June 7, 1932. H. A. DREFFEIN 1,861,790

APPARATUS FOR HEATING BILLETS OR THE LIKE

Filed Dec. 19, 1927 2 Sheets-Sheet 1

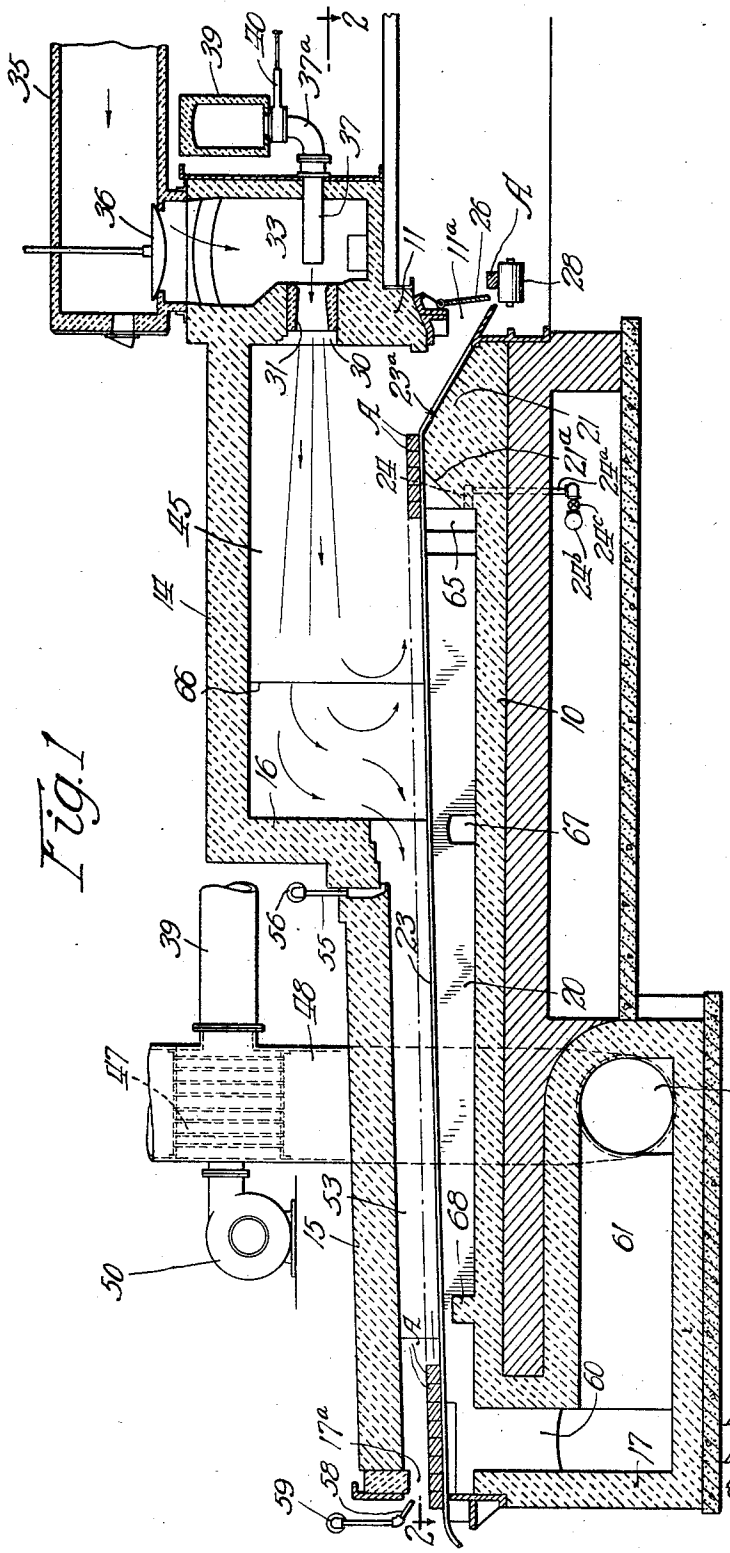


Fig. 1

Inventor
Henry A. Dreffein
By
Emery Booth Janney & Varney
Attys

June 7, 1932. H. A. DREFFEIN 1,861,790

APPARATUS FOR HEATING BILLETS OR THE LIKE

Filed Dec. 19, 1927 2 Sheets-Sheet 2

