E. P. ROBERTS.

PROCESS OF BURNING POWDERED COAL AND ANALOGOUS FUEL.

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1,200,028. Patented Oct. 3, 1916.

Fig. 1.

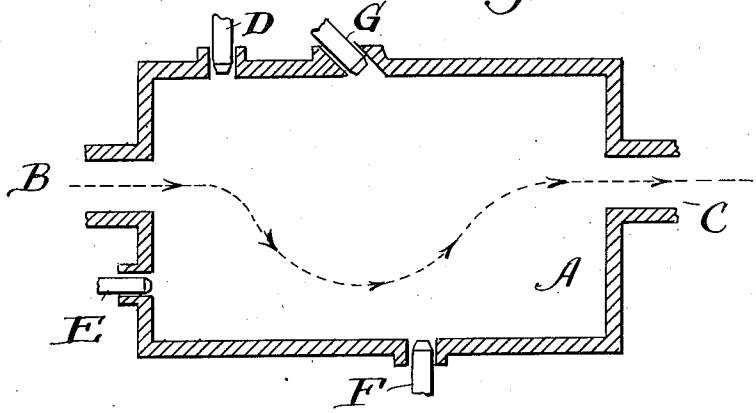


Fig. 2.

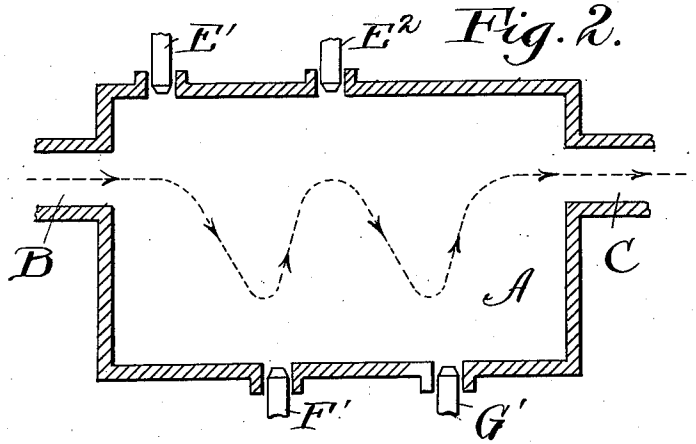
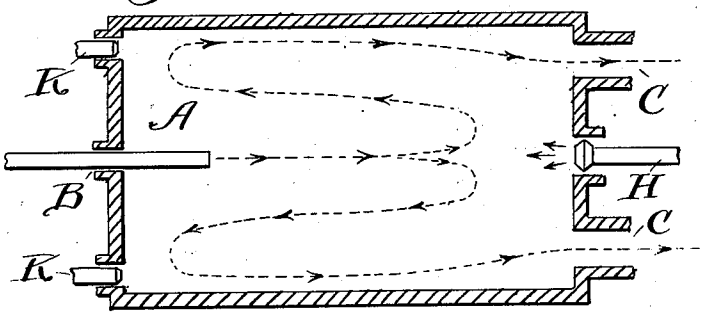


Fig. 3.



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PROCESS OF BURNING POWDERED COAL AND ANALOGOUS FUEL.

1,200,028. Specification of Letters Patent. Patented Oct. 3, 1916.

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To all whom it may concern:

Be it known that I, EDWARD P. ROBERTS, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Processes of Burning Powdered Coal and Analogous Fuel, of which the following is a full, clear, and exact description.

This invention has for its special object to practically and efficiently burn powdered coal in a shorter combustion chamber than is now required when mechanical baffles are not used, and under conditions such that a substantially complete combustion of the fuel may be effected, and the produced heat controlled and distributed as required, and the fuel particles prevented from impinging against the walls or other parts of the combustion chamber. It will be apparent, however, that the invention may be advantageously employed in the burning of oil or gas, although the beneficial results of so doing may not be relatively as great as when powdered coal is used as the fuel.

To these ends the invention consists in the herein described method by which to so deflect the flaming stream of air and fuel which is blown into the combustion chamber in the usual way, that said stream will follow any desired sinuous path through the combustion chamber without allowing the fuel content to contact with the walls thereof, and whereby also the originally introduced supply of fuel and air may be supplemented by the introduction of additional air and additional fuel to what extent may be desired,—which invention is hereinafter described and definitely set forth in the appended claims.

In the drawing, Figure 1 is a sectional side elevation of a combustion chamber associated with means by which to control in the desired manner the burning stream of air and fuel discharged forcefully into the same; Fig. 2 is a sectional plan view of another combustion chamber and associated means whereby to deflect said burning stream of fuel and air horizontally from one side of the combustion chamber to the other as it travels from the inlet to the outlet of said combustion chamber; Fig. 3 is a longitudinal sectional view of another combustion chamber associated with somewhat different means for causing the required deflection of the stream of air and fuel which has been blown into said chamber.

