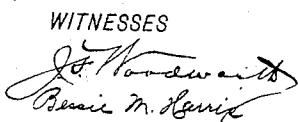


931,645.

2 SHEETS--SHEET 1.



BY
Stewart & Stewart
ATTORNEYS

G. L. PRENTISS.
METHOD OF FIRING FURNACES.
APPLICATION FILED SEPT. 14, 1907.

931,645.

Patented Aug. 17, 1909.

2 SHEETS—SHEET 2.

Fig. 3.

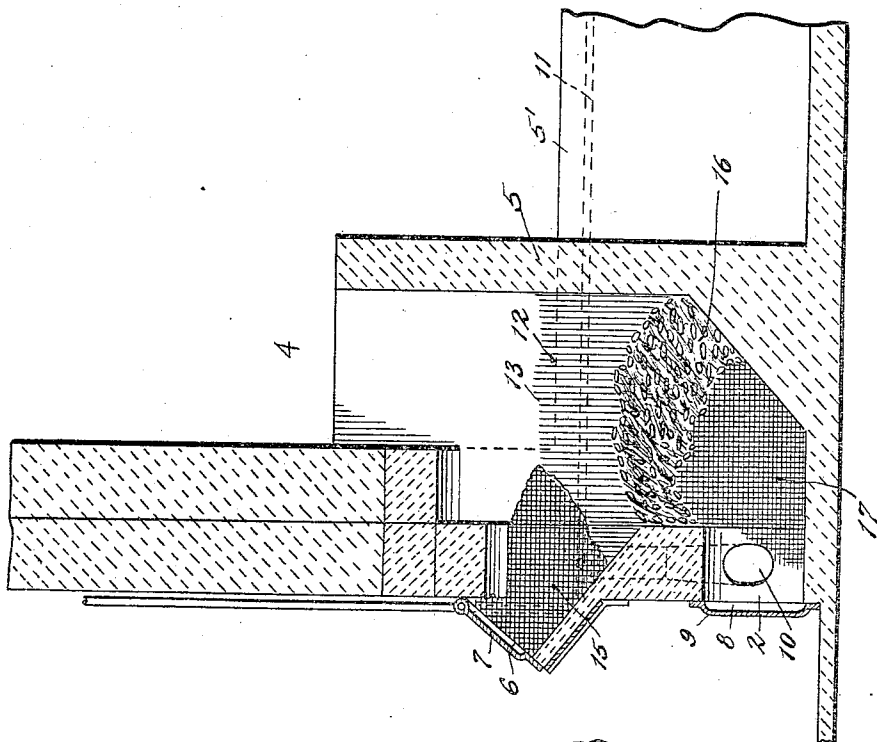
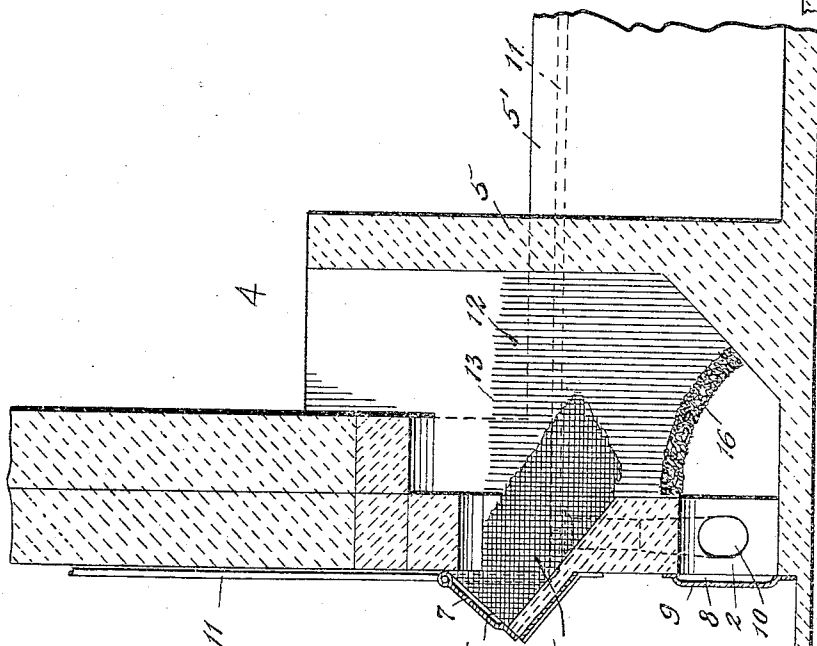


Fig. 2.



