July 6, 1937. F. H. LOFTUS 2,085,811

METHOD OF TREATING STEEL INGOTS AND REGENERATIVE SOAKING PIT THEREFOR

Filed Dec. 18, 1935 2 Sheets-Sheet 1

Fig. 1.

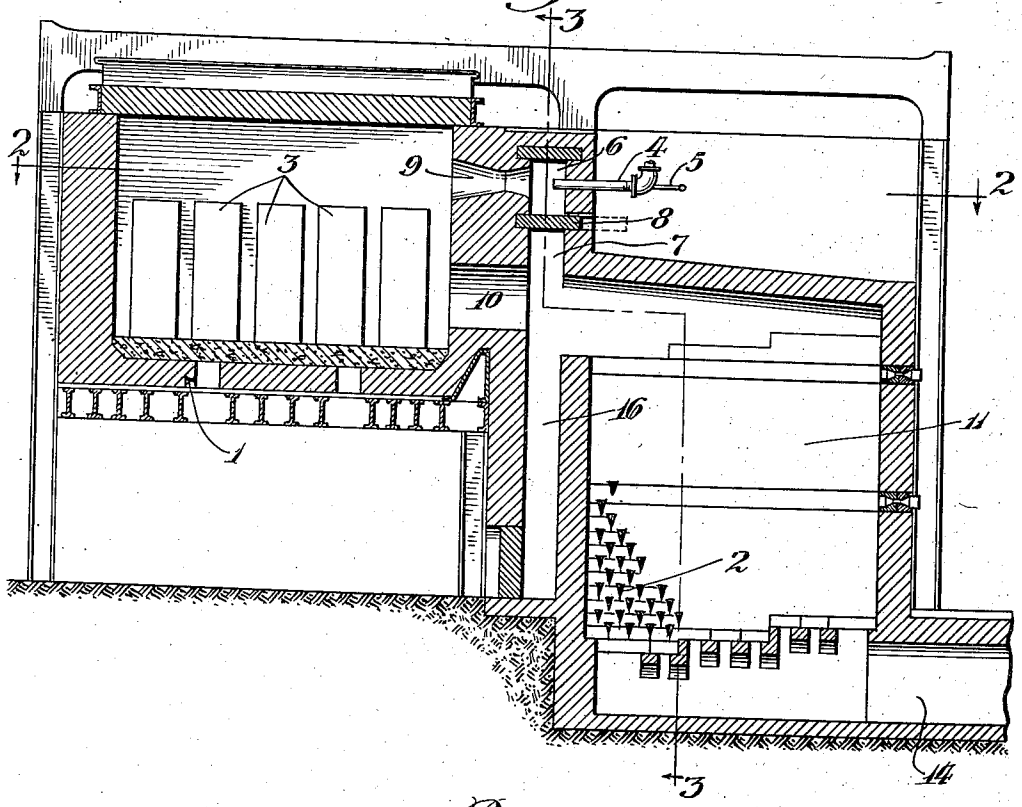

Fig. 2.

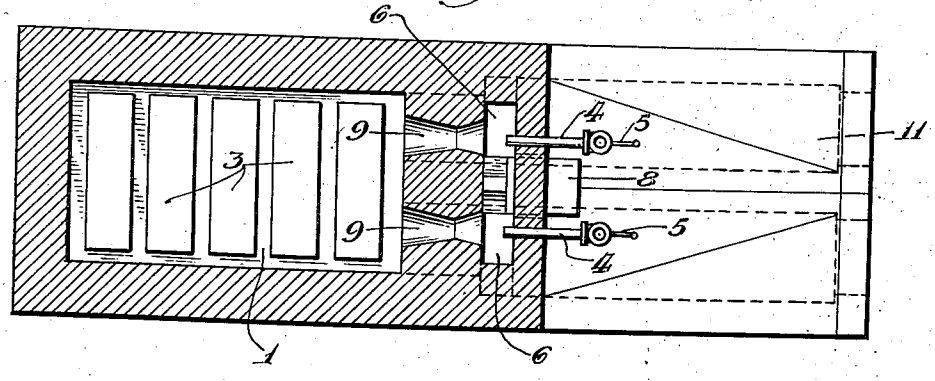

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Fig. 3.

