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B. E. ELDRED.

APPLICATION OF HEAT IN METALLURGICAL AND OTHER FURNACES.

APPLICATION FILED SEPT. 9, 1904.

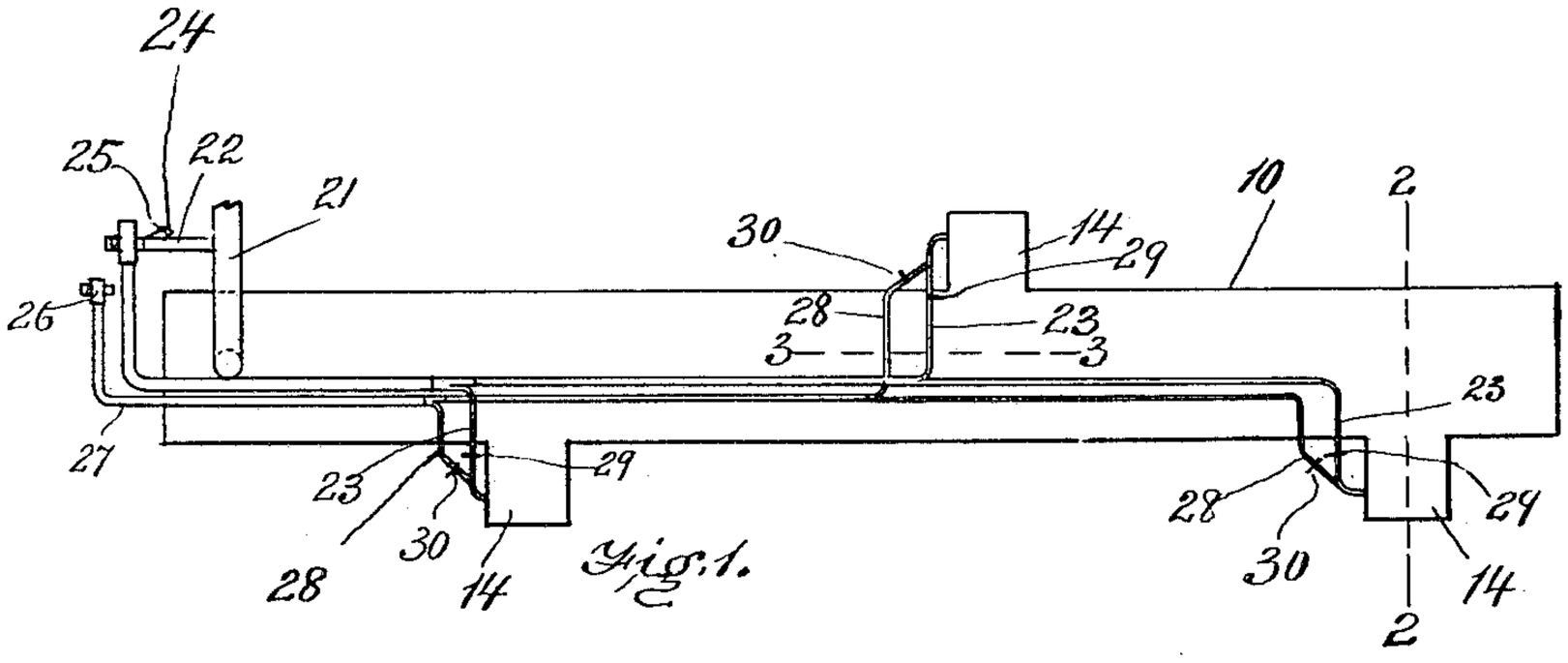

Fig. 1.

