W. R. CLYMER.

CALCINING FURNACE.

APPLICATION FILED SEPT. 29, 1911.

1,147,706. **Patented July 27, 1915.**

3 SHEETS—SHEET 1.

Fig. 1.

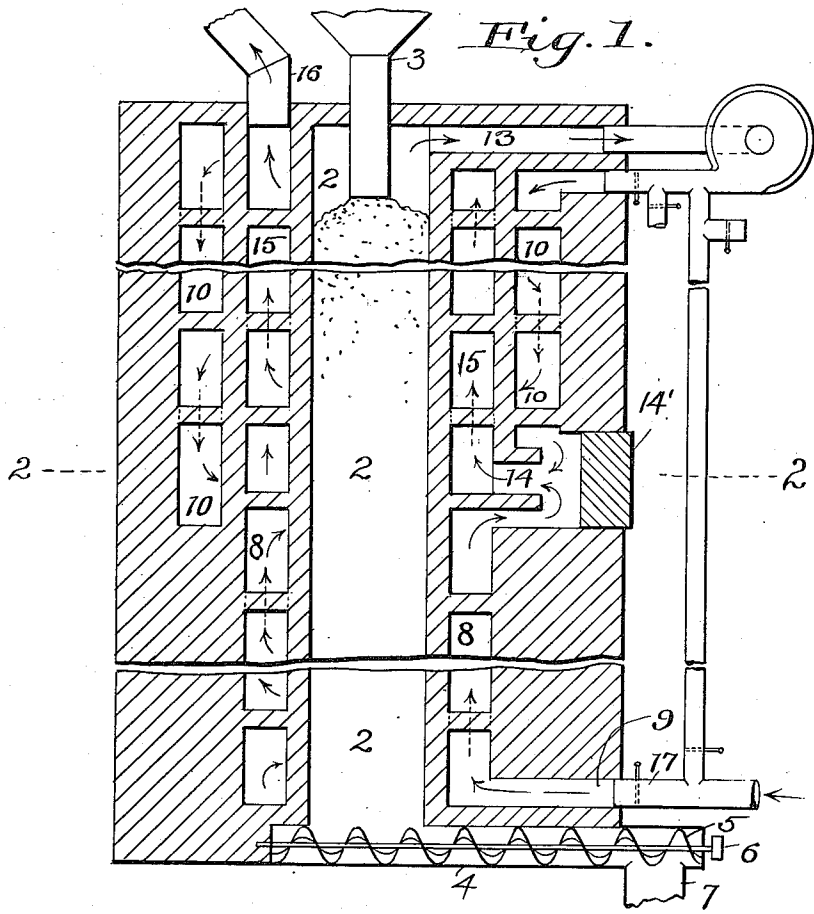
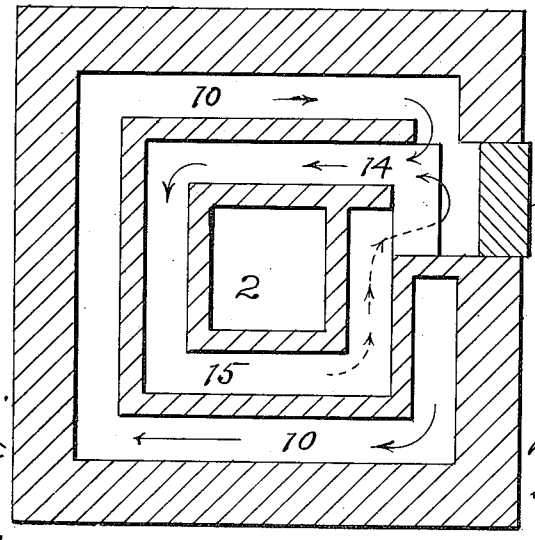


Fig. 2.



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3 SHEETS—SHEET 2.

Fig. 4.