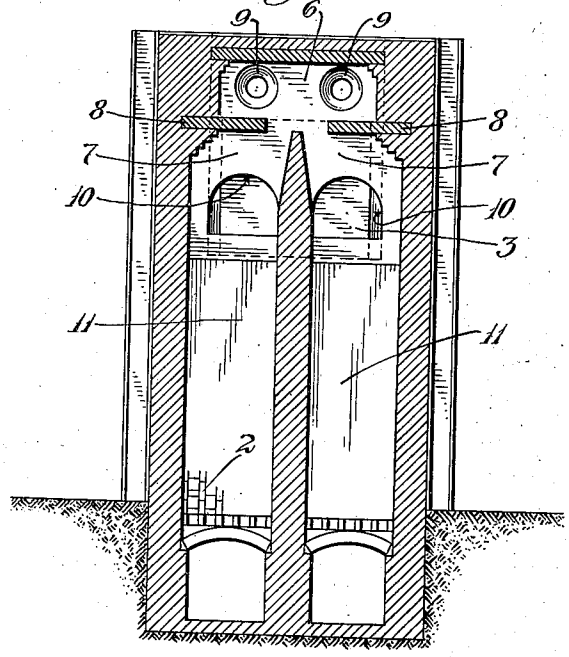
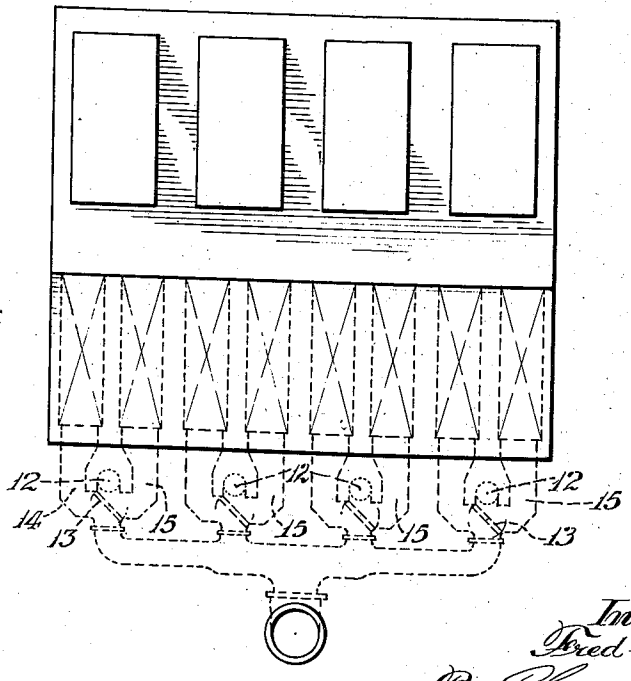


Fig. 4.



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UNITED STATES PATENT OFFICE

2,085,811

METHOD OF TREATING STEEL INGOTS AND REGENERATIVE SOAKING PIT THEREFOR

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8 Claims. (Cl. 263—15)

The present invention relates to a regenerative soaking pit for treating ingots and more particularly to a novel method of heating the steel ingots.

The old type pit furnace consists of a shallow pit hole with ports at opposite ends, each port being connected to a pair of regenerators, one for air and the other for gas, the fuel and air being introduced through a set of reversing valves and flues to each regenerator where it is preheated and unites in the inlet port near the pit hole. Combustion occurs at this point and the flame travels across the pit hole, passing out of the pit through the opposite ports and then through the regenerators to the stack. The cycle is reversed periodically. This set-up and method of treating steel ingots has many objections and disadvantages long recognized in the art among others, excessive flame temperatures, the bane of the industry, are developed transmitting heat to the ingot faster than the steel will absorb it, the result being that the skin or surface of the ingot is fused or washed. It has been attempted to overcome this by burning the fuel with a deficiency of air thereby heating the ingots by means of a hot column of partially burnt gas, but due to the fact that the flame temperature must be held within certain limits, the efficiency of the present method is very low.

Broadly, my invention is primarily for a method and means of heating steel ingots preparatory to rolling, by transmitting heat to the ingots within the heat absorptive capacity of the steel and without fusing or washing the skin or surface of the ingot.

Among the other objects of the present invention is to provide a novel method of heating steel ingots in a regenerative pit furnace by controlling the flame with hot waste gases.

Another object of the present invention is the provision of a novel improvement in regenerative soaking pits for regenerative furnaces.

