J. C. GORMAN, Jr.

METHOD OF OPERATING HOT BLAST STOVES.

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1,068,424.

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Fig. 1

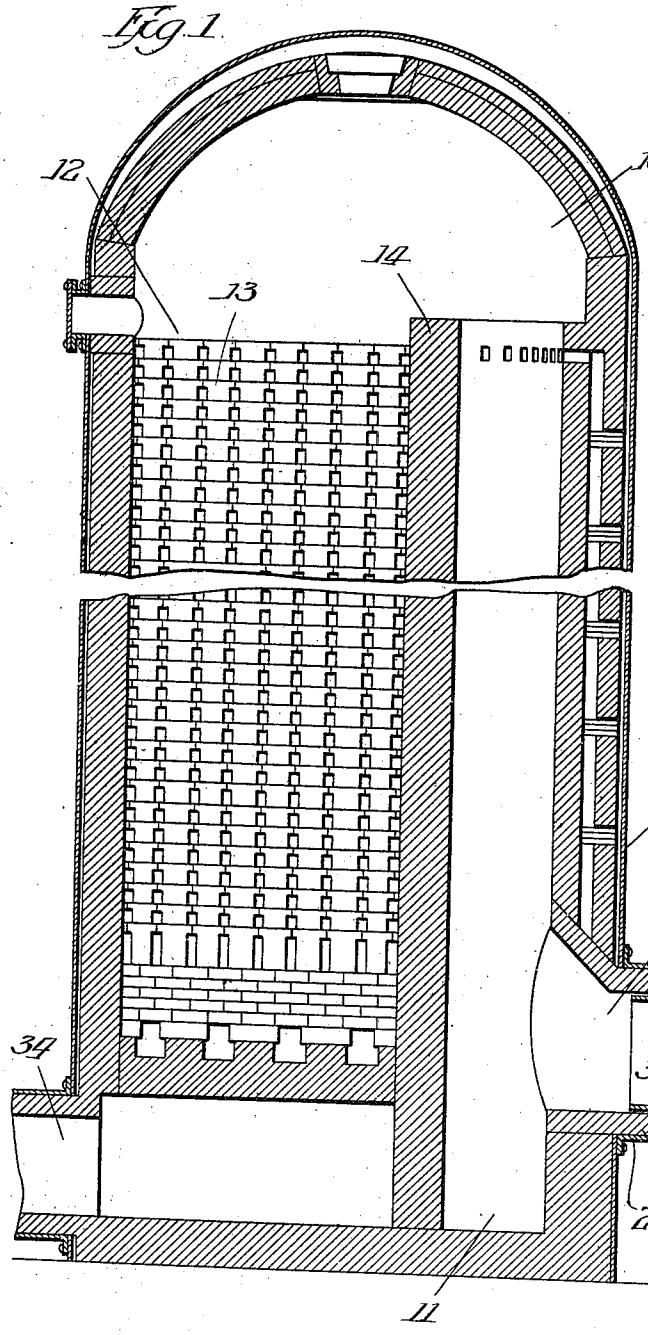


Fig. 3

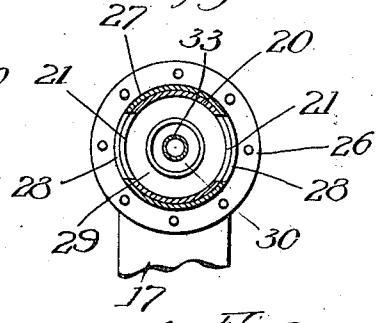
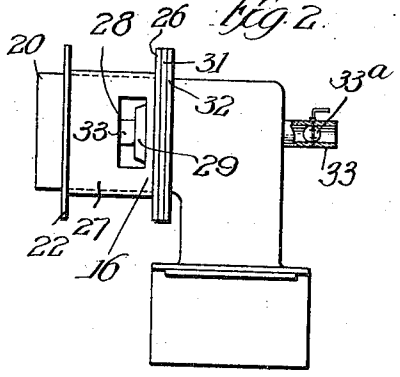


Fig. 2.



Witnesses:

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UNITED STATES PATENT OFFICE.

