2 Sheets—Sheet 1.

I. KENDRICK.

Apparatus for Promoting Combustion in Furnaces.

No. 209,273. **Patented Oct. 22, 1878.**

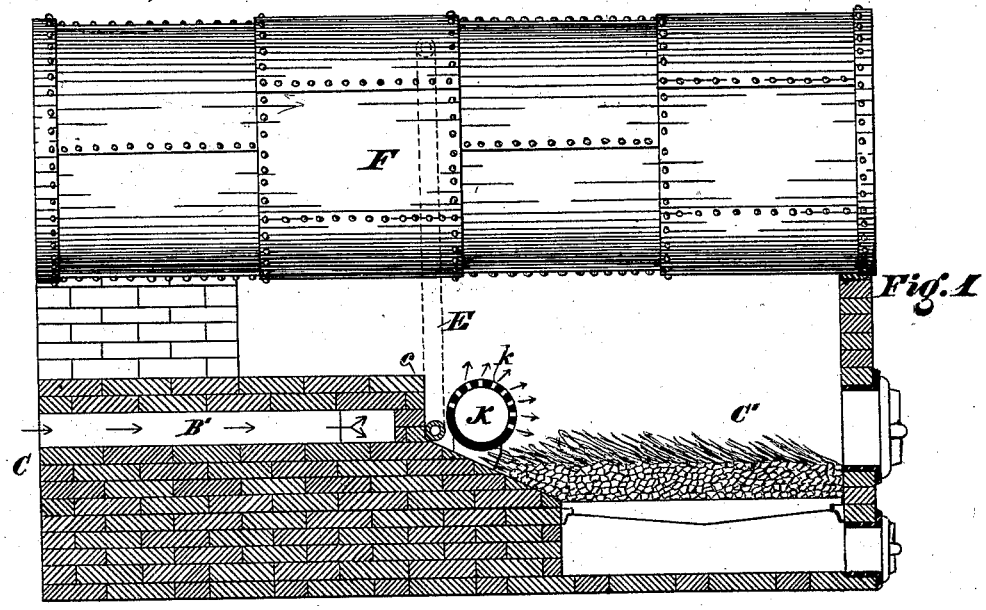

Fig. 1

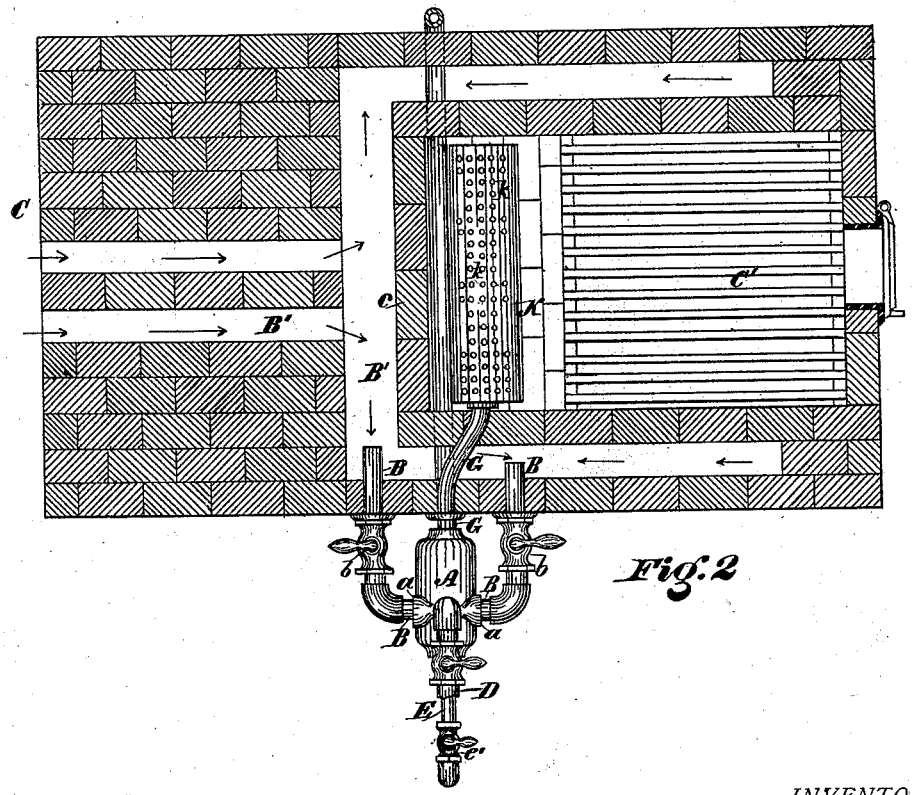

Fig. 2

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2 Sheets—Sheet 2.