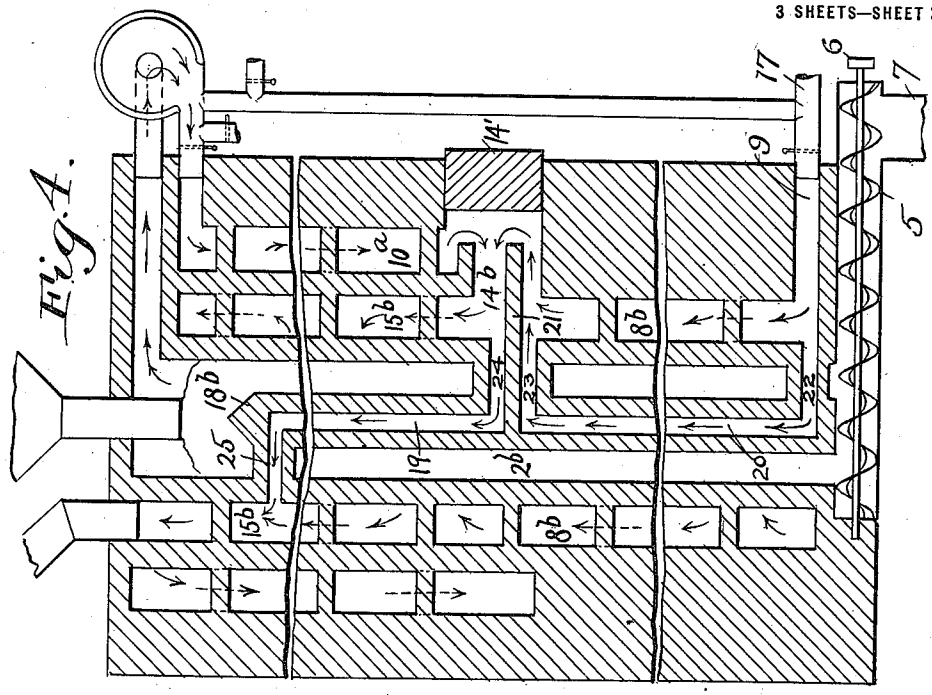
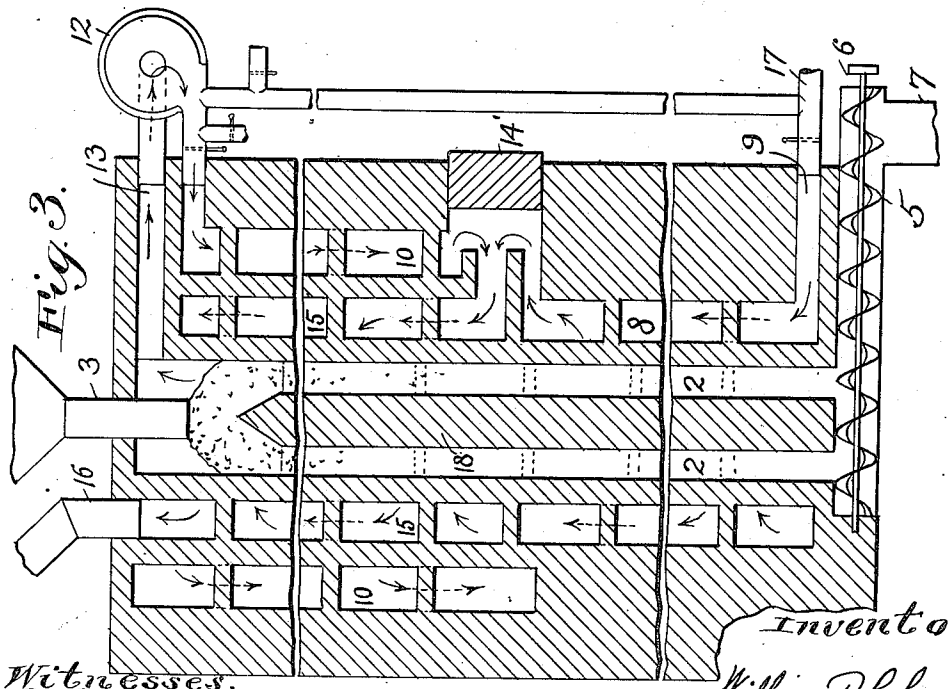


Fig. 3.



