

July 14, 1942.

C. E. MORAN
METALLURGICAL FURNACE

Filed Aug. 3, 1940

2,289,719

2 Sheets-Sheet 1

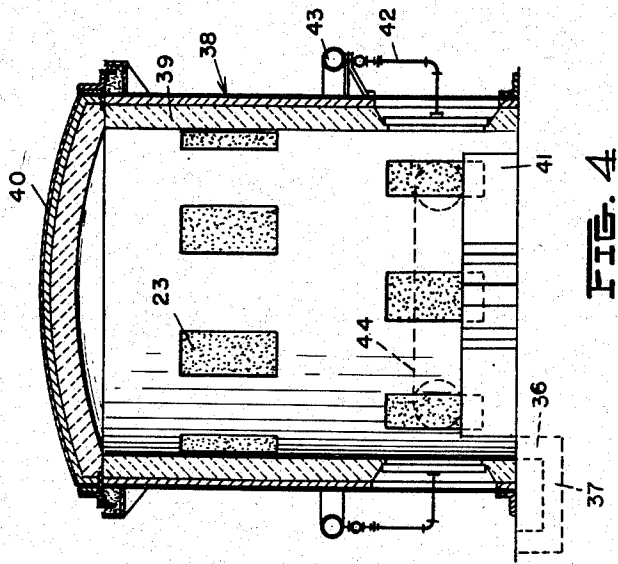


FIG. 4

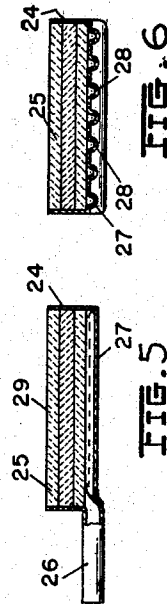


FIG. 6

FIG. 5

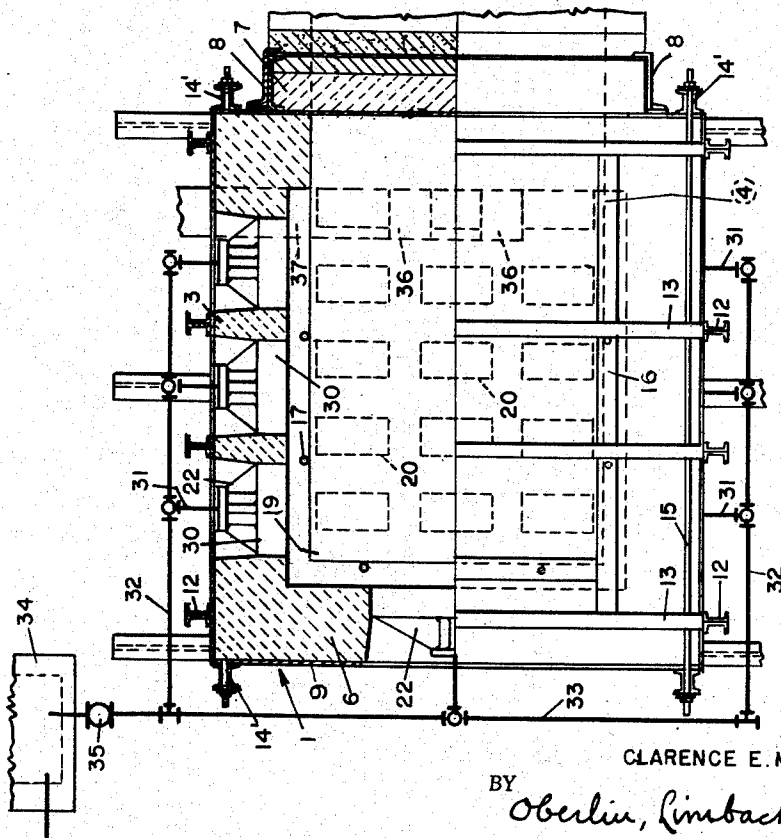


FIG. 1

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FIG. 2

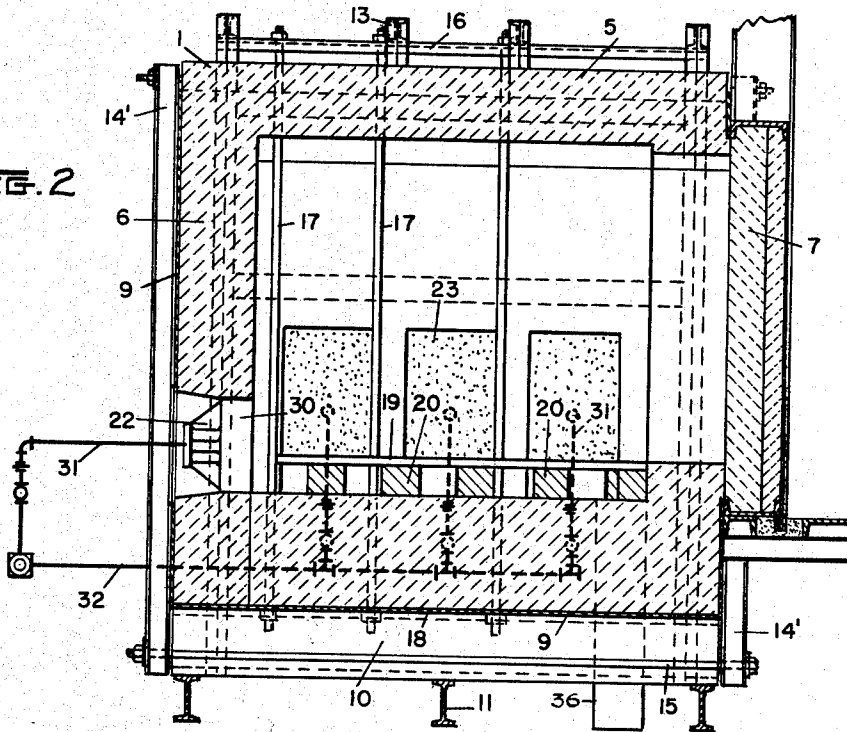
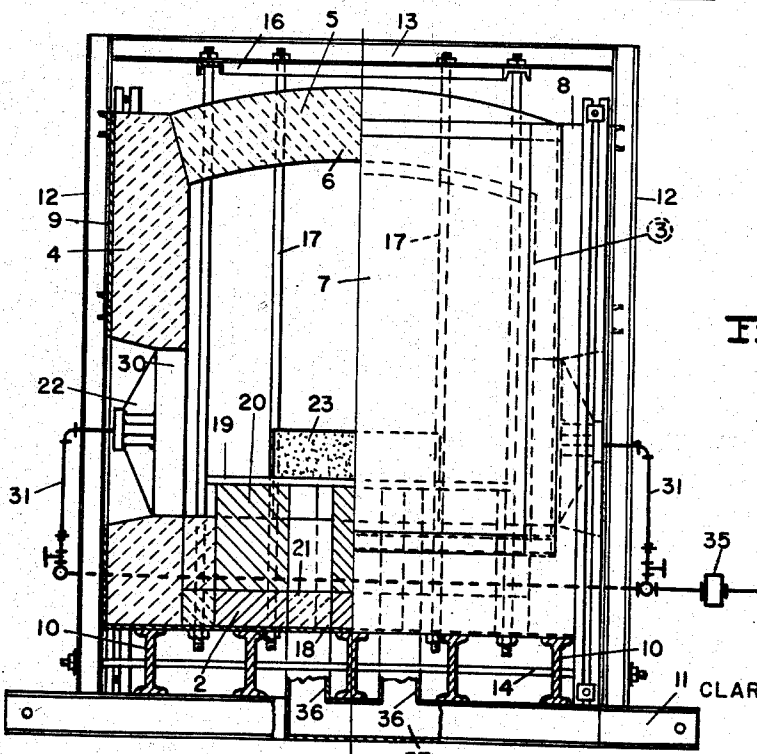


FIG. 3



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UNITED STATES PATENT OFFICE

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METALLURGICAL FURNACE

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Application August 3, 1940, Serial No. 350,437

1 Claim. (Cl. 263—43)

This invention relates to a metallurgical furnace, and more particularly to an improved construction of furnace having novel means for supplying heat to the heating chamber thereof.

