

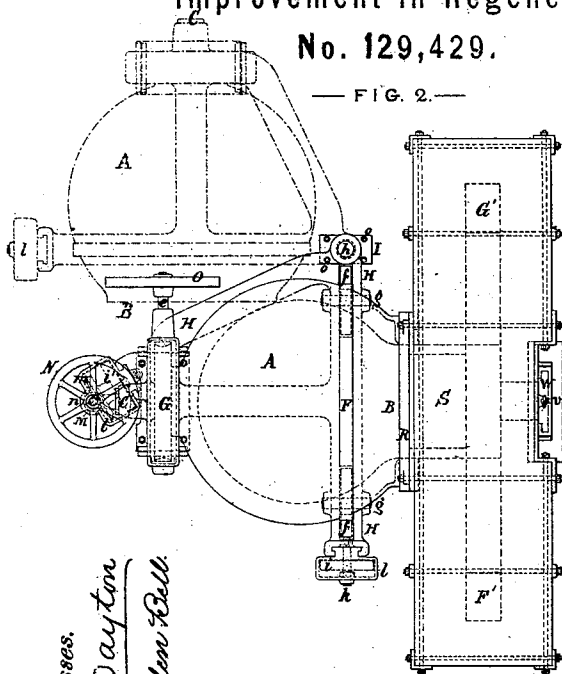
WILLIAM SELLERS.

Improvement in Regenerator-Furnaces.

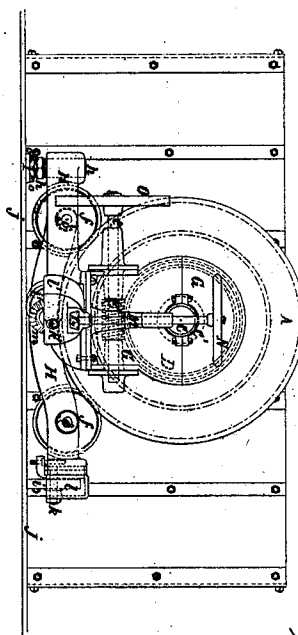
No. 129,429.

Patented July 16, 1872.