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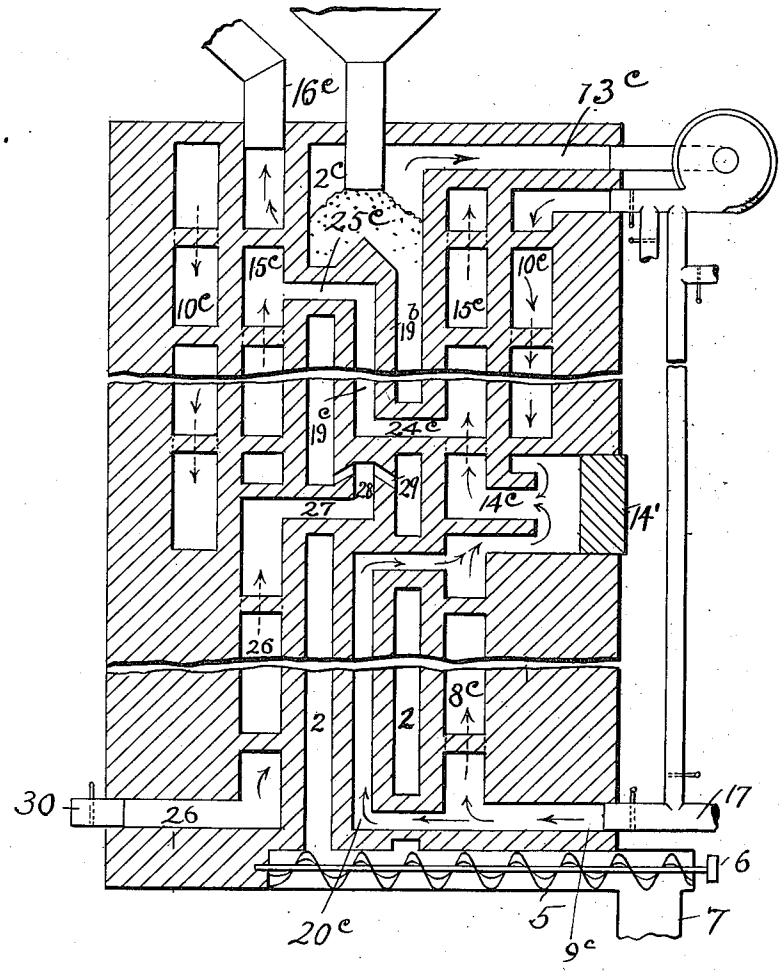
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3 SHEETS—SHEET 3.

Fig. 5.



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UNITED STATES PATENT OFFICE.

WILLIAM R. CLYMER, OF CLEVELAND, OHIO, ASSIGNOR TO NATIONAL CARBON COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF NEW JERSEY.

CALCINING-FURNACE.

1,147,706. Specification of Letters Patent. Patented July 27, 1915.

Application filed September 29, 1911. Serial No. 651,918.

To all whom it may concern:

Be it known that I, WILLIAM R. CLYMER, 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 Calcining-Furnaces, of which the following is a full, clear, and exact description.

This invention relates to a furnace for the heating of various materials and more particularly such material as granular or finely divided carbon.

The furnace is continuously operating, the charge being heated during its passage through the furnace.

The heat required to calcine may be provided by burning the gases given off by the carbon as it is heated, which, of course, will be mixed with air in quantities sufficient for combustion. With equal facility, the heat for heating may be provided by burning a portion of the carbon charge, or a combination of both methods of heating above described may be employed. Moreover, combustible gas may be introduced from an extraneous source, and with the addition of air, burned within the furnace to produce the required heat.

Generally speaking, the invention comprises the elements and combinations thereof set forth in the accompanying claims.

Reference should be had to the accompanying drawings, forming a part of this specification in which—

Figure 1 is a sectional elevation of the furnace; Fig. 2 is a cross section of the furnace upon the line 2—2 of Fig. 1; Fig. 3 is a sectional elevation of a modified form of furnace; Fig. 4 is a sectional elevation of a further modification; and Fig. 5 is a sectional elevation of still another form of furnace.

The body of the furnace is represented at 1, and may be of any desired shape, either round, square, or polygonal. The body of the furnace and the various walls therein are composed of suitable refractory material, such as fire brick.

