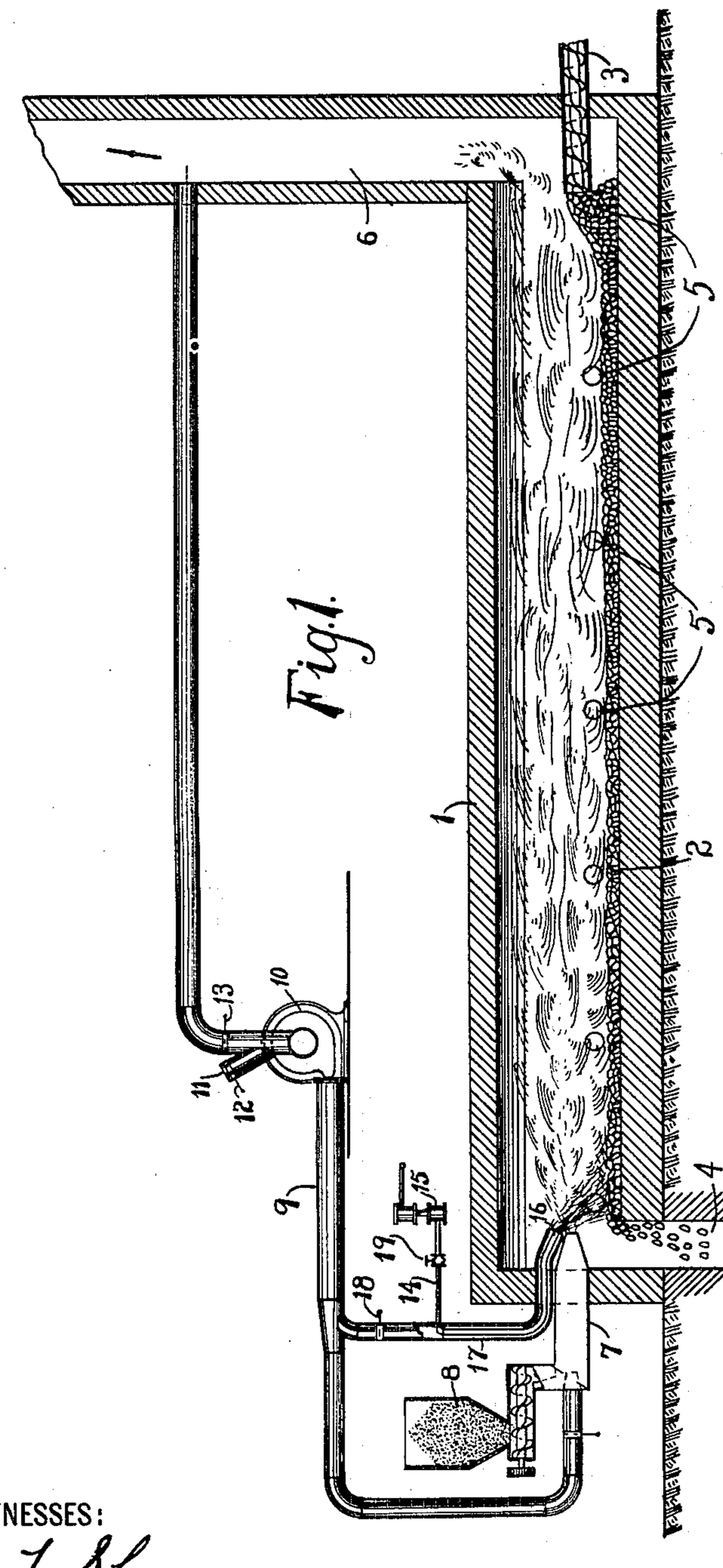

Fig. 1.

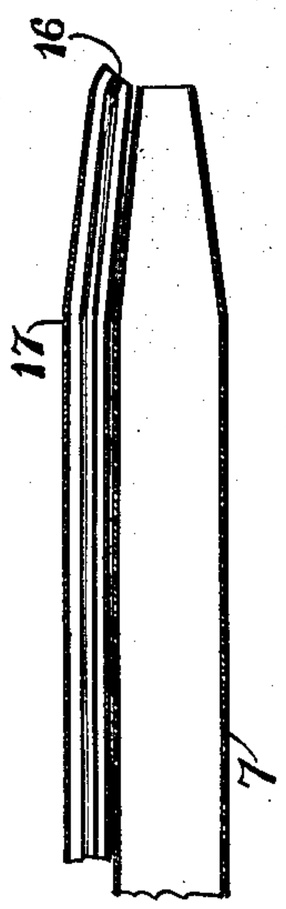

Fig. 2.