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Fig. 3

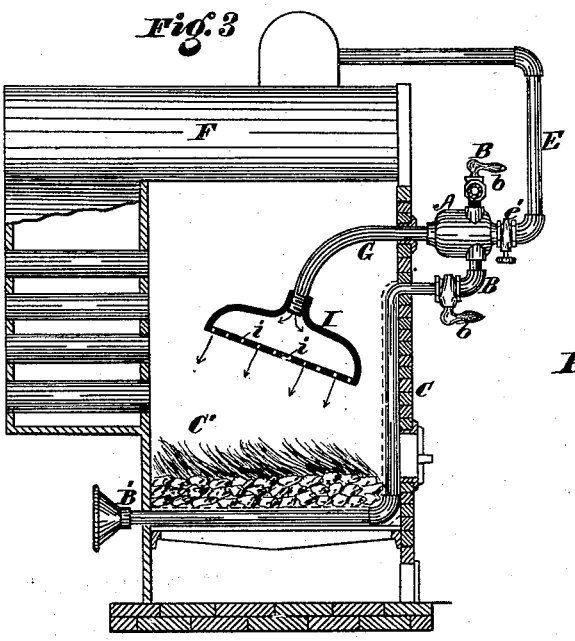
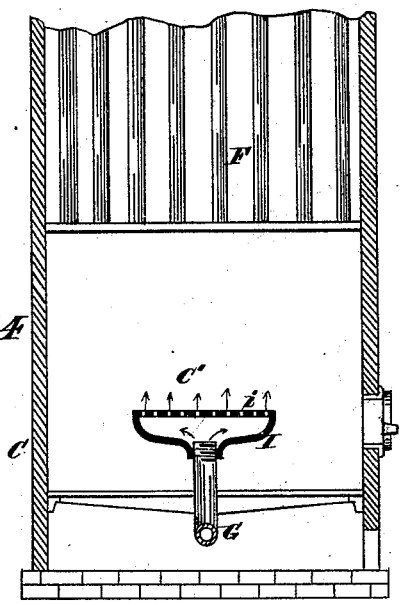


Fig. 4



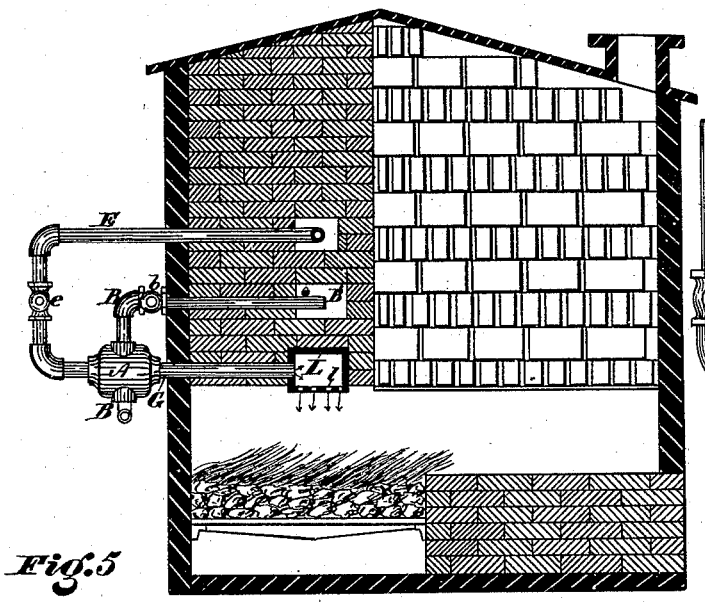


Fig. 5

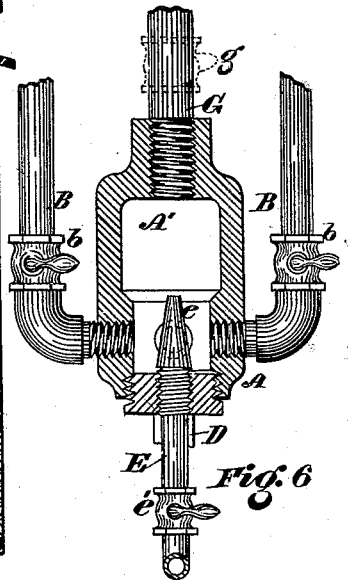


Fig. 6

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UNITED STATES PATENT OFFICE.

ISAAC KENDRICK, OF PHILADELPHIA, PENNSYLVANIA.

IMPROVEMENT IN APPARATUS FOR PROMOTING COMBUSTION IN FURNACES.

Specification forming part of Letters Patent No. **209,273**, dated October 22, 1878; application filed November 14, 1877.

To all whom it may concern:

Be it known that I, ISAAC KENDRICK, of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Apparatus for Promoting Combustion in Furnaces; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use it, reference being had to the accompanying drawings, which form part of this specification, in which—

Figures 1 and 2 are, respectively, a vertical and horizontal longitudinal section of my invention. Figs. 3 and 4 are sectional views, showing modifications of my invention. Fig. 5 is a section of a brick-kiln, showing my improvements applied thereto; and Fig. 6 is a detail section of the mixing-chamber.

