Jan. 9, 1923. 1,441,721.

V. Z. CARACRISTI.

METHOD FOR THE BURNING OF PULVERIZED FUEL AND GAS.

ORIGINAL FILED MAY 23, 1919. 2 SHEETS—SHEET 1.

Fig:1.

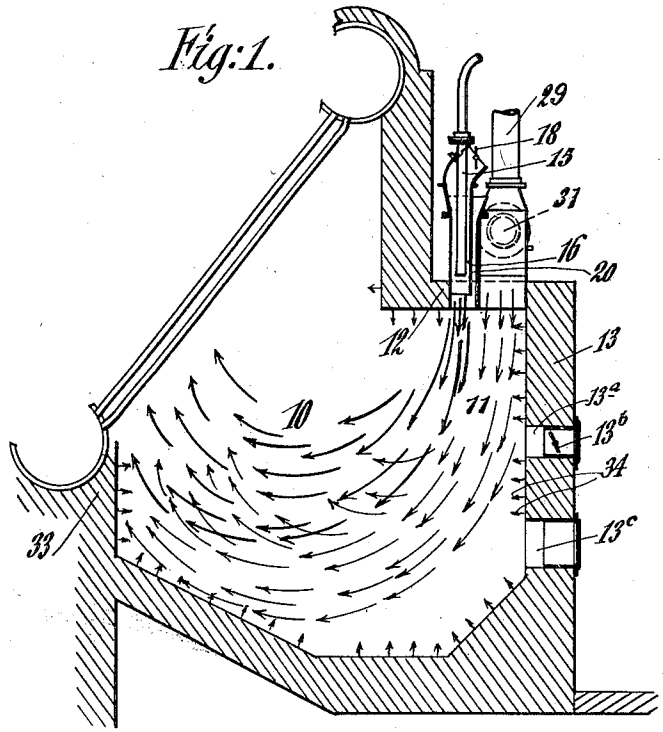


Fig:6.

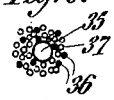


Fig:2.

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METHOD FOR THE BURNING OF PULVERIZED FUEL AND GAS.

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Fig. 3.

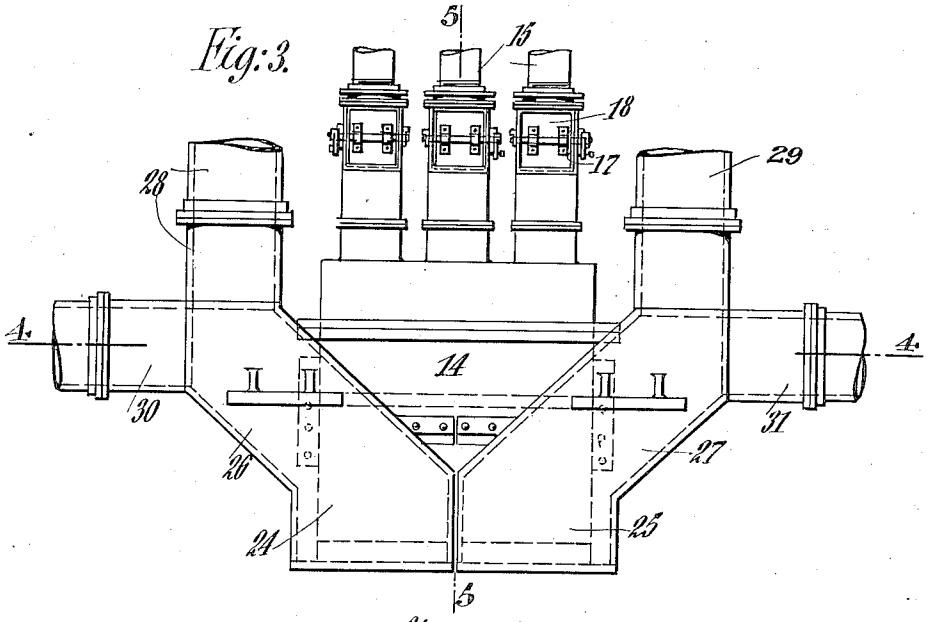


Fig. 4.

