

Oct. 6, 1942.

H. G. ELDER ET AL

2,297,696

FURNACE

Filed Oct. 29, 1940

FIG. 1.

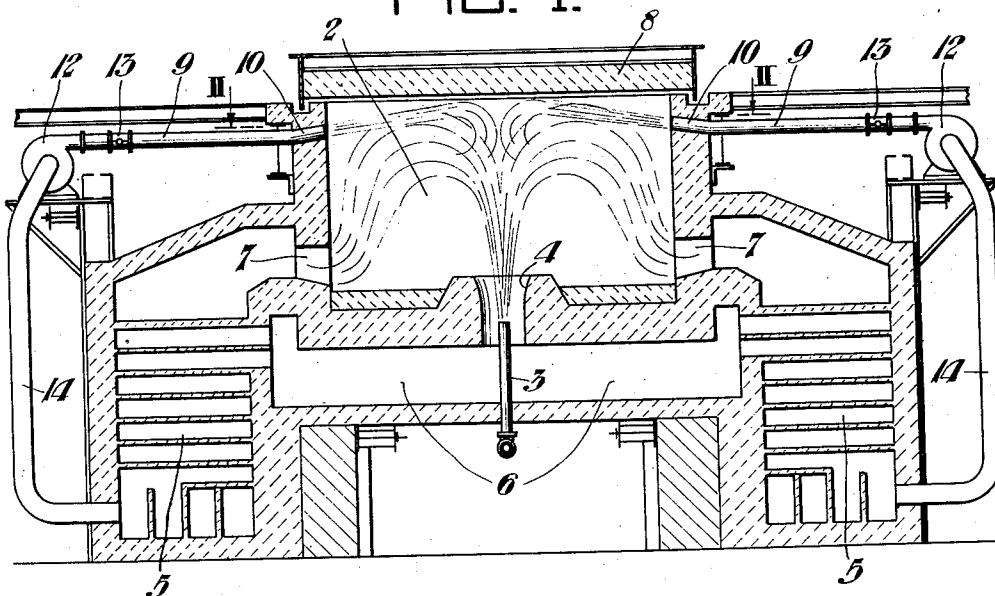


FIG. 2.

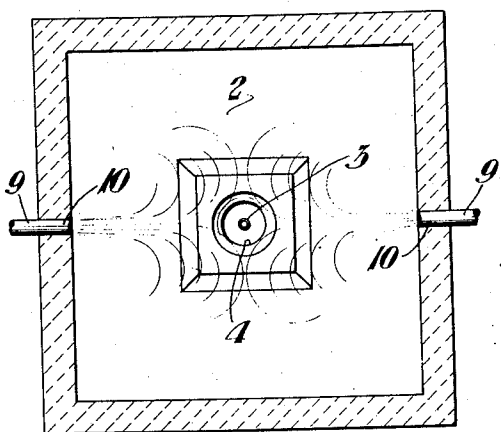
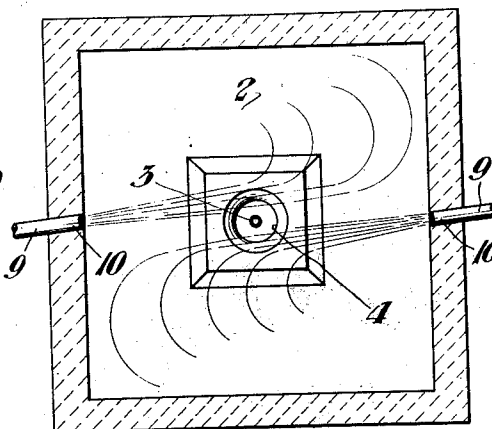


FIG. 3.



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UNITED STATES PATENT OFFICE

2,297,696

FURNACE

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Application October 29, 1940, Serial No. 363,337

3 Claims. (Cl. 263—44)

This invention relates to metallurgical furnaces and particularly to an improved metallurgical furnace of the bottom fired type sometimes called a soaking pit for heating ingots and the like.