My invention has for its object to promote the combustion of fuel in furnaces, and relates to a process whereby such object is attained; and consists in the peculiar construction and combination of devices for carrying such process into effect; and said devices consists of a peculiarly-constructed mingling or mixing chamber and a distributing-retort, combined with sundry air-flues and steam-pipes, as hereinafter fully set forth.

The process to the performance of which said devices are adapted, but which, it is to be understood, is not claimed as my invention, consists, essentially, in supplying mingled heated air and steam, or the elements thereof which have been reheated to a high heat after their mingling or combination has been effected, to the furnace-fires, or the inflammable gases thereof.

Heretofore, in supplying steam and air to furnaces to promote combustion therein, due regard has not been paid to the proportions in which the same were provided, nor, so far as I am aware, have mingled air and steam been reheated in an expansion chamber or retort after their union has taken place and before discharging them into furnaces. The result of this neglect or absence of invention has been that the supply or proportions of such air and steam not having been duly regulated, nor any reheating in such expansion chamber or retort having been effected after the mingling of the air and steam and before their discharge, the carbon in the inflammable gases of the furnace did not unite with the air and steam, whence imperfect combustion resulted.

With my invention the air and steam are mingled in such proportions and reheated to such a degree after mingling that when supplied to a furnace each atom of carbon in the gases of the latter is furnished with its equivalent of oxygen, the atoms instantly combining and producing perfect and complete combustion of such gases and every part thereof.

In carrying my invention into effect, I provide a hollow or chambered casting of iron or other suitable material, the side walls of which are formed with one or more openings for the admission of air, its respective ends having orifices for the reception of a steam-pipe and for the exit of the mingled air and steam. The side openings are connected with pipes which convey heated air; and when for special purposes a pure flame, free from sulphur, is required, and it is desired to make use of a hydrocarbon or other gas in lieu of coal as a fuel, I attach another pipe to one of said side openings and connect the same with a gas retort, holder, or well. The steam-pipe, which enters at the rear end of the casting, terminates in a short nipple, which extends slightly forward of the air-openings, so that when steam is admitted through said pipe it will produce suction in said side openings and draw in air through the pipes connected with the latter. From the end of the chamber opposite the steam-inlet end proceeds a pipe, through which the mingled air and steam are conveyed to the furnace. This pipe preferably terminates in a retort-distributer, composed of iron or other material capable of resisting high heat, said retort being, by preference, in the form of a rose-head when applied to the furnaces of tubular steam-boilers, and when applied to furnaces having a hearth, bridge-wall, or fire-chamber composed of brick, it is preferred that this reheating and distributing device should be cylindrical in form and perforated with small drill-holes; or it may be a chamber or flue, located so as to be fully exposed to the heat action of the furnace, pref-

erably made in the bridge-wall, having openings leading to the combustion-chamber.

The purpose of this retort-distributer is, first, to receive and subject the mingled hot air and steam to the influences of a high heat—*i. e.*, a red heat—whereby they are, in a measure, resolved into their constituent gases; and, second, to break up, discharge, and distribute the same in a divided condition over the furnace-bed, or into the inflammable gases of the furnace, preferably in a direction obliquely to the line of the draft-current of the furnace, so that the elements of such highly-heated air and steam are brought forcibly into collision with the combustible gases of the furnace, thus furnishing each atom of carbon in said gases with its equivalent of oxygen, thereby securing perfect and complete combustion. Said retort-distributer I make of larger capacity than its inlet-pipe or exit-openings, so as to permit the expansion therein of the entering air and steam current or blast, thus exposing the latter for a longer period to the action of heat and raising its temperature to a higher degree than would be obtained if no such large chamber were provided.

Referring to the accompanying drawings, A designates a hollow or chambered casting, having side openings *a a*, with which pipes B B are connected, said pipes communicating with hot-air flues, chambers, or heat-reservoirs B′ in a furnace, C.

Where a hydrocarbon gas is desired to be used to produce a pure flame, as already suggested, one of the pipes B, or a separate pipe, D, entering the side of the casting A, and communicating with a gas retort, holder, or well, is provided.

E is a pipe which enters the rear end of the casting A, and is provided with a nipple, *e*, projecting into the chamber A′ a short distance forward of the openings *a*. Said pipe leads to a steam-generator, F, or to a dome on the latter, being, by preference, passed through the furnace C, or otherwise subjected to heat, for the purpose of superheating its contents before their admission to the chamber A′.

