UNITED STATES PATENT OFFICE.

BRERETON TODD, OF NEWCASTLE-UPON-TYNE, ENGLAND.

IMPROVEMENT IN CONVERTING WASTE GASES INTO COMBUSTIBLE GAS.

Specification forming part of Letters Patent No. **134,332**, dated December 24, 1872.

To all whom it may concern:

Be it known that I, BRERETON TODD, of No. 8 Victoria Square, Newcastle-upon-Tyne, England, a subject of the Queen of Great Britain, have invented or discovered new and useful Improvements in the Treatment of Gases and Fumes; and I, the said BRERETON TODD, do hereby declare the nature of the said invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement thereof—that is to say:

This invention has for its object improvements in the treatment of gases and fumes. The improvements relate to the treatment of the gases of combustion generated during the burning of coal, coke, charcoal, or any carbonaceous substance, or hydrocarbon in any state, or carbonic oxide and hydrogen gases, or coal gas. The object of the invention is, after the heat generated by the combustion has been employed or utilized, to convert the gaseous products of combustion, while still highly heated, into inflammable gases for reburning.

This I accomplish by passing the gaseous products of combustion through coal, coke, charcoal, or other carbonaceous substance, heated by the waste heat from the combustion of the fuel which escapes with the products of combustion, from the furnace in which the heat is employed; and when the waste heat is not enough for the absorption and transformation of the gases I increase it by the heat developed from the combustion of some of the carbon through which the gases pass, by allowing a certain quantity of air to enter. The carbonic acid in the gases is converted into carbonic oxide, forming an inflammable gas ready for burning again.

I prefer to conduct the process in the following manner: I cause the gases and fumes to pass through what I call a transformer, which may be described as follows: It is a space or or chamber containing carbonaceous matter placed close over or by the side or end of a furnace or oven; its size, form, and height may vary according to the quantity of gases and fumes to be transformed and the nature of the furnace or oven to which it is attached. When a reverberatory furnace is employed I prefer having it the length of the inside end of such furnace, one foot to one foot six inches wide, and about six feet high, with sufficient openings left in the bottom where it joins the furnace to allow the gases and fumes to pass through. From the top or upper part of the sides it is connected with a flue which leads away the transformed gases to the gas-furnace, to where they are required for burning. A few openings should also be left as near the bottom of the transformer as possible for stirring, taking out clinkers, and admitting air where a certain amount of combustion is required to be kept up in the transformer, but from the upper part of the transformer air is carefully excluded. When not in use the openings near the bottom of the transformer may be closed with a door or by other means. Enough carbonaceous matter is put into the transformer to insure that when the apparatus is at work there shall be about thirty inches of red-hot fuel for the gases to pass through. The quantity required will vary to some extent, according to the size of the pieces, its solidity, and also according to the power of the draft passing through the transformer.

The transformer may be made with any material that will stand the heat and allow of its being made air-tight above the fuel. No air, or as little as possible, must be allowed to mix with the transformed gases. Therefore the fuel required from time to time to replace that consumed in it should be introduced through one or more hoppers, placed either on the top or sides of the transformer.

When the furnace to which the transformer is attached is heated with coal, coke, or charcoal, on first lighting the fire I do not pass the products of combustion through the transformer, but through a separate heating-up flue, and this I continue until the furnace is red hot. I then close this flue with a damper and cause the gases to pass through the transformer. When inflammable gases are used for heating the furnace I pass the gases arising from the combustion through the transformer at once.

When the fuel in the transformer becomes red hot the gases passing through it will be transformed, and in a state for reburning. The carbon absorbed in the transformer during the transformation of the carbonic acid in the gas-

es produces double the quantity of carbonic oxide to what it would if burned directly into carbonic oxide.

Any carbonic acid arising from the combustion of carbon, promoted by admitting air into the bottom of the transformer, will be converted in passing through it into carbonic oxide.

The products of combustion from a boiler or retort furnace I pass through a converter in a similar manner, and so prepare them to be used as gaseous fuel. I proportion the size of the transformer to that of the furnace from which it receives the products of combustion, so that the velocity of the gases in their passage through the transformer may be, if possible, somewhat less than it is in the flue leading away from the transformer.

When coal is used for heating the furnace a certain portion of the gases of combustion consists of vapor of water from the air and that formed by the hydrogen in the coal. When coke is used for heating the furnace they will contain the vapor of water from the air and the water which was contained in the coke. In passing the gases through the transformer this vapor is decomposed into hydrogen and carbonic oxide. The carbonic acid is converted into double its volume of carbonic oxide, and the gases are enriched by the hydrogen driven off from the coal consumed in the transformer when coal is used in it.

The gas-furnace in which the transformed gases are burned as fuel is placed at any convenient distance from the transformer, and so that the workmen may have free access to it on all sides.

The improvements also relate to the treatment of the gases arising from the manufacture of coke from coal, which have hitherto been wasted; and consist in treating them in the same way as that described above for the treatment of the gaseous products of combustion, by which process the gases are obtained in an inflammable state for burning.

When the transformer is attached to coke-ovens I prefer having them so placed that in a set of four an opening in the corner of each shall meet in the center of the block, over which I place the transformer, so that the gases from all may pass through it, and the charging of the ovens is so arranged that two or three of them may be at a red heat during the drawing of one charge and putting in of another. A large quantity of inflammable gases is driven off from coke-ovens with the products of combustion. By transforming the latter we obtain all in an inflammable state.

