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B. E. ELDRED.

HEATING FURNACE.

APPLICATION FILED SEPT. 21, 1904.

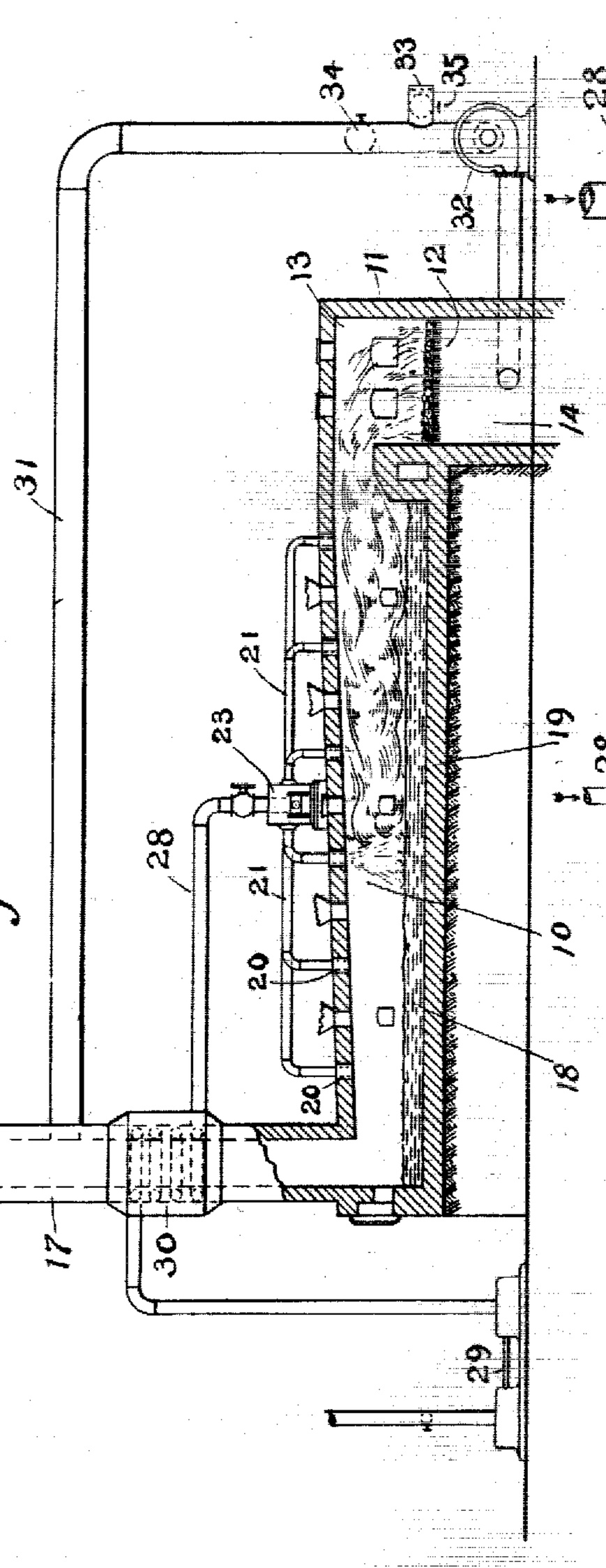

Fig. 1.