G is a pipe leading outwardly from the chamber A′, and serving to convey the mingled air and steam to the furnace C. Said pipe terminates in what I call a "retort-distributer," which is located within the fire-chamber C′ of the furnace C, or in such position as to receive the influences of the heat of the latter. Said retort-distributer may be a rose-head, I, of cast-iron, or a cylinder, K, of iron or other material capable of resisting high heat, having, respectively, exit-orifices *i k*. In some cases said retort-distributer may be a flue or chamber, L, formed in the wall or in the ceiling of the fire-chamber, having exit-openings *l*, leading to the latter. In every case the retort-distributer should be of greater capacity than its inlet or its outlets, so that the heated air and steam conveyed to it may expand therein before being discharged, and be subjected to the influences of the furnace-heat for a longer time than they would be if merely passed through the device without being detained therein.

The air and steam pipes B B E and the pipe G, for conveying the mingled air and steam to the retort-distributer, as well as the gas-pipe D, when the latter is employed, are provided with suitable cocks and valves *b d e′ g*, for regulating the volume and flow of their contents.

The chamber A′, within the casting or body A, is enlarged to permit the expansion of the steam and air, so as to better effect their mingling or mixing within said chamber, while the outlet G from said chamber is diminished or contracted, so as to increase the velocity of such steam and air in issuing therefrom.

The operation is substantially as follows: Fire being started in the furnace, generating steam in the boiler, heating the flues B′, and bringing the retort-distributer to a red heat, the valves *b* and *e′* are opened, admitting air and steam to the chamber A′, where they mingle and proceed by the pipe G to the retort-distributer. In the retort-distributer the mingled air and steam expand, and are thereby detained until they are in a measure resolved into their constituent gases, when they are discharged through the outlets *i*, *k*, or *l* into the fire-chamber C′, upon the furnace-bed, or into the red-hot inflammable gases of the furnace, furnishing each atom of carbon in said gases with its highly-heated equivalent of oxygen, which results in the immediate union or combination of such carbon and oxygen equivalent, thereby insuring perfect and complete combustion.

By preference, the retort-distributer is arranged so as to discharge its contents into the furnace-gases obliquely to the line of the draft-current of the furnace, as shown in Fig. 3.

It may, however, be arranged as shown in Fig. 4, wherein it is located above the grate-bars, with its inlet-side or back downward. In said Figs. 3 and 4 the iron rose-head I is employed, while in Figs. 1 and 5 the cylinder K and chamber or flue L are illustrated, said cylinder K being in advance of the bridge-wall *c* of the furnace, and discharging its contents upwardly and obliquely, while the contents of the chamber L are rained or ejected downwardly, as shown.

The proportionate sizes of the steam and air pipes leading to the mixing-chamber must be governed to some extent by the character of the fuel burned in the furnace and the construction and uses of the latter.

I have produced very thorough combustion of the gases of anthracite coal in a boiler-furnace with a steam-jet of one-eight inch and two air-pipes, each one and one-half inch in diameter, leading to a mixing-chamber of larger capacity than said pipes combined, the outlet therefrom to the retort-distributer being a pipe two and one-half inches in diameter.

I do not however restrict myself to these measurements or proportions, as the same may be greatly varied within my invention.

The higher the temperature of the air and steam before being admitted to the mixing-chamber the better the results. The temperature to which the mingled air and steam should be raised, or the temperature of the retort-distributer in which they expand, and from which they are discharged, is, as already stated, a red heat. The volume of such reheated air and steam admitted to the furnace must be governed by the judgment of the operator, according to the condition of the furnace-fire and the amount and character of the fuel being consumed, just as the draft-current is.

The advantages of my invention are briefly as follows: Heated air or gas and air can be drawn by suction from a retort, chamber, or holder, and commingled with steam in properly-regulated proportions, and may then be delivered at any desired part or parts of the fire-box or combustion-chamber of the furnace at a pressure corresponding to that of the steam, thus insuring a perfect combustion of the inflammable furnace-gases and great economy in fuel.

By means of the flow-regulating valves I am enabled to produce and maintain a more intense and uniform heat than can be obtained by any other known way, such heat being absolutely controllable at will.

What I claim as my invention is—

In a furnace for generating steam or other purposes, the combination of the following elements, to wit: a fire or combustion chamber, a perforated heating and distributing retort or chamber for highly-heating mingled air and steam, an injecting device for feeding air and steam to the heating and distributing retort, a connecting-pipe, G, one or more flues or pipes for heating air prior to its being fed to the heating and distributing retort, and having valves or dampers for regulating the flow of air through the same, steam-pipe E, valve e', and steam-boiler, arranged and operating together, substantially as and for the purposes described.

In testimony that I claim the foregoing I have hereunto set my hand this 9th day of November, 1877.

ISAAC KENDRICK.

Witnesses:
GEO. C. SHELMERDINE,
THOS. A. CONNOLLY.