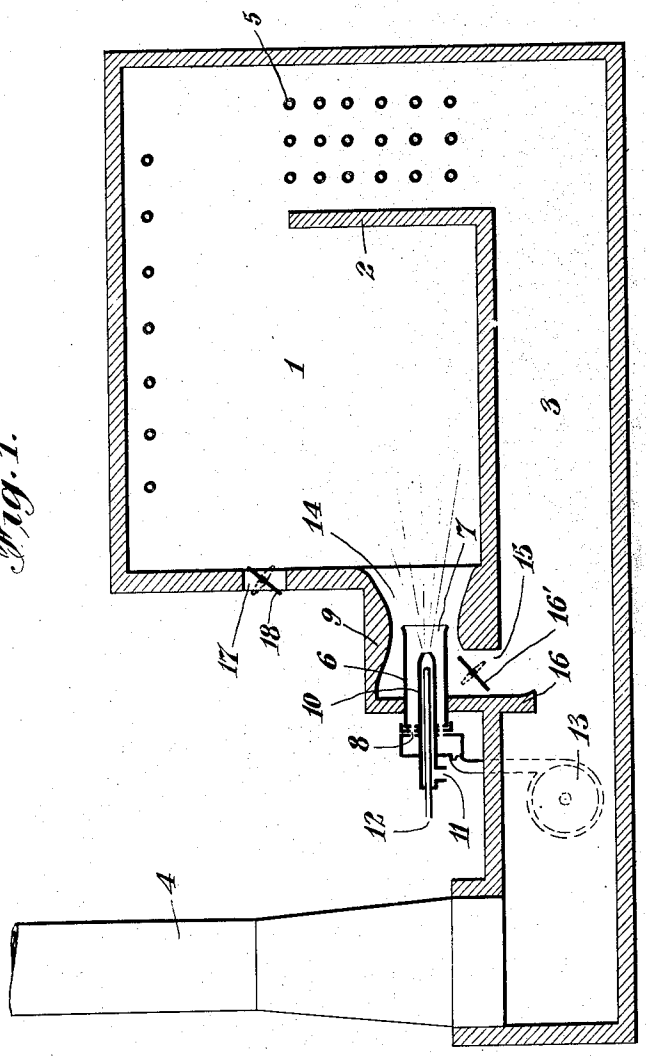
Oct. 1, 1929. L. DE FLOREZ 1,729,763

APPARATUS AND METHOD OF FUEL BURNING

Filed Nov. 2, 1925 2 Sheets-Sheet 1

Fig. 1.



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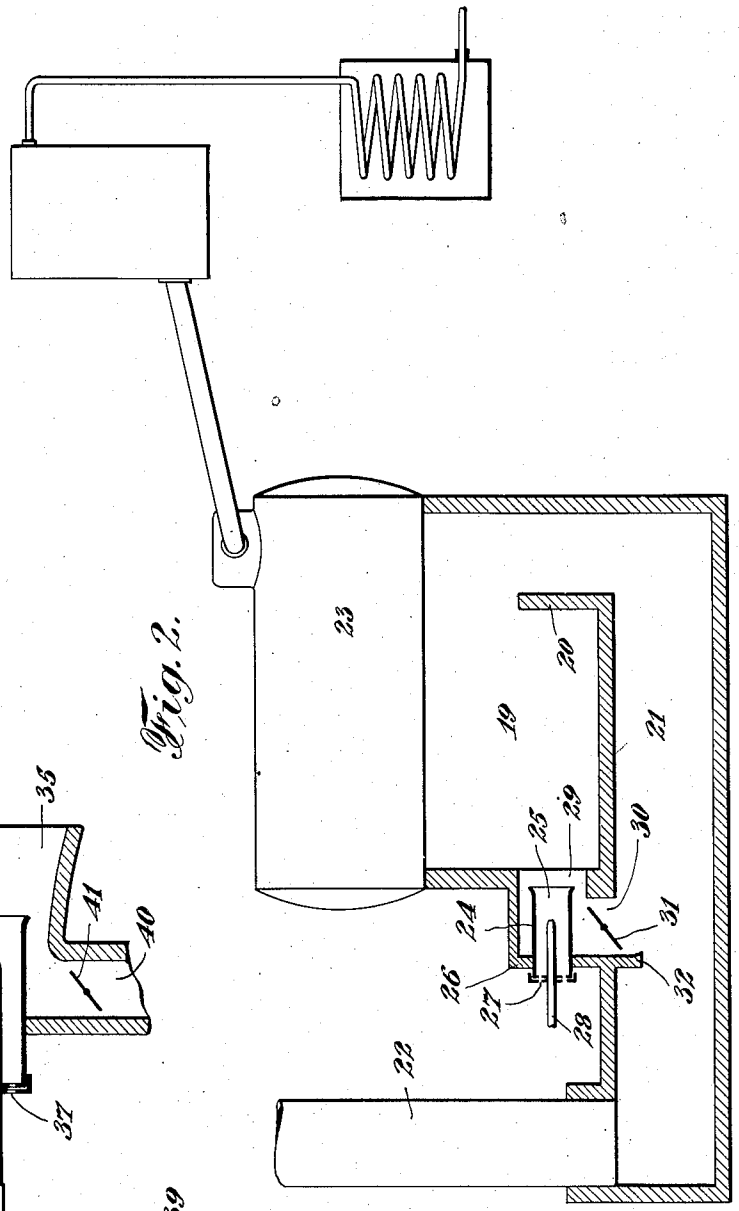