WITNESSES

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UNITED STATES PATENT OFFICE.

GEORGE L. PRENTISS, OF MONTCLAIR, NEW JERSEY.

METHOD OF FIRING FURNACES.

No. 931,645.

Specification of Letters Patent.

Patented Aug. 17, 1909.

Application filed September 14, 1907. Serial No. 392,898.

To all whom it may concern:

Be it known that I, GEORGE L. PRENTISS, a citizen of the United States of America, residing at Montclair, New Jersey, have invented certain new and useful Improvements in Methods of Firing Furnaces, of which the following is a specification.

My invention relates to an improved method for firing blank and other furnaces, with special reference to brick kilns, whereby certain desirable conditions of combustion may be obtained in the furnace, or in the blank or heating chamber of the furnace.

More particularly, the invention relates to the maintenance of these conditions of employing as the source of heat a gas producer conducted and operated in a peculiar and novel manner.

In the burning of brick and other refractory material for instance there appear to be certain laws relating to combustion to be observed if the best product is to be obtained. A departure from these laws involves an inferior product. It is desirable, for instance, that the gases burning in a brick kiln be under pressure and the same is true of every heating furnace; otherwise, they take the shortest path to the stack, and the brick or other material is not uniformly affected by them. Suitable pressure, however, will cause the burning gases to engage the brick or other material over all exposed surfaces alike and in the most effective manner. Again, certain kinds of brick for instance, seem to be peculiarly sensible to changes of temperature and to need a carefully adjusted and uniformly progressive temperature, and to be susceptible to injury by an excess of improperly burned or heated oxygen. It seems desirable that a certain carefully graduated progression of temperature be had in a brick kiln, and that the temperature conditions be uniform, and that there be no contact with the brick of unburned oxygen. These considerations apply with equal force to the burning or heating of other material than brick.

Attempts to maintain in a kiln or heating chamber, a proper pressure, a uniformity of temperature, determined rise or progression of temperature, and the other desirable conditions of combustion have not been lacking. Attempts have also been made to obtain these conditions by the employment of gas producers and steam blasts in various manners. For one reason or other, however, the

desired conditions have not been satisfactorily obtained. Particular difficulty seems to have been experienced in the use of gas producers and steam blasts. Bricks heretofore produced by processes in which these have been employed have been checked, cracked or discolored or the cost of operation has been found too high. Other material has been variously and injuriously affected when treated by these processes.

Where a grate fire of the usual kind, or any other thin fire, has been heretofore employed, particularly when in connection with a steam blast, the material being treated has often been injured. The most probable reason for this seems to be that it is difficult with fires of such a nature to prevent the burning or blowing of holes through the fuel and the consequent admission into the heating chamber through such holes of unburned oxygen or free air and steam, in excess. The admission of cold air to the heating chamber is especially likely to occur in furnaces as heretofore constructed when the door is opened to supply fresh fuel, or when the ash-pit door is opened to remove ash. The admission of cold air at such times, besides cooling the heating chamber and causing undesirable fluctuations of temperature therein, results in a waste of heat and lengthening of the time required for heating the material.

I have discovered that a certain combination of gaseous elements so treated that, after being emitted from the furnace and intimately mixed and brought to a state of uniform temperature, and then fed to the kiln under pressure, will produce in the heating chamber or kiln a condition of combustion which has heretofore not been attained, which is eminently satisfactory for the burning of brick and other material. More particularly, I have found that, by constructing my furnace in connection with a steam blast in such a way that no excess of unburned oxygen, cold air, or steam can be admitted to the heating chamber, the proper conditions of uniformity of temperature, pressure and combustion may be obtained.

