Jan. 12, 1960 R. G. RENNINGER ET AL 2,920,692

METHOD OF FIRING OPEN HEARTH FURNACES

Filed March 2, 1955

FIG. 1.

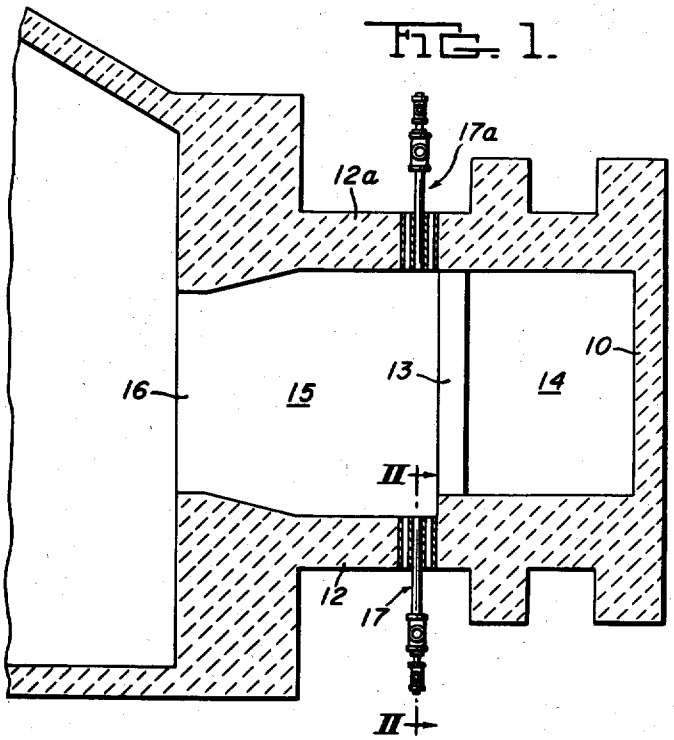


FIG. 2.

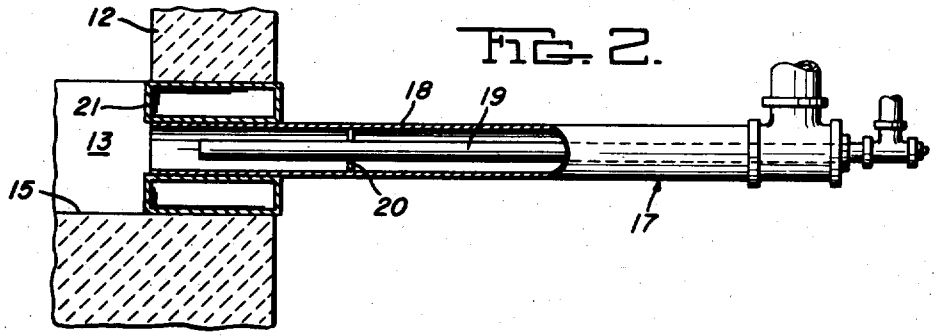
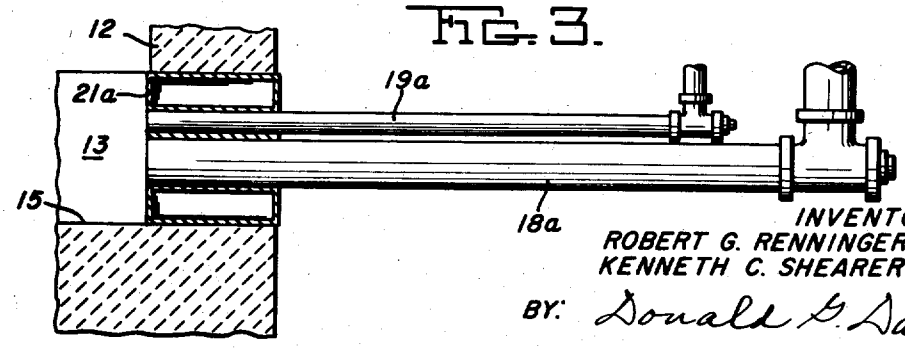


FIG. 3.



INVENTORS:
ROBERT G. RENNINGER and
KENNETH C. SHEARER,

BY: Donald G. Dalton
their Attorney.

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METHOD OF FIRING OPEN HEARTH FURNACES

Robert G. Renninger, Monongahela, and Kenneth C. Shearer, Belle Vernon, Pa., assignors to United States Steel Corporation, a corporation of New Jersey

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1 Claim. (Cl. 158—117.5)

This invention relates to an improved method of firing side-fired open hearth furnaces.

A conventional side-fired open hearth has burners for introducing gaseous fuel mounted in both side walls between the air uptake and the furnace port, the structure being duplicated at each end. Fuel from these burners enters the stream of preheated combustion air while flowing at right angles to the direction of flow of the latter. Conventional burners are limited in the rate at which they can introduce fuel efficiently to this type of furnace. For example, using natural gas as fuel in a side-fired open hearth of 115 tons capacity and bath dimensions of 34 by 15 feet, we find the maximum efficient rate of fuel input is about 45 million B.t.u. per hour. Higher rates produce a long flame which has poor melting qualities and in which combustion is not completed over the furnace bath. The foregoing maximum rate usually is sufficient once the furnace attains its operating temperature, but unduly low during the melt-down period starting with a cold furnace.