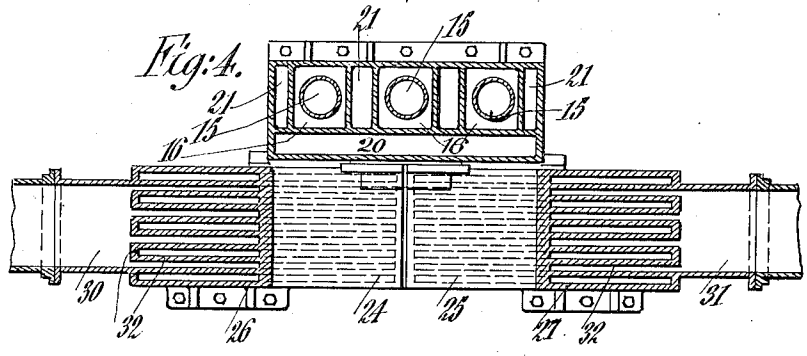
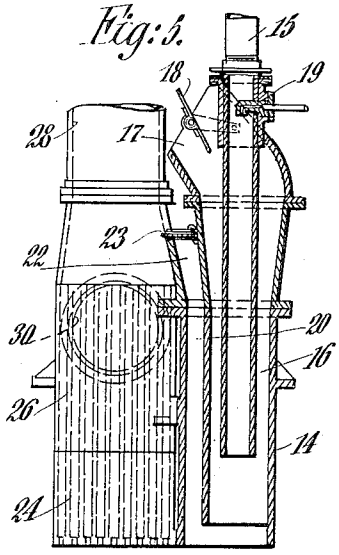


Fig. 5.



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Patented Jan. 9, 1923. 1,441,721

UNITED STATES PATENT OFFICE.

VIRGINIUS Z. CARACRISTI, OF BRONXVILLE, NEW YORK, ASSIGNOR TO LOCOMOTIVE PULVERIZED FUEL COMPANY, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

METHOD FOR THE BURNING OF PULVERIZED FUEL AND GAS.

Original application filed May 23, 1919, Serial No. 299,327. Divided and this application filed August 26, 1919. Serial No. 319,929.

To all whom it may concern:

Be it known that I, VIRGINIUS Z. CARACRISTI, a citizen of the United States, and a resident of Bronxville, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Methods for the Burning of Pulverized Fuel and Gas, of which the following is a specification.

The present invention relates to improvements in methods for the burning of pulverized fuel and gas, being a division of my copending application Serial No. 299,327, filed May 23, 1919, and particularly has for an object to enable the efficient burning of low grade gas in combination with the burning of pulverized coal, utilizing the heating effect of the pulverized coal as a regenerative heating medium to assist in the complete combustion of the gas. It will be understood that other auxiliary fuel than pulverized coal may be utilized in combination with the burning of low grade gas to produce a regenerative heating effect upon the gas according to my invention.

Low grade gas is burned with difficulty under ordinary conditions, it being necessary to provide regenerative heating means to effect complete combustion and obtain the maximum heating effect and certain methods heretofore in use consisted in passing the current of gas over a body of coal fire which supplied the regenerative heat for effecting complete combustion of the gas, but from which no direct benefit was obtained other than the said regenerative heat. In other words, the final heating result upon the heat absorbing parts of the furnace was only the heating effect obtained from the burning of the gas. Regenerative heat has also been provided by means of large regenerative brick surfaces in the furnace.

According to the present invention I propose to provide a flame of pulverized fuel and air and in combination with this a gas flame, the arrangement being such that the gas must be forced into and through the current of pulverized fuel in its progress to the stack. As the gas mixes into the current of pulverized fuel, the incandescent particles of coal become surrounded by a molecular mixture of the combustibles of the gas and oxygen, sufficient air being fed in connection with the gas to support the combustion, and innumerable combustion zones are therefore created within the furnace which cause a complete combustion and maximum heating effect from both the coal and the gas, the one acting as a regenerative medium to the other with the result that complete combustion is effected.

With these and other objects in view, examples of my process will be hereinafter described and structures suitable for carrying out the same will be shown in the accompanying drawings and more fully described with reference thereto and the invention will be finally pointed out in the claims.