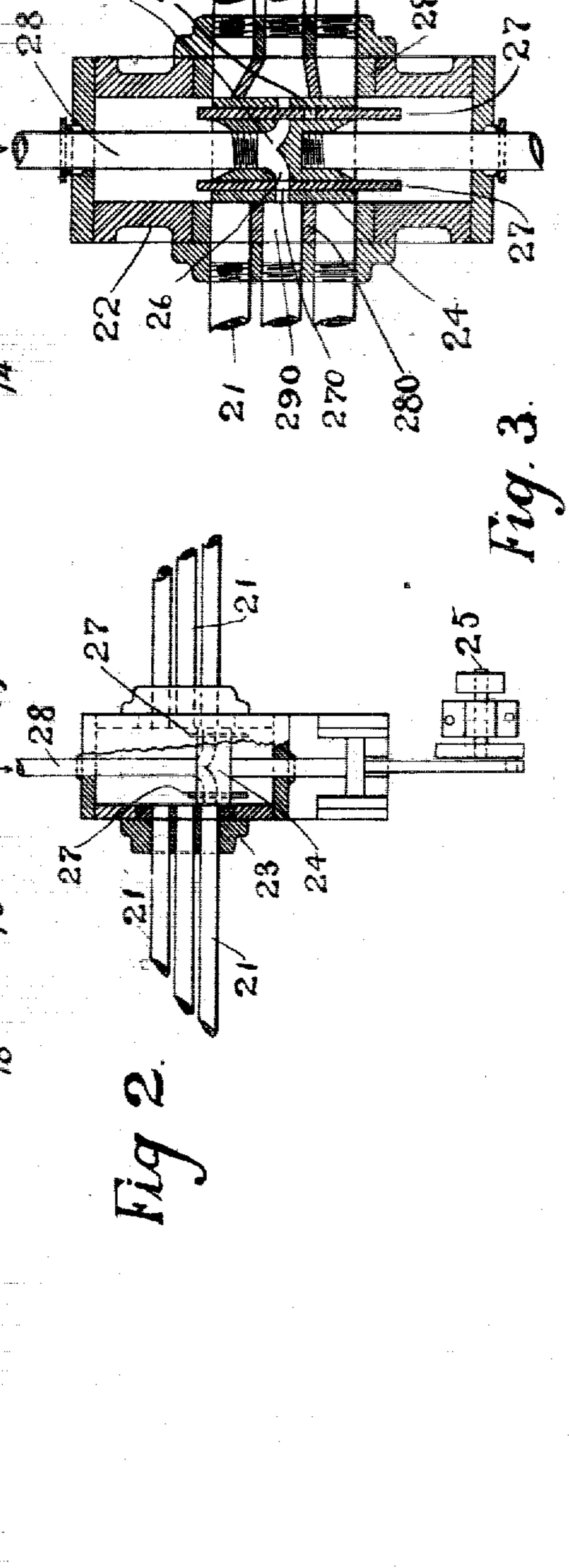

Fig. 3.

Fig 2.

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

HEATING-FURNACE.

No. 866,635. Specification of Letters Patent. Patented Sept. 24, 1907.

Application filed September 21, 1904. Serial No. 225,395.

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 Heating-Furnaces, of which the following is a specification.

This invention relates to the art of heating materials where the flame plays over the materials on a hearth or support, as in the various kinds of reverberatory furnaces.

In case of furnaces for roasting, calcining, or smelting ores, mattes and other materials, puddling iron, melting glass, heating plates and billets, and performing other operations which are commonly carried on in reverberatory furnaces, it is frequently of advantage to apply the flame at a particular point or to have it somewhere near a predetermined temperature, or to secure both of these results, so that the materials may be locally heated, and, when desired, uniformly heated throughout their entire extent or over any predetermined area. Furthermore in many of these operations an intense heat is desired at some one or more points or stages in the process, the attainment of which at the proper point or stage has heretofore been attended with considerable difficulty in most cases and in practically all cases with great extravagance in the consumption of fuel, much of the heat being uselessly developed and thrown away. My invention enables me to control these matters perfectly. The preferred means which I adopt to this end consists in the employment of a suitable flame or gas-current, preferably of a voluminous tardily-burning character, which may be obtained according to the method described in my Patent No. 692,257, February 4, 1902, by passing through the fire on the grate or seat of initial combustion a draft-current composed of air and a predetermined quantity of diluent derivable in the form of products of combustion, etc., from the stack or laboratory of the furnace. Under proper working conditions such 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. There is thus obtained a slow-burning inflated flame whose combustion is maintained throughout a long distance from the grate, the continuance of ignition being insured by the heat-retaining character of the region in which the combustion takes place. The activity of this flame is then locally intensified in a desired region by suitable means such as a pressure jet of a gaseous character which brings together or agitates at a predetermined point the ingredients of the flame and consequently produces a greater activity in the combustion at the point where the jet takes effect.

Many of the advantages of the invention may be realized without causing any relative shifting of the region of local intensification of combustion but the invention further contemplates causing this region to shift or travel with respect to the material under treatment, so that any predetermined length or area of the object or material may be subjected to the localized combustion, thereby giving an even and regular heat throughout this length or area. In practice I prefer to intensify the action of the flame in a series of restricted regions or areas successively, and the specific means employed may to this end consist of a series of nozzles through which an air-jet is projected in succession. The effect is somewhat that of a traveling "brush" of flame.