In the embodiment of my invention hereinafter to be described in detail, there is employed a steam blower or blowers for supplying steam to the fire and for maintaining a pressure in the kiln or other heating chamber, sufficient to cause the burning

gases to engage the material uniformly. Interposed between the main or primary blower of which there is at least one to each furnace and the heating chamber is the fire, which, in this instance, consists of a mass of burning coal tamped or packed to considerable depth in a comparatively narrow passage forming the fire chamber, and opening at one end into the heating chamber. At the other end of the passage is the ash-pit into which the blower ejects the steam and air under pressure. At a point of the fire chamber intermediate the ends of the fuel column, I provide an opening through which the fire may be fed and tamped or packed. This opening may be provided with an exterior sealing door which is closed except when fuel is being fed or tamped through the opening, and which when closed prevents any passage of air, gases or other fluids through the opening. The presence of such a door is not always a necessity as the fuel itself (in its unburned condition) frequently forms an effective barrier to the passage of air. The fuel column being fed or tamped from an intermediate point of the same, the portion of the fuel above the feed openings serves to seal the heating chamber against the admission of cold air at the time the furnace door or hopper is open for feeding or tamping. In the furnace shown I employ no grate. As the fuel burns, and the ash and clinkers must be removed at the pit, other fuel may be supplied through the pit as necessary into the part of the fuel column previously occupied by the ash removed. The opening to the ash-pit is also normally closed by a sealing door to prevent the passage of air, steam, or gases through the same when the blower is in operation. As the column of packed fuel drops or is burned away, new fuel is packed in through the intermediate and sometimes also the ash-pit openings referred to in order that the length and homogeneity of the column may be maintained.

Owing to the depth and solidity of the fuel column, no holes are burned or blown through it, and no opportunity is offered for unburned oxygen or excess steam to reach the kiln or other heating chamber from the pit. All air and steam must pass from end to end through the column of closely packed fuel and be thoroughly and uniformly heated and mixed with the other gaseous constituents before being delivered to the heating chamber. The steam, when thus heated and intimately mixed with the other gases, in addition to providing the pressure for the heating chamber, produces therein, by reason of the hydrogen forming one of its elements, a condition of long, burning flames which seem to be peculiarly beneficial to brick and many other materials capable of being thus treated. The closely packed column acts as

a regulator to prevent any fluctuation of temperature within the kiln or other chamber such as might otherwise occur through the burning of holes through the fuel, or upon the opening of the furnace and doors. The temperature in the heating chamber or kiln is maintained substantially uniform throughout its area and said temperature may be progressively raised. Properly managed, it can never drop so that the brick or other material will be injured by the condensation of steam thereon by the interruption to the duly progressive rise or the uniformly maintained temperature which may be needed in the particular case, or by the other incidents of an uncertain or fluctuating temperature accompanied by free air and improperly burning gases.

The progressive burning of a solid column of fuel, as has been described, will with all fuels bring about the progressive accretion or deposition of ash or clinker, or both combined at the base of said column. Sometimes this clinker becomes too hard or too glutinous and "ropy" for satisfactory handling, and it is necessary to adopt means for its treatment of an extraordinary character. One of such means is the placing in the ash-pit upon the floor or hearth of the furnace of fresh coal after the removal of sufficient clinker to clear the furnace and enable it to further consume fuel. The office of such coal placed in the ash-pit is to there burn as a result of its ignition by radiated heat, and by giving off its own heat, melt or make plastic clinker above it, which may have hardened unduly. Another of such means is the supplying of subsidiary blowers, the location of which, with reference to the body of the fuel, is determined by the stage of combustion of the various parts of the fuel column. One or more of such subsidiary blowers may be so located as to drive air and steam (by an injector blower) or air alone (by the use of a fan or other propeller) directly upon the incandescent bed of coal in a line substantially parallel with the line at which ash forms in the furnace and directly above it. The result of this treatment is in many instances to prevent clinker where under any other method of treatment clinker would form and to raise the furnace temperature where desirable. The reason for this is that the hydrogen and air take heat very rapidly from the fuel just forming into ash and do it at such a time and in such a manner that sufficient heat does not there exist to cause the ash to run together into clinkers. When the ash drops down and away from the bed of fire, it becomes progressively cooler and thus never has an opportunity to vitrify and is ultimately removed as ash.