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METHOD OF OPERATING HOT-BLAST STOVES.

1,068,424. Specification of Letters Patent. Patented July 29, 1913.

Application filed February 25, 1911. Serial No. 610,906.

To all whom it may concern:

Be it known that I, JAMES C. GORMAN, Jr., a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Methods of Operating Hot-Blast Stoves, of which the following is a specification.

My invention relates to a method and apparatus for obtaining an intimate and proper mixture of gas and air, and is especially (although not exclusively) adapted for use in connection with hot-blast stoves of blast furnaces for smelting iron.

As is well known, in the operation of the ordinary type of blast furnace a large amount of combustible gas is formed, this gas being conducted from the top of the furnace through suitable flues. After proper cleaning the gas is used for obtaining heat under boilers, for operating gas engines and for heating hot-blast stoves. In connection with the last-mentioned use of blast-furnace gas, it has been customary to introduce the gas into a combustion chamber within the stove and to simultaneously introduce air into the same chamber through separate ports or flues, these ports being placed at various horizontal angles from each other, and not necessarily in the same horizontal plane. The mixture of gas and air takes place within the combustion chamber. A very serious disadvantage of this method of operation consists in the fact that there is not a perfect mixture of air and gas, and either an excess of air or an excess of gas, or even a mixture of unburned gas and air escape through the stack of the stove. This condition is shown by the following actual analyses of the chimney gas:

	CO_2.	O.	CO.
September 6th, 1910	14.0	9.2	0
" 8th, 1910	13.3	10.2	1.4

On account of the fact that air contains approximately twenty per cent. (20%) of oxygen and eighty per cent. (80%) of nitrogen, it will be apparent that for every one per cent. (1%) of oxygen contained in the chimney gas there will be five per cent. (5%) of air. This excess of air materially lowers the combustion temperature within the stove, and, in turn, affects the quantity of heat which is absorbed by the checker work through which the products of combustion pass after leaving the combustion chamber during the heating-up period of the stove. Any unburned carbon monoxid in the chimney gases has the same effect as the presence of excess air. In both cases the heat absorbed by the hot blast during the blast period is largely decreased, resulting in either increased fuel consumption for a given tonnage of iron or less iron for a given amount of fuel.

In my improved method of operation the gas and air are intimately and perfectly mixed before their entrance to the combustion chamber of the stove, thus allowing practically perfect combustion, as is shown from the following analyses of the chimney gas which were obtained after the installation of my improvement:

	CO_2.	O.	CO.
November 9th, 1910	26.4	.4	0
" 10th, 1910	27.0	.8	0
" 12th, 1910	25.4	.8	0

As a result of the greatly improved combustion demonstrated by the above analyses, it will be apparent that a given amount of fuel will create a much higher temperature within the combustion chamber, which, in turn, causes the checker work to be heated to a higher temperature, and during the blast period causes the hot blast to absorb more heat. By actual experiment it has been demonstrated that from 10 to 25% of gas is saved by the use of my improvements.

A still further advantage of my invention consists in the fact that combustion takes place as soon as the mixture of gas and air reaches the combustion chamber, and the flame is confined to the lower portion of said chamber, whereby the life of the stove is considerably lengthened. By the old method of mixing the air and gas within the combustion chamber itself combustion takes place throughout the length of the chamber, and very frequently in portions of the checker work, thereby greatly shortening the life of the stove.

A still further advantage resides in the production of a more intense heat within the combustion chamber whereby more of the dust is sintered and falls to the bottom of the combustion chamber. This results in much less dust being carried over into the checker work than by the old process, and

the clogging of the checker work is thereby prevented for a much longer period.

I have found that in using my improved apparatus, when the gas volume is increased beyond that permitted for perfect combustion consistent with the existing air-inlet opening, the mixture of gas and air will puff back unburned from the combustion chamber through the holes through which air is ordinarily introduced, as will be explained hereinafter. This condition is easily seen, and the gas burner may then be properly regulated, thus insuring complete combustion and preventing any unburned carbon monoxid passing through the stove with a consequent loss of heat.