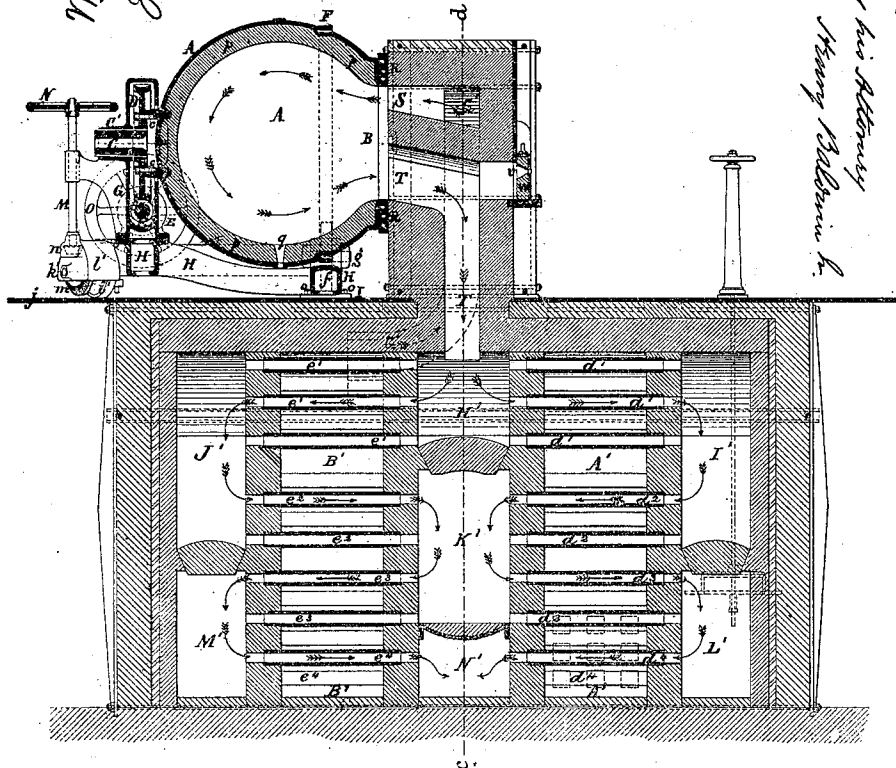
— FIG. 2.—



— FIG. 3. —



— FIG. 1.—

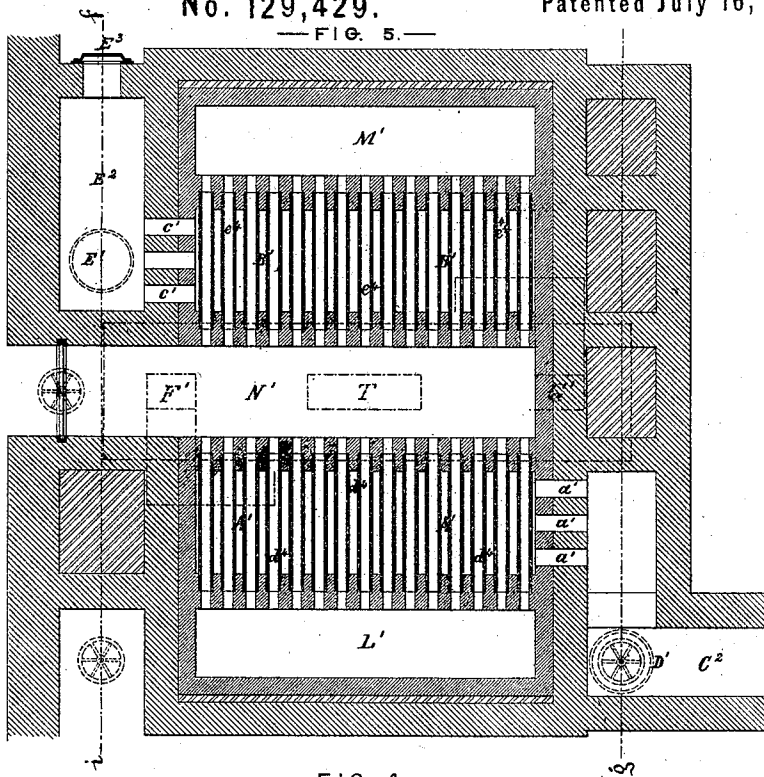


Witnesses,
Mrs. B. Dayton
 J. Snowden Bell.

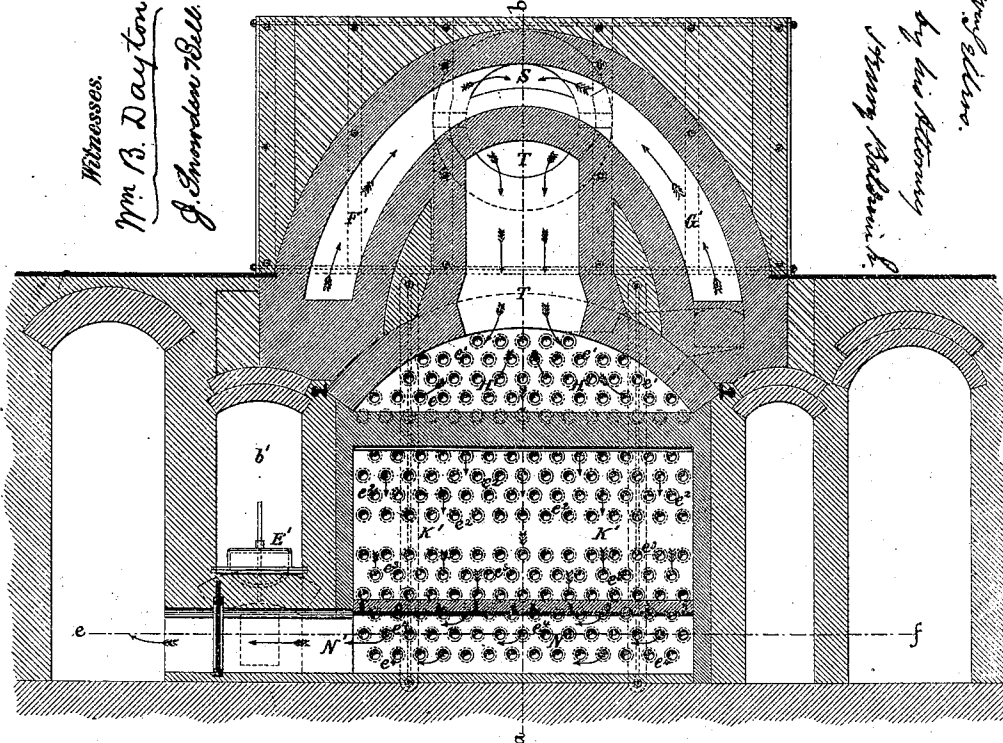
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Henry Adams Jr.