Having set forth briefly the objects and nature of my invention, I will now describe

the same in connection with the accompanying drawings in which—

Figure 1 represents the furnace in connection with a brick kiln or other blank chamber, the fuel in the furnace being shown in an early stage of the process of combustion. Fig. 2 represents a second or later stage of a combustion in the same furnace. Fig. 3 represents a still later and perhaps the normal condition of combustion after the fire is fully under way. Fig. 4 shows the applicant's method of representing in Figs. 1, 2 and 3 the fresh and burning fuel, and ash and clinkers.

Referring to Figs. 1, 2 and 3 the furnace combustion chamber is illustrated at 1, terminating at its lower end in the ash pit 2 and at its upper end opening through the passage 3, into the blank or heating chamber 4 of a brick kiln or other furnace. The burning gases from the combustion chamber are directed to any desired part of the heating chamber by means of the partition or wall 5 the shape and position of which may be varied at will. This means 5 of directing the gases to a desired part of the chamber is of importance as heretofore stated. In brick kilns for example, I have found it extremely desirable that the gases enter the chamber above the brick and circulate over and down through the same instead of entering below the brick. The wall 5 is accordingly shown as carried well above the floor 5' of the chamber, on which brick is stacked.

The furnace is shown as having an opening 6 through the front wall into the combustion chamber 1 at a point intermediate the ends of the latter. The opening 6 is provided with a normally closed fluid sealing door 7. The opening 8 into the ash pit is similarly provided with a fluid sealing door 9. The doors 7 and 9 when closed prevent passage to or from the furnace through the openings 6 and 8 of any air, gas, steam or other fluid. A blower is located at the point 10 of the fire-pit. Through this the air and steam necessary to the combustion is injected into the furnace. Steam is supplied to the blower by a pipe 11 from a boiler, the pipe 11 being led through the walls of the heating chamber before terminating at the blower in order that the steam may be effectively superheated before its injection into the furnace. The blower is also in connection with an air supply passage, and this passage also passes through the furnace before terminating at the blower. The superheating of the air and steam is of considerable importance to the process of this invention.

In carrying out the process of the invention the furnace is first filled, say with wood, and a fire started. As the fire gets underway, coal 12 is supplied through the opening 6 to a level 13 in the combustion chamber,

above such opening, the door 7 being opened for this purpose. As the coal burns ash and clinker will collect in the fire pit as illustrated at 14 in Fig. 1. After the coal 12 is burning well throughout its mass the door 7 is again opened and a fresh body of coal 15 fed in and tamped through the burning coal 12. Because of the level 13 at which the coal 12 is maintained, no air can reach the heating chamber 4 when the door 7 is opened for feeding and tamping in the fresh coal 15 unless such air first passes through the burning coal 12. In passing through the burning coal 12, any such air will be burned, and it cannot reach the brick or other material in the chamber 4 in cold or unburned conditions. Air for combustion of gases formed in this furnace may, of course, be supplied in any suitable manner, analogous to the process employed in regenerative or recuperative chambers or furnaces, or directly to the blank chamber or solely through the fire bed, as the circumstances may require. The blower is now shut off, the ash pit door 9 opened, and the ash and clinker 12 removed from the ash pit. The solidity with which the fuel 15 is packed together with the fact that the clinker tends to form a solid bridge 16 over the ash-pit (see Fig. 2) prevents the collapse of the fuel column into the ash pit when the ash and clinker 12 are removed from the same. Fresh fuel 17 (see now Fig. 3) is then fed into the ash pit as may be needed through the opening 8 and packed therein under the fuel column burning above. In Fig. 3 the clinker bridge or arch 16 as shown is well developed at this stage of the combustion. While the door 9 of the ash is open any air entering the same must pass through the burning column above, and be thoroughly heated or burned before it reaches the chamber 4, so that here again the brick or other material is protected from cold or unburned air. The depth and solidity of the column of burning fuel eliminates, of course, the possibility of the air entering at 8, blowing holes through the fuel and escaping through such holes in a relatively cold condition to the chamber 4. Such holes could be blown through a thin fire such as the ordinary grate fire, but never through such fire as is here employed. After the fuel 16 is supplied and the door 9 closed the blower is again put in operation. As the fire continues to burn the operations heretofore described are repeated when necessary. The fresh fuel 16 under the clinker bridge at the ash pit burns more rapidly than the fresh fuel supplied through the door 6, and must from time to time be renewed, but before each renewal the ash and clinker must be removed. As the fuel 12 above the clinker bridge 16 burns away, new fuel is tamped in through the door 6. If clinker becomes so troublesome that the method just