At substantially the central portion of the furnace there extends from top to bottom thereof a calcining chamber 2, into which the charge may be fed by means of a hopper device indicated at 3, although other forms of feeding mechanism may be used. The granular material substantially fills the chamber 2, and is removed from the bottom of the chamber by the operation of the screw conveyer 5, which is operated from the pulley 6. As the material is removed from the bottom of the hopper, it is conveyed through the passageway 4 to the spout 7, from which it may be conveyed to the desired point for use.

Surrounding the heating chamber and extending along the same for a distance, is a tortuous passageway 8, which communicates with the passageway 9, which in turn leads to the outside of the furnace and is connected with a source of air supply. Above the central portion of the furnace is a tortuous passageway 10, surrounding and extending along the calcining chamber, which at its upper end communicates with a passageway 11, and this passage, by suitable connections communicates with a fan 12. The fan is also in communication with the passageway 13 in the body of the furnace which communicates with the upper portion of the calcining chamber 2. The gases which are evolved during the heating or calcining of the carbon are drawn from the upper part of the calcining chamber through the passageway 13 by means of the fan 12, and by the fan are forced to the passageway 10.

The passageways 8 and 10 merge into each other in a combustion chamber 14, which embraces the calcining chamber and in turn communicates with a tortuous passageway 15, which at its upper end is in communication with a stack or flue 16. Access to the interior of combustion chamber from the outside of the furnace may be had by removing the closure 14'. Inasmuch as the gases which are drawn from the calcining chamber 2 are very hot, it is desirable that the gases be cooled before they pass through the fan 12. This cooling of the gases has no effect upon the resultant use of the gases, but is merely to protect the fan against undue heating and consequent damage.

As before stated, the gases from the top of the calcining chamber are conducted to the tortuous passage 10 and to the combustion chamber 14. Likewise air is admitted to the passageway 9 through the damper controlled pipe 17. The air passing through the passageway 8 mixes with the gas in the burning chamber 14, the gas there being

ignited and burned. The greatest heat of the furnace is produced by the burning of gas in the chamber 14, and at this point in the chamber 2, the greatest heat will be supplied to the charge passing through the furnace.

As the products of combustion pass through the tortuous passage 15 on their way to the flue 16, they will pass around the calcining chamber 2, and deliver the heat which they are carrying to the walls of the calcining chamber, which will in turn pass it on to the charge which is within the calcining chamber. Therefore, when the burned gases pass to the stack 16, they will have delivered up substantially all of their heat to the charge within the furnace preheating the same, so that as a given portion of the charge approaches the hottest zone of the calcining chamber, heat is supplied to it in increasing amounts up to the maximum, which as before stated, takes place at that portion of the calcining chamber which is embraced by the combustion chamber 14.

As the charge descends below the region of the combustion chamber, it will deliver its heat to the air which is passing through the passageway 8, thus preheating the air so that the same will be highly heated at the time it mixes with the gases for burning, thus saving for use in the hottest zone of the calcining chamber, a large amount of heat which would otherwise be necessary in raising the temperature of the air. When the charge reaches the bottom of the calcining chamber 2, the heat will have been substantially all removed therefrom, so that the material removed from the spout 7 will be sufficiently cool, that it may be easily handled.

The passageway 10 occupies a position in the body or walls of the furnace immediately outside of the passageway 15 and the combustion chamber 14. The gas from the combustion chamber having been cooled previous to its passage through the fan 12, is in a cool condition when it enters the upper part of the passageway 10. However, as it descends through this passageway to the combustion chamber, it will absorb the heat from the walls which are between the passageways 10 and 15, in gradually increasing amounts, as it nears the combustion chamber. Consequently, when the gas meets the air in the combustion chamber, it is highly heated, and thereby saves for use in the combustion chamber, a large amount of heat which would otherwise be necessary to raise the temperature of the gases.

The forms which the passageways 8, 10 and 15 may assume may be varied, the main idea being to make the path tortuous to provide an extended path for the gases and at the same time to lead them in a path along the calcining chamber.

