Sept. 16, 1941.

A. J. BOLAND

2,256,275

ENAMELING FURNACE

Filed Nov. 18, 1939

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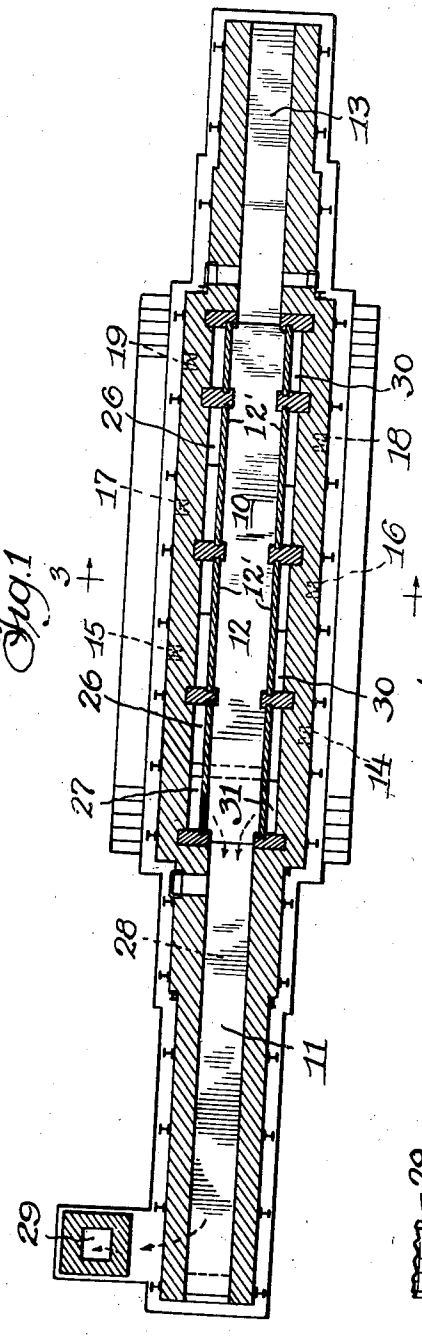


Fig. 1

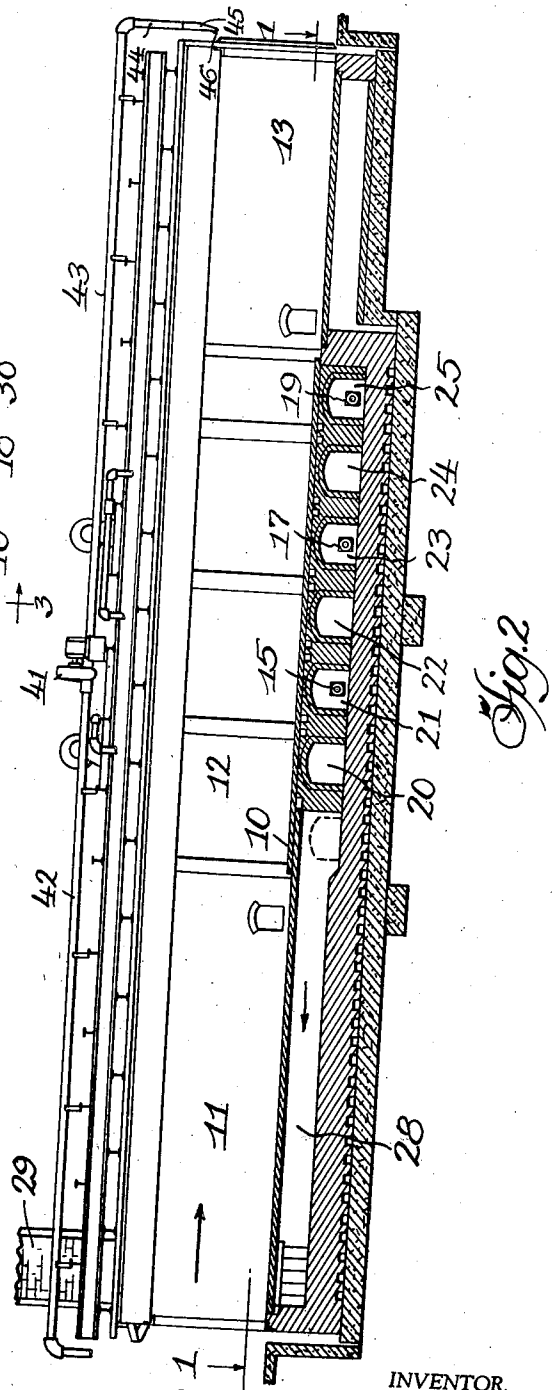


Fig. 2

INVENTOR.