Referring to the parts by reference characters, A represents the combustion chamber which, as shown in Figs. 1 and 2, is rectangular, but may have any desired shape. It may be constructed of any suitable material, and it has at one end the inlet B and at the opposite end the outlet C. A stream of fuel and air is to be blown through the inlet into the combustion chamber in the usual way and by the usual or any suitable means,—which stream will be immediately ignited within the combustion chamber, and will therefore appear as a long flame therein. The heated products of combustion will leave the combustion chamber through the outlet C, and may be led to any desired point of use.

It will be noted that the combustion chambers shown in Figs. 1 and 2 are wholly unobstructed, and that the combustion chamber shown in Fig. 3 contains nothing by which the stream of fuel and air will be mechanically obstructed in its passage from the inlet to the outlet of said combustion chamber. Therefore, except for the supplemental streams of air, or air and fuel, to be introduced as hereinafter described, the burning main stream of fuel and air blown forcefully into this chamber through the inlet would pass directly to and through the outlet.

Referring particularly to Fig. 1, D, E, F and G represent respectively nozzles which pass through the walls of the combustion chamber so that they may discharge air, or air and fuel mixed; and these may be set at any angle to the flaming main stream, such that the supplemental air streams will intersect said main stream and deflect it to the desired extent and in the desired direction. The number and capacity of these nozzles, and the position in which they are placed, will depend upon what particular results one desires to obtain by means of the streams of air or air and fuel discharged through them into the combustion chamber. In this figure the nozzle D is directed downward through the top wall of the combustion chamber; the nozzle E is directed horizontally through the end wall near the bottom of the combustion chamber, and the nozzle F is directed upward through the bottom wall of the combustion chamber, and

the nozzle G is directed downward through the top wall of the combustion chamber. And all are so directed that the blasts therefrom will impinge against, and therefore deflect the flaming main stream. The dotted line indicates the path of the center of the flaming main stream as it passes from the inlet to the outlet when said stream is deflected by the supplemental streams which are blown into the combustion chamber through those nozzles. It will be noted that the main stream of fuel and air as it enters the combustion chamber, is met by a properly graduated blast from the nozzle D which deflects diagonally downward. Before it reaches the bottom of the combustion chamber it is intercepted by another properly graduated blast from nozzle E which deflects it horizontally before the fuel particles have contacted with the bottom of the chamber; and shortly thereafter it is again intercepted by a blast from the nozzle F by which it is deflected diagonally upward; and finally it is met by a blast of air from nozzle F by which the flaming main stream is deflected diagonally downward and toward the outlet in which ordinarily there will be sufficient draft to carry the products of combustion through it. By way of illustration, it may be observed that if the heat required in the combustion chamber calls for the combustion of only a relatively small quantity of fuel, the rate at which the main stream will be blown into the combustion chamber will be correspondingly reduced. It might, therefore, be possible to deflect the flaming main stream to an extent sufficient to burn all of this fuel by using two nozzles, for example, nozzles D and E. The first one will deflect the stream downward; the nozzle E may turn the stream horizontally; and the draft usually presented to the outlet opening may be sufficient to carry the flaming stream upward and through said outlet.

In the construction shown in Fig. 2 there are four nozzles E′, E², F′, and G′, which pass through the side walls of the combustion chamber. The blasts blown through these nozzles successively encounter the flaming main stream of fuel and air and deflect it and prevent it from impinging against the walls of the combustion chamber, and cause it to follow the horizontally sinuous path indicated by the dotted line as it travels through the combustion chamber from the inlet to the outlet thereof. As to this apparatus shown in Fig. 2, it may be assumed that the so-called combustion chamber is a furnace, the floor of which is the furnace hearth. The flaming main stream, by passing sinuously back and forth over this hearth will more evenly heat the material on said hearth than if the stream was a straight stream.

In the construction shown in Fig. 3, the combustion chamber A may be cylindrical or rectangular. A supplemental air blast nozzle H is disposed directly opposite the inlet opening B. If the chamber is cylindrical the outlet C may be an annular opening around the blast nozzle H. The air blast from nozzle H will, in that event, meet the main stream of air and fuel, head on, so to say, and turn it outward and backward upon itself. The draft of the outlet may be sufficient to again turn this stream outward and backward toward and through the outlet; or an annular series of blast nozzles K may be disposed at the inlet end of said chamber in such wise that the air blast therefrom will turn the flaming main stream back toward the outlet.

The three forms of combustion chamber and associated means for discharging the stream of fuel and air into the same and for discharging into it also the necessary deflecting supplemental streams, have been shown as typical apparatus for practicing the invention; and for the purpose of emphasizing the fact that the apparatus may be widely varied, and must be varied in accordance with the special functions to be performed by the practice of the process.