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—FIG. 5.—



—FIG. 4.—



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Wm. B. Dayton
J. Amosden Bell

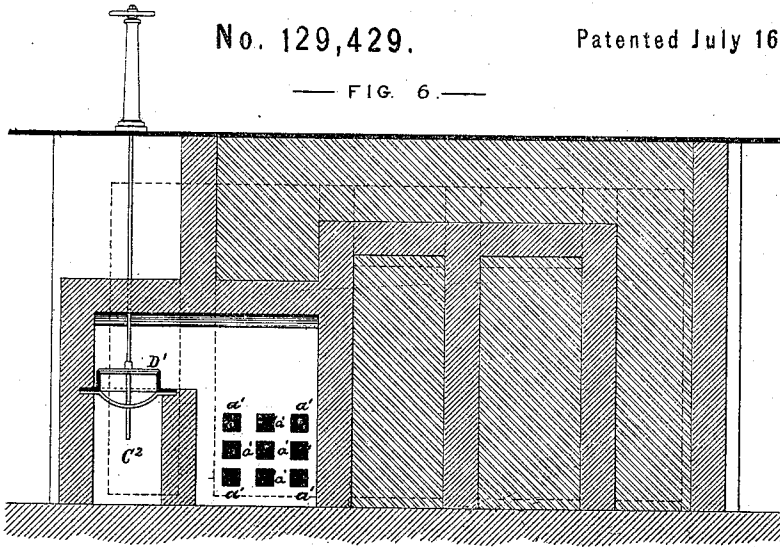
Wm. Sellers.
by his Attorney
Henry Williams & Co.

WILLIAM SELLERS.
Improvement in Regenerator-Furnaces.