BY Albert J. Boland,

Chritton, Wiles, Davies, Hirschl & Dawson

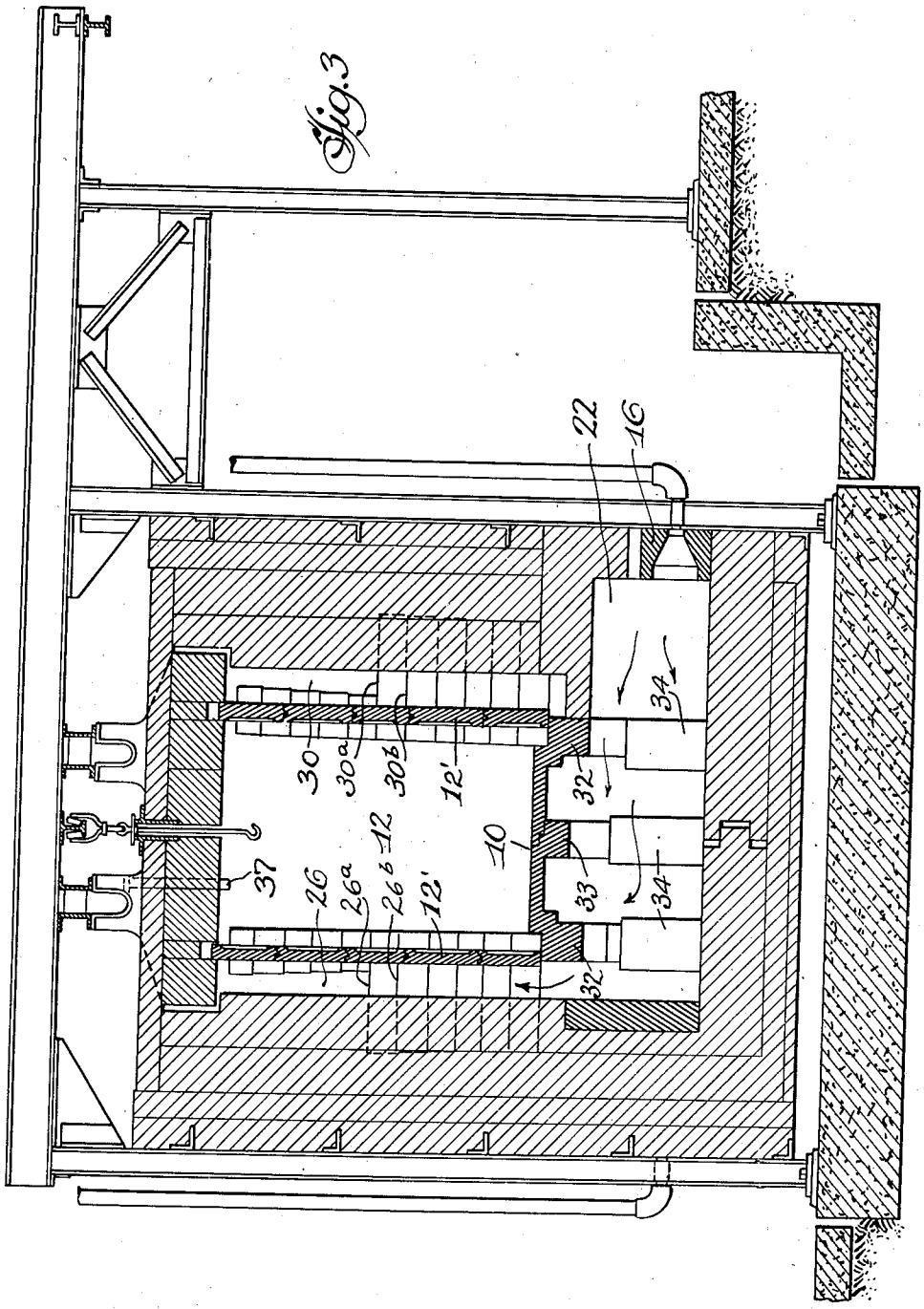
ATTORNEYS

Sept. 16, 1941. A. J. BOLAND 2,256,275

ENAMELING FURNACE

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Fig. 3



INVENTOR.