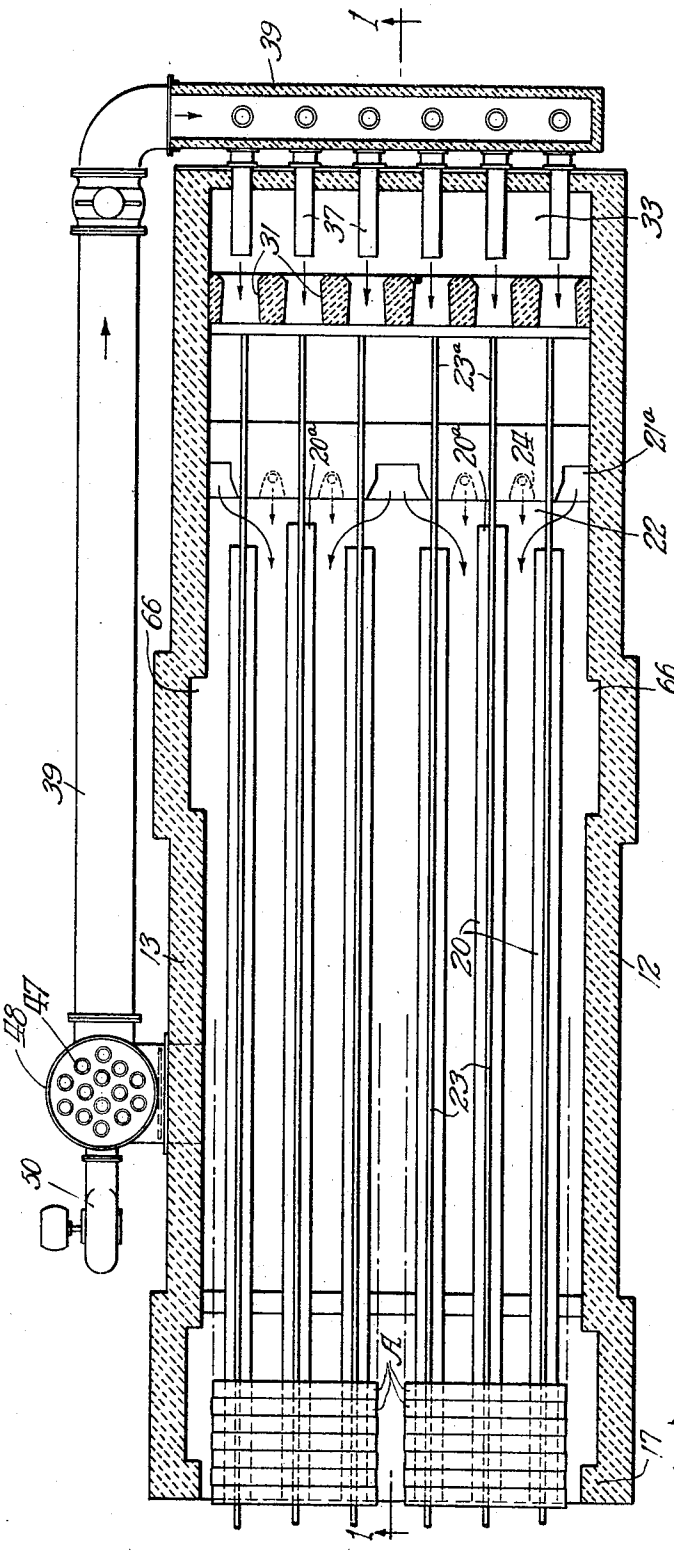


Fig. 2

Inventor
Henry A. Dreffein
By
Emery Booth Janney & Varney
Attys.

Patented June 7, 1932

1,861,790

UNITED STATES PATENT OFFICE

HENRY A. DREFFEIN, OF CHICAGO, ILLINOIS

APPARATUS FOR HEATING BILLETS OR THE LIKE

Application filed December 19, 1927. Serial No. 240,990.