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— FIG. 6. —

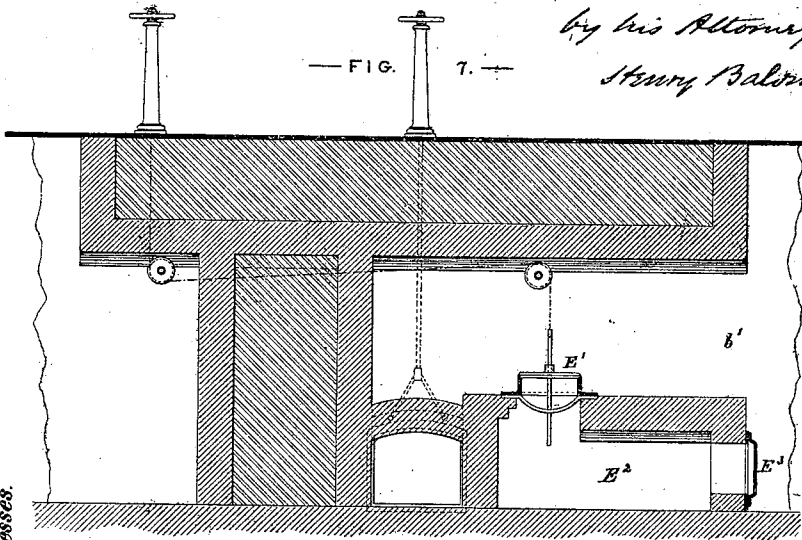


Wm. Sellers

by his Attorney

Henry Baldwin

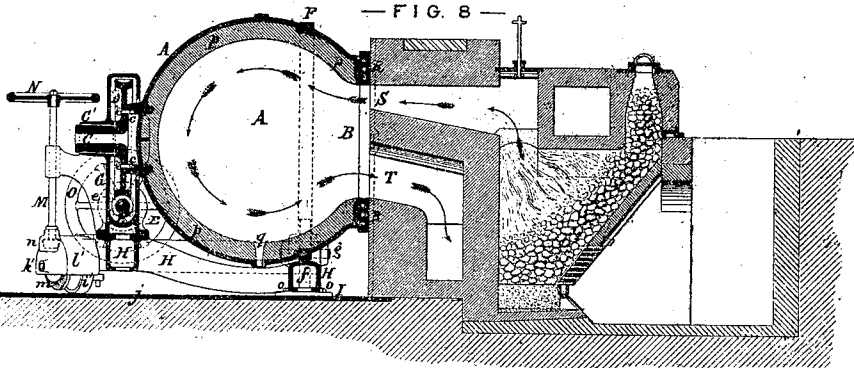
— FIG. 7. —



Witnesses.

Wm. B. Dayton
J. Snowden Bell

— FIG. 8. —



UNITED STATES PATENT OFFICE.

WILLIAM SELLERS, OF PHILADELPHIA, PENNSYLVANIA.

IMPROVEMENT IN REGENERATOR-FURNACES.

Specification forming part of Letters Patent No. 129,429, dated July 16, 1872.

To all whom it may concern:

Be it known that I, WILLIAM SELLERS, of the city and county of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in the art of Regenerating Heat for Furnaces, of which improvements the following is a specification:

My invention relates to that class of heat-regenerators by means of which the waste products of combustion from a furnace, on their way to the chimney, are employed to heat the gaseous fuel or the atmospheric air to be supplied thereto for its combustion, or both the gaseous fuel and the air on their way to the furnace in which they are to be consumed. Waste products of combustion have heretofore been thus utilized in the arts under two systems differing from each other. By one of these systems the heat of the waste products is continuously given off to a surface of suitable material, through which material it is continuously transmitted to and taken up from the opposite surface. By the other, the heat of the waste products is, by alternate intermissions, given off to and taken up from the same surface.

A further distinctive feature of these two systems respectively is that, in the first, one surface always takes up the heat of the waste products passing continuously over it, and the other surface gives off this heat to the incoming air passing continuously over it, while in the other system the same surface to and from which the heat of the waste products is by alternate intermissions given off and taken up, is also by alternate intermissions exposed to the action of the waste products and to the action of the air (or gas,) the waste products passing in one direction and the air (or gas) in the opposite direction.

In the first system the waste products and the air respectively act upon all parts of the respective surfaces simultaneously, while in the other system the waste products and the air (or gas) alternately act intermittently upon all parts of the same taking up and giving off surface. In the first system, however, the air alone is heated on its way to the furnace while the gas moves toward the furnace in which it is to be consumed without any elevation of its temperature above that of its producing

furnace, this temperature being much lower than that of the air when they meet.