Of the accompanying drawings,—Figure 1 represents a longitudinal vertical section of a reverberatory heating furnace showing the novel features of construction and adapted to carry out my improved process. Figs. 2 and 3 represent horizontal sectional details of the valve-mechanism for shifting the jet.

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

In the drawings, 10 is a long horizontal chamber constituting the laboratory or hearth-chamber of a furnace which is adapted for the heating of various materials, the said chamber being provided with a furnace 11 shown at one end thereof and having grate 12, fire-chamber 13 above the grate and ash-pit 14 below the same, the firing and ash-openings having suitable doors normally kept closed to prevent access of pure or undiluted air. At the opposite end is a stack 17.

18 indicates the materials supported on the floor or hearth 19 and adapted to be heated by subjection to the flame from the fire-box 11.

In the roof of the furnace are a series of nozzles 20 20 arranged in a row longitudinally of the furnace and pointing downwardly toward the hearth, said nozzles connecting by pipes 21 21 with the casing 22 of a valve-mechanism 23 containing a valve 24 reciprocated by a crank-shaft 25, and having opposite ports 26 26. Compressed air is supplied by means of an air-compressor 29, to the interior of the valve through a pipe 28 containing a flexible or telescopic section (not shown), the air being preferably preheated, as by means of the flue-gases in a stack heater 30. The pressure may be anything sufficient to penetrate the gas-current and mix or condense its ingredients at the point where the jet operates. The jet does not necessarily contribute any con-

siderable volume to the gases passing through the furnace. The valve carries two shutters 27 27 intersecting the valve-ports 26 and themselves having non-coincident ports 270 270 which are brought successively into register with the inlet ends of the pipes 21 by the movement of valve 24, the shutters 27 being shifted at the end of each stroke by encountering the end-wall of casing 22 so as to bring one group and then the other of pipes 21 into connection with the interior of the valve. The stationary ports 290 may if desired be of different widths, and to make them interchangeable the removable boxes 280 are provided.

A small portion of the stack-gases is drawn back through a pipe 31 and forced by a fan blower 32 into the ash-pit 14 in company with a predetermined proportion of air entering through an inlet 33, there being preferably about three or four volumes of air to one of the neutral diluent, the proportion being regulated by valves 34 35. 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.

In the operation of my invention the presence of the diluent gases in the draft supplied by the fan 32 to the ash-pit 14 and forced through the bed of fuel on grate 12 considerably retards the combustion and renders the heating agent which passes off from the fire-box slow-burning and voluminous, as more fully described in my aforesaid patent. The operation of the valve mechanism 23 projects the pressure jets in succession through the several nozzles 20, which jets have the effect of localizing and intensifying the combustion of the flame or gas-current from the fire-box by furnishing a local excess of oxygen, which, under the well understood laws governing combustion, accelerates the burning of the mixed oxygen and fuel gas already present in the flame. Using heated air, less of it is necessary to produce this result which is more physical than chemical. A needling jet of hot air directed through the inflated tardily burning flame in the furnace chamber, produces a localized rapid combustion in its vicinity. Since the jets are directed toward the hearth they cause the flame to impinge more directly upon the materials 18, and thereby subject said materials directly to the action of those fuel-gases which would otherwise burn in the top of the hearth-chamber and waste their heat. As the jet is projected in succession from the several nozzles, the effect is that of a flame with a shifting terminus, whereby the materials are heated throughout a predetermined area.

The carbon dioxid of the products of combustion exercises both a specific prohibitive action upon the formation of more carbon dioxid by oxidation of the fuel by the draft current and also is in part reduced to carbon monoxid, both reactions coöperating to make the fire run cool. In its two-stage combustion carbon, speaking roughly, gives out 30 per cent. of its total heat in forming monoxid and the remaining 70 in forming dioxid from the monoxid. Therefore a fire where combustion is to monoxid is relatively cool, and therefore also, to form monoxid from dioxid and carbon an access of heat is necessary; or the reaction is endothermic.

Combustion on the grate being retarded both by the specific retarding action of the carbon dioxid and by the relatively low temperatures prevailing, much of the draft current passes through unchanged to dilute the combustible gas, or carbon monoxid, formed from the fuel. In this gaseous mixture, the carbon dioxid exercises its specific retarding action to slow up the combustion of the monoxid to form dioxid, and as there is very little, if any, excess of oxygen present, this fact also retards such combustion. It is well known that an excess of oxygen must be present for rapid combustion of any fuel; 20 per cent. excess, the furnaceman often estimates in running reverberatories. The result of these conditions in the present invention is that the reverberatory chamber is filled with a flame atmosphere; a body of gas which is burning tardily but uniformly throughout, in lieu of in strata as with ordinary flames. The impinging jets of air, furnishing the necessary excess of oxygen, set up a rapid and intense combustion wherever they penetrate this flame atmosphere.