This invention relates to apparatus for heating billets or the like, and has among its objects to provide a new apparatus for efficient and satisfactory heating of metal masses, as billets for example, an efficient combustion of the heating gases, and an efficient application of the heat to the apparatus.

Other objects consist in the provision of apparatus comprising a furnace having a novel laboratory with means to supply fuel and air for combustion in such wise as to obtain a substantially uniform desired heat in the laboratory; to provide means for the introduction and combustion of the fuel mixture in such wise as not to impinge it upon the articles being heated until combustion of the mixture is well under way, so that oxidization which might otherwise result from the contact of uncombined air or oxygen upon the articles during combustion is substantially avoided; to provide means for fuel mixture introduction in such wise that combustion of such mixture will be at some distance from the articles being heated and to provide for recirculation of at least a portion of the gases into the incoming fuel mixture and flame after passage of such gases over the articles; to provide means including a laboratory in which the heating gases are retained by reduction of velocity and recirculation for an appreciable period of time before discharge; to provide a furnace of the class described in which gases resulting from combustion in the laboratory or the like will be directed downwardly upon and beneath the metal masses being heated and thereafter recirculated in a measure at least; to provide such an apparatus in which sufficient pressure may be maintained in the furnace to resist infiltration or leakage of air, particularly at the discharge end of said furnace; to provide apparatus including means whereby fuel, as for example gas, will be supplied for admixture with air with subsequent combustion, and preferably with an excess of gas to maintain a reducing atmosphere about the metal masses being heated, particularly at the zone of maximum heat application, to obviate oxidization of such masses; to provide apparatus utilizing auxiliary or secondary air supply means to assist the recirculation of the gases, resist leakage of the gases out of the charging end of the furnace and effect completion of the combustion of the excess unburned fuel prior to exhaust from the apparatus; to provide new and improved means of air supply and control; to provide for the effectuation of substantially complete combustion in the laboratory out of contact during flame initiation with the metal masses being heated; and in general, to provide apparatus comprising novel and meritorious details of construction and operation.

The above and other objects will be more fully apparent and set forth in the following specification and shown in the accompanying drawings in which—

Fig. 1 is a vertical section through a furnace embodying my invention;

Fig. 2 is a horizontal section of the same along the line 2—2 of Fig. 1.

In the drawings 10 indicates the bottom or floor of a furnace having the front wall 11, side walls 12 and 13, and a roof or top wall composed of the portion 14, portion 15 and the connecting vertical wall 16, as shown in Fig. 1. A rear end wall 17 is also provided having a charging opening 17^a therein. Leading from the rear end wall 17 toward the front wall 11 is a plurality of spaced supporting walls 20, gradually increasing in height from the rear to the front ends thereof, as shown in Fig. 1. Between the front ends of the supporting walls 20 and the front or discharge end 11 of the furnace is a raised base portion 21. The raised base portion 21 in the embodiment shown is spaced from the adjacent ends of the wall members 20 to provide a transverse passage 22 across the furnace, certain of the walls 20 being extended closer to the base portion 21 than the others, as indicated by numeral 20^a.

Located in the front of the base portion 21, preferably in alignment with the passages between the walls 20, is a plurality of air nozzles 24 communicating through suitable pipes 24^a with an air line 24^b, control valves 24^c being provided for each of the supply pipes 24^a.

At the juncture of the front wall of the

base portion 21 with the side walls of the furnace are provided vertical passages or recesses 21ª for a purpose hereinafter described.

Trackways comprising water cooled tubular members 23 or the like are mounted on the supporting walls 20 and base portion 21. The base portion 21 is downwardly inclined at 21ª at its front portion, and the tubular members 23 are similarly inclined at 23ª, thus providing a downwardly inclined trackway at the discharging end of the furnace, the same leading to a discharge opening 11ª normally closed by the pivoted gate or door 26. At the front of the furnace adjacent the discharge opening 11ª is a series of rollers 28 or other conveying means upon which billets A may be discharged from the furnace under force of gravity.