In some types of bottom fired furnaces or soaking pits, the fuel, usually gas or oil, is supplied thereto in a vertical stream through a port or burner located in the bottom of the heating chamber centrally thereof. Surrounding the stream of fuel in the pit or heating chamber there is provided an annular column of preheated air which provides oxygen for delayed combustion, forming a long flame which rises vertically to the top wall or usually a removable cover for charging the ingots or articles to be heated into the furnace whereby it is deflected in an outward and downward direction by the cover in a manner well known to those skilled in the art with the flow being similar to that of a fountain. The flame and products of combustion in the downward path pass between and around the ingots deposited in the furnace to be heated, and then leave the heating chamber or pit through outlet ports located at the bottom of the furnace, and usually enter heat exchangers, or other heating means positioned adjacent the same.

In such a furnace or soaking pit it will be seen that the high temperature flame impinges directly against the inner side of the top wall or cover, and that the brickwork of the cover is subjected to extremely high temperatures, particularly the central portion thereof immediately above the firing port. For this reason the top wall or cover has a relatively short life thereby resulting in high replacement and maintenance costs, which is both undesirable and unsatisfactory, and is also troublesome and inconvenient. Also, since the central portion of the cover cannot be conveniently insulated without increasing the deterioration of the brickwork to a marked degree, there is an excessive heat loss for the reason that the maximum flame temperature occurs at this point, that is, where the flame first contacts the cover. It is to a furnace or soaking pit having means incorporated therewith for protecting the inner side of the top wall or cover from the direct impingement of this high temperature flame that the present invention relates.

Accordingly, it is one of the objects of the present invention to provide an improved metallurgical furnace or soaking pit having means incorporated therewith for protecting the top wall or cover from the intense heat to which it is subject, thereby reducing maintenance cost thereof

to a minimum and, at the same time, eliminating excessive heat losses.

It is another object of the invention to provide an improved metallurgical furnace or soaking pit which is simple and inexpensive in its construction and use, and, at the same time, one that is most efficient and effective.

It is a further object of this invention to provide an improved metallurgical furnace or soaking pit in which the circulation of the hot gases therein is increased, thereby resulting in a more thorough mixing of the gases and permitting gas dilution to any extent desired.

Various other objects and advantages of this invention will become more apparent in the course of the following specification and will be particularly pointed out in the appended claims.

In the accompanying drawing, there is shown for the purpose of illustration and description one embodiment which our invention may assume in practice.

In the drawing:

Figure 1 is a vertical section through a metallurgical furnace or soaking pit with which the improved cover protecting means of our invention is shown incorporated;

Figure 2 is a horizontal section taken on the line II—II of Figure 1; and,

Figure 3 is a horizontal section similar to Figure 2 showing a slight modification in accordance with our invention.

Referring more particularly to the drawing, our invention is shown incorporated with a conventional type furnace or soaking pit for heating ingots and the like. Such a furnace or soaking pit comprises a heating chamber 2 usually rectangular or square in shape which is adapted to be center fired at the bottom thereof by any suitable means. In the present instance there is provided a pipe 3 through which the fuel is supplied and directed into the heating chamber through a relatively large port 4 where combustion of the fuel initially takes place. The preheated air for combustion is directed and supplied preferably from the recuperators 5 positioned to either side of the furnace through a horizontally disposed duct 6 arranged below the hearth and upwardly through the port 4 around the outer side of the fuel pipe 3 into the heating chamber. There is provided preferably in the opposed side walls of the furnace at the bottom of the heating chamber outlet ports 7 which preferably communicate with the recuperators 5. Thus it will be seen that the flame from the burner or fuel supply pipe 3 is directed vertically

upwardly to contact the inner side of the top wall or removable cover 8 before the resulting products of combustion descend and enter the recuperators 5 through the outlet ports 7.