In the accompanying drawings,

Fig. 1 is a vertical sectional view of a furnace of the boiler type adapted to carry out one example of my method;

Fig. 2 is a similar view of a modified form of furnace;

Fig. 3 is a front elevation of the type of burner employed in the furnace shown in Fig. 1;

Fig. 4 is a horizontal sectional view taken along the line 4—4 of Fig. 3;

Fig. 5 is a vertical sectional view taken along the line 5—5 of Fig. 3; and

Fig. 6 is a diagrammatic view showing one of the minute combustion zones comprising an incandescent particle of coal and molecules of combustibles of the gas and of oxygen surrounding the same.

Similar reference characters indicate corresponding parts throughout the several figures of the drawings.

Referring to Fig. 1 of the drawings, the furnace shown therein comprises a combustion chamber 10 having a forwardly projecting mixing oven 11 in the top wall 12 of which there is disposed a combination pulverized fuel and gas burner, the gas burner portion being adjacent the perpendicular front wall 13 of the furnace. The front wall 13 is provided with auxiliary air feed openings 13^a having dampers 13^b, and a lower cleanout opening 13^c.

In Figs. 3, 4 and 5, I have illustrated the combination burner, comprising a lower casing 14 of rectangular cross section and into which extend the ends of the pulverized fuel feed pipes 15 surrounded by air channels 16, open to the atmosphere at 17 and adapted to

be controlled by dampers 18. The separate streams of fuel induced through pipes 15 by steam or air jet nozzles 19, embraced by air from the channels 16, are separated by streams of air entering the furnace through air spaces or channels 20 and 21, said air spaces being open to the atmosphere at 22 and controlled by dampers 23. By this means of feeding and mixing with air, a more perfect mixture of the fuel and combustion air is afforded permitting rapid combustion to take place.

In front of the auxiliary pulverized fuel burners there are secured a pair of gas burners having their outward end portions 24 and 25 disposed directly in front of the pulverized fuel burner outlets and extending in oppositely inclined directions as at 26 and 27 to the sides of the fuel burners where they are in communication with the vertically disposed air inlets 28 and 29, and the horizontally disposed gas inlets 30 and 31. Within the gas burners there are provided a plurality of spaced hollow walls 32 between which the gas flows from the inlets 30 and 31, the spaces being in communication with the said inlets. Through these hollow walls 32 air flows from the air inlets 28 and 29, the spaces within the walls being in communication with the said air inlets. The gas becomes mixed with the air as it emerges from the outlets of the burners.

The current of pulverized fuel and air is uppermost in the furnace in its progress to the stack. The rear wall 33 of the furnace is of such height that the lower limit of the stream of pulverized fuel and air passes just over the top of the said wall. Thus there is formed below the said stream a gas confining space bounded by the rear wall 33, the floor of the furnace, the front wall 13 and the stream of pulverized fuel and air. The heavy arrows indicate the flow of pulverized fuel and air while the light arrows indicate the flow of gas. The draft through the furnace causes the gas flame to be forced substantially transversely into and through the current of pulverized fuel, and the transverse currents of air from the openings 13^a across the two fuel currents has also this effect. A primary regenerative heating effect is produced upon the gas before its entry into the current of pulverized fuel and air by the heat radiating walls of the furnace as indicated by the arrows 34.

As the gas flame is drawn into the flame of pulverized fuel and air, the innumerable incandescent particles of coal 35 (Figure 6) become surrounded by a zone of gas, the molecules of combustibles 36 of the gas and of oxygen 37 constituting innumerable minute combustion zones about the incandescent coal particles. The regenerative heat of these zones together with the supply of oxygen mixed with the gas to support combustion causes a complete combustion of the gas. Thus the full combustion of the gas and coal flame may be effected without any loss of the heating effect of either in its final application to the heat absorbing parts of the furnace, and with a maximum efficiency and augmented heating effect from both, the one being auxiliary and complementary to the other.

It will be seen that the solid fuel and the combustible gas fuel streams are first in juxtaposed relation and that as the draft turns the solid fuel and flame stream toward the outlet in the upper part of the combustion chamber, the gas fuel stream borders the lower part of the said flame stream being between it and the bottom of the chamber. The gas is thus subject to the heavier glowing particles which precipitate thereinto, and also as it rises it is subject to further glowing particles. The gas is thus subject to a sort of regenerative action from the refractories, from the solid fuel and flame stream, and from the glowing particles. Furthermore, the combustion temperature of the low grade gaseous fuels in air is lower than the temperature of the glowing particles and is approximately in the neighborhood of the fusion temperature of the precipitating ash in the solid fuel and, therefore, the gas acts in a sense as a blanket under the solid fuel and flame stream and reduces the tendency to the slagging of the ash so detrimental in steam generating furnaces burning pulverized coal.