A further object of this invention is the provision of a novel method of firing the pit in which the invention comprehends a recirculation of the hot waste gases from the pit and thereby efficiently and accurately controlling the flame temperature, while at the same time utilizing a substantial and desired amount of the heat in the waste gases by transferring it to the air for supporting combustion.

A still further object of the present invention is the provision of a novel burner construction. In the preferred form, the invention comprehends a set of aspirating burners so constructed and arranged as to draw preheated air from one regenerator and hot inert waste gas from another source, and such mixture being then drawn into the pit with the fuel supply.

Yet another object of the invention is the provision of a novel regenerative pit furnace in which it is not necessary to reverse the fuel supply.

Another object is the provision of a regenerative pit furnace construction in which the regenerators are positioned on one side of the pit only, thereby saving floor space and making possible the installation of greater capacities in the space occupied.

Still another object of the invention is the provision of a regenerative pit furnace in which there is provision between the pit and regenerator for the columns and disposal of slag overflowing from the pit proper, thereby preventing the slag from entering the checker work.

Further objects are to provide a construction of maximum simplicity, efficiency, economy and ease of assembly and operation, and such further objects, advantages and capabilities as will later more fully appear and are inherently possessed thereby.

The invention further resides in the construction, combination and arrangement of parts illustrated in the accompanying drawings, and while I have shown therein a preferred embodiment, it is to be understood that the same is susceptible of modification and change, and comprehends other details, arrangements of parts, features and constructions without departing from the spirit of the invention.

In the drawings:

Fig. 1 is a longitudinal view in vertical cross section through the novel furnace construction;

Fig. 2 is a view in a horizontal cross section taken on the line 2—2 of Fig. 1;

Fig. 3 is a view in vertical cross section taken on the irregular line 3—3 of Fig. 1;

Fig. 4 is a diagrammatic plan view of a four hole battery.

Referring more particularly to the embodiment disclosed in the drawings, the soaking pit is designated generally as 1, and the checker work or regenerator chambers as 2. The pit 1 is of sufficient size to receive the necessary ingots 3 and relatively deep to permit the fuel to be burnt over and above the top of the ingots being heated since the heat can be applied over the top of the ingots much more safely than across the bottom or butts thereof without the possibility of damaging the salable portion of the ingots. Ordinarily, the tops of the ingots are of little value, due to defects formed during the process of solidification, and

therefore, the tops must be sheared or cropped from the semi-finished product.

In order to heat the ingots to the desired temperature, the pit is fired by means of a plurality of aspirating burners 4 utilizing the potential energy of the fuel gas in combination with the energy from a source of low pressure, primarily air or steam from the pipe or line 5. The energy from the source or line 5 passing into a burner 4 and thence into the mixing chamber 6, is utilized to aspirate a mixture of preheated combustion air and flue or waste gas from the passage or port 7 intermediate the pit 1 and regenerators 2. Hot waste gases from the pit are recirculated in order to control the flame temperature and at the same time utilize a substantial amount of heat in the waste gases by transferring it to the combustion air.

Excessive flame temperatures, such as would result by utilizing combustion air, preheated to approximately 2000° F., normally cannot be applied when heating the ingots. Therefore, in order to reduce the quantity of fuel consumed by salvaging the maximum quantity of heat from the waste gas and returning it to the system through the medium of the combustion air, it is essential that the air gas mixture be diluted in order to reduce the flame temperature to the proper working limit. This is accomplished by recirculating some of the hot waste gases issuing from the pit 1 and port 7. For regulating the amount of waste gases for this purpose I provide the damper 8.

The diluted burning fuel column discharged from the burner blocks 4 passes through the firing port 9 and thence across the pit over the top of the ingots, thence down toward the bottom of the pit, thence in a reverse direction and discharged through the outlet port 10 positioned in the same wall as the firing port, at or near the bottom of the pit by means of the draft exerted by a stack or the like. The length and path of travel of the gas is controlled largely by the intensity of the draft applied. The waste gases not used to dilute the air gas mixture, then pass to the stack through one of the flues 11 of the checker chambers while the combustion air is preheated and supplied through the flue 11 in the other checker chamber.