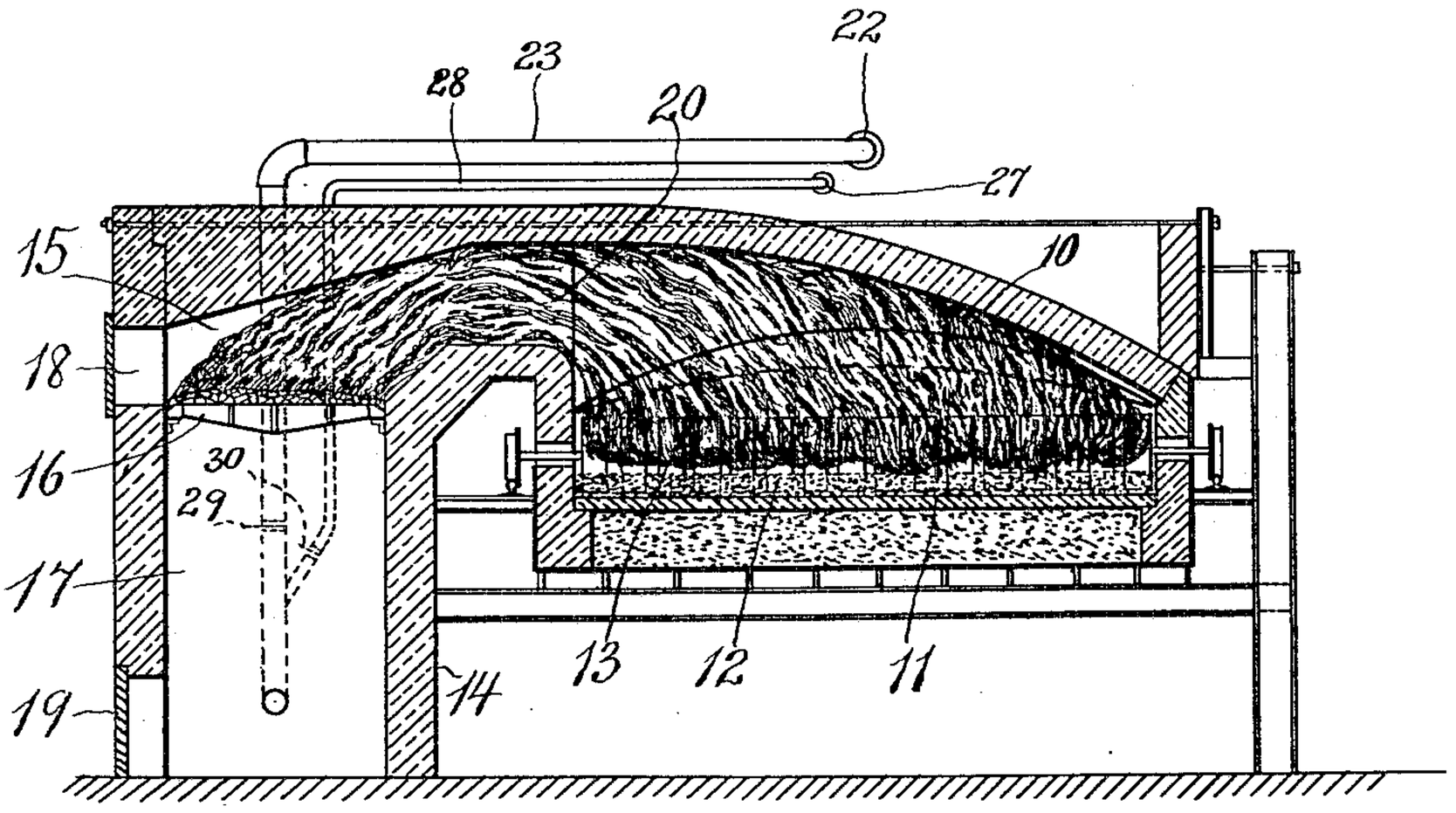

Fig. 2.

