April 28, 1931. H. A. DREFFEIN 1,803,007

PROCESS FOR HEATING BILLETS OR THE LIKE

Original Filed Dec. 19, 1927 2 Sheets-Sheet 1

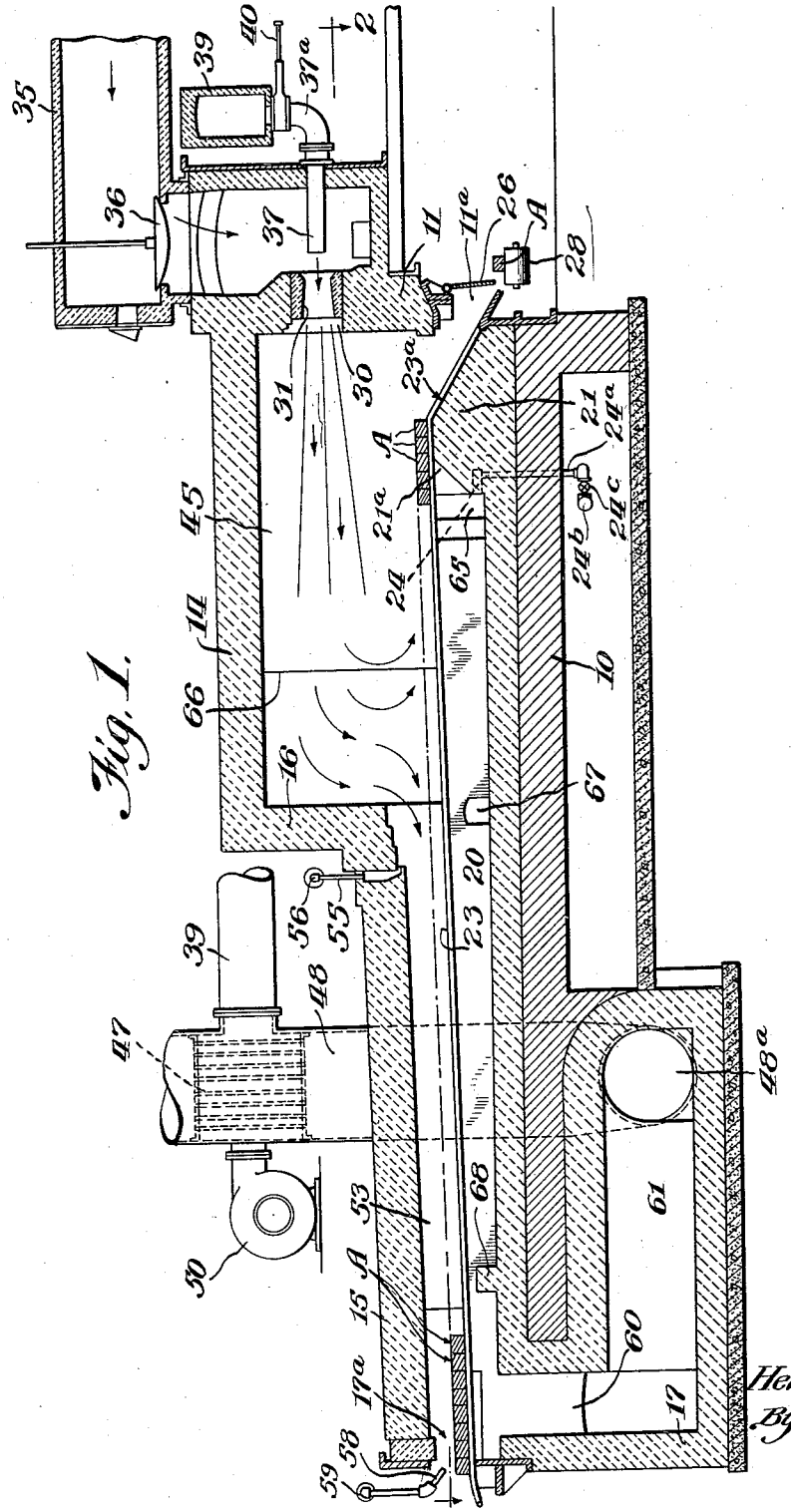


Fig. 1.