According to the present invention, there is arranged in two of the opposed side walls of the furnace adjacent the top thereof above the recuperators 5 and outlets ports 7, a supply pipe 9 having the inner end thereof extending through an upwardly inclined port 10 arranged in each of the opposed side walls of the furnace with the outer ends of each of the pipes 9 connected to a suction fan 12 suitably mounted above the recuperators. There is arranged in each of the supply pipes 9, preferably a valve 13 which is adapted to control the quantity and the velocity of the products of combustion passing there-through from the suction fans 12. Each of the suction fans 12 is preferably connected to their respective recuperators 5 at the bottom thereof by means of a duct or pipe 14. Thus it will be seen that the suction fans 12 draw a relatively cool stream of products of combustion from the recuperators 5 and force it through the pipes 9 into the heating chamber 2. It will be understood that the ports 10 together with the inner ends of the pipes 9 arranged therethrough, are upwardly inclined and are constructed and arranged so that the cooled streams of products of combustion supplied thereby will be directed toward each other and upwardly toward the center of the top wall or removable cover 8 above the upwardly impinging flame directed from the fuel supply pipe 3 so as to provide a protective screen between this hot upwardly impinging flame and the inner side of the top wall or cover, thereby protecting the same from the intense heat of this flame.

In Figure 3 there is shown a slight modification of our invention. This construction is generally the same as that shown in Figures 1 and 2 but differs therefrom in that the ports 10 together with the inner ends of the air supply pipes 9 are angularly disposed relative to the side walls of the furnace as shown so as to produce a combined turbulent and whirling effect of the hot gases within the heating chamber as well as to provide a protective screen.

While the cooled products of combustion introduced into the furnace in the manner described are relatively cool as compared with the flame temperature of the burning fuel, which may be rich gas, such as coke oven gas, natural gas or refinery gas, or lean gas, such as blast furnace gas or producer gas, or a mixture of various combustible gases, or oil, they still will be at a temperature of from 1000° to 1500° F., which is high enough not to cause any undesirable cooling action in the heating chamber, particularly since the volume of products of combustion utilized is small compared to the total volume of products of combustion. Further, operating conditions are satisfactory, since the maximum temperature of about 1500° F. lies well within the safe operating range of mechanical equipment available for handling hot gases.

Although two fans and two streams of products of combustion are shown, it may, at times, be desirable to install additional fans, or additional ducts from individual fans, either to take the cooled products of combustion from any number of recuperators, or other heat exchange media, that may be installed or to introduce the cooled products of combustion from various points in the furnace and, while fans have been

shown and described as the means for moving products of combustion, air or inert gases, it will be understood that other available devices may also be used successfully in accordance with the teachings of our invention.

While the arrangement shown provides for the introduction of heated gases of relatively low temperature, an arrangement may be provided whereby air, either at atmospheric temperature or preheated in recuperators, or other heat exchange media, may be introduced in the same manner to promote secondary combustion and to increase turbulence, or to accelerate combustion, through automatic or manual proportioning of the total amount of air introduced into the furnace. An arrangement may also be utilized whereby any combination of heated air and waste gas may be introduced, with automatic or manual proportioning of the heated air and waste gas so introduced and automatic or manual proportioning of the air in the mixture to the air introduced through the burner port, with regulation being accomplished through known means. In the same manner we may proportion and mix the secondary air and waste gas or other gases to control the temperature and the atmosphere may be proportioned as described. Likewise it may be desirable to introduce inert gas, such as nitrogen, carbon dioxide or the like, to minimize oxidation of the material being heated.

At times pit furnaces or other heating furnaces of the bottom fired type are constructed without any provision for waste heat recovery. In such cases the fuel and cold air are introduced through a burner. When used for heating steel, such a burner is preferably of the long flame type, where slow mixing of the fuel and air delays combustion and through a deficiency of air in the mixture of fuel and air leaving the burner causes "cracking" or "reforming" of the rich fuel used, with a resultant luminous flame. Such a flame is much longer than the short "sharp" nonluminous flame resulting from an intimate mixture of fuel and air, which type of flame would have a very highly localized temperature zone adjacent the material being heated, with resultant "washing" of the metal.