A feature peculiar to the second system is, that the air (or gas) as it enters the furnace to be consumed will pass over a surface which has been exposed to and which has acquired the highest temperature of the waste products, and the incoming air (or gas) will acquire this temperature momentarily, but as the taking-up action of the air (or gas) continues, the giving-off action of the waste products being suspended, the temperature of the inflowing air (or gas) passing to the furnace must necessarily diminish as its source of supply becomes exhausted, and the resulting temperature of the air (or gas) as it enters the furnace must be the mean between the two extremes.

The result which characterizes these two systems respectively is, that the temperature obtained under the first, while substantially uniform, is not so high as might be derived from the same fuel if the gas met the air with an equally high temperature, while under the second system the mean temperature obtained, though high, is remittent.

For convenience I shall designate the first system as the double-surface system, and the other as the single-surface system. My invention relates to and is an improvement upon the double-surface system, my object being to maintain continuously the highest temperature heretofore attained only at intervals. My invention consists of a chamber in which the waste products of combustion are received directly from the furnace, in which chamber these products, if unconsumed, may be thoroughly consumed, and from which chamber the products of combustion may be discharged through series of pipes on each side of this chamber, for purposes hereinafter described. And my invention further consists in combining a chamber in which the waste products of combustion are received directly from a furnace, and in which chamber they may be thoroughly consumed; series of pipes on each side of said chamber, through which the products may be discharged from the receiving chamber; and secondary chambers into which the pipes on each side of the first chamber discharge the products, from which secondary chambers respectively these products pass

through secondary series of pipes, either directly to the chimney or otherwise, as herein-after set forth.

I am aware that some of the high temperatures of waste from furnaces cannot be exhaustively utilized in heating both the air and the gas through the medium of two or even three sets of chambers with intermediate series of pipes, as above set forth, and I, therefore, multiply the chambers between the receiving-chamber and the chimney, with series of pipes to correspond, to any number required to extract the desired quantity of heat from the waste products of combustion, and to impart this heat to both the air and the gas, each series of pipes being combined with two chambers, as hereinbefore and as hereinafter more fully set forth.

As, in order to obtain the greatest quantity of heat from a given quantity of waste products of combustion, both the air and the gas on their way to the furnace in which they are to be consumed should, just before entering that furnace, be exposed to the highest temperature of the waste, and as to obtain high temperatures the chambers and series of pipes must be multiplied, my invention further consists in arranging the chambers and the interposed series of pipes in such order that as the products of combustion pass from the receiving-chamber through the pipes and succeeding chambers and series of pipes to the chimney, both the air and the gas to be consumed in the furnace will move over series of pipes successively in the opposite direction, and as they approach the furnace pass over successively more highly-heated pipes. The products of combustion, moving meanwhile toward the chimney, and at each series of pipes parting with a portion of their heat, are, moreover, passing successively through series of pipes, the exterior surfaces of which have been subjected to the earlier action of the incoming air and gas, and are, therefore, of successively lower temperature, so that the difference of temperatures to which the inside and the outside of each series of pipes are respectively exposed, is reduced to the minimum.

The temperature of the chamber in which the waste products of combustion are received directly from the furnace being higher than that of any succeeding chamber, my invention further consists in encompassing the receiving-chamber with air and gas chambers and flues, so that any heat that may be transmitted through the walls of the receiving-chamber will be taken up by the air and gas on their way to the furnace. My invention further consists in combining the chambers and series of pipes through which the products of combustion pass from the furnace to the chimney with the chambers through which the gas and air pass from their respective entrance-flues to the furnace in vertical lines, so that the passage of both the gas and the air toward the furnace will be facilitated by accretions of heat taken up from each successive series of

pipes in their course; and my invention further consists in combining series of chambers and series of pipes, extending from one chamber to another, with air and gas chambers, so that the pipes extend across the air and gas chambers respectively, and the products of combustion passing through the pipes give off their heat to the air and gas passing over them.