The roof portion 14 is raised and offset with respect to the lower rear end portion 15 as viewed in Fig. 1 of the drawings, and with the vertical connecting wall 16, the front wall 11, the floor 10 and supporting base portion 21 is formed what is termed a laboratory or combustion and heating chamber into which the billets A are charged and from which they are discharged after heating.

In the front wall 11, opposed to the vertical wall 16, is a plurality of burner openings 30 in which are mounted nozzles 31 of refractory material or the like, the burner openings and nozzles leading from a gas chamber 33 into which gas is fed from a supply duct 35, the supply of gas being controlled by an adjustable valve 36 (see Fig. 1). Projecting into the gas chamber 33, in alignment with the nozzles 31, is a plurality of air supply pipes 37, preferably of heat resistant steel or the like, the same at their discharge ends terminating short of the nozzles 31. These pipes 37 are in connection with an air supply duct 39, through pipe elbows 37ª. A slide valve generally indicated by numeral 40 is provided for each of the pipes 37 to control the air supply thereto and through. It will be apparent that the air being delivered under pressure through pipes 31 will mix with the gas for combustion and discharge the mixture through the nozzles 31 into the laboratory, which I have designated by numeral 45. Control of combustion and heating across the laboratory may be effected by regulation of the valves 40, as will be apparent.

The air duct 39 in the embodiment shown, leads from a species of preheater or recuperator indicated in dotted lines by numeral 47 in the stack 48, a fan or blower 50 being utilized to force air through the recuperator 47, thereby utilizing the waste gases to effect a preheating of the air before it is delivered to the pipes 37. The pipes being constructed of heat resistant material will permit the use of preheated air in the manner described.

The lower roof section 15 is spaced closer to the track members 23, and constitutes in effect a low ceiling extension 53 of the furnace in which initial or preheating of the billets is effected by the outwardly flowing gases. Adjacent the juncture of the laboratory 45 and the reduced furnace portion 53 is provided a plurality of air supply nozzles or pipes 55 connected with a supply line 56, and directed toward the laboratory.

At the charging or rear end of the furnace is also provided a plurality of air nozzles or pipes 58 connected with a supply line 59, and also preferably directed toward the interior of the oven.

Leading downwardly from the bottom of the furnace adjacent the charging opening 17ª is an exhaust duct 60 which leads to the angularly disposed duct portion 61 in turn leading to a stack connection 48ª.

A transverse opening 65 is provided beneath the track members 23 in the laboratory to permit cleaning and circulation of the heating gases. Simialrly transverse openings 67 are provided in the supporting walls 20 to provide a transverse circulation and clean-out passage rearwardly of the passage 65. Near the charging or rear end of the furnace small baffles of abutments 68 of variable height project upwardly between the outermost supporting walls 20 and the furnace side walls and a similar abutment 68 is located between the central supporting walls, these serving to favor the flow of gases through the tunnels beneath the billets A.

In the utilization of the apparatus embodying my invention, the gas for combustion is supplied through ducts 35 into the chamber 33, and the valves 40 are adjusted to insure proper delivery of air through pipes 37. This air commingles with and carries the gas for combustion through nozzles 31 and the mixture is burned in the laboratory or chamber 45. Due to their velocity, the combustible mixture and the resultant flame are directed toward the vertical wall 16 at some distance above the trackways 23 so that combustion, in so far as it takes place in the chamber 45, occurs before contact of the gases with the billets A. The air is preheated to a desired degree in its passage through the preheater or recuperator 47 under propulsion of the fan 50.

The impact of the burning gases and gases of combustion against the upright wall 16 serves to direct them downwardly upon the billets or other articles as they are entering the laboratory, at which point they are relatively cool in contrast with the final temperature at discharge. While I find it decirable to use a substantially vertical wall 16, its inclination may be varied and the check or retardation and the ensuing recirculation of the gases may be assisted by the air introduced through nozzles 55. In the form shown these

nozzles may be utilized and they will resist outward flow of the gases of combustion through the reduced furnace portion 53 and assist in returning such gases toward the end wall 11 of the furnace over and around the billets in the laboratory. The alcoves or side passages 66 permit downward flow of some of the gases to the passageways beneath the billets and the transverse passage 67 permits transverse distribution of such gases. Similarly the recesses 21ª in the raised base portion also permit flow of some of the heating gases to the passages beneath the walls 20 beneath the billets. The recirculated gases otherwise flow over and around the billets, as stated, toward the furnace wall 11 and are picked up and commingle with the incoming fuel mixture and are again directed toward the wall 16.