In the form shown in Fig. 1, the charge within the calcining chamber passes through the same in the form of a solid column. It is therefore necessary that the heat penetrate from the outside of the column to the inner part thereof. It may be desirable to cause the charge to be calcined, to assume a form which would be more easily penetrated by the heat for the calcining and in carrying forward this idea, the construction of the furnace may be changed, as suggested in Fig. 3. In this form of furnace, the passageways 8^a, 10^a, and 15^a are arranged and used in exactly the same manner as that heretofore described. The only difference in the construction of the furnace resides in the fact that a central pillar or column 18 is placed within the calcining chamber 2, and extends from the bottom of the chamber to a point just a short distance below the top thereof. The upper portion of the column 18 may be pointed, in order to permit an easy division of the material fed into the chamber so that the material will spread and flow equally to all portions of the chamber around the column. The provision of the column 18 causes the material treated to assume a hollow form, and the wall of the cylinder is very much thinner than the diameter of the column of material, as shown in Fig. 1. Working the charge in a hollow form enables the heat to much more readily penetrate to all portions of the charge and to heat the relatively thin walls of the hollow cylinder to a higher degree than would be possible in the first form of furnace.

In Fig. 4 is shown a form of furnace which carries forward the idea disclosed in Fig. 3, one step further, and provides a construction whereby the inner wall of the hollow form which the charge assumes, may be heated at the same time that the outer wall of the hollow form of material is heated, and also permits the air which is being fed to the combustion chamber to extract the heat from the inside and outside of the hollow cylinder of material treated, after the material has passed the zone of highest heat. The passageways 8^b, 10^b, and 15^b, and their various connections function in exactly the same manner as that described in connection with Fig. 1, and the passages 10^b, and 8^b are united in the combustion chamber 14^b. The column 18^b within the calcining chamber 2^b is hollow and is divided at the center thereof, so that there is formed an upper channel 19, and a lower channel 20, these channels being divided by a partition 21. The channel 20, at its upper and lower ends communicates with the air passage 8^b, by means of the passageways 22 and 23 respectively. The channel 19 connects with the combustion chamber by means of the channel 24, and at its upper end connects with the passageway 15^b, by means of the channel 25. It will be clear that in this form of

furnace, the charge of material assumes substantially a hollow form, although the travel of the charge is interrupted by the walls through which the passageways 22, 23, 24 and 25 are formed. The gas and air burn within the combustion chamber 14^b, and portions of the products of combustion pass through the passageways 24, 19 and 25, while other portions of the products of combustion pass directly through the passageway 15^b. It will thus be seen that the heat developed by the combustion of the gas and air is applied directly to the inner walls of the charge simultaneously with its application to the outer walls of the charge, thus insuring a complete heating of all of the material. The air admitted through the passageway 9^b will partly pass through the passageways 22, 20 and 23, and also through the passageway 8^b. In this manner, the cool air will abstract the heat from both the inner wall and the outer wall of the hollow cylinder of material to be calcined, prior to its expulsion from the furnace, thereby delivering a greater amount of heat to the air than in the cases previously discussed.

As before stated, it may be desirable to produce a greater amount of heat within the calcining chamber than can be produced by the burning of the gas and air, and in carrying forward this idea, I have shown in Fig. 5, a form of furnace which permits the combustion of the gas and air as a source of heat in conjunction with a construction which permits a portion of the charge to be burned. The air for the burning of the gas is admitted through the passageways 9^c, 8^c and 20^c, while the gas from the calcining chamber passes through the passageways 13^c and 10^c to the combustion chamber 14^c. The products of combustion from the burning of the gas pass through the passageways 15^c and 24^c, 19^c, and 25^c to the flue 16^c. A tortuous passageway 26 formed in the furnace wall extends to the outside of the furnace and permits the entry of air into the same. Communicating with this passageway is another passageway 27, which communicates with a chamber 28 formed in the column 19^b. This chamber has a plurality of outlets, one of which is indicated at 29, which communicate directly with the calcining chamber 2^c.

By virtue of the fact that the charge of material is heated by the burning of the gas within the combustion chamber 14^c, the admission of air to the calcining chamber through the passageways 29, will cause the combustion of a portion of the material within the calcining chamber, and thus supply additional heat. It will be noted that the combustion of the material within the calcining chamber will take place in that zone of the calcining chamber which is most directly affected by the burning of the gases in the combustion chamber. Hence the application of the heat to the material within the furnace will be culminative at this point, and supply to the charge to be treated the maximum amount of heat, which it is possible to obtain in a furnace of this type.