Fig. 2.

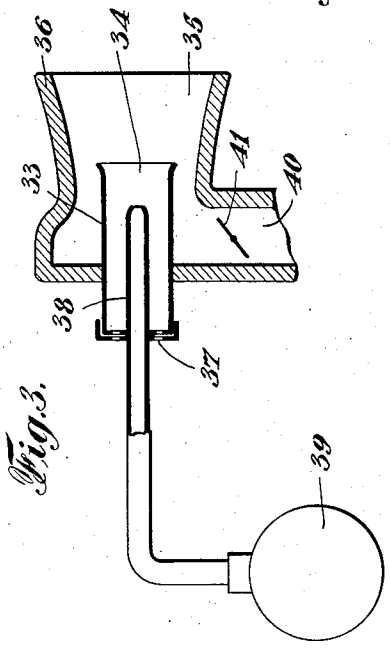


Fig. 3.

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UNITED STATES PATENT OFFICE

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APPARATUS AND METHOD OF FUEL BURNING

Application filed November 2, 1925. Serial No. 66,335.

This invention relates to improvements in the art of burning fuel in a furnace and particularly in a furnace of the type in which the fuel is supplied by a jet.

It is well known that for the maximum economy fuel should be burned with just sufficient air for proper combustion, but in practice it is often found that burning fuel under such conditions creates fire box temperatures which are too high for practical operation inasmuch as they cause a rapid deterioration of brick settings and the heating elements.

In order to permit the combustion of the fuel under the most efficient conditions, and at the same time reduce the fire box temperature to a practical maximum and to attain other advantages, such as increasing the velocity of the heated gases by the heating surfaces to effect a greater transfer of heat, it has been the practice to introduce a portion of the spent products of combustion or flue gases, either from the furnace itself, or from other suitable sources, whereby the temperature of combustion is moderated and it is thus made possible to control to some measure the temperature in the combustion chamber.

The recirculation of flue gases has usually been accomplished by forcing the flue gases back into the fire box at some suitable point by means of a mechanical blower. This method, however, involves the handling of the flue gases by the blower at a comparatively high temperature so that the blower is subjected to unfavorable operating conditions resulting in rapid deterioration and consequently high cost of maintenance.

The object of my invention is to accomplish the introduction, by utilizing the energy of a jet such as that formed by the fuel burner, irrespective of the particular form of burner used, of gases extraneous to the jet such as flue gases or other suitable diluting medium into the fire box of the furnace. For instance, the invention is applicable where a fuel oil burner of the steam atomizing type, either with or without forced draft, is used, or where a gas burner with or without a steam jet and forced draft is used, or where a powdered fuel burner in which the powdered fuel is served to the burner by a stream of air or other suitable vehicle is used.

The jet of incandescent gases injected into the furnace is composed of fuel, air and in some instances steam, all of which or part of which may be supplied to the burner under pressure. Irrespective of the particular type of burner used in the application of my invention, the energy available to aspirate the flue gases from a suitable source and inject them into the furnace is derived from the initial pressure under which the various elements required for combustion or to assist combustion are fed to the burner, and also to the velocity head generated by the expansion of the gases and vapors incident to combustion which velocity head is used to overcome the difference in pressure between the source of supply of the flue gases and that existing in the fire box.

