June 25, 1929. G. L. DANFORTH, JR 1,718,732

METHOD OF FURNACE OPERATION

Filed Oct. 8, 1921

Fig. 1.

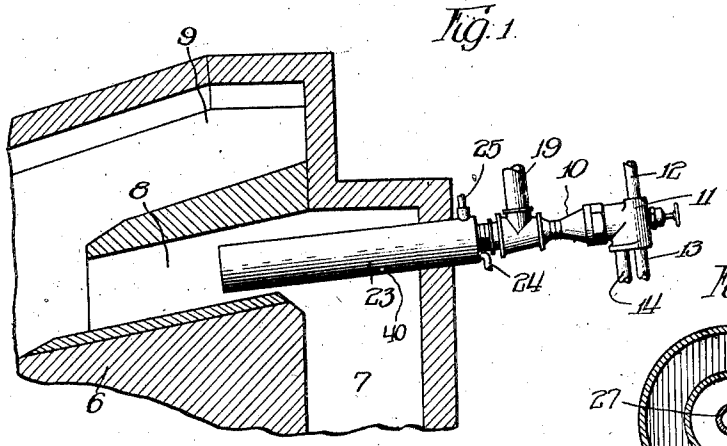


Fig. 6.

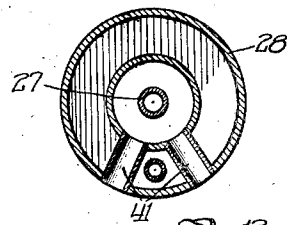


Fig. 2.

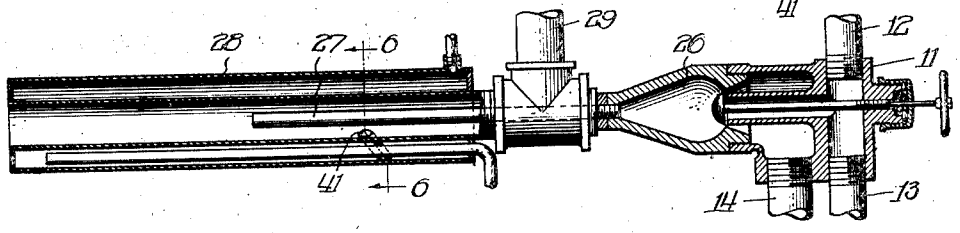


Fig. 3.

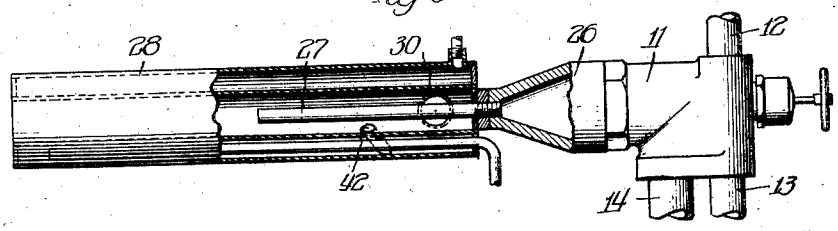


Fig. 4.

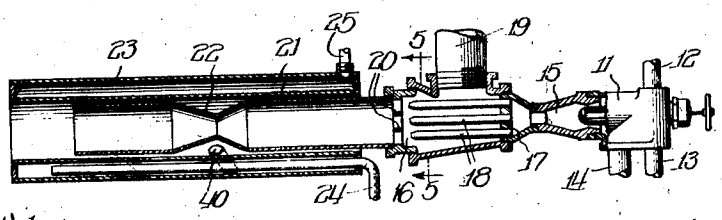
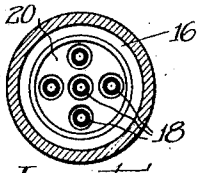


Fig. 5.



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UNITED STATES PATENT OFFICE.

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METHOD OF FURNACE OPERATION.

Application filed October 8, 1921. Serial No. 506,353.

This invention relates to a new and improved method of furnace operation.