In the accompanying drawing, which makes part of this specification, Figure 1 is a sectional side view of a heat-regenerator embodying my improvement, and of a puddling-machine in which the gas and air are consumed and from which the waste products of combustion are discharged, thus illustrating the operation of my improvements. Fig. 4 is a transverse section at the line *cd* of Fig. 1. Fig. 5 is a sectional plan at the line *ef* of Fig. 4. Fig. 6 is a vertical section at the line *gh* of Fig. 5. Fig. 7 is a vertical section at the line *ik* of Fig. 5. Figs. 2, 3, and 8 are views of the puddling-machine, to which no further reference need be made herein, as it forms no part of this patent.

The regenerator is of rectangular form, with four cross-walls extending from bottom to top in such manner as to form five chambers, as shown in plan, Fig. 5, and in elevation, Fig. 1. The middle chamber is subdivided transversely so as to form the three chambers *H'*, *K'*, and *N'*. The two chambers, *A'* and *B'*, adjoining the middle chambers, are not subdivided. The two side chambers are subdivided so as to form in each two chambers, *I'* and *L'*, and *J'* and *M'*. From the puddling-vessel *A*, in which the air and gas are to be consumed, a flue, *T T*, extends down into the chamber *H'*. Across each of the chambers *A'* and *B'*, respectively, a series of fire-clay pipes, *d' d' d'*, *e' e' e'* extend from the chamber *H'* to the chambers *I'* and *J'*, respectively. Below these pipes a second series of similar pipes in like manner extend across the chambers *A'* and *B'*, respectively, from the chamber *K'* to the chambers *I'* and *J'*, respectively. Below these again a third series of pipes (which may be of iron) in like manner extend across the chambers *A'* and *B'* from the chamber *K'* to the chambers *L'* and *M'*, respectively, and below these a fourth series of similar pipes in like manner extend across the chambers *A'*, *B'*, respectively, from the chamber *N'* to the chambers *L'* and *M'*, respectively. It is obvious that the number of sets of chambers and series of pipes may be more or less, according to the height of the furnace. It may further be observed that, as the waste products are reduced in volume as they are diminished in temperature, a smaller number of pipes will suffice in the lower series than is required for the larger volume of their higher temperature. From the bottom middle chamber, in this instance *N'*, a flue leads to the chimney, and this flue is provided with a damper. The gas to be consumed in the furnace is admitted through a flue, *C²*, provided with a damper, *D'*, to a

chamber, from which it passes through openings $a' a' a'$ into the chamber A' , Figs. 5 and 6. The air to be supplied to the gas at the furnace is admitted through a damper, E^1 , to a chamber, E^2 , from which it passes through openings $e' e'$, Figs. 4, 5, and 7, to the chamber B' . From the chamber A' the gas passes to the flue S by the flue F' , and from the chamber B' the air passes to the flue S by the flue G' , the two uniting in the flue S , which opens into the puddling-vessel A , burst into flame and are utilized therein, the products of combustion being discharged through the flue $T T$ into the chamber H' . It will be observed that the chamber H' has on either side of it the gas and air chambers A' and B' , while the gas and air flues F' and G' , leading to the furnace, pass over either side of the top, and the discharge-flue T' enters the center of the top of this chamber, so that this chamber, which is subjected to the highest temperature of the waste products of combustion, is entirely surrounded by chambers and flues, which will take up any heat that may be transmitted through its sides and return it back again into the furnace. The arrangement shown in Figs. 1 to 7 is the best mode in which I contemplate applying my improvements, and the advantages combined in it are numerous. The location of the receiving-chamber H' in the top of the middle division of the regenerator with the air and gas chambers on either side thereof, and the chambers K' and N' below it, with the chambers I' and L' on the outer sides of the chamber A' , and the chambers J' and M' on the outer side of the air-chamber B' , gives the best plan for construction, all the lines being vertical, the most convenient arrangement for the introduction of the waste products of combustion from the furnace, and for the introduction of gas and air to the furnace, the largest area of surface for the transmission of heat to the gas and air, with the smallest area for loss of heat by radiation.