For the purpose of simplifying the disclosure of the invention I will refer to the various combinations of elements discharged from the burners of whatever type they may be into the combustion chamber as the output of the burners. I will, however, for the purpose of illustration, describe the application of the invention to the various types of burners to which I have hereinbefore r ferred.

In the drawings:

Figure 1 is a vertical sectional view of a furnace in which tubular heating elements are employed, the burner in this instance being of the steam atomizing type;

Figure 2 is a similar view showing the application of the invention where fuel oil is injected without the use of steam to produce combustion in the fire box of a furnace used in connection with a shell still; and

Figure 3 is a fragmental sectional view showing the application of the invention to a powdered coal burner.

Referring now particularly to the construction shown in Figure 1, the furnace includes a fire box 1, having the usual bridge wall 2 and flue 3, which leads to a stack 4, the heating elements 5 being arranged in the path of the products of combustion as they pass from the fire box to the flue.

The burner here illustrated includes an outer tube 6 which is made preferably of heat resisting material, has an open end 7 and variable air inlet ports 8, the tube being mounted in a housing 9. Mounted within the outer tube 6 is a steam tube 10, opening toward the open end 7 of the outer tube 6 and receiving its steam from a source of supply through a steam inlet 11. An oil supply tube 12 is arranged within the steam tube 10 and opens toward the end of the same, terminating preferably short of the open end of the steam tube.

If desired, the air inlet ports 8 may be supplied with air under pressure from a suitable source, such as a blower 13.

The burner extends into a chamber 14 in the housing 9 which chamber is preferably in the form of a Venturi tube opening into the combustion chamber of the furnace. The open end of the outer tube 6 which tube extends beyond the steam tube 10, is located preferably at the throat of the Venturi tube.

Communication is established between the chamber 14 and the flue 3 by means of a duct 15, the flue 3 being provided with a baffle 16 adjacent the duct. This duct 15 communicates with the chamber 14 at a point preferably to the rear of the open end of the tube 6, and is provided with a damper 16′ by means of which the effective area of the duct may be varied.

The combustion chamber of the furnace may also be provided with an air inlet opening 17 having a damper 18 therein, for controlling the effective area of the duct.

In operation the effect of the jet caused by the burner is to create a reduced pressure in the rear of the chamber 14 and draw a portion of the flue gases therein from the duct 3. These flue gases are then forced into the fire box of the furnace by the jet.

The magnitude of the jet will be dependent upon the amount of fuel burned, since the air requirements and steam requirements will be substantially regulated for good combustion in accordance with the amount of fuel handled, and the quantity of flue gases will also be substantially proportional to the amount of fuel burned. Consequently for a given opening of the damper 16′ a substantially constant proportion of flue gases will be admitted to the furnace, the proportion, however, bearing a definite relation to the output of the burner and varying with the output of the burner. The variation of the area of the duct 15 varies the ratio of the flue gases to the output of the burner.

The auxiliary air port 17 which is controlled by the damper 18 may be used should it be found desirable to operate the burner with an insufficiency of air, the desired auxiliary air being admitted through this port.

The construction illustrated in Figure 2 includes a furnace having a fire box 19, a bridge wall 20, and a flue 21, leading to a stack 22. A shell still 23 is supported above the fire box of the furnace. In this form the tube 24 having an open inner end 25 is mounted in a housing 26 and is provided with variable air inlet ports 27 which may or may not be supplied with air under pressure. An oil injection tube 28 extends into the tube 24 and terminates short of the open end of this tube. The housing 26 is provided with a chamber 29 in which the burner is located, which chamber opens into the fire box of the furnace and as illustrated is preferably cylindrical in form, communication being established between the chamber and the flue 21 by a duct 30 having a control damper 31 therein for varying the effective area of the duct, there being provided a baffle 32 adjacent the duct which extends into the flue 21. In this form of the invention, where the oil is fed through the pipe 28 under pressure without the use of steam, the resultant jet caused by the burner creates a reduced pressure in the rear of the chamber 29 and draws a portion of the flue gases therein through the duct 30, which flue gases are then forced into the fire box by the jet.