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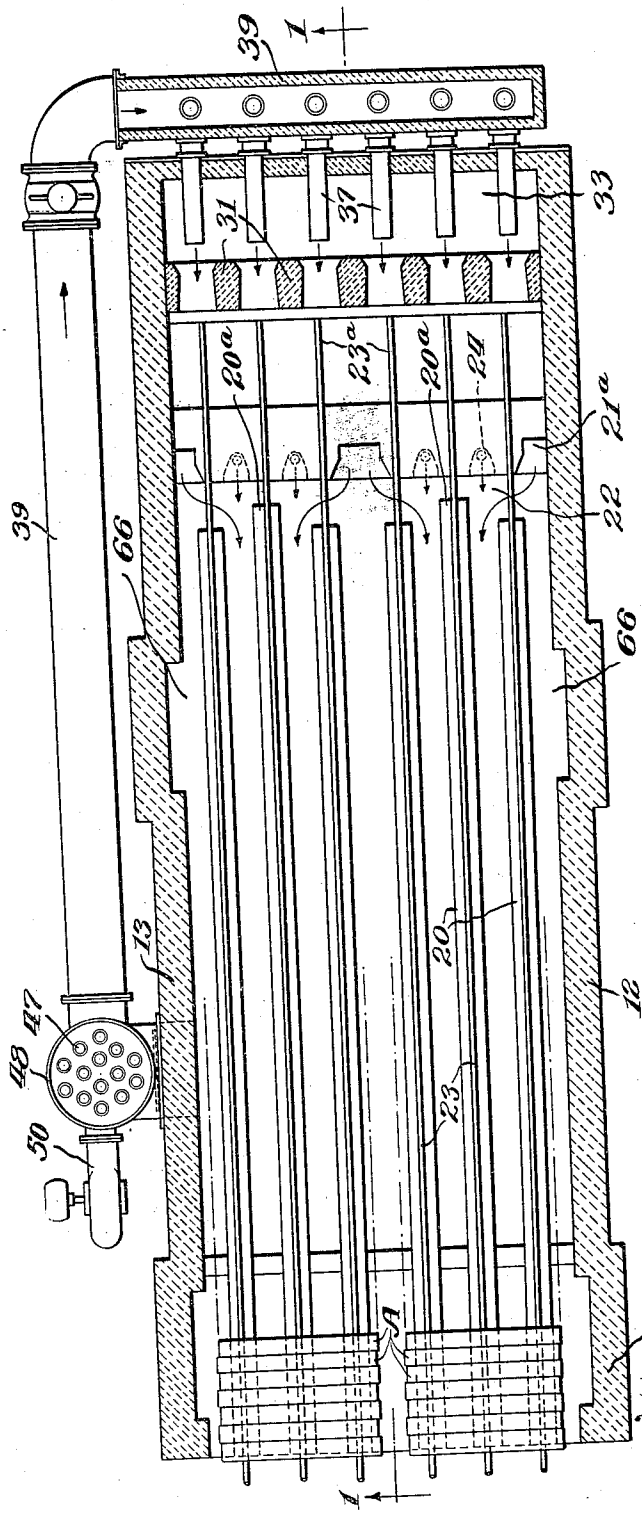


Fig. 2.

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Patented Apr. 28, 1931

1,803,007

UNITED STATES PATENT OFFICE

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PROCESS FOR HEATING BILLETS OR THE LIKE

Original application filed December 19, 1927, Serial No. 240,990. Divided and this application filed November 2, 1928. Serial No. 316,695.

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

This application is a division of my former application Serial No. 240,990, filed December 19, 1927.

These and other objects will be more fully set out and made apparent in the following specification and shown in the accompanying drawings in which—

Fig. 1 is a vertical section through a furnace designed to permit the practice of my process;

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 21^a 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 21^a at its front portion, and the tubular members 23 are similarly inclined at 23^a, thus providing a downwardly inclined trackway at the discharging end of the furnace, the same leading to a discharge opening 11^a normally closed by the pivoted gate or door 26. At the front of the furnace adjacent the discharge opening 11^a 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 37^a. 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 reg-

ulation 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 17^a is an exhaust duct 60 which leads to the angularly disposed duct portion 61 in turn leading to a stack connection 48^a.

A transverse opening 65 is provided beneath the track members 23 in the laboratory to permit cleaning and circulation of the heating gases. Similarly transverse openings 67 are provided in the supporting walls 20 to provide a transverse circulating and clean-out passage rearwardly of the passage 65. Near the charging or rear end of the furnace small baffles or abutments 68 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 practice of my process of the apparatus described above, 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. It is desirable to introduce a combustible mixture with considerable velocity, and such mixture and the flame resulting therefrom, together with the gases of combustion created, are directed toward the vertical wall 16 at some distance above the trackways 23, so that combustion, insofar as it takes place in the chamber or laboratory 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 moving gases, including the burning gases and gases of combustion, impinge against the wall 16, which first translates their velocity into pressure and thereafter from pressure into velocity in a direction substantially at right angles to the original direction of flow, and such gases are directed downwardly upon the billets or other articles as they are entering the laboratory, at which point they are relatively cool as contrasted with the final temperature at the time of the discharge from the furnace. While I find it desirable to use a substantially vertical wall 16, its inclination may be varied from the vertical, and the check or retardation of the velocity and the ensuing circulation or recirculation of the gases over and around the billets may be assisted by air introduced through the nozzles 55. In the form shown these nozzles may be utilized, if found desirable, and they will resist outward flow of the gases of combustion through the reduced furnace portion 53, and as stated will assist in directing 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 21^a 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 of 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 ex-

cess 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.