The amount of air admitted to the passageway 26 for the purpose of burning a portion of the charge may be regulated by the damper 30, and in this way the extent of the combustion of the charge may be controlled. It will be well understood and perfectly apparent that the heat for calcining the charge may be furnished entirely by the burning of a portion of the charge in the manner indicated, and not utilize the burning of the gases formed in the calcining chamber. In this form of furnace, the partial combustion of the charge produces carbon dioxid, but this gas as it ascends through the heated charge, is by reaction with the carbon, reduced to carbon monoxid, which when burned in the combustion chamber produces a high heat.

In the various forms of furnaces shown, the passages which have been designated for air and unburned gas, may be used interchangeably for gas and air, and, as will be readily seen, this does not affect the operation of the furnace in any way. The fan 12 has been shown in the connection between the top of the calcining chamber and the passage which conducts the gas to the combustion chamber. However, it will be understood that the fan may be placed in any position where it will cause the various gases and air to travel through the several passageways. If for any reason, it is found desirable to supply gas for burning from some extraneous source, this may be readily accomplished by introducing the same at any point in the connection between the top of the calcining chamber and the gas passage. In the event that some material is being calcined which does not yield a combustible gas, then the passageway leading from the top of the calcining chamber may be closed, and gas introduced into the gas passageway from some outside source.

While I have disclosed my furnace in connection with the calcining of carbon, it will be readily understood that other materials may be calcined in the furnace disclosed with equal facility.

Having thus described my invention, what I claim is:

1. A calcining furnace comprising a body portion having a heating chamber through which the material to be heated may pass, said body being provided with a combustion chamber surrounding a portion of the heating chamber intermediate its ends, said body having a tortuous passageway adjacent the intake end of said chamber for conducting gaseous material to the said combustion chamber, said body having another passage-

way extending adjacent the discharge end of the heating chamber, said passageway communicating with the combustion chamber, the last mentioned passageway being adapted to convey air to the combustion chamber, whereby the heated charge is cooled by the passing air, and means for conducting away the burned gases.

2. A calcining furnace comprising a body having a calcining chamber therein, a tortuous passageway formed in the wall of the furnace and extending along the lower portion of the calcining chamber, a tortuous passage formed in the walls of the furnace and extending along the calcining chamber near the upper portion thereof, a burning chamber adjacent the calcining chamber with which the said passageways connect, means for conducting gases from the upper part of the calcining chamber to the tortuous passageway at the upper portion of the calcining chamber, means for admitting air to the passageway at the lower portion of the calcining chamber, and means for conducting away the burned gases.

3. A calcining furnace comprising a body portion having a calcining chamber through which material to be treated may pass, a passageway for the admission of air extending along a portion of said chamber, a passageway also extending along a portion of said chamber, said last mentioned passageway conducting away products of combustion, a combustion chamber adjacent the calcining chamber with which said passageways connect, and means for supplying a combustible gas to the combustion chamber.

4. A calcining furnace comprising a body having a calcining chamber through which the material to be treated may pass, a combustion chamber embracing a portion of the calcining chamber, a passageway in the walls of the furnace extending along a portion of the calcining chamber and communicating at one end with the combustion chamber and at its opposite end with a flue, a second passageway formed in the walls of the furnace, paralleling the first mentioned passageway and communicating at one of its ends with the combustion chamber, means connecting the opposite end of said passageway with the upper portion of the calcining chamber, a third passageway in the walls of the furnace extending along a portion of the calcining chamber, one end of said passageway connecting with the combustion chamber, and the other end of the passageway connecting with a source of air.

5. A calcining furnace comprising a body having a calcining chamber, means for feeding the material to be treated into said chamber, means for continuously removing the material treated from the opposite end of the chamber, means for supplying a relatively strong heat to the material within the calcining chamber at a place between the ends thereof, and means for preheating the charge of material before the greatest heat is applied thereto.

6. A calcining furnace comprising a body having a calcining chamber through which the material being treated may pass, means for applying a relatively strong heat to said chamber at a portion between the ends thereof, and means for circulating the excess heat from the said heating, outside of and around the said chamber to preheat the charge before the greatest heat is applied.