An object of the present invention is to provide an improved burner arrangement and method of firing which enable the fuel input rate to be increased materially over conventional arrangements and methods and yet afford efficient operation.

A further object is to provide an improved burner arrangement which embodies a low velocity fuel inlet and a high velocity fuel inlet in each burner, said low velocity inlet being constructed to deliver sufficient fuel by itself for efficient operation after the furnace attains its maximum temperature, and said high velocity inlet being adapted to deliver additional fuel when the furnace is heating up.

In accomplishing these and other objects of the invention, we have provided improved details of structure, preferred forms of which are shown in the accompanying drawing, in which:

Figure 1 is a somewhat diagrammatic horizontal sectional view of one end portion of an open hearth equipped with a burner arrangement for practicing the method of our invention;

Figure 2 is a vertical sectional view on a larger scale on line II—II of Figure 1; and

Figure 3 is a view similar to Figure 2, but showing a modification.

Figure 1 shows a portion of a side-fired reversible open hearth which includes an end wall **10**, opposed side walls **12** and **12***a* and a bridge wall **13**. An air uptake **14** is situated between the bridge wall and end wall and is adapted to introduce preheated air which flows in a direction parallel with the length of the furnace. When the furnace is fired from the other end, this uptake becomes a downtake for waste gases in accordance with usual practices. The side walls inwardly of the bridge wall define a throat **15** and a port **16**, beyond which the bath is located. The side walls **12** and **12***a* contain burners **17** and **17***a* which are located immediately inwardly of the bridge wall. The same structure is duplicated at the other end of the furnace. Apart from the burner arrangement, the furnace construction is well known and hence is not described in detail.

Figure 2 shows the burner **17** in more detail, the other burner **17***a* being similar. Burner **17** comprises a low velocity gas inlet pipe **18** and a concentric high velocity gas inlet pipe **19** positioned inside the former pipe by a spider **20**. The pipe **17** is mounted in a conventional water cooled block **21** set in the side wall **12**. Figure 3 shows a modification in which the burner comprises low and high velocity gas inlet pipes **18***a* and **19***a* outside each other, but both mounted in a common water cooled block **21***a*. In both instances the two gas inlet pipes discharge streams of combustible gases at right angles to the direction of flow of preheated combustion air from the uptake **14**.

According to the method of our invention, when the open hearth is heating up, for example during a melt-down period, combustible gas is introduced through both the low and high velocity gas inlet pipes of both burners **17** and **17***a* at the end of the furnace from which it is currently being fired. In the furnace throat **15** this combustible gas mixes intimately with preheated air from the uptake **14** and burns completely over the charge with a relatively short sharp flame. Once the furnace attains its maximum temperature, the high velocity gas is cut off, and the low velocity gas alone burns with a long uniform flame to heat the furnace and its charge. If at any time subsequently more heat is needed, the high velocity gas again can be turned on.

As a specific example, when the aforementioned open hearth of 115 tons capacity and bath dimensions of 34 by 15 feet is fired in accordance with our invention, for all flows below 45,000 cubic feet per hour of natural gas (45 million B.t.u.) and where a long uniform flame is desired, the low velocity inlets alone are used. For greater flows up to 80,000 cubic feet per hour of natural gas (80 million B.t.u.) or where a short sharp flame is desired, the high velocity inlets are used in conjunction with the low velocity inlets. The low velocity inlet pipe has a diameter of 3 to 4 inches and the high veloicty pipe a diameter of 1½ to 2 inches. The velocities we have used are as follows:

	Minimum, ft./min.	Maximum, ft./min.
Low Velocity Pipe	4,500 to 8,000	8,000 to 14,000.
High Velocity Pipe	14,000	48,000.

In this particular furnace by increasing the fuel input rate to as high as 80 million B.t.u. per hour divided between the two burners, we are able to shorten both the melt-down period, as well as the time needed to complete a heat.

We ascribe the benefits attained over a single gas inlet at each burner to a more complete mixing of the gas and air within the furnace throat. The two gas streams issuing from each burner at different velocities and at right angles to the direction of flow of the air mix more thoroughly than is possible with other arrangements of which we are aware.

While we have shown and described certain preferred embodiments of our invention, it is apparent that other modifications may arise. Therefore, we do not wish to be limited to the disclosure set forth but only by the scope of the appended claim.

We claim:

A method of firing a side-fired open hearth furnace containing a charge comprising introducing to one end of the furnace a stream of preheated combustion air

which flows in a direction parallel to the length of the furnace, introducing to said air stream parallel streams of high velocity and low velocity combustible gas which touch each other substantially at the point they enter said air stream, the direction of flow of both said gas streams being substantially at right angles to said air stream at said point, thereby intimately mixing the air and gas adjacent the points where the gas is introduced before they reach the charge, burning the gas over the charge with a short sharp flame until the charge is melted down and the furnace attains its maximum temperature, thereafter cutting off said high velocity gas stream and

burning gas from said low velocity stream over the charge with a long uniform flame.

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