The problems incident to the construction and operation of metallurgical furnaces using gas as a fuel, and which are adapted to heat metal to high temperatures, are many and well known. Obviously, the most desirable way to supply heat to a furnace is to feed the fuel into and burn the same in the heating chamber of the furnace. In those furnace constructions where the fuel is fed through a nozzle and burned in the heating chamber which also serves as a combustion chamber, it is necessary to make the heating or combustion chamber of a size considerably larger than required for the purpose of holding the material to be heated, in order to enable complete combustion of the fuel to take place.

An additional objection to this type of furnace is that the inside surface of the walls forming the heating chamber is directly subjected to the action of the burning fuel, and care must be taken to prevent melting of the firebrick from which such walls are made. Another feature which renders this type of furnace objectionable for many purposes, such as its use as an annealing furnace, is that, in providing the necessary draft to insure proper combustion of the fuel, the furnace will not be uniformly heated throughout and there will be relatively hot and cold spots therein due to the uneven movement of the burning gases through the furnace under the influence of the draft.

Accordingly, the tendency of the art, in many furnace constructions for metallurgical purposes, has been to abandon the more efficient method of heating by convection and rely on the more expensive and lesser efficient heating furnaces employing radiation to effect the desired heating in order to provide a furnace which may be heated uniformly throughout and which will not be unnecessarily large in size. Well known examples of such furnaces are the electric resistance furnace, electric arc type furnace, and those furnaces employing muffles or heat covers which are heated to a red heat and operate to keep the burning gases out of contact with the material being heated and the walls of the furnace.

One of the principal objects of this invention is to provide a metallurgical furnace construction in which the heating fuel is fed directly into the furnace in such manner as to enable the employment of both radiation and convection in heating the contents of the furnace.

A further object is to provide a metallurgical furnace having a novel form of burner for gas fuel which will permit a reduction in size of the furnace, provide uniform heat throughout the furnace, and enable the heat loss through the walls to be reduced to a minimum.

A further object is the provision, in a furnace of the character referred to, of furnace walls having a plurality of fuel burners mounted therein in such manner as to constitute a substantial part of the total wall area.

A further object is to provide, in a furnace of the character referred to, a plurality of surface burners mounted in the walls of the furnace in such manner as to constitute a substantial part of the total wall surface area, the surface burners comprising porous refractory diaphragms through which fuel is fed into the furnace and burned to produce a heating effect over the entire surface area of the diaphragms.

To the accomplishment of the foregoing and related ends, said invention, then, consists of the means hereinafter fully described and particularly pointed out in the claim.

The annexed drawings and the following description set forth in detail certain mechanism embodying the invention, such disclosed means constituting, however, but one of various mechanical forms in which the principle of the invention may be used.

In said annexed drawings:

Fig. 1 is a top plan view of a furnace constructed in accordance with the principles of this invention, a part being broken away centrally thereof and shown in section;

Fig. 2 is a central longitudinal vertical sectional view of the furnace shown in Fig. 1;

Fig. 3 is a front elevational view of the furnace shown in Fig. 1, a part being broken away centrally thereof and shown in section;

Fig. 4 is a vertical sectional view of a modified form of furnace; and

Figs. 5 and 6 are transverse sectional views illustrating the fundamental construction of the burners to be used for supplying heat to the furnace.

In the drawings, the numeral 1 designates as a whole a furnace having a bottom 2, side walls 3 and 4, a top 5, an end wall 6, and a front door closure member 7. The front door closure member 7 is preferably of the counterweighted type mounted for vertical movement in channels 8 to and from closed position. The furnace is also provided with a metallic sheet metal protective covering 9.

The bottom 1 is carried on beams 10 mounted on suitable supporting members 11. The side walls of the furnace 1 are reinforced by vertical beams 12, connected at their tops by cross beams 13 and at the bottom by tie rods 14. The front and rear ends of the furnace are likewise reinforced by beams 14' connected at the top and bottom thereof by tie rods 15. Supporting channels 16 are secured to the under side of the transverse beams 13 to which the upper ends of a plurality of protecting rods 17 are connected. The protecting rods 17 extend through the interior of the furnace for a purpose to be described, and have their lower ends suitably secured to the lower surface 18 of the bottom of the furnace 1.