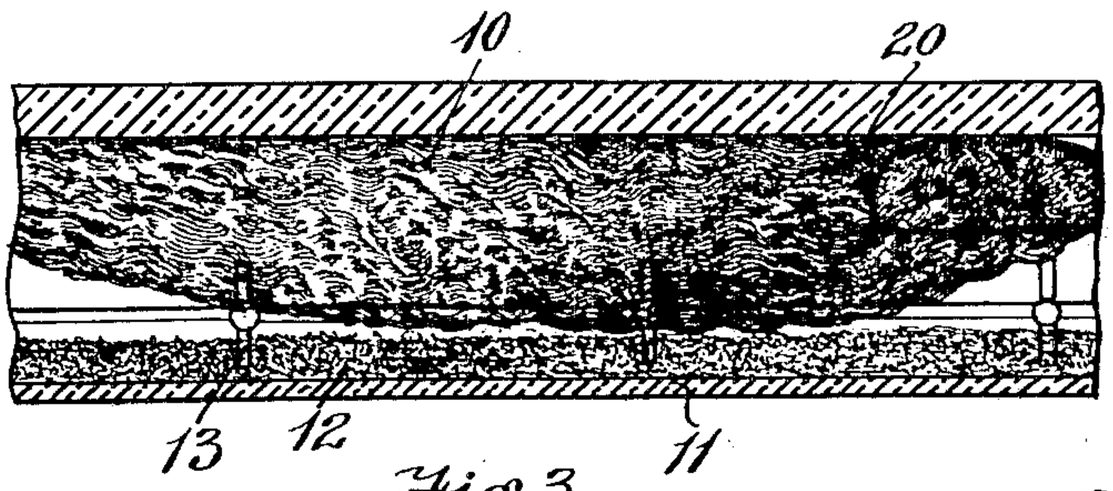

Fig. 3.

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UNITED STATES PATENT OFFICE

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

APPLICATION OF HEAT IN METALLURGICAL AND OTHER FURNACES.

No. 819,045. Specification of Letters Patent. Patented May 1, 1906.

Application filed September 9, 1904. Serial No. 223,880.

To all whom it may concern:

Be it known that I, BYRON E. ELDRED, a citizen of the United States, and a resident of Brookline, in the county of Norfolk and State of Massachusetts, have invented certain new and useful Improvements in the Application of Heat in Metallurgical and other Furnaces, of which the following is a specification.

This invention relates to the art of conducting combustion in reverberatory furnaces, such as Portland-cement kilns, and metallurgical furnaces, including ore-roasters, and various kinds of furnaces used in iron and steel manufacture, among which are puddling, billet, and plate-heating furnaces.

It also applies to many kinds of annealing-furnaces, glass-furnaces, and the like.

The present invention is a development of that described in my Patent No. 692,257, covering the art of conducting combustion with a draft-current of air and a gaseous diluent which is passed through the fire at the seat of combustion and controls the temperatures, giving cooler combustion, the invention being capable of producing a flame of increased length and volume in a region capable of attaining an igniting temperature. Heretofore that invention has been made known as applied specifically to lime-burning, where the material is calcined in a vertical chamber and the flame passes through the fragmental mass and drives off carbon dioxid. Increased fuel efficiency results from the fact that the combustion takes place more largely in the region of the material treated and to a less extent at the seat of combustion. In furnaces of the reverberatory type, where the materials are usually located on or near the lower or floor side of the laboratory or hearth and the flame from an external grate or other seat of initial combustion plays over them in a general horizontal direction, I have found that the invention can be applied with advantage by reason of the long flame which it produces and the increased volume which that flame possesses, due to its inflation with the artificially-supplied diluent. It may be here stated that where my inflated slow-burning flame develops in a comparatively free space, such as the laboratory of a reverberatory furnace, as distinguished from the shaft of a lime-kiln obstructed with fragmental material, the marked characteristics differentiating it from flame phenomena heretofore produced or observed are made clearly manifest to the eye. Not only is this flame in a reverberatory furnace effective at an increased distance from the seat of initial combustion, but its inflation by the diluent and the combustible gases due thereto brings its lower side closer to the materials on the floor or hearth and increases the effectiveness both of its radiant and convective or conductive heat. The diluent, as heretofore in the practice of my parent invention, may be derived by bringing back a small portion of the products of combustion and treatment of the materials and passing them through the burning fuel.