7. A calcining furnace comprising a body portion having a calcining chamber through which the material to be treated may pass, means for applying a relatively strong heat to a portion of said chamber between the ends thereof, means for preheating the charge in the calcining chamber previous to the application of the strongest heat, and means for circulating a cooling medium around that portion of the chamber into which the material passes after being heated.

8. A calcining furnace comprising a body portion having a calcining chamber through which the material to be treated may pass, means for heating a portion of the said chamber by means of a burning gas, means for preheating the charge within the calcining chamber by the products of combustion from the burning of said gas, and means for circulating air around and outside of that portion of the chamber into which the material passes after being heated, which air mixes with the gas to be burned.

9. A calcining furnace comprising a body having a calcining chamber, means for heating a portion of said calcining chamber by the burning of the gas which is formed when the material within the calcining chamber is treated, means for supplying air to said gas to burn the same, said air previous to burning being utilized to cool the charge within the calcining chamber after it has been treated.

10. A calcining furnace comprising a body having a calcining chamber therein, means for utilizing the gases formed by the calcining of the material treated to heat a portion of the calcining chamber, means for supplying air to said gas, means for conducting the said air adjacent the calcining chamber to cool the material within the calcining chamber after it has been calcined, whereby the air is heated, means for preheating the material within the calcining chamber by the heat derived from the products of combustion from the burning of the gas and air, and means for preheating the gas to be burned, by passing the same adjacent to the means conducting away the products of combustion.

11. A calcining furnace comprising a calcining chamber, a column centrally located

in said chamber about which the charging material flows, means for applying a relatively strong heat to said chamber at a portion between the ends thereof, and means for preheating the charge before the greatest heat is applied.

12. A calcining furnace comprising a body provided with a calcining chamber, a column centrally located within said chamber and extending substantially throughout the length thereof, a passageway extending through the upper part of said column and a passageway extending through the lower part of said column, a combustion chamber embracing the calcining chamber, means for conducting gases formed in the calcining chamber to the combustion chamber, means for supplying air through the passage in the lower part of the column to the combustion chamber, means for conducting the products of combustion from the combustion chamber along the outside of the calcining chamber, a portion of said combustion gases passing through the passage in the upper part of said column.

13. A calcining furnace comprising a body having a calcining chamber, a column located centrally within said chamber and extending substantially throughout the length thereof, a passageway extending longitudinally through the upper portion of said column, a combustion chamber embracing the calcining chamber, a passageway connecting the said combustion chamber with the passageway in the upper portion of the column, a tortuous passageway extending through the wall of the furnace along the calcining chamber, said passageway being connected with the combustion chamber at one end and with a flue at its opposite end, a passageway connecting the said tortuous passageway and the passageway extending through the upper part of the column, a tortuous passageway extending along the calcining chamber at the lower portion thereof, said passageway being connected at one end with the combustion chamber and at its opposite end with a source of air, a passageway extending through the lower portion of the column, said passageway at its upper and lower end being connected with the last mentioned tortuous passageway.

14. A calcining furnace comprising a body having a calcining chamber, a column centrally located in said chamber and extending substantially throughout the length thereof, a chamber located in said column, and ducts connecting the said chamber with the interior of the calcining chamber, a passageway extending through the body of the furnace and connected with the chamber within the column, said passageway being connected with a source of air supply.

15. A calcining furnace comprising a body having a calcining chamber, a column centrally located within said chamber and extending substantially from end to end thereof, a tortuous passageway extending along the upper portion of the calcining furnace, a passageway extending through the upper portion of said column, said passageway in the column being connected at both its ends with the said tortuous passageway, a combustion chamber embracing the calcining chamber, said tortuous passageway being connected at one end with said combustion chamber and at its opposite end with a flue, a second tortuous passageway formed in the body of the furnace and extending along the lower portion of the calcining chamber, said tortuous passageway being connected at one end with combustion chamber and at its other end with a source of air supply, a passageway formed in the column near the lower portion thereof, the opposite ends of said passageway being connected with the said second tortuous passageway, a chamber formed in the central portion of a column, a passageway formed in the body of said furnace with which the said chamber connects, the last mentioned passageway being connected with a source of air supply.

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

WILLIAM R. CLYMER.

Witnesses:
MINER W. ALLEN,
OSCAR S. PULMAN.