A floor is provided for supporting the material to be heated in the furnace and comprises a plate 19 formed of suitable alloy steel carried by a plurality of supporting blocks 20 resting on the upper surface 21 of the bottom 2 and spacing the plate 19 from the upper surface 21. The supporting blocks 20 are spaced from each other, as best shown in Fig. 1, to provide spaces through which the hot gases may pass in a manner to be described.

A plurality of burners 22 are mounted in the walls 3, 4 and 6 for supplying heat to the furnace 1. The burners 22 are provided with burner surfaces 23 in alignment with the interior surface of the furnace, as best shown in Figs. 1, 2 and 3. It will be noted that the combined area of the burner surfaces 23 occupies a substantial portion of the total wall surface defining the heating chamber within the furnace 1. The burners 22 are preferably constructed in accordance with the disclosure of my Patent No. 2,194,208, issued March 19, 1940. This construction is illustrated in Figs. 5 and 6 and comprises a hollow metallic casing 24 in which is mounted a diaphragm 25 formed of a plurality of porous refractory slabs through which the fuel may be fed from a supply line 26. The diaphragm 25 and bottom 27 of the casing 24 are formed to provide a plurality of passageways 28 at the rear of the diaphragm 25. The passageways 28 are interconnected with the supply conduit 26 and operate to deliver a combustible mixture of fuel from the supply conduit 26 uniformly over the entire back surface of the diaphragm 25. The combustible mixture of fuel is fed under pressure through the conduit 26 and is forced outwardly through the porous diaphragm 25 and is burned uniformly over the surface 29 thereof in such manner that the surface 29 will be heated to a uniform degree of incandescence after the burner has been in operation for a short time.

Although the construction of Figs. 5 and 6 illustrates a diaphragm 25 formed of a plurality of porous refractory slabs, it will be understood that the diaphragm 25 may be formed of a single porous refractory block in accordance with the teachings of my aforementioned patent. It will also be understood that the showing of Figs. 5 and 6 is intended only to illustrate the principles of the preferred construction of the burners 22, the particular shape of the burners 22 and the manner in which the fuel is fed thereto being different from the construction shown in Figs. 5 and 6.

The burners 22 comprise metallic housings 30 mounted in suitable openings formed in the sides 3 and 4 and end 6 of the furnace 1 in such manner that the surface 23 of the porous refractory block in each casing 30 is flush with the interior wall surface of the furnace. The burners 22 are

so positioned with respect to the floor or plate 19 as to be directly opposite the material to be heated, which is placed on the floor 19. As best shown in Fig. 1, the combustible mixture of air and gas is fed centrally of the burners 22 through conduits 31 connected by branch conduits 32 and 33 to a suitable source of fuel supply 34, a fire check valve 35 being interposed between the source 34 and the conduits 32 and 33.

The protecting bars 17 extending through the heating chamber within the furnace 1 are positioned closely adjacent the peripheral edges of the floor 19. The bars 17 operate to protect the burner surfaces of the burners 22 by preventing movement of the material to be heated from the floor 19 into engagement with the burner surfaces 23.

The combustible mixture of gas and air is fed to the individual burners 22 under pressure, and to permit the escape of the heated gases after burning, the bottom 2 of the furnace 1 is provided with vents 36 connected with a duct 37 through which such gases may be carried away, a fan or other suitable apparatus (not shown) being provided to assist in the removal of the products of combustion from the heating chamber. By reason of the location of the burners 22, the hot gases will move outwardly from the burner surfaces 23 and then downwardly over the material to be heated. After contacting the material being heated, the gases escape to the vents 36 through the space provided between the peripheral edge of the hearth 19 and the side walls of the furnace and the space between the supporting blocks 20 for the hearth 19. In this manner, heating by convection is provided through the passage of the hot gases over the material to be heated.