The aforesaid advantages arising in the application of my parent process to furnaces of the reverberatory type, as well as others which will be pointed out, constitute the objects of the present invention.

Of the accompanying drawings, Figure 1 represents a plan view of one of several types of reverberatory furnace in which my invention may be carried into effect, the illustration here given being that of a furnace of the type usually employed for roasting ores. Fig. 2 represents a section on line 2 2 of Fig. 1 on a larger scale. Fig. 3 represents a longitudinal vertical section of a portion of the furnace.

The same reference characters indicate the same parts in all the figures.

In the drawings, 10 represents the substantially horizontal or prone laboratory or hearth-chamber of the furnace, on the floor 11 of which are supported the ores or other materials 12 which are undergoing treatment in the furnace, the said materials being introduced at the left-hand or stack end by a chute or suitable feeding apparatus (not shown) and discharged at the opposite end after being roasted by the action of the flame from the fire-boxes. 13 represents the usual rabbles or plows for stirring the materials and moving them from one end of the furnace to the other. This type of furnace has a number of fire-boxes 14 located at intervals along the hearth-chamber and each provided with a fuel-chamber 15, grate 16, ash-pit 17, fuel and ash doors 18 19, and an opening 20 into the hearth-chamber 10. From the openings

20 the flame travels in the opposite direction to the travel of the materials toward a stack 21, through which the gaseous products of combustion and of treatment of the materials escape. From the stack 21 a pipe 22 leads back to the several ash-pits through branches 23, and in said pipe is placed a fan-blower 24, whereby a small portion of the products of combustion and calcination or roasting may be brought back and passed through the fuel on the grate. These products, mainly nitrogen and carbon dioxid, I term "neutral," as they are neither combustible nor supporters of combustion, although I am well aware of the action of carbon dioxid and air on incandescent fuel under certain conditions. The pipe 23 is provided with an air-inlet 24 back of the fan, controlled by a gate or valve 25, whereby a predetermined relative quantity of air may be passed on with the diluent to the ash-pits. Additional air in predetermined relative quantity is supplied to this draft-current by a second fan-blower 26, piped through a delivery-conduit 27 and branches 28 thereof into the branches 23. Gates or valves 29 30 in the branches 23 28 further control the relative quantity of air and diluent in the draft-current.

In operation as the ash-pit doors 19 and preferably the fire-doors 18 are kept closed the fire is supplied with an artificially-accelerated draft-current of air and a gaseous combustion-retarding neutral diluent present in predetermined proportion, which current, passing through the ignited fuel-bed on the grate, maintains a combustion which is sufficient to produce a large evolution of combustible gases, but is of less intensity than that of a fuel-bed or other body of fuel effected with a pure-air draft.

Under proper working conditions the products of combustion comprise a gaseous mixture of the burned-out or oxidized combustibles, together with air which has been largely impoverished of its oxygen by the burning or oxidizing of the combustibles. This mixture, by reason of the preponderance of its neutral constituents, is neither a combustible nor a supporter of combustion and is therefore well adapted to serve as a diluent when mixed in proper proportions with the draft-current of air. Obviously the actual volumes of stack-gases and air drawn in by the fan to produce a given percentage of air and neutral diluent in the mixture discharged into the fire-box will vary with the temperature and the percentages of the various gaseous constituents contained in the former. The result is a very long slow-burning flame which appears to be materially inflated by the diluent and the gases due thereto. This flame, beside being effective at an increased distance from the seat of initial combustion, is of such volume as to fill the cross-section of the hearth-chamber to a greater extent than heretofore, and its lower side is hence brought nearer to the materials on the hearth. The combustion is therefore much more effective and economical in respect to the materials under treatment than a flame which hugs the roof of the hearth-chamber. The maintenance of ignition and complete combustion are insured by reason of the combustion taking place under the influence of radiant heat in an enveloping region capable of attaining an igniting temperature and furnished by the fire-brick walls of the hearth-chamber and by the materials under treatment, which latter in some instances add to the heat by their chemical action.