When a powdered coal burner such as illustrated in Figure 3 is used, the operation of injecting the portion of the flue gases into the fire box of the furnace is substantially the same. This burner includes a tube 33 having an open end 34, opening into a chamber 35 of the housing 36, and having variable air inlet ports 37 which may either be supplied with air under atmospheric or superatmospheric pressure. The powdered coal injector 38 which is connected to a suitable pressure source 39 extends into the tube 33 and discharges therein at a point to the rear of the open end of the tube. The chamber 35 has communication with the flue of the furnace through a duct 40 having a control damper 41 therein which duct preferably communicates with the chamber 35 to the rear of the open end of the tube 34.

Of course when a gas burner is used the action of the jet in injecting the extraneous gases into the furnace is similar to that when the other types of burners are used.

I have illustrated three types of burners and have illustrated the chambers into which the burners extend in the forms of cylinders and a Venturi tube, but it is to be understood that either the cylindrical form or the Venturi tube form may be used with any of the burners, and furthermore, that the burners may be so disposed as to discharge directly into the fire box of the furnace, communication being established with the flue so that the pressure created by the jet will draw the requisite amount of flue gases from the flue and inject them into the fire box.

I do not wish to be limited to the particular embodiment of the invention which I have

shown, for it is obvious that many details of construction of the apparatus may be made without departing from the scope of the claims.

What I claim is:

1. In the heating of a furnace, the method of effecting a recirculation of a portion of the flue gases which comprises passing a jet of burning fuel and the products of combustion thereof into the furnace, permitting a predetermined expansion of the gaseous combustion products and utilizing the kinetic energy of such expansion to draw flue gases into the furnace, thereby maintaining the temperature of the furnace relatively low.

2. The method of heating a furnace chamber which comprises injecting thereinto a jet of fuel, forming a high temperature flame by supplying substantially the amount of air required for complete combustion of said fuel, permitting the flame and the gaseous products of combustion to expand, thereby creating kinetic energy, and employing such energy to effect the introduction of hot flue gases to mix with the combustion products, whereby the temperature of the furnace chamber is kept relatively low by such admixture.

3. In the heating of a furnace, the method of effecting a recirculation of a portion of the flue gases which comprises passing a jet of burning fuel and the products of combustion thereof into the furnace, permitting a predetermined expansion of the gaseous combustion products, utilizing the kinetic energy of such expansion to draw flue gases into the furnace, and regulating the quantity of flue gases so recirculated to provide the desired temperature conditions in the furnace.

4. In a furnace, in combination, a fire box, a fuel burner projecting into said fire box, means for supplying fuel and air to the burner, said burner being adapted to produce a normally developed high temperature flame, a flue for leading away waste gases from the fire box, a fire resisting passage surrounding said burner and extending therebeyond and spaced therefrom a sufficient distance to permit substantial expansion of the flame and the hot products of combustion while in said passage, and a conduit means connecting said flue with said passage and enabling the drawing in of a portion of said waste gases by the expansion of the hot combustion gases.

5. In a furnace, in combination, a fire box, a fuel burner projecting into said fire box, means for supplying fuel and air to the burner, said burner being adapted to produce a normally developed high temperature flame, a flue for leading away waste gases from the fire box, a fire resisting Venturi tube surrounding said burner and extending therebeyond and spaced therefrom a sufficient distance to permit substantial expansion of the flame and the hot products of combustion while in said Venturi tube, a conduit means connecting said flue with said Venturi tube and enabling the drawing in of a portion of said waste gases by the expansion of the hot combustion gases.

6. In a furnace, in combination, a fire box, a fuel burner projecting into said fire box, means for supplying fuel and air to the burner, said burner being adapted to produce a normally developed high temperature flame, a flue for leading away waste gases from the fire box, a fire resisting Venturi tube surrounding said burner and extending therebeyond and spaced therefrom a sufficient distance to permit substantial expansion of the flame and the hot products of combustion while in said Venturi tube, a conduit means connecting said flue with said Venturi tube and enabling the drawing in of a portion of said waste gases by the expansion of the hot combustion gases, and means located in said conduit means for controlling the flow of waste gases therethrough.

In testimony whereof, I have signed my name to this specification this 30th day of October, 1925.

LUIS DE FLOREZ.