WITNESSES:
L. T. Shaw
M. A. Moder

INVENTOR
B. E. Eldred
BY
Bentley & Pierson
ATTORNEYS

UNITED STATES PATENT OFFICE.

BYRON E. ELDRED, OF BRONXVILLE, NEW YORK, ASSIGNOR TO COMBUSTION UTILITIES COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

PROCESS OF BLAST COMBUSTION.

No. 812,193. Specification of Letters Patent. Patented Feb. 13, 1906.

Application filed April 8, 1905. Serial No. 254,476.

To all whom it may concern:

Be it known that I, BYRON E. ELDRED, a citizen of the United States, residing at Bronxville, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Processes of Blast Combustion, of which the following specification and accompanying drawings illustrate the invention in a form which I now regard as the best out of the various forms in which it may be embodied.

This invention relates to a process of burning solid, liquid, or gaseous fuel introduced under propulsion by blast or similar agency into a combustion-chamber without previous ignition in the form of a stream, cloud, or current in a finely-divided, pulverized, sprayed, atomized, gaseous, or similar condition. It relates to the production of a slow-burning flame by employing a draft-current of air diluted with a predetermined amount of neutral gaseous diluent, somewhat as described in my prior patent, No. 692,257.

In particular the invention applies to the concentrated fuels of high calorific power—such as powdered coal, oil, natural gas, &c.—as distinguished from weaker fuels, such as producer-gas, although it might be used with these latter where a very low flame temperature is needed. As previously practiced the method of introducing these concentrated carbonaceous fuels into furnaces by blast or current, generally in long furnaces of the reverberatory type, has resulted in very high temperatures within the combustion-chamber, and while of recognized efficiency in causing the combustion to take place largely in the region of the objects to be heated and over a considerable length of space this method has not, so far as I am aware, hitherto been made practical in arts requiring a comparatively low temperature, a regulated temperature, or a wide range of temperature. Among the injurious effects produced by an excessively-hot blast-flame is the rapid destruction of linings which ensues, often making necessary the use of means to prevent impingement of the flame on the lining, thereby sacrificing part of its efficiency.

By employing as an ingredient of the blast a gaseous diluent, such as products of substantially complete combustion equivalent in volume to a small portion of the stack-gases from the furnace or other source, I am enabled to control the temperature and volume of the flame and the duration of its combustion. These gases should preferably be completely burned out of combustible, or substantially so, but may contain uncombined oxygen. The flame may thus be rendered longer, more voluminous, slow-burning, and cooler and applicable to practically all of the uses to which long blast-flames have been successfully applied and to many others for which they have hitherto been unsuitable. The flame may be allowed to impinge on the furnace-linings with much less destructive effect than heretofore, which is a very important consideration and forms one of the chief advantages of my invention.

The invention also relates to the production of locally-intensified combustion by means auxiliary to the main blast. Specifically, where a local high temperature or a greater or less range of temperature is desired I provide for obtaining it by intensifying the combustion of a portion of the thus-modified blast or flame by means of an auxiliary jet or jets of a suitable gas or mixture of gases, preferably directed counter or at an angle to the axis of the flame and adapted to deflect and agitate only a part of the combustible stream. This gas is preferably a supporter of combustion and may be air or dilute air.

In the accompanying drawings, Figure 1 shows a sectional view of a reverberatory furnace adapted to carry out this invention and equipped for burning a blast of powdered coal, which I have selected as illustrating the principle of the invention. Fig. 2 represents a section of the blast and jet nozzles.