With the proper type of burner, the flame must be longer and greater in volume than when preheated air for combustion is used, if the same rate of heat input is to be maintained. This condition increases the danger of the long flame contacting the steel ingots or other material being heated, with resultant probability of "washing" or burning the metal. Under such conditions, the introduction of secondary air by means of the present invention, as explained more in detail later, will accelerate combustion, thus minimizing the danger of damage to the steel. As stated above, it may be desired to add waste gases from the waste heat flue to the air to increase the volume and also the air temperature, thus not only providing oxygen for secondary combustion at a temperature higher than otherwise possible, but also by increasing the volume, increasing the amount of turbulence, with resultant further acceleration of combustion, and decreased danger of damaging the material being heated.

Another advantage inherent in this invention lies in the increased circulation caused by the introduction of products of combustion by means of the fans, which circulation results in improved mixing of the gas and air near the top of the heating chamber, with more rapid combustion

and a flame shortened in the latter stages, so that the descending stream of gas consists only of products of combustion, thus avoiding the undesirable effect of having burning fuel contact the steel. This advantage applies particularly to the recuperative type of pit furnace when burning rich gas, in which case the ascending column of gas is surrounded by an envelope of air, the combustion occurring largely as diffusion causes the air and gas to come in contact with each other. This process is necessarily slow, as long as the two parallel streams are not disturbed. In the present invention, it will be seen that the ascending column of unmixed gas and air enters the zone where the high velocity streams of waste gas meet, with the resulting turbulence causing an intimate mixture of the unburned gas and air, with accelerated combustion before the gases reach the cover.

While we have shown and described one specific embodiment of our invention, it will be understood that this embodiment is merely for the purpose of illustration and description and that various other forms may be devised within the scope of the invention, as defined in the appended claims.

We claim:

1. In a furnace of the class described for heating ingots and the like including a heating chamber having side and top walls, a hearth arranged centrally of the heating chamber upon which the articles to be heated are adapted to be placed, means arranged centrally of said hearth for firing the furnace by a flame rising upwardly therefrom, and means arranged in two of the opposed side walls of said furnace adjacent the top thereof substantially opposite each other for supplying and directing a relatively cool stream of substantially inert gas or air toward each other and the center of the heating chamber so that the relatively cool gases or air supplied thereby will be interposed between the flame and the top wall of said furnace and meet the unburned gases of the flame at a point spaced from the top wall whereby a turbulent action is provided so as to cause an intimate mixture of the inert gas and the unburned gases of the flame and thorough combustion of the unburned fuel gases before they contact the top wall of the furnace.

2. In a furnace of the class described for heating ingots and the like including a heating chamber having side and top walls, a hearth arranged centrally of the heating chamber upon which the articles to be heated are adapted to be placed, means arranged centrally of said hearth for firing the furnace by a flame rising upwardly therefrom, an upwardly inclined port arranged in at least each of two of the opposed side walls of said furnace adjacent the top thereof substantially opposite each other, and means arranged with each of said ports for supplying a relatively cool stream of substantially inert gas or air therethrough and into the heating chamber toward the upper central portion thereof whereby the stream of gas or air is directed upwardly toward the center of the top wall by the inclined ports so that the same will be interposed between the flame and the top wall of said furnace and meet the unburned gases of the flame at a point spaced from the top wall whereby a turbulent action is provided so as to cause an intimate mixture of the inert gas and the unburned gases of the flame and thorough combustion of the unburned fuel gases before they contact the top wall of the furnace.

3. In a furnace for heating ingots and the like, including a heating chamber having side and top walls, a hearth arranged in said heating chamber upon which the objects to be heated are adapted to be placed, means for directing fuel gases into said furnace chamber in substantially a vertical plane for firing the same, means for directing opposed streams of inert gas into said chamber adjacent the top thereof slightly tangential to each other and substantially perpendicular to the stream of fuel gases being directed thereinto so that the streams of inert gas and stream of fuel gases will meet at a point spaced from the top wall of the furnace whereby a whirling and turbulent action is provided so as to cause an intimate mixture of the inert gases and the unburned fuel gases and accelerated combustion of the unburned fuel before they contact the top wall.

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