The flame and combustion, occurring in the main some distance above and substantially parallel to the billets, also radiates heat which impinges upon the billets so that the heating effect in the laboratory results from the direct contact of the gases and the radiant heat and a constant recirculation of the gases is maintained, during which continuous mixture of such gases with the incoming fuel mixture occurs. Also the velocity of the incoming fuel mixture and gases is greatly reduced, permitting retention of such gases for a longer period of time in the laboratory.

The recirculated gases which have passed over the relatively cool billets contribute to the reduction in temperature of the incoming fuel mixture to lower its temperature, the temperature of such recirculated gases being at the same time properly maintained.

As a consequence of all of these factors I am enabled to obtain a substantially uniform temperature throughout the laboratory and the temperature of the flame or combustion which would otherwise be in considerable excess at or near the discharge end of the furnace is modified and may be brought to a temperature more closely approaching the desired final temperature of the articles being heated, and this temperature being substantially uniform throughout the laboratory, a "soaking" action is obtained, which results in a desirable penetration of the heat through the billets or other articles, and the discharge of such billets at a temperature closely approaching that of the temperature of the gases in the laboratory. This is the ideal condition sought in this art, and not obtained by present day apparatus or processes.

When air is supplied through nozzles 55 it also is preferably directed substantially parallel to the underpassing billets, and since I find it desirable to supply fuel in considerable excess of that which will burn with the air initially supplied in order to maintain a strong reducing atmosphere in the laboratory, this secondary air through nozzles 55 will commingle with the unburned fuel and contribute to the heat in the laboratory and salvage the heat content of fuel which would otherwise be wasted. Since the secondary air through nozzles 55 is introduced substantially parallel to the billets again there is no direction of the burning gases or uncombined air directly upon the billets and danger of oxidization is again obviated.

The laboratory, being of relatively great size and length, permits substantial expansion of the gases, this also contributing to the check of the velocity thereof, and I find it desirable to maintain a pressure in the laboratory in excess of that outside the furnace which prevents the entrance or infiltration of air at the discharge end of the furnace.

The enlarged laboratory and the retention of the gases for a period of time therein permit the effectuation of substantially complete combustion for those gases for which there is sufficient air to support such combustion, which I find desirable in practice.

As stated, I find it desirable at least in some instances, to introduce a preponderant excess of gas for combustion, for example, as high as 20% of excess gas, an thereby maintain a strongly reducing atmosphere in the laboratory 45 where the billets are subjected to the greatest heat, thereby substantially preventing oxidization of such billets. Completion of combustion before contact of the gases with the billets in the chamber 45 is also desirable, as it is well known that combustion taking place closely adjacent the billets results in the formation of scale and other detrimental substances upon such billets.

The billets are advanced from the charging opening 17ª up and along the track members 23 by any desired means, the movement imparted being that desired to permit proper heating and penetration of the heat into and supply of the billets for subsequent operations.

The travel of the billets through the laboratory 45 is at a sufficiently slow rate to permit complete penetration of the greater heat which obtains there. As the billets reach the inclined portions 23ª of the track they slide by gravity downward past the swinging gate 26 and are deposited upon the transversely arranged conveyor rolls 28 for passage to subsequent treating stations.

The provision of a plurality of transversely arranged air inlet pipes 37 each with valve control permits regulation or control of the heat across the laboratory and affords the operator an opportunity to control the lateral distribution of the heat therein.

The introduction of an excess of combustible gas into the laboratory 45 over that capable of combustion with the air supplied

also lower the average flame temperature as well as maintains a reducing atmosphere.

From the laboratory chamber 45 the gases flow through the reduced furnace portion 53, both below and above the billets. The restricted chamber compacts the outwardly flowing gases and brings them closer to the billets, whereby the heat in such gases is more efficiently applied for the preheating of such billets.