BY Albert J. Boland,

Chritton, Wiles, Davies, Hirschl and Dawson.

ATTORNEYS.

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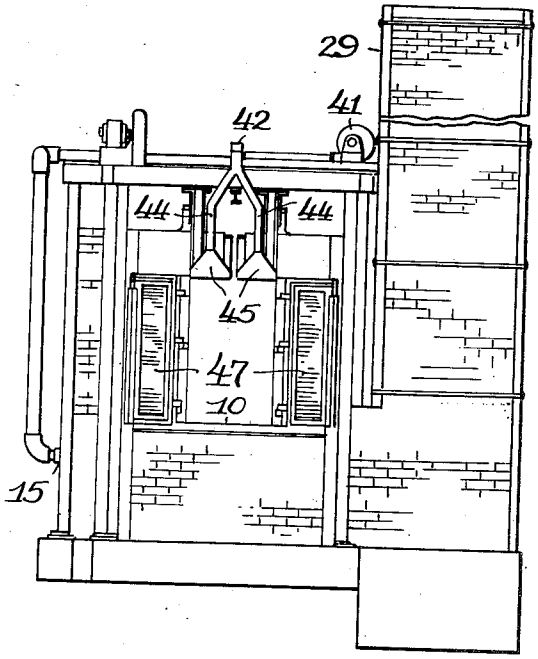


Fig. 6

Fig. 4

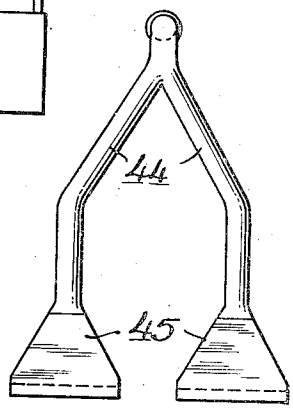
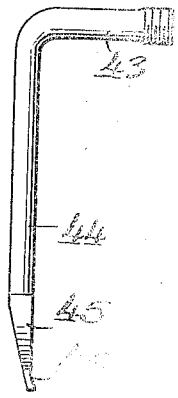


Fig. 5



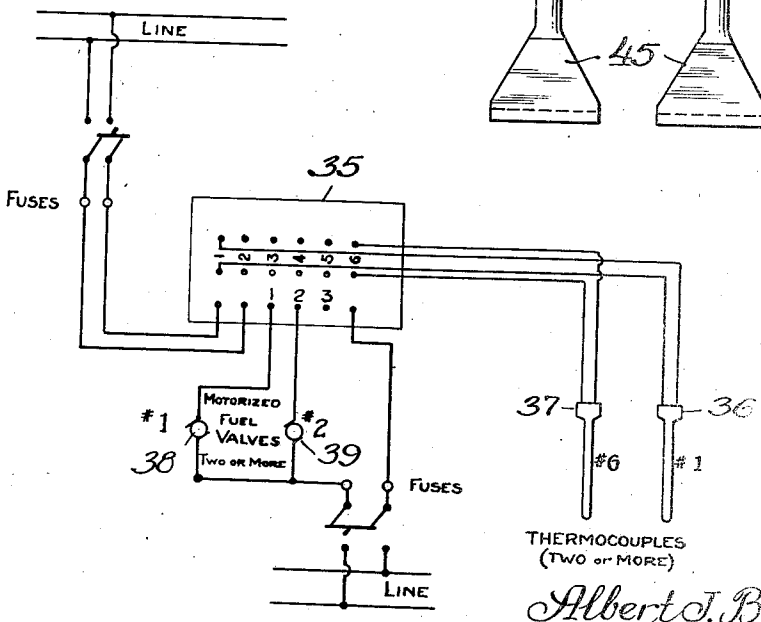


Fig. [illegible]