Air as the material for the jet and solid fuel as a means for supplying the heating gases have been selected as they are believed to be the most practical agents for carrying on the process, but it will be understood that the broad invention is not confined to the use of these specific agencies.

The art of conducting combustion in reverberatory furnaces by means of a slow-burning flame produced as above described is claimed in a separate application Serial No. 223,800.

I claim:—

1. A furnace comprising a hearth chamber, means for supplying a flame thereto, means for localizing the combustion of said flame at a predetermined point, and automatic means to cause said point to travel relatively to the hearth.

2. A furnace comprising a hearth-chamber, means for heating the same, a series of jet-outlets directed into said chamber, and automatic means for supplying to said outlets in succession air to localize the combustion in said chamber.

3. A furnace comprising a hearth-chamber, means for supplying a flame thereto, a series of jet-outlets directed into said chamber and distributed longitudinally thereof, and automatic means for supplying air to said outlets in succession.

4. A furnace comprising a hearth-chamber, a series of jet-outlets directed thereinto, an air compressor to supply said outlets, and automatic mechanism distributing the compressed air successively to said outlets.

5. A reverberatory furnace comprising a hearth-chamber, a normally closed fire-box therefor, a stack, a conduit connecting the stack with the fire-box at a point of the latter anterior to the seat of combustion, a series of jet-outlets in the roof of the hearth-chamber directed toward the hearth, an air-compressor to supply said outlets, and automatic valve mechanism for connecting said outlets in succession with the air-compressor.

6. A furnace comprising a hearth-chamber having heat retaining walls, a seat of combustion, means for passing therethrough a draft current of admixed air and products of combustion in controlled proportions, and means for successively and automatically passing into different portions of the hearth-chamber, jets of air under pressure.

7. A furnace comprising a hearth-chamber, a chimney stack therefrom, an air heater in the stack, a series of jet nozzles penetrating the walls of the hearth-chamber, automatic mechanism for causing hot air from the heater to flow alternately and successively through each of said nozzles.

8. A furnace comprising a hearth-chamber, a chimney stack therefor, a grate for burning fuel, a normally closed ash pit thereunder, a pipe connection from the stack ending under the grate provided with means for causing a flow of stack gases therethrough and for admixing regulated amounts of air with said gases, and means for successively

admixing an excess of air with the flame products from the grate at a plurality of points within the hearth chamber.

9. A furnace comprising a hearth-chamber, a source of tardily burning dilated flame therefor, a series of jet-nozzles penetrating the walls of the chamber and automatic means for directing a jet of air alternately and successively through each of said nozzles to impinge on the flame within the chamber.

10. A furnace comprising a hearth-chamber, a source of tardily burning dilated flame, a series of jet-nozzles penetrating the walls of the chamber, and means for directing a jet of hot air alternately and successively through each of said nozzles to impinge on the flame within the chamber.

11. A furnace comprising a reverberatory hearth-chamber, a normally closed grate chamber provided with a grate, and means for supplying to said grate chamber below the grate an accelerated draft of air uniformly diluted with small and controlled proportions of products of complete combustion.

12. A furnace comprising a reverberatory hearth-chamber, a normally closed grate chamber provided with a grate, means for supplying to said grate chamber under the grate an accelerated draft of air diluted in controlled proportions with products of complete combustion and means for completing and accelerating combustion of the effluent from the grate within the reverberatory chamber by impinging jets of air.

13. A furnace comprising a reverberatory hearth-chamber, a normally closed grate chamber provided with a grate, means for supplying to said grate chamber under the grate an accelerated draft of air diluted in controlled proportions with products of complete combustion and means for completing and accelerating combustion of the effluent from the grate within the reverberatory hearth chamber by impinging jets of hot air.

14. A furnace comprising a reverberatory hearth-chamber, a normally closed grate chamber provided with a grate, means for supplying to said grate chamber under the grate an accelerated draft of air diluted in controlled proportions with products of complete combustion, and means for completing and accelerating combustion of the effluent from the grate by a series of successively acting impinging jets of air at different points within said reverberatory hearth chamber.

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.