Air may be supplied through nozzles 24 substantially parallel to the overlying billets and this air supply induces and assists the flow of gases and unburned fuel from the laboratory to the transverse passage 22 under the billets. Such gases are then directed by the air jets through the passageways between the walls 20 beneath the billets, the additional air supply permitting combustion of any unburned fuel drawn or flowing beneath the billets and insuring circulation of such gases beneath the billets in cooperation with the gases flowing thereover. Additional gases may flow downwardly through alcoves 66 across the passage 67 for subsequent flow through the passages between the walls 20, as will be obvious.

Air may also be supplied through nozzles 58 at the charging opening 17^a, which will effect combustion of any unburned gases prior to their discharge in the stack, and the jets of air through the nozzles 58 will assist in preventing leakage of the gases out through the charging opening 17^a. Any supplemental combustion resulting from the introduction of air through nozzles 58 boosts the heat of the burned gases before they are delivered to the recuperator 47 so that the heating effect of such gases is salvaged and assists materially in the preheating of the air for combustion.

I believe it desirable to operate the nozzles 55 when a richer mixture is delivered into the laboratory, so that the heating effect of the greater amount of unburned gas is availed of before the passage of the gases through the reduced furnace portion 53.

It will be apparent that my process and apparatus are capable of variation and modification, and I do not wish to be restricted to the details of structure and operation described and illustrated, except as the appended claims are limited thereto by fair interpretation.

What I claim is:

1. A furnace having a charging end and a discharge end, said furnace being provided with an enlarged laboratory at one end and a restricted portion leading from said laboratory toward the other end, means to support billets for movement through said restricted and laboratory portions, means to supply fuel and air under velocity into said laboratory, and means to reverse the flow of at least a portion of said fuel and air mixture and the gases of combustion therefrom, said reversing means including an air supply.

2. A furnace having an enlarged laboratory and a restricted portion leading therefrom, means to support billets for movement through said restricted and laboratory portions, means to supply fuel and air at velocity into said laboratory in spaced relation to said billet supporting means, said laboratory being provided with means spaced from said fuel supply means to receive the impact of said fuel and air mixture and the gases of combustion therefrom and direct them upon said billets, and air jets constructed and arranged to direct said mixture and gases of combustion rearwardly over said billets toward said fuel supply means.

3. A furnace having a charging end and a discharge end, said furnace being enlarged to form a laboratory at one end and having a restricted portion leading therefrom to said charging end, means to supply combustible gases substantially horizontally to said laboratory at the upper portion thereof, means to direct said gases downwardly toward the bottom of said laboratory, said last named means being opposed to and spaced from said gas supply means, means to support billets or the like in said laboratory in spaced relation to the bottom thereof, said last named means comprising spaced trackways, said furnace being provided with a transverse circulation passage beneath billets carried on said trackways, and air supply means in alignment with the passages between said trackways and constructed and arranged to deliver air jets into said passageways.

4. A furnace having a charging end and a discharge end, said furnace being enlarged to form a laboratory at one end and having a restricted portion leading therefrom to said charging end, means to supply combustible gases substantially horizontally to said laboratory, at the upper portion thereof means to direct said gases downwardly toward the bottom of said laboratory, said last named means being opposed to and spaced from said gas supply means, means to support billets or the like in said laboratory in spaced relation to the bottom thereof, said last named means comprising spaced trackways, said furnace having a transverse passage at the ends of said trackways, and means to supply air jets across said transverse passageway toward the passages between said trackways.

5. A furnace having a laboratory chamber and a restricted portion leading therefrom, means to supply fuel to said laboratory, an exhaust duct leading from said restricted furnace portion, spaced trackways in said furnace and abutments projecting upwardly from the bottom of said furnace in certain of passages formed by said trackways.

6. A furnace having a relatively large

laboratory chamber and a relatively restricted portion leading therefrom, means to supply fuel to said laboratory, and means to supply additional air in said furnace in the restricted portion thereof in such wise as to resist flow of gases through said restricted portion from said laboratory chamber.

In testimony whereof, I have signed my name to this specification.

HENRY A. DREFFEIN.