Albert J. Bo[illegible]

BY

Chritton, Wiles, Davies, Bice[illegible]

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ENAMELING FURNACE

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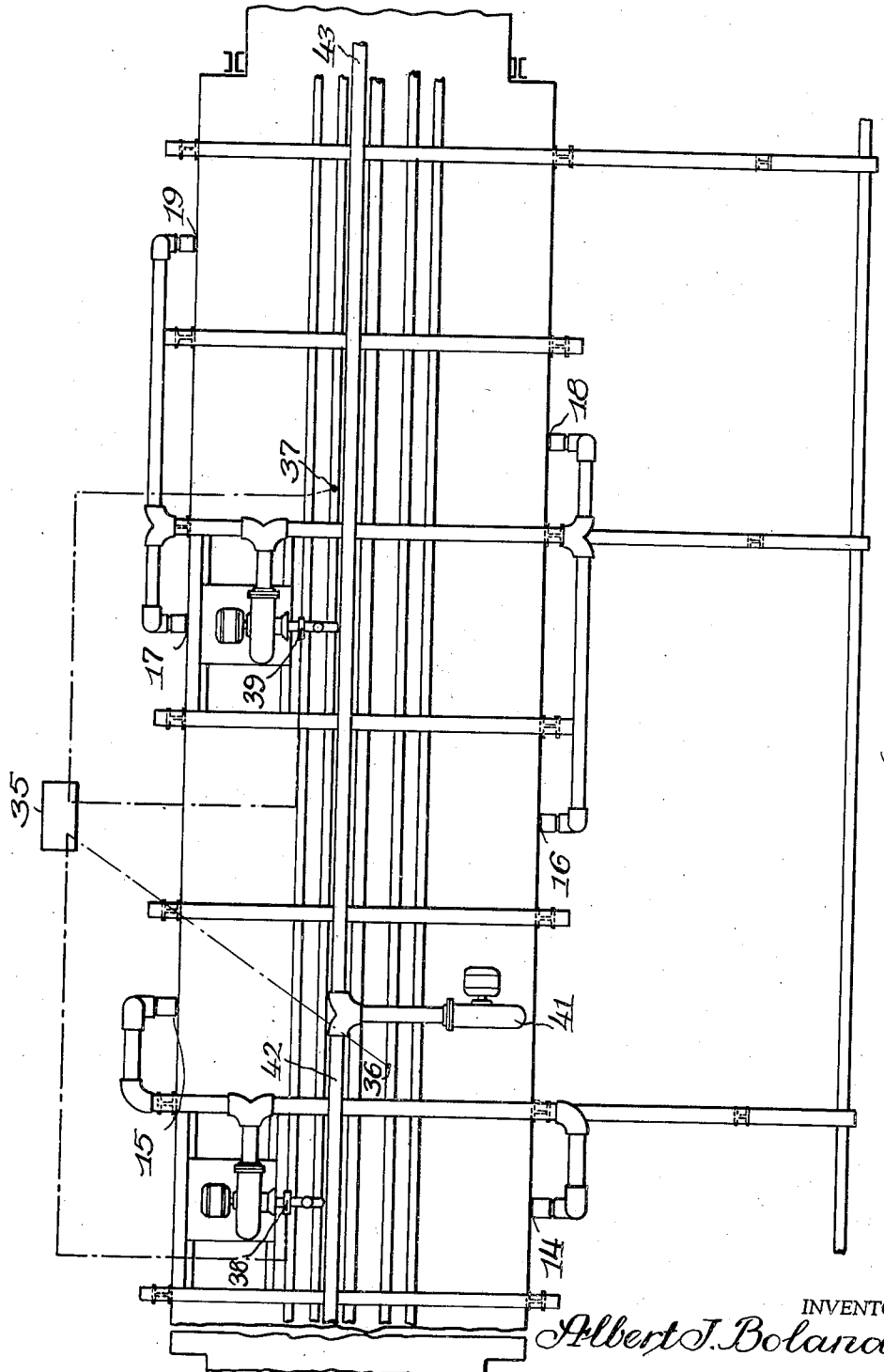


Fig. 7

INVENTOR.
Albert J. Boland,

Chritton, Wiles, Davies, Hirschl & Dawson, ATTORNEYS.