In open hearth and similar furnaces, a large variety of fuels are used and methods of operation are practiced at present. Some furnaces have been operated solely with a liquid such as tar or heavy oil as a fuel and others solely with coke-oven gas. These fuels each have disadvantages which may be eliminated by combining the liquid and gaseous fuels.

In the operation of a furnace with tar as a fuel, the checkerwork is rapidly clogged up by oxide of iron carried thereto by the outgoing gases. The tar flame also has a very high luminosity which is hard upon the brick work of the furnace. Coke-oven gas is of comparatively low specific gravity, having usually been debenzolized. The flame therefrom has no luminosity and cannot be properly seen by the furnace operator. Further difficulties with coke-oven gas lie in the fact that, due to its low specific gravity, it passes through the furnace with low velocity and tends to rise to the roof and overheat and burn away the roof while at the same time, it fails to adequately operate upon the furnace charge.

Attempts have heretofore been made to correct the inherent difficulties of the use of these two fuels by a combination thereof. The gas has been introduced below a jet of vaporized liquid fuel with the intention that the vaporized liquid shall prevent the gas from rising and shall so intermingle as to provide the desirable luminosity of flame.

In actual practice, the flow of gas is only partially covered by the vaporized liquid and a considerable portion of the gas rises. Further, since there is no complete intermixture of the gas and vapor, the flame is not luminous throughout and hence it is impossible to adequately direct its operation.

It is an object of the present invention to provide a method of operation whereby gas and liquid fuels may be thoroughly intermingled.

It is also an object to utilize the high velocity of the atomized or vaporized fuel to give greater velocity and better direction to the flow of the combined liquid and gaseous fuels.

Broadly, my invention comprises the intermixture of the atomized liquid fuel and the gaseous fuel in a mixing chamber and thereafter discharging the mixture into the furnace and there supplying the air necessary for combustion. In the preferred form of the device, the liquid fuel is atomized by air or steam under pressure and the stream of atomized fuel is directed into a restricted space to which the gaseous fuel is led. The velocity of the atomized or vaporized stream has an aspiratory action upon the gas stream and serves not only to move the gas but thoroughly to intermingle the vapor and the gas.

I have illustrated certain preferred embodiments of my invention in the accompanying drawings, in which—

Figure 1 is a fragmentary view showing one form of burner adapted for carrying out my method, the burner being introduced into the gas port of a furnace;

Figure 2 is a longitudinal section of another form of burner adapted for carrying out my invention;

Figure 3 is a view showing a modified form of burner;

Figure 4 is a view showing in section the form of burner shown in Figure 1;

Figure 5 is a section taken upon line 5—5 of Figure 4, the section being upon a somewhat enlarged scale; and

Figure 6 is a section taken upon line 6—6 of Figure 2, the section being upon a somewhat enlarged scale.

Referring now to the drawings, and first considering the form shown in Figures 1, 4 and 5, the furnace 6 is provided with the uptake 7 and port 8. Above the port 8 is the auxiliary port 9. The fuel burner 10 is introduced through the rear wall of the uptake 7 into the port 8. This burner is best shown in Figures 4 and 5, comprising the atomizer 11 to which lead the fuel pipes 12 and 13 and the steam or compressed air pipe 14.

The atomizer chamber 15 is connected to a mixing chamber 16 by means of a discharge passage of Venturi section. Interposed in the mixing chamber is the wall 17 from which

extend five pipes 18. These pipes lead beyond the gas entrance pipe 19. The exit end of the mixing chamber 16 is provided with a spider 20 which further serves to aid in mixing the gas and vaporized fuel. Beyond the mixing chamber is the discharge barrel 21 which is necked down at 22 to a Venturi section to further facilitate mixture of the gas and vapor. Surrounding the barrel 21 is the water-cooling jacket 23 having the inlet pipe 24 and discharge pipe 25. This jacket 23 is spaced from the discharge barrel 21 providing a small air passage therebetween.

The ports 40 extend diagonally through the water jacket 23 upon either side of the cooling water pipe 24 and are adapted to permit a limited amount of heated air to be drawn into the burner by induction.