In all cases where the fuel used in the transformer is too compact to allow of sufficient draft through it, I create sufficient by drawing away the gases from the ends of the flues or condensers by the use of an exhauster, by which means the inflammable gases may be forced in any direction for burning.

The improvements also relate to the treatment of the acids and fumes arising from the calcining or smelting of sulphides and sulphates; and consist in the deoxidation of the said acids and fumes by passing them through coal, coke, charcoal, or other carbonaceous matter heated by the waste heat from the furnace, assisted, when required, by the combustion of a certain quantity of the carbonaceous matter through which they pass. The deoxidized fumes are then to be conveyed through flue chambers or condensers in order to condense the sulphur and any sulphides contained in them. The transformed gases of combustion, after the sulphur and any sulphides are condensed, will be fit for reburning. In conducting this process I pass the gases and fumes generated in the furnace through the transformer, and then convey the transformed gases and sulphur and other vapor through large flues or condensing-chambers until the latter is condensed, when the inflammable gases will be fit for burning; or, I pass them through a condenser packed with brick, coke, or some such material, with water falling down it to wash out the sulphur and any sulphides that may be present, and allow the water to run into a receptacle for the sulphur and other condensed matter to settle, when the water may be used again.

Sulphur and arsenic (when they are present) are contained in the gases of combustion, as sulphurous or sulphuric acid and arsenious acid, and when deoxidized obtained as sulphur or the sulphide of arsenic.

The improvements also relate to the treatment of the fumes arising from the smelting of the sulphides, sulphates, or arsenides in a blast-furnace. Instead of allowing air to enter at the charging or other places, as is usual, and thus causing the formation of oxides, acids, sulphates, and so on, I prevent any air entering by charging through a hopper or other equivalent means, and thus prevent the oxidation of the fumes and obtain an atmosphere of carbonic oxide and nitrogen in the flues, condensing-chambers, or condensers, through which I pass the fumes in order to condense the sulphur and arsenic, after which the gases will be fit for burning. When a door is used for charging, it is not possible to maintain an atmosphere of carbonic oxide and nitrogen in the flues, chambers, or condensers, for as soon as the door is opened the carbonic oxide and nitrogen are driven out of the condensers and lost, being replaced by air, which oxidizes a portion of the fumes.

The improvements also relate to the treatment of the fumes arising from the reducing or smelting of oxides—such as those of lead, tin, antimony, copper, or zinc—by the deoxidation of such oxides contained in them as are reduced to metal at the temperature obtained by the process, which I accomplish by passing them through a carbonaceous substance, as above described, for the fumes arising from the calcining or smelting of sulphides or sulphates,

by which process I obtain the carbon consumed in their reduction in the state of carbonic oxide mixed with the transformed gases of combustion for reburning.

When a furnace to which a transformer is attached is used for reducing or smelting oxides the transformed products of combustion will be enriched by the carbonic oxide formed with the oxygen given off during the process of reducing or smelting the oxides. Any oxides in the fumes reducible at a red heat will be deoxidized, and those not so reducible will be retained among the fuel in the transformer and found in the ashes.

Having thus described the nature of my said invention, and the manner of performing the same, I would have it understood that I am aware that it is not new to generate carbonic-acid gas by the combustion of fuel, and then by passing such gas through a further quantity of highly-heated fuel to convert it into carbonic-oxide gas. I do not therefore claim the same; but

What I claim is—

1. The application of the products of combustion of fuel, first, to heat a furnace in which metals, ores, or other materials in process of manufacture may be treated and worked as the nature of the manufacture may require, or in which a boiler or retorts are set; then causing such products of combustion to pass through and heat a "transformer" and afterward collecting the transformed gases, taking care to avoid admixture of air, and conveying them away by flues to a gas-furnace placed at a convenient distance from the transformer, and there burning them as the fuel of such furnace.

2. The treatment of the products of combustion and gases from a coke-oven by passing them, while still highly heated, through a "transformer," in such manner that the products of combustion escaping from the coke-oven may be converted (in part) into carbonic oxide and hydrogen, which, with the other gases, are suitable for use as the fuel of a gas-furnace.

3. The treatment of furnace-fumes containing sulphurous acid, sulphuric acid, or arsenious acid, mixed with products of combustion, by passing them, while still highly heated, through a "transformer," which they heat, then passing the transformed gases and vapors through a condensing apparatus in which sulphur and arsenic are condensed (either alone or in combination) and recovered for use, while the gases leave the condensers in a state suitable for use, as the fuel of a gas-furnace.

4. The treatment of the gases and fumes from a blast-furnace in which sulphides or arsenides are smelted, and which is so charged as to prevent air entering at the charging-openings, by passing such gases and fumes through a condensing apparatus in which sulphur and arsenic are condensed in an atmosphere of carbonic oxide and nitrogen, and recovered for use, while the gases leave the condenser in a state suitable for use as the fuel of a gas-furnace, or for other purposes.

5. The treatment of the gases and fumes from a furnace in which metallic oxides are reduced or smelted, by passing such fumes through a transformer, and then though condensing flues or chambers, by which any metallic vapor passing off with the products of combustion is reduced, condensed, and retained, while the gases leaving the condenser are in a state suitable for use, as the fuel of a gas-furnace.

BRERETON TODD.

Witnesses:
DANIEL GREEN,
ABRAHAM BEWICK GOLDSBROUGH.