Patented Sept. 16, 1941 2,256,275

UNITED STATES PATENT OFFICE

2,256,275

ENAMELING FURNACE

Albert J. Boland, St. Louis, Mo.

Application November 18, 1939, Serial No. 305,178

3 Claims. (Cl. 25—142)

My invention relates to improvements in furnace construction and includes, for example, furnaces of the continuous, single flow type, used in making porcelain enamelware.

In certain designs of these prior furnaces, where gas or oil is burned under the hearth or floor, it has proved difficult to heat the hearth uniformly. In other cases the control of the heat has been attempted by regulation of a single source of supply for the entire furnace.

One feature of my improvement is the provision of means for supplying heat substantially uniformly to the hearth from beneath the same.

Another feature provides for effective regulation of the heat by what I call unit regulation, automatically controlled.

In my improved construction the entire hearth is underlaid with transverse passages in which combustion takes place in such a manner as to uniformly heat the combustion chamber above the hearth. These transverse passages are of substantial width to insure good combustion. Automatic controls are provided which prevent overheating and which insure a desired range of temperatures. To accomplish these results a number of burners are employed, preferably in excess of two, which are directed alternately across the furnace from one side toward the other. In providing the desired regulation all of the burners are not shut off when the desired temperature has been attained but the fuel supply to some of the burners is reduced, none of the burners being completely shut off at one time and certain burners to which the fuel supply has been reduced may have the fuel supply restored subsequently, with the result that the furnace may remain uniformly heated throughout the entire operation, lasting several weeks or months. Certain burners are on the same control which means that their fuel supply is reduced simultaneously, whereas other burners may continue to operate at full capacity.

An additional feature relates to the provision of an air seal at opposite ends of the furnace to prevent loss of heat. This is accomplished by taking hot air from the top of the furnace and blowing it downwardly and inwardly, at a slight angle, into the furnace at the open ends thereof.

In the accompanying drawings I have illustrated a commercial embodiment of the invention, which will serve to illustrate the novel features. Some of these features are applicable to somewhat different types of furnaces, however, and all of them need not necessarily be combined in a single equipment or structure.

Fig. 1 is a horizontal section through the furnace on the line 1—1 of Fig. 2;

Fig. 2 is a vertical, central longitudinal section through said furnace with most of the roof structure shown in elevation;

Fig. 3 is an enlarged section on the line 3—3 of Fig. 1;

Fig. 4 is an end elevation of the air seal;

Fig. 5 is a side elevation thereof;

Fig. 6 is an end elevation of the furnace;

Fig. 7 is a top plan view of part of the central chamber structure; and

Fig. 8 is a circuit diagram.

The furnace selected for illustration is a gas or oil fired, six burner furnace but either a smaller or larger number of burners may be employed. The hearth floor is indicated at 10. The ware enters the preheating chamber 11, which is shown at the left hand end in Figs. 1 and 2, and passes successively through the fusing or burning chamber 12, which is the central chamber, and through the cooling chamber 13. The said central chamber is of the muffle type, having muffle walls 12' at each side.

The fuel issues from a number of nozzles or burners 14, 15, 16, 17, 18 and 19, of which there are preferably three on each side in this instance, arranged in staggered relation. The burning fuel is directed across the furnace beneath the hearth or floor of the central chamber, in a series of individual tunnels 20, 21, 22, 23, 24 and 25, one of said burners being mounted in one end of each of said tunnels. The burning fuel from the burner 14, for example, (which is the left hand one shown in Fig. 1) is directed across beneath the burning chamber, thence upwardly in a narrow, vertical duct to the horizontal passageway 26, thence to the left and down through the vertical duct or flue 27 and thence to the horizontal duct 28 beneath the floor of the preheating chamber, then transversely over and out the stack 29.