referred to is difficult, the placing of blower or blowers intermediate between the ends of the column of fuel and at about the point where ash normally begins to form in the column is very beneficial.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is:—

1. The method of firing furnaces consisting in packing with fuel the passage which supplies the burning gases to the heating chamber, in maintaining the fuel so packed in active combustion by a draft through part of the same, withdrawing the ash from the ash pit end of the fuel column, feeding fresh fuel to an intermediate point of the column and tamping the same to maintain the column compact and homogeneous.

2. The method of firing furnaces consisting in packing with fuel the passage which supplies the burning gases to the heating chamber, in maintaining the fuel so packed in active combustion by a blast of air and steam through part of the same, withdrawing the ash from the ash pit end of the fuel column, feeding fresh fuel to an intermediate point of the column and tamping the same to maintain the column compact and homogeneous.

3. The method of firing furnaces consisting in packing with fuel the passage which supplies the burning gases to the heating chamber, in maintaining the fuel so packed in active combustion by superheated steam and air through part of the same, withdrawing the ash from the ash pit end of the fuel column, feeding fresh fuel to an intermediate point of the column and tamping the same to maintain the column compact and homogeneous.

4. The method of firing furnaces consisting in packing with fuel the passage which supplies the burning gases to the heating chamber, maintaining the fuel so packed in active combustion by a draft therethrough, withdrawing the ash from the ash-pit end of the fuel column, feeding fresh fuel to an intermediate point of the column and tamping the same to maintain the column compact and homogeneous.

5. The method of firing furnaces consisting in packing with fuel the passage which supplies the burning gases to the heating chamber, maintaining the fuel so packed in active combustion by a blast of steam and air therethrough, withdrawing the ash from the ash-pit end of the fuel column, feeding

fresh fuel to an intermediate point of the column and tamping the same to maintain the column compact and homogeneous.

6. The method of firing furnaces consisting in packing with fuel the passage which supplies the burning gases to the heating chamber, maintaining the fuel so packed in active combustion by a blast of superheated steam and air therethrough, withdrawing the ash from the ash-pit end of the fuel column, feeding fresh fuel to an intermediate point of the column, tamping the same to maintain the column compact and homogeneous.

7. The method of firing furnaces, consisting in packing with fuel the passage which supplies the burning gases to the heating chamber, maintaining the fuel so packed in active combustion by a draft therethrough, withdrawing the ash from the ash-pit end of the fuel column, substituting fuel at the ash-pit end of the column for the ash removed, feeding fresh fuel to an intermediate point of the column and tamping the same to maintain the column compact and homogeneous.

8. The method of firing furnaces consisting in packing with fuel the passage which supplies the burning gases to the heating chamber, maintaining the fuel so packed in active combustion by a blast of steam and air therethrough, withdrawing the ash from the ash-pit end of the fuel column, substituting fuel at the ash-pit end of the column for the ash removed, feeding fresh fuel to an intermediate point of the column and tamping the same to maintain the column compact and homogeneous.

9. The method of firing furnaces, consisting in packing with fuel the passage which supplies the burning gases to the heating chamber, maintaining the fuel so packed in active combustion by a blast of superheated steam and air therethrough, withdrawing the ash from the ash-pit end of the fuel column, substituting fuel at the ash-pit end of the column for the ash removed, feeding fresh fuel to an intermediate point of the column, tamping the same to maintain the column compact and homogeneous.

Signed by me at New York city this 13th day of September, 1907.

GEORGE L. PRENTISS.

Witnesses:

JACOB I. BERGEN,
BESSIE M. HARRIS.