This enables me to use the radial heat of the burning gases during their flow at the upper portion of the laboratory as well as the heat of the recirculating gases by direct contact with the billets during the reverse flow. The ability to maintain a substantially uniform temperature throughout the laboratory enables me to readily design my apparatus for the capacity desired, and further enables me to obtain the very desirable "soaking" action which results in substantially uniformly heated billets or metal masses.

Also, I am enabled by regulating or properly determining the fuel and air supplied to the laboratory, to maintain a pressure therein at least equal to or in excess of atmospheric pressure which prevents infiltration or leakage of air into the laboratory through the discharge of 11^a or elsewhere, a highly desirable result.

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 as stated, I am enabled and find it desirable to maintain a pressure in the laboratory equal to that of the surrounding atmosphere or slightly in excess thereof.

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, and 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 17^a 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 23^a 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 lowers 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 17ª, 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 17ª. 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 is probable that my process may be carried out as to its essential and novel steps in apparatus differing from that illustrated in the drawings and described in the specification, and I do not wish to be restricted to such apparatus nor to the process as described except as the appended claims define the same under fair interpretation.

What I claim is:

1. A process of the class described consisting in continuously passing billets through a preheating chamber, thereafter into and through an enlarged main heating chamber and out of a discharge opening from said main chamber, supplying fuel and air at substantial velocity to said main chamber above said billets adjacent the point of discharge thereof and in spaced relation thereto, the combustion of said fuel being substantially effected out of contact with said billets but in such wise as to subject the latter to direct unobstructed radiant heat, at least a portion of the gases of combustion being thereafter reversely circulated in contact with said billets and into admixture with the incoming fuel and air.

2. A process of the class described consisting in continuously passing billets through a preheating chamber, thereafter into and through an enlarged main heating chamber and out of a discharge opening from said main chamber, supplying fuel and air at substantial velocity to said main chamber above said billets adjacent the point of discharge thereof and in spaced relation thereto, the combustion of said fuel being substantially effected out of contact with said billets but in such wise as to subject the latter to direct unobstructed radiant heat, at least a portion of the gases of combustion being thereafter reversely circulated in contact with said billets and into admixture with the incoming fuel and air, a portion of the gases from said laboratory being conducted through said preheating chamber.

3. A process of the class described consisting in continuously passing billets through a preheating chamber, thereafter into and through an enlarged main heating chamber and out of a discharge opening from said main chamber, supplying fuel and air at substantial velocity to said main chamber above said billets adjacent the point of discharge thereof and in spaced relation thereto, the combustion of said fuel being substantially effected out of contact with said billets but in such wise as to subject the latter to direct unobstructed radiant heat, at least a portion of the gases of combustion being thereafter reversely circulated in contact with said billets and into admixture with the incoming fuel and air, the supply and combustion of said fuel and air being controlled to maintain at least atmospheric pressure in said laboratory.

4. A process of the class described consisting in continuously passing billets through a preheating chamber, thereafter into and through an enlarged main heating chamber and out of a discharge opening from said main chamber, supplying fuel and air at substantial velocity to said main chamber above said billets adjacent the point of discharge thereof and in spaced relation thereto, the combustion of said fuel being substantially effected out of contact with said billets but in such wise as to subject the latter to direct unobstructed radiant heat, at least a portion of the gases of combustion being thereafter reversely circulated in contact with said billets and into admixture with the incoming fuel and air, a portion of the gases from said laboratory being conducted through said preheating chamber, the supply and combustion of said fuel and air being controlled to maintain at least atmospheric pressure in said laboratory.

5. A process of the class described consisting in continuously passing billets through a preheating chamber, thereafter into and through an enlarged main heating chamber and out of a discharge opening from said main chamber, supplying fuel and air at substantial velocity to said main chamber above said billets adjacent the point of discharge thereof and in spaced relation thereto, the combustion of said fuel being substantially effected out of contact with said billets but in such wise as to subject the latter to direct unobstructed radiant heat, at least a portion of the gases of combustion being thereafter reversely circulated in contact with said billets and into admixture with the incoming fuel and air, a portion of the gases from said laboratory being conducted through said preheating chamber, and supplying additional air to admix with and oppose the flow of gases through said preheat-

ing chamber whereby combustion of unburned fuel will be effected.

6. A process of the class described consisting in continuously passing billets through a preheating chamber and therefrom into and through an enlarged main heating chamber and from said main chamber out of a discharge opening adjacent the end of said chamber opposite to the entrance point, supplying and burning fuel and air in said laboratory above said billets, said fuel and air being supplied thereto in spaced relation to said billets adjacent the discharge end of said main chamber, the combustion of said fuel and air being substantially effected out of contact with said billets but in such wise as to subject the same to direct unobstructed radiant heat of said combustion, passing a portion of the gases of combustion through said preheating chamber and reversely recirculating the remainder of said gases in said laboratory in contact with said billets and into admixture with the incoming fuel and air.

In witness whereof, I hereunto subscribe my name this 31st day of October, 1928.

HENRY A. DREFFEIN.