Burning fuel issuing from the next burner 15 on the opposite side, flows through the tunnel 21, thence upwardly to the horizontal duct 30, down through duct 31 to the horizontal flue 28, leading to the stack.

Fig. 3 shows a section on a somewhat larger scale through the tunnel 22, the gas flowing from the burner 16 across the furnace beneath the burning chamber in direct contact with the underside of the tiles which constitute the hearth floor, up through the vertical duct to the horizontal flue 26 and thence to the stack, as before. The products of combustion in the remaining tunnels flow in the same manner through the tunnels

from one end of each to the other, the flow being in opposite directions in successive tunnels. By way of illustration only, the height of the muffle chamber or burning chamber in the furnace shown may be assumed to be about five or six feet. The floor or hearth is uniformly heated by the products of combustion in the transverse tunnels and said products of combustion, as will be apparent from Fig. 3, flow vertically upwardly at one side of the muffle or the other, about half the height of the muffle chamber, after which they flow horizontally to the end of the furnace through the narrow ducts **26** and **30** positioned on each side of the vertical walls of the muffle chamber.

One of the important features of the present invention arises out of the provision of a sufficient number of transverse tunnels to underlie practically the entire hearth of the furnace so that the combustion which takes place in said tunnels insures substantially uniform heat in the chamber.

Said tunnels, as shown particularly in the central sectional view, Fig. 2, include supporting arches, i. e. the burning arches **32**, **33** (see Fig. 3) which are supported on a series of brick piers **34**, and which support the tiles **10** of the hearth floor. There are preferably three such arches in each tunnel, one beneath each muffle wall **12'** and one in the middle beneath the joint where said tiles meet. With this arched construction, wider combustion chambers may be provided which insure more complete combustion and the burning gases are in direct contact wtih the undersurfaces of practically all of said tiles, except for a limited area at the middle where the arch **33** is engaged by said tiles. Said arches are made of suitable refractory material such for example as silicon carbide brick, permitting the use of a wider span and shorter tile on the top, which forms the floor of the burning chamber. In a furnace having a muffle chamber of the height suggested, the transverse tunnels are about two and a half feet wide.

Automatic temperature controls are provided to prevent overheating. The temperature measuring, controlling and recording instrument **35** is shown diagrammatically in Fig. 7 and in Fig. 8, the same being connected to thermocouples **36** and **37**, one located in the entrance end of the burning chamber and the other located near the exit thereof. Said instrument is also connected with the automatic gas pressure control valves **38** and **39** shown in Fig. 7.

In the particular form of equipment illustrated in the drawings, the two burners **14**, **15**, shown also in Fig. 1, are connected to the same pressure control valve **38**, although a group of three or four or more may be controlled as a unit. Where a greater number of burners are used, a larger number of thermocouples are installed. The first two or more burners are preferably larger than the remaining burners, to insure greater heating capacity at the entrance end of the burning chamber.

The purpose of the described arrangement is to permit independent regulation of different parts or zones of the burning chamber. For example, the two burners **14**, **15**, may be set for a temperature of 1575° F. whereas some of the other units may be set for a higher temperature, as for example 1600° F. As the temperature in the burning chamber increases to the desired point, the fuel supply to the first unit or pair of burners may be reduced, or on the other hand the fuel supplied to the remaining burners may be reduced first, the regulation being obtained by automatic adjustment of the valves which control the flow of gas. Also, the fuel supply may, of course, be increased during the operation as well as decreased so as to maintain substantially uniform heat throughout the entire operation, which may last for several weeks or even several months. In view of the provision of these regulating units for the individual burners, I refer to the control as unit regulation, as distinguished from regulation of a single source of supply for the entire burning chamber.

Although two power lines are shown in Fig. 8, the regulating circuits may be parts of the same outside circuit. In other words, the electrical characteristics for operating the temperature measuring and control devices may be different from those operating the fuel control valves, in which case two independent sources of supply may be required.

Another feature of importance is the means for preventing undue loss of heat at the open ends of the furnace, which in this case involves a straight tunnel from one end of the structure to the other. Certain features of the invention, however, are useful in furnaces of other types.