1 is a long combustion-chamber lined with the usual refractory materials which furnish a heat-retaining region in which the ignition of the flame is maintained and its combustion carried to substantial completion when the fuel and air are furnished in proportions essential to perfect combustion. Premature chilling of the inflated flame would tend to cause incomplete combustion. Such materials as mineral solids, being of a heat-retentive incandescing character—that is to say, incandescing objects or materials or those

capable under the conditions of treatment of attaining a temperature of incandescence—may be subjected to impingement of the flame without undue chilling of the latter. On the hearth or floor 2 are supported the materials under treatment, such as ore undergoing a roasting or smelting operation, Portland-cement material which is being calcined and sintered, or other materials. The materials may be fed in at one end by a conveyer 3 and propelled along the hearth to an outlet 4 by means of rabbles 5. The particular means of introducing, feeding, or removing the materials forms no part of the invention and may be as desired. In other words, I do not broadly confine myself to any particular form of furnace, although preferably employing a reverberatory furnace. Where the materials require to be fed along the hearth, this may be done in any convenient way—as, for example, in a rotary inclined-barrel cement-furnace.

At one end is the stack or chimney 6 and at the other is a blast-nozzle 7, directed longitudinally of the combustion-chamber. Into this nozzle is fed by known means pulverized coal 8, propelled by a draft-current from a pipe 9, which connects with the chimney 6 and contains a fan-blower 10. If a different fuel is used, such as oil or gas, the fuel-feeding arrangements will be those suited to the particular fuel employed. On the suction side of the fan is an air-inlet 11, in which and the trunk of the pipe are valves or dampers 12 13 for regulating the proportions of air and products of combustion used in the blast.

14 is an auxiliary pipe leading from an air-compressor 15 and terminating in a jet-nozzle 16 above the main blast-nozzle and directed at an angle downwardly toward the hearth 2.

In the operation of this particular apparatus the material travels from the rear end toward the front end of the furnace and the flame passes over it in an opposite direction toward the stack. I so regulate the quantity of fuel and air supplied to the blast as to furnish the conditions essential for combustion, and by introducing an additional volume of neutral products of combustion equivalent to a modicum of these gases—that is, preferably only a small portion of the total volume of the stack-gases—I retard the union of the oxygen and combustible, thereby modifying, lengthening, and inflating the flame and reducing its natural temperature. The proportion of the total stack-gases returned and passed through the fire may be varied more or less, depending upon the conditions; but I have obtained satisfactory results by returning about ten per cent. of the gases. The temperature of the flame is under control without varying the ratio of air to combustible, since by increasing the proportion of diluent the flame may be lengthened and reduced in temperature and by reducing the proportion it may be shortened and made hotter. It is in any event, if allowed to fully develop, longer, more diffuse, and cooler than a flame produced with the same quantity and proportions of fuel and air alone in the blast. The whole quantity of air necessary to a complete combustion of the main flame may be introduced with the fuel in the blast-current or a portion may be added within the combustion-chamber; but I prefer the former method, since it affords better control of combustion. The temperature of the flame in general tends to be higher than a flame produced with an external fuel-bed and a dilute air-draft, as specifically described in my Patent No. 692,257.

The auxiliary air-jet from nozzle 16 by deflecting and agitating a portion of the combustible stream produces a local high temperature, which, as shown, operates upon the material just prior to its discharge into the outlet 4. It might operate at a different point or points. Such local high temperature may be useful, for example, in effecting the final sintering or formation of cement clinkers after the lime in the cement material has been calcined by the cooler part of the flame and in acting on refractory ores. The burning of cement was made the subject of a separate application, Serial No. 254,474, filed April 8, 1905, on which Patent No. 797,506 was granted August 15, 1905. Owing to the concentrated character of the fuel the auxiliary jet will afford an extraordinarily high temperature, if required, while the main flame is much cooler. The maximum may be reduced by modifying the velocity or volume of the jet or by diluting it, so that a smaller range of temperature results.

17 is a diluent-supply pipe branching from pipe 9 and discharging concentric with the jet-nozzle 16 under suction of the jet, whereby the jet is diluted. Valves 18 19 regulate the proportions and velocity of the dilute jet. It is obvious that the jet or jets may be so placed as to obtain localized temperatures at different points or over an extended area. The auxiliary gaseous jet may be omitted where its effect is not required.

The comparative coolness and diffuseness of the main flame, besides exerting a beneficial effect in the heating operation, tends to avoid destruction of the furnace-lining. Moreover, the greater volume of the blast-current and its retarded combustion due to the diluent gas enable the blast to be reduced in strength, while maintaining a very long flame, and without added danger of backfiring or explosion.