The difficulties which have heretofore been encountered in the attempt to successfully use powdered coal as fuel have been greatest when large heating results are desired, requiring the combustion of large quantities of fuel per unit of time. This is partly due to the fact that, heretofore, it has been the practice to blow into the combustion chamber at one end thereof all of the fuel to be consumed and all of the air required to consume it. This has necessitated a rapid blast, and a very long combustion chamber, or else the use of mechanical baffles. Mechanical baffles are objectionable because they check the flow of the stream, promote the settling of the fuel out of the stream, and necessarily cause the impingement of the fuel particles against said baffles and furnace walls, which causes more or less rapid deterioration of the surfaces impinged against. In many cases the use of very long combustion chambers is not practical; and even when it can be used there is difficulty in getting the air and fuel so completely mixed that all of the fuel will be burned. In any event the operator has, heretofore, had no substantial control over the flame or the heat produced thereby. In my invention, however all of these and other difficulties which need not be catalogued, are substantially obviated. For example, the air streams which are blown diagonally into the combustion chamber from the nozzles shown in the drawing, for the primary purpose of deflecting the flaming main stream of fuel and air, will add air to this main stream. Therefore, the main

stream may contain considerably less air than is required to effect the complete combustion of the fuel introduced. Not only will the deflecting air stream supply the supplemental air required, but they will promote the more complete mixture of the fuel with the air, and therefore, the more complete combustion of the fuel. Additionally, it is not necessary that the main stream of fuel and air shall contain all of the fuel to be burned. In case it does not, any one or more of the deflecting streams discharged from the inclined nozzles may be made up partly of fuel and partly of air. These streams may be made to join the air stream at any desired point, and therefore cause more uniform distribution of the heat in different parts of the combustion chamber. Again it may be desirable that some one or more of these deflecting streams shall be neither air nor a mixture of air and fuel. For example, if in order to produce the desired deflections of the main stream the amount of air supplied in the supplemental streams delivered from the nozzles be greater than is required for the combustion of fuel, one or more of said deflecting streams may comprise a gas which either contains no oxygen, or a smaller percentage of oxygen than air. Such gas might, for example, be drawn from the stack into which the products of combustion are discharged. Again it might be desired to maintain a reducing flame throughout some part of the main stream travel, and to have a reducing atmosphere in contact with the material being heated, as in some classes of metallurgical processes, and at the same time to prevent fuel or ash being deposited. Some one or more of the nozzles therefore may be made to discharge such a reducing gas in the combustion chamber.

From the foregoing it is apparent that an operator by intelligently controlling the volume of the main and supplemental streams, the proportion of fuel and air therein, and the force of said streams, may burn in a small combustion chamber powdered coal in any desired quantity, and may control the flame and its heating effects in any manner and to whatever extent desired. Likewise the deflecting streams may be of such character that they will in a very large degree prevent the settling of the fuel particles out of the main stream, wherefore as a corollary, it will not be necessary that the fuel be as fine as has heretofore been necessary. It will, therefore, be seen that to successfully carry on this process for producing different specific results one may, while still employing the fundamental essentials of the process, vary it by varying the positions of the nozzles, by varying their size or number, by supplying part of the air and part of the fuel through these nozzles, or by causing one or more of the supplemental streams to be made up of some gas other than air.

Having described my invention, I claim:

1. The process of burning powdered coal, gas or oil in a combustion chamber having inlet and outlet passages, which consists in introducing into said chamber, through the inlet passage, a main fuel stream, in igniting said main fuel stream, and in deflecting said stream as an entirety as it is passing through said combustion chamber solely by blowing a number of streams of gas into said combustion chamber in different directions but against and transversely of said main stream and with such force as will cause said main stream as an entirety to be deflected and to follow a sinuous path between the inlet and outlet passages of said combustion chamber.

2. The process of burning powdered coal, gas or oil in a combustion chamber having inlet and outlet passages, which consists in forcefully blowing through said inlet passage into said combustion chamber a main stream composed of a mixture of fuel and air, in igniting said fuel stream, and in also blowing a suitable number of other streams of gas into said combustion chamber against said main stream, and in such different directions and with such force as will prevent the impingement of said main stream against those walls of said combustion chamber toward which it flowed and said gas streams acting alone to cause said main stream to flow in a sinuous path between the inlet and outlet passages of said chamber.

3. The described process of burning powdered coal or other suspended fuel in a combustion chamber having inlet and outlet passages, which consists in forcefully blowing into said combustion chamber through said inlet passage a main stream comprising a mixture of the fuel and a volume of air insufficient to produce complete combustion of said fuel, in igniting said fuel stream, and in also blowing into said combustion chamber and against said main stream a suitable number of other streams of air at such points and in such different directions and with such force that said supplemental air streams will impinge against and mix with the main stream and which streams acting alone will cause it to be deflected bodily and to pursue a sinuous course in said combustion chamber and will supply to said main stream such additional air as may be required to promote substantially complete combustion of the fuel.

4. The described process of burning powdered coal or other suspended fuel in a combustion chamber having inlet and outlet passages, which consists in forcefully blowing into said combustion chamber through the inlet passage a main stream

comprising a mixture of fuel and air, in igniting said fuel stream, and in also blowing into said combustion chamber and against said main stream a suitable number of other streams of air,—one of which contains also a quantity of fuel,—at such points and in such different directions and with such force as will cause them to mix with the main stream and be the sole means of deflecting it bodily and thereby cause it to follow a sinuous course through said combustion chamber from the inlet to the outlet passages thereof.

In testimony whereof, I hereunto affix my signature in the presence of two witnesses.

EDWARD P. ROBERTS.

Witnesses:
E. L. THURSTON,
M. M. ROYAN.