As shown in Figs. 2, 4 and 5, hot air is taken off from the top of the furnace by means of a blower **41** which blows the hot air through pipes **42**, **43** to the opposite ends of said furnace. Each end has a downward extension which is divided into branches, two such branches **44** being shown in this instance. Said branches are provided with widened lower ends **45** which terminate in transverse slots or nozzles inclined inwardly somewhat as shown at **46**, so that the heated air is blown inwardly at an angle of about 10° into the furnace. With this arrangement a substantial screen or seal is provided at each end which prevents the loss of large quantities of heat, by greatly checking the tendency of the hot air to escape at the top of the tunnel openings and this in turn substantially prevents the inward flow of cold air near the bottom of said openings to replace the hot air. Said air seal is very effective for about twenty or twenty-four inches out of a total opening from five to six feet high, and remains decreasingly effective at lower points.

In Fig. 6, which is an end view of the furnace, doors **47** are shown in open position and these doors are not closed except when no ware is traveling through the furnace.

The roof structure may be of any suitable design and is preferably that described and claimed in my Patent 2,156,008, granted April 25, 1939, for Continuous furnace.

While I have shown and described certain embodiments of my invention, it is to be understood that it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as disclosed in the appended claims.

I claim:

1. In a furnace, a preheating chamber having a flue extending longitudinally beneath the same but shut off from open communication therewith by the floor of said chamber, a burning chamber and a cooling chamber, said chambers being arranged in alignment in open communication with each other, means for conveying the ware through said chambers in succession, a plurality of transverse passageways underlying substantially the entire hearth of said burning chamber, and fuel

burners arranged alternately on opposite sides beneath said chamber to direct burning fuel through said passageways and heat said hearth substantially uniformly, said passageways having a roof construction of wide span to afford ample combustion space and being closely spaced in parallel relation to heat the maximum hearth area, a narrow horizontally extending flue on each side of said burning chamber and shut off therefrom by the imperforate side walls of said chamber, a vertically extending flue from the exit end of each of said passageways to the horizontal flue on the corresponding side of said chamber, an additional flue on each side of the furnace extending downwardly from said horizontally extending flues to said longitudinally extending flue beneath said preheating chamber, and means for withdrawing the products of combustion from said longitudinally extending flue.

2. In a furnace, a preheating chamber, a burning chamber and a cooling chamber, communicating with each other, said chambers each having a longitudinal slot in the roof, an overhead conveyer depending through said slots for moving the ware through said chambers in succession, a plurality of transverse tunnels underlying substantially the entire hearth of said burning chamber, fuel burners arranged alternately on opposite sides beneath said chamber, to direct burning fuel through said tunnels and heat said hearth substantially uniformly, a horizontal flue immediately outside of each side wall of said burning chamber, into which the products of combustion from said transverse tunnels are directed, means for automatically controlling the temperature by regulating the fuel supply to the burners on opposite sides nearest the entrance end of said burning chamber and another automatic control for reducing the fuel supply to other burners, whereby regulation of the heat is provided.

3. In a furnace for enameling metal ware including large sheets of steel, a preheating chamber, a burning chamber and a cooling chamber, communicating with each other, means for conveying the ware through said chambers in succession, a plurality of transverse tunnels underlying substantially the entire hearth of said burning chamber, fuel burners arranged alternately on opposite sides beneath said chamber, to direct burning fuel through said tunnels and heat said hearth substantially uniformly, a horizontal flue immediately outside of each side wall of said burning chamber, into which the products of combustion from said transverse tunnels are directed, an automatic mixing valve connected to certain of said alternately arranged fuel burners, a thermocouple mounted near the top of said burning chamber, a temperature measuring instrument to which said thermocouple is connected and additional connections from said instrument to said automatic mixing valve to regulate the combustion of fuel in said tunnels to supply heat to the entrance end of said furnace chamber in accordance with the variable demand occasioned by the entrance of ware in various quantities and thicknesses, and a second thermocouple mounted near the top of said burning chamber in a region more remote from said entrance end for maintaining a higher temperature in said more remote region.

ALBERT J. BOLAND.