In Fig. 2 I have illustrated a slightly modified form of furnace in which the gas burner 38 is separated from the pulverized fuel burner 39 and disposed in the front wall 13 of the furnace, the flow of gas therefrom being beneath the flow of pulverized fuel from the burner 39 disposed in the upper wall 12, and thence by the draft of the furnace into and through the current of pulverized fuel and air.

I have described preferred and satisfactory examples of my invention and have shown satisfactory structures in which the same may be carried out, but it is obvious that changes may be made therein within the spirit and scope thereof as defined in the appended claims.

I claim:

1. The hereindescribed process of burning fuels in a furnace having means creating a draft which consists in admitting pulverized fuel in an upper portion of the combustion chamber in a downward direction, in igniting the fuel, in turning the fuel and flame stream substantially above the bottom of the combustion chamber, and in admitting a combustible gas in a stream bordering the said fuel and flame stream whereby the heavier particles of pulverized fuel will

gravitate into the gas stream and whereby the gas is caused to burn.

2. The hereindescribed process of burning fuels in a furnace having means creating a draft which consists in admitting pulverized fuel in an upper portion of the combustion chamber in a downward direction, in igniting the fuel, in turning the fuel and flame stream substantially above the bottom of the combustion chamber, and in admitting a combustible gas in a stream bordering the said fuel and flame stream whereby the heavier particles of pulverized fuel will gravitate into the gas stream and the gas will rise and mingle with the said fuel and flame stream as it becomes heated and combustion proceeds and whereby the gas is caused to burn.

3. The hereindescribed process of burning fuels in a furnace having means creating a draft which consists in admitting pulverized fuel in an upper portion of the combustion chamber in a downward direction, in igniting the fuel, in turning the fuel and flame stream substantially above the bottom of the combustion chamber, and in admitting a combustible gas in a stream bordering the said fuel and flame stream whereby the heavier particles of pulverized fuel will gravitate into the gas stream and whereby the gas is caused to burn, and in admitting air into the chamber.

4. The hereindescribed process of burning fuels in a furnace having means creating a draft which consists in admitting pulverized fuel in an upper portion of the combustion chamber in a downward direction, in igniting the fuel, in turning the fuel and flame stream substantially above the bottom of the combustion chamber, and in admitting a combustible gas in a stream bordering the said fuel and flame stream whereby the heavier particles of pulverized fuel will gravitate into the gas stream and whereby the gas is caused to burn, and in inducing a flow of air into the chamber.

5. The hereindescribed process of burning fuels in a furnace having means creating a draft which consists in admitting pulverized fuel in an upper portion of the combustion chamber in a downward direction, in igniting the fuel, in turning the fuel and flame stream substantially above the bottom of the combustion chamber, and in admitting a combustible gas in a stream bordering the said fuel and flame stream whereby the heavier particles of pulverized fuel will gravitate into the gas stream and whereby the gas is caused to burn, and in inducing a flow of air into the chamber at a point below that at which the gas is admitted.

6. The hereindescribed process of burning fuels in a furnace having means creating a draft which consists in admitting pulverized fuel in an upper portion of the combustion chamber in a downward direction, in igniting the fuel, in turning the fuel and flame stream substantially above the bottom of the combustion chamber, and in admitting a combustible gas in a stream bordering the said fuel and flame stream whereby the heavier particles of pulverized fuel will gravitate into the gas stream and whereby the gas is caused to burn, and in inducing a flow of air into the chamber at a point adjacent the inlet of pulverized fuel and also at a point below that at which the gas is admitted.

7. The hereindescribed process of burning fuels in a furnace having means creating a draft which consists in admitting pulverized fuel in an upper portion of the combustion chamber in a downward direction, in igniting the fuel, in turning the fuel and flame stream substantially above the bottom of the combustion chamber, and in admitting a combustible gas in a stream bordering the said fuel and flame stream whereby the heavier particles of plverized fuel will gravitate into the gas stream and whereby the gas is caused to burn, the combustion being completed in the combustion chamber.