In the form of device shown in Figure 2, the atomizer 26 discharges through a single pipe 27 into the water-cooled barrel 28. Gas is introduced through a pipe 29 and the gas stream entirely surrounds the pipe 27. The burner shown in Figure 3 is similar to that shown in Figure 2 with the exception that the gas instead of being introduced through a pipe between the air jacket and atomizer is introduced through a lateral opening 30 formed in the side of the water jacket. These two forms of the device are also provided with the ports 41 and 42 respectively adapted to permit the induction of a limited amount of heated air.

The form of device as shown in Figures 1, 4 and 5 is operated by directing the flow of either oil or tar through the pipes 12 or 13, this oil or tar being directed in a disk-like stream by the atomizer 11. This stream is intersected by the steam or air under pressure, which is introduced through the pipe 14, and is thus atomized.

The atomized fuel stream is divided into five streams by the pipes 18 and these five streams serve by their aspiratory effect to draw the gas down through the pipe 19. The jets from the pipes passing through the restricted orifices in the spider 20 cause a mixture of the atomized fuel and gas. This mixture is further facilitated by the greater velocity and smaller stream area caused by the Venturi section 22. The barrel 21 is not itself directly water-cooled and since the vaporized fuel does not engage the water-cooled surface, there is no tendency for the vapor to condense.

A limited amount of heated air is induced through the ports 40 and serves to raise the temperature of the mixture and to counteract any tendency for deposition of drops of the liquid fuel. It is not intended to introduce sufficient air in this manner to provide for combustion although some slight preliminary combustion may take place.

The forms of device shown in Figures 2 and 3 are operated in a similar manner. The jet of vaporized fuel draws with it the gas and intimately mixes with that gas in the water-cooled barrel so that the discharge from the end of the burner is an intimate mixture of gas and atomized liquid fuel. This mixture gives a flame which is readily directed and which is luminous throughout so that the operation is facilitated. The mixture is not so light as to tend to rise to the roof but adequately operates upon the furnace charge. A certain amount of air is induced through ports 41 and 42 for purposes similar to the introduction of air through ports 40 in the form of device of Figure 1.

As has been stated, the atomization of the liquid fuel is preferably caused by air or steam under pressure. This air, or the air carried with the steam, will be materially less than the amount necessary for combustion and will be at a temperature such that the fuel mixture will not be raised to its ignition point thereby. The additional air induced through the small lateral ports will aid in maintaining the fuel vaporized but is not sufficient for combustion although in some cases, a relatively small amount of preliminary combustion may take place.

My method is capable of a number of variations to meet different conditions and it is my intention to cover all modifications coming within the spirit and scope of the appended claims.

I claim:

1. The method of furnace operation comprising mixing a liquid fuel and a gaseous fuel by atomizing the liquid fuel and discharging the atomized fuel in a stream surrounded by the gaseous fuel in a restricted space whereby the liquid fuel has an aspiratory action upon the gaseous fuel and discharging the mixture from the restricted space into the furnace and there supplying the air necessary for combustion.

2. The method of furnace operation comprising the atomization of a relatively heavy liquid fuel and the discharge of the atomized fuel through a relatively restricted space to which coke-oven gas is supplied, the liquid fuel having an aspiratory action upon the gas and intimately mixing therewith, and discharging said mixture into the furnace and there supplying the air necessary for combustion.

3. The process of operating a reversing open hearth furnace consisting of supplying air to the mixing port, supplying liquid fuel under pressure to a point adjacent said mixing port, supplying a combustible gas to said point, mixing the gas and liquid fuel in a confined space, and spraying and directing the mixture into said mixing port.

4. The process of operating a furnace consisting of supplying preheated air to the mixing port, supplying liquid fuel under pressure to a point adjacent said mixing port,

supplying a combustible gas to said point, mixing the gas and liquid fuel in a confined space, and spraying and directing the mixture into said furnace.

5. The process of operating a furnace consisting of supplying air to the mixing port, supplying fuel under pressure to a point adjacent said mixing port, supplying a combustible gas to said point, mixing the gas and fuel in a confined space, and spraying and directing the mixture into said mixing port.

Signed at Chicago, Illinois, this 29th day of September, 1921.

GEORGE L. DANFORTH, JR.