Each battery is preferably provided with an air valve 12 having a valve member 13 regulating flues 14 and 15, whereby the checker chambers or regenerators alternately serve air and waste gas through these ports. This is accomplished by a reversal of the valve member whereby an operation of this valve simultaneously shifts the air supply and the source of draft from one chamber or regenerator to the other. The air valve through which the regenerator receives air is so regulated as to establish a negative pressure at the top of the checker work of approximately the same intensity as the negative pressure existing at the top of the checker work or regenerator receiving the waste gases. The pressure at these points is less than the pressure at the bottom of the pit and greater than the pressure produced by the aspirating burners 4.

Under these pressure conditions, waste gas issues from both waste gas or outlet ports 10 at the bottom of the pit, thereby setting up a complete circulation over and around both rows of ingots 3. After the waste gases leave the outlet ports, a portion of the total quantity of waste gases is aspirated with the combustion air through the restricted port 7 regulated by the damper 8 positioned immediately below the aspirating burners, and adapted to adjust the ratio of the waste gas to the combustion air for the purpose of regulating the flame temperature. This flow is caused by the fact that the pressure at or near the exit of the outlet port is greater than the pressure in the chamber at the entrance to the burners. The balance of the waste gases passes through the checker chamber serving the waste gases and thence to the stack through the flue 14 or 15.

In the novel and preferred construction, the burners 4 are fired continuously and it is, therefore, not necessary to reverse the fuel supply to shut it off during reversal as the length of time required to reverse will be very short. The fixed burner and port construction are so designed and constructed as to burn fuel only and are not utilized as a passage for waste gases leaving the pit furnace.

In order to eliminate the possibility of slag from the pit over-flowing the level of the waste gas ports and entering the checker work there is provided a pocket 16 between the pit and checker work for the purpose of receiving the slag and from which it may be removed through a suitable opening provided therefor.

From the above description and the disclosure in the drawings, it will be readily appreciated that the invention comprehends a novel method of treating the steel ingots, and in the novel means for carrying out such method.

Having thus described the invention, I claim:

1. The improvement in the heating of steel ingots in a soaking pit of a regenerative furnace, which comprises controlling the flame temperature by recirculating a part of the hot waste gases directly from the pit into the preheated incoming combustion supporting air supply.

2. The improvement in heating of steel ingots in a soaking pit of a regenerative furnace, which comprises recirculating and directing a part of the hot waste gases passing from the pit directly into the preheated incoming air supply for supporting combustion and mixing these waste gases which have previously passed over the ingots, with the preheated combustion supporting air for controlling the flame temperature.

3. The method of regenerative furnace operation which consists in drawing from the soaking pit, hot waste gases which have previously passed over the ingots, and delivering these waste gases direct from the pit into the preheated air supply whereby to dilute this air and control the flame temperature.

4. In a regenerative pit furnace for heating steel ingots, the combination of a soaking pit, means for firing the pit, and means for recirculating hot waste gases issuing from the pit and directly mixing these waste gases with the preheated combustion supporting air for controlling the flame temperature.

5. In a regenerative pit furnace for heating steel ingots, the combination of a soaking pit, means for firing the pit, and means for recirculating a desired quantity of the hot waste gases passing directly from the pit into the preheated incoming air supply and mixing these waste gases with the preheated air for supporting combustion and for controlling the flame temperature, and also transferring a substantial amount of the heat in the waste gases to the combustion supporting air.

6. In a regenerative pit furnace for heating steel ingots, the combination of a soaking pit, means for firing the pit, means for recirculating hot waste gases as they are drawn from the bot-

tom of the pit directly into the preheated air supply for diluting the preheated air for supporting combustion and thereby controlling the flame temperature and additionally preheating the combustion supporting air, and a damper for regulating the proportion of waste gases to that of the combustion air.

7. In a regenerative pit furnace, a soaking pit for receiving steel ingots, aspirating burners positioned to discharge a diluted burning fuel column over the top of the ingots, regenerators for supplying preheated air to the burners and for discharging waste gases issuing from the pit, and means for drawing preheated air from one regenerator and a desired quantity of the hot inert waste gas issuing directly from the pit and adding such mixture to the fuel supply to dilute the fuel mixture in order to reduce or control the flame temperature.

8. In a regenerative pit furnace, a soaking pit for receiving steel ingots, aspirating burners positioned to discharge a diluted burning fuel column over the top of the ingots, regenerators for supplying preheated air to the burners and for discharging waste gases issuing from the pit, and means for regulating the pressure at the top of the regenerator supplying preheated air so as to control the flame temperature by increasing or decreasing the amount of inert waste gas being utilized with the preheated air.

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