While aware that prior patents have been granted purporting to show the use of pulverized fuel, together with stack-gases, I believe myself to be the first who has aimed to secure or has industrially applied with the agents

herein described a long slow-burning voluminous flame in a reverberatory chamber or elsewhere or a locally-intensified combustion of the character specified.

The heat losses due to excess of air employed for combustion are by my process materially reduced, inasmuch as the slow drawn-out combustion produced allows of the substantial completion of combustion with a minimum amount of air or oxygen. The stack-gases resulting from this method of combustion are therefore, generally considered, richer in CO_2 than ordinary stack-gases.

What I claim as new, and desire to secure by Letters Patent, is—

1. The process of producing a voluminous flame of large heating area which consists in projecting into an unobstructed hot-walled chamber of refractory material an ignited blast of suspended fuel carried by air containing sufficient products of combustion to retard burning and completing the combustion by radiant heat from the walls.

2. The process of producing a voluminous flame of large heating area which consists in projecting into an unobstructed chamber with roof of refractory heat-radiating material an ignited blast of suspended fuel carried by air containing sufficient products of combustion to retard burning and completing the combustion by radiant heat from the roof.

3. The process of producing a voluminous flame of large heating area which consists in projecting into an unobstructed hot-walled chamber of refractory material a blast of powdered coal carried by air containing sufficient products of combustion to retard burning and completing the combustion by radiant heat from the walls.

4. The process of producing a voluminous flame of large heating area which consists in projecting into an unobstructed chamber with roof of refractory heat-radiating material a blast of powdered coal carried by air containing sufficient products of combustion to retard burning and completing the combustion by radiant heat from the roof.

5. The process of burning pulverized fuel which consists in projecting pulverized fuel into a reverberatory furnace in suspension in a forcible current composed entirely of air and products of combustion, such products being in sufficient amount to retard combustion by the air of the current and completing combustion by radiant heat.

6. The process of producing differential heating which consists in forming a voluminous flame of large heating area in an unobstructed hot-walled chamber of refractory material by an ignited blast of suspended fuel carried by air containing sufficient products of combustion to retard burning and locally intensifying combustion at a desired point by a cross-jet containing air.

7. The process of producing differential heating which consists in forming a voluminous flame of large heating area in an unobstructed hot-walled chamber of refractory material by an ignited blast of suspended fuel carried by air containing sufficient products of combustion to retard burning and locally intensifying combustion at a desired point and to a desired degree by a cross-jet containing air and products of combustion in regulated proportions.

8. The herein-described process of intensifying the combustion of a blast-current of powdered coal diluted with products of combustion which consists in subjecting the same to the impingement of a high-pressure jet of air.

9. The process of intensifying the temperature of flame which consists in subjecting a fuel-laden current to impingement by an air-jet diluted with a neutral fixed gas.

10. The process of intensifying the temperature of flame which consists in subjecting a fuel-laden current to impingement by an air-jet diluted with gaseous products of combustion.

11. The process of intensifying the combustion of a blast-current of powdered fuel which consists in subjecting the same to impingement by a high-pressure jet of air diluted with products of combustion.

12. The process of regulating the temperature of flame which consists in subjecting a fuel-laden current to impingement by a jet of dilute air in such manner as to increase the normal temperature of combustion, and varying the proportion of diluent to air.

13. The process of obtaining regulated temperatures in a furnace which consists in producing a blast-flame of previously-unignited fuel, subjecting a current of the same composition to impingement by a dilute air-jet to locally intensify its combustion, and varying the proportion of diluent in the jet to vary the local temperature.

14. The process of obtaining regulated temperatures in a furnace which consists in producing a blast-flame of powdered coal diluted with products of combustion, acting on a similar current with an air-jet diluted with products of combustion to obtain a local high temperature, and varying that temperature by varying the proportion of diluent to air in the jet.

In testimony whereof I have hereunto set my hand, in the presence of two subscribing witnesses, the 1st day of April, 1905.

BYRON E. ELDRED.

Witnesses:
JAS. K. CLARK,
R. M. PIERSON.