In the modified construction shown in Fig. 4, the numeral 38 indicates as a whole a circular furnace having annularly shaped side walls 39 and a removable top 40. The furnace 38 is provided with supports 41 in the bottom thereof for the material to be heated which may be placed in and taken from the furnace upon removal of the top 40. In this construction, it will be noted that the burners are mounted in such manner as to provide a plurality of burner surfaces 23 in spaced rows. The burners in each row are staggered with relation to the burners in the other row to provide a more uniform heating effect and prevent hot and cold spots likely to occur if the individual burners were vertically aligned. All the burners in the furnace 38 are fed with a combustible mixture of air and gas from branch conduits 42 connected to a common supply conduit 43. It will be noted that the circular construction of the furnace 38 is particularly adapted for heating materials circular in shape, such as coiled steel, indicated diagrammatically by the dotted lines 44 in the drawings.

The operation of both modifications shown in the drawings is essentially the same. The material to be heated is placed on the hearth of the furnace and a combustible mixture of fuel is fed to the burners 22. In a short period of time, the burner surfaces 23 will become incandescent and radiate heat directly to the material to be heated. The location of the burner surfaces 23, directly opposite the surface on which the material being heated is supported, is desirable to provide the maximum effect from the radiated heat. In addition, the hot gases from the burner surfaces 23 will flow downwardly over the material to the vents 36, and such gases will be

operable to apply heat directly to the material by convection. Accordingly, it will be apparent that the burners 22 enable heat to be supplied directly to the material being heated by both radiation and convection.

Since the combustible mixture of fuel supplied to the burners 22 is substantially all burned at the surface 23, it will be apparent that it is not necessary to provide additional space in the heating chamber to permit complete combustion to take place, and the size of the heating chamber may therefore be merely made sufficient to accommodate the materials to be heated.

By reason of the fact that the burner surfaces 23 occupy a substantial portion of the total area of the wall surface defining the heating chamber, it will be apparent that the burners 22 provide an advantage with respect to heat losses by reducing the effective area through which heat may escape from the heating chamber, it being obvious that heat cannot escape through the burner surfaces where the combustion of the fuel takes place. The radiation of a substantial portion of the heat directly to the material being heated, together with the manner in which the hot gases flow from the burner surfaces 23 to the vents 36, provides an additional element of protection with respect to the firebrick from which the walls of the furnace are made. By reason of the fact that the hot gases are not directed toward the side walls, the temperature of the inner surface of such side walls is kept down with a consequent reduction in loss of heat through such walls and less danger of the walls burning.

In connection with the use of the burners 22 as a means of supplying heat to a furnace by burning gas fuel, I am aware of the fact that the use of such so-called surface burners has been proposed with respect to certain types of furnace constructions. However, I believe that I am the first to provide a metallurgical furnace, embodying surface burners as a heat source, and which

is capable of complete and satisfactory operation under the conditions and requirements imposed in the metallurgical heat-treating field.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed, provided the means stated by the following claim or the equivalent of such stated means be employed.

I therefore particularly point out and distinctly claim as my invention:

A high temperature metallurgical furnace of the character described, comprising top and vertical side furnace walls normally forming an enclosed heating chamber having an opening only in the bottom side, a plurality of porous refractory, gaseous fuel burner diaphragms mounted vertically in said furnace walls with the front faces of said burner diaphragms facing inwardly toward said heating chamber and being flush with the inner surface of said side walls, said burner diaphragms being spaced from each other both horizontally and vertically in said side walls and forming a substantial part of the total inner surface thereof, casings for enclosing the rear faces of each of said burner diaphragms, said casings having a portion of their opposed faces substantially in contact with said diaphragms, gaseous fuel conduits leading to the interior of said casings, a plurality of inter-connecting passageways communicating with said conduits and parallel to the rear faces of said diaphragms, said passageways being defined in part by said diaphragms, said heating chamber being adapted to receive the gases of combustion from the front faces of said burner diaphragms, together with the radiant heat therefrom, and a gas eduction vent connected to said opening in said bottom side of said heating chamber for the withdrawal of the gases of combustion from said furnace.

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