8. The hereindescribed process of burning fuels in a furnace having means creating a draft which consists in admitting pulverized fuel in an upper portion of the combustion chamber in a downward direction, in igniting the fuel, in turning the fuel and flame stream substantially above the bottom of the combustion chamber, and in admitting a combustible gas in a stream bordering the said fuel and flame stream whereby the heavier particles of pulverized fuel will gravitate into the gas stream and whereby the gas is caused to burn and rise and mingle with the said fuel and flame stream as it becomes heated and combustion proceeds, the combustion being completed in the combustion chamber.

9. The herein described process of burning fuels in a furnace having a waste outlet and draft creating means which consists in admitting and igniting pulverized fuel and in admitting a combustible gas in a stream bordering the fuel and flame stream, the pulverized fuel being admitted sufficiently high in the combustion chamber to permit of the introduction of the gas therebelow in such manner that the latter is subjected to regenerative heat from the walls of the combustion chamber on one side and also heat from the fuel and flame stream on the opposite side and whereby the gas is caused to burn.

10. The herein described process of burning fuels in a furnace having a waste outlet and draft creating means which consists in admitting and igniting pulverized fuel and in admitting a combustible gas in a stream bordering the fuel and flame stream, the

pulverized fuel being admitted sufficiently high in the combustion chamber to permit of the introduction of the gas therebelow in such manner that the latter is subjected to regenerative heat from the walls of the combustion chamber on one side and also heat from the fuel and flame stream on the opposite side and is caused to burn, the heavier particles of the pulverized fuel gravitating into the gas stream and the latter rising and mingling with the former as it becomes heated and combustion proceeds.

11. The herein described process of burning fuels in a furnace which consists in admitting and igniting pulverized fuel, and in blanketing the lower portion of the fuel and flame stream with a combustible gas the temperature of combustion of which is not materially higher than the fusion temperature of the precipitating ash in the solid fuel.

12. The herein described process of burning fuels in a furnace having an outlet in an upper part thereof and means creating a draft which consists in admitting pulverized fuel in an upper part in approximately a vertically downward direction, in turning the fuel and flame stream upward toward the outlet by the draft at a point materially above the bottom of the furnace, in admitting a combustible gas in such manner as to approximately blanket the lower portion of the fuel and flame stream, and in igniting the gas the size of the combustion space being such that combustion is substantially completed therein.

13. The herein described process of burning fuels in an approximately cubical combustion chamber having an outlet in the upper part thereof with the evaporating surfaces of the boiler extending thereover and having means creating a draft, which consists in admitting pulverized fuel in the upper part of the chamber in an approximately vertically downward direction, in turning the fuel and flame stream by the draft upward to the outlet at a point materially above the bottom of the chamber so that such stream takes a general U-shaped course through the chamber, in admitting air at a plurality of points in the front wall of the combustion chamber, in admitting a combustible gas in such manner as to approximately blanket the lower portion of the fuel and flame stream, and in igniting the gas the size of the combustion space being such that combustion is substantially completed therein.

14. The herein described process of burning fuels in a substantially unobstructed furnace combustion chamber having an outlet in the upper part thereof with evaporating surfaces extending thereover and having means creating a draft which consists in admitting pulverized coal in the upper part of the chamber to one side of the outlet in an approximately vertically downward direction, in turning the fuel and flame stream by the draft from a downward to an upward direction to the outlet so that the bend is materially above the bottom of the chamber, in admitting air for combustion into the chamber, and in admitting a combustible gas in such manner that heavy gravitating particles of the solid fuel will precipitate thereinto, and in igniting the gas the combustion chamber being of a size to complete combustion therein.

15. The herein described process for the promotion and acceleration of the combustion of a gas, the combustion of which alone presents difficulties, which consists in admitting pulverized coal and air into the furnace, in igniting the coal, in admitting the gas separately so as not to interfere with the ignition and combustion of the coal, and in subjecting said gas to the regenerative action of the previously burning or glowing particles of the solid fuel substantially in suspension, the gas flame finally mingling with the solid fuel flame stream in its traverse through the combustion space.

In testimony that I claim the foregoing as my invention, I have signed my name hereunder.

VIRGINIUS Z. CARACRISTI.