It will be understood that the fuel-bed need be no thicker than the ordinary, and in general enough oxygen passes through the fuel to complete the combustion of the fuel-gases evolved, although it is permissible in certain applications of the invention to vary the proportion of oxygen in the draft-current so as to produce either an oxidizing or a reducing flame. I have sometimes used a very thick fuel-bed in an apparatus of this kind, making the fire-box practically a gas-producer and admitting secondary air through the fire-door or an uncovered part of the grate or by other suitable means and have found that under such conditions clinkers will form in the fuel-bed in objectionable amounts, with coals containing considerable fusible matter, unless the draft-current fed to the fire be very considerably cooled. The metal pipes 22, 23, &c., serve to cool the gases returned to the ash-pit, and to these may, if necessary, be added special cooling features to avoid slagging of the fuel, especially where a thick bed—for instance, a foot or more in depth—is used.

Where the furnace is provided with means for causing a progression of the material, as shown in the drawings or otherwise, it has heretofore been customary to control the rate of burning or heating of the material by varying the speed of travel of the latter through the furnace. This is somewhat awkward and is not always satisfactory in its results. Very little could be done in the matter of regulating the temperature of the flame or the rate of combustion and the temperature in the burner or fire-box. This invention, however, provides for control of the temperature and volume of the flame and the rate of combustion in the burner with respect to the rate of travel of the material, and thus affords a much better control than formerly over the burning or heating operation.

I have in a separate application, Serial No. 254,474, claimed a furnace for controlling the combustion by means of stack-gases, with reference to the travel of the material, and have shown and claimed a blast-burner for powdered fuel. In respect to the relative variation of the travel of the material and the

combustion of the fuel I especially claim in the present application the use of a bed of solid fuel.

I do not wholly confine myself to the use of a bed of solid fuel nor to the exact manner of carrying out the steps of the process.

I claim—

1. The art of heating materials in furnaces of the reverberatory type which consists in transmitting through a body of ignited fuel a draft-current of air diluted with products of combustion in such proportion as to check and cool the combustion of said fuel and to retard combustion of its gaseous products, passing said gaseous products through an igniting region in a general horizontal direction over the material to be heated and completing the combustion of the said gaseous products thereabove by radiant heat from the igniting region.

2. The art of heating materials in furnaces of the reverberatory type which consists in transmitting through a body of ignited fuel a draft-current of air diluted with products of combustion in such proportion as to check and cool the combustion of such fuel and to retard combustion of its gaseous products, passing said gaseous products into a refractory-walled chamber containing the material to be heated and there completing their combustion by radiant heat from the walls.

3. The art of heating materials which consists in transmitting through a body of ignited fuel a draft-current of air diluted with products of combustion in such proportion as to check and cool the combustion of such fuel and to retard combustion of its gaseous products and applying the resultant tardily-burning flame to the materials in a substantially unobstructed refractory-walled region capable of completing the burning of said flame by radiant heat.

4. The art of heating materials which consists in producing above such materials in a refractory-walled chamber a tardily-burning flame composed of air, combustible gases and preformed products of combustion, the latter being present in proportions to substantially retard combustion, and completing the burning of said flame by radiant heat from the walls.

5. The art of heating materials which consists in transmitting such materials continuously through a reverberatory furnace and past a plurality of inflated and diluted flames.

6. The art of heating materials which consists in continuously transmitting the same through a refractory-walled chamber containing a tardily but uniformly burning flame atmosphere.

7. The art of heating materials which consists in continuously transmitting the same through a refractory-walled chamber containing a tardily but uniformly burning flame atmosphere of admixed carbon dioxid, oxygen and combustible gas.

Signed at New York city, in the county of New York and State of New York, this 6th day of September, A. D. 1904.

BYRON E. ELDRED.

Witnesses:
CHAS. B. CRANE,
M. A. MODER.