The various advantages of my improvements will be more readily understood by reference to the accompanying drawings, which show a preferred embodiment of my invention, and in which—

Figure 1 is a diagrammatic vertical section through a hot-blast stove, showing my improved burner applied thereto; Fig. 2 is a side elevation of the gas flue and the burner connected therewith, and Fig. 3 is a transverse section on the line 3—3 of Fig. 1.

The hot-blast stove 10 has a combustion chamber 11, connected with the upper end of which is the chamber 12 containing the checkers 13, the combustion chamber 11 being separated from the chamber 12, containing the checkers, by means of the vertical wall 14, according to the well-known construction. Toward the bottom of the combustion chamber 11 is the gas inlet port 15, connected with which is my improved gas burner 16. This burner is also connected with the flue 17, which, in turn, is in direct communication with the gas main 18, the slide valve 19 being provided between the gas main 18 and the flue 17.

The gas burner 16 consists of a cylindrical pipe 20 having in its sides one or more openings 21. This pipe 20 projects within the inlet port 15, and a tight connection is formed by means of the ring 22 inclosing the pipe 20 and abutting against the outwardly projecting fire brick flange 23, which is preferably strengthened and supported by the frame 24 bolted to the main casing 25 of the stove. The pipe 20 at its exterior end is provided with the flange 26. Inclosing the pipe 20 is the sleeve 27 having therein the openings 28, which may be brought in register with the openings 21 of the pipe 20. It will be apparent that the size of the openings from the exterior to the inside of the pipe 20 may be regulated as desired by proper rotation of the sleeve 27. Mounted within the pipe 20 is the reducer 29, of a general cone shape, and having in its end the opening 30 of considerably smaller diameter than the inside diameter of the pipe 20. The reducer 29 has the flange 31, which is riveted between the flange 26 of the pipe 20 and the flange 32 of the gas flue 17. The gas flue 17 is preferably bent in the shape of a right-angle, and has passing therethrough the air inlet pipe 33, which passes through the opening 30 of the reducer 29, and is preferably provided with the damper 33[a] to regulate the supply of air.

The method of operation of my improvements may now be readily understood. The gas passes from the gas main 18 past the slide valve 19 into the flue 17, and from said flue through the opening 30 of the reducer 29, into the pipe 20. As the body of gas of reduced cross-sectional area passes through the opening 30 of the reducer 29 it draws air through the openings 28 and 21 of the sleeve 27 and pipe 20, this air then becoming intimately mixed with the gas and being of an amount proportional to the adjusted position of the sleeve 27. When the gas reaches the end of the pipe 33 an additional amount of air is drawn from the exterior through this pipe and also intimately mixes with the gas. The mixture of gas and air which has been thus formed then passes into the inlet port 15, and thence into the combustion chamber 11. As is well understood, the temperature within the combustion chamber is high, thereby causing the mixture of gas and air to be ignited, and a practically complete oxidation of the carbon monoxid to carbon dioxid is effected in the lower portion of the combustion chamber. The further course of the products of combustion is the same as takes place in the usual practice, the gases passing upwardly through the combustion chamber 11 into the chamber 12, containing the checkers 13, then downwardly through said checker work, and finally into the flue 34 which is connected with the stack of the stove. During the blast period the blast is first introduced through the flue 34 by the regulation of suitable valves, then passes upwardly through the checker work chamber 12, from which it passes to the blast furnace, in the well-known manner, through a port, which, for the sake of simplicity, is not shown in the diagrammatic representation of Fig. 1.

It will be apparent to those skilled in the art that the details of the method of operation and also of the apparatus which I have described may be varied within wide limits without departing from the spirit or scope of my invention.

I claim—

The method of operating hot blast stoves having checker work and a combustion chamber communicating at one end with the checker work, which consists in mixing gas and air externally of the combustion chamber to form a mixture for producing complete combustion, introducing the mix-

ture into the combustion chamber at that end thereof which is remote from its connection with the checker work, igniting and burning the mixture at the point of entrance thereof into the combustion chamber, completing the burning of the mixture before it reaches the exit of the combustion chamber and permitting the heated products of combustion to pass from the other end of the combustion chamber into the checker work, substantially as described.

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Witnesses:
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Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."