The operation, it will be seen, is as follows: The products of combustion from the chamber H' pass through the pipes $d^1 d^1 d^1$ into the chamber I' , and through the pipes $e^1 e^1 e^1$ into the chamber J' . From these chambers, respectively, the products pass through the pipes $d^2 d^2$ and $e^2 e^2$ into the chamber K' . From K' they pass through the pipes $d^3 d^3$ into the chamber L' , and through the pipes $e^3 e^3$ into the chamber M' , and from these chambers they pass through the pipes $d^4 d^4$ and $e^4 e^4$ to the chamber N' , whence they pass into the chimney through a flue. While the products of combustion are thus moving through these series of pipes successively toward the chimney, the gas is passing through the chamber A' , and the air through chamber B' toward the furnace, the air and the gas, respectively, taking up the heat transmitted by the products of combustion through the pipes and given off from their outer surfaces, it being obvious that the gas and the air enter their respective chambers at the bottom, where the pipes, being

heated only by the waste products, which have passed through all the series above, are reduced to a low temperature, and rise through the spaces between the higher series successively, which have had an earlier contribution of heat from the waste products until they reach the series of pipes nearest to the chamber H' , which are, of course, more highly heated than any series below, and the gas and air thus pass to and meet at the flue S with the highest temperature derivable from the waste products. On the other hand, the waste products passing at their highest temperature through the series of pipes nearest the chamber H' , and descending through the successive series of pipes below, reach the lower pipes, which are subjected to the cooling action of the entering air and gas, respectively, with a temperature so much reduced that the difference between the temperatures of the waste products and that of the incoming air and gas is reduced to the minimum. As the ascending air and gas acquire, and the descending products lose, heat at each stage of the series, it is obvious that the minimum difference of temperature between the two is obtained at each stage of the series. The accretion of temperature by the air and gas to be supplied to the furnace being progressive, the flow of air and gas being continuous from the entrance-flues to the point of combustion, and the temperature of the waste products of combustion being constantly decreasing from the chamber H' to the chimney—the flow of the waste products also being continuous—I attain by this system a continuous flow of gas and air, a continuous heating of both, a continuous flow of waste products of combustion, a constant flame, and the highest temperature, with a minimum of destructive action upon the regenerative system.

I do not claim, under this patent, subjecting the air moving to the furnace in a continuous current to a progressively-increasing temperature, while the waste products of combustion moving from the furnace to the chimney in a continuous current are subjected to a constantly-decreasing temperature; nor do I claim the combination, in vertical lines, of chambers and series of pipes extending from one chamber to another, with an intermediate chamber across which the pipes extend, and through which air or the waste products of combustion pass; nor do I claim passing the waste products of combustion through the pipes, and passing the air to be heated over the pipes, so that the heat from the products of combustion is taken up by the interior surfaces of the pipes, transmitted through the body to the exterior of the pipes, and given off from the exterior surface to the air passing over the pipes, as, although I believe myself to be a true and original inventor of these features of my regenerative system, I have since learned that I am not the first inventor thereof, the same, or substantially the same, having been first invented by William Gorman and John Paton,

of Glasgow, North Britain, and being described and represented in Letters Patent of the United Kingdom of Great Britain and Ireland, granted to them under date of December 5, 1863, No. 3,057, and an application for Letters Patent of the United States therefor being filed by them simultaneously with the filing of this application; but

I claim as my invention, and desire to secure by Letters Patent—

1. The improvement in the art of regenerating heat for furnaces, hereinbefore set forth, which consists in subjecting both the air and the gas moving to the furnace in continuous currents, substantially as described, to a progressively-increasing temperature, while the waste products of combustion, moving from the furnace to the chimney in a continuous current, are subjected to a constantly-decreasing temperature from the incoming currents, both of air and gas.

2. As an improvement in the art of regenerating heat for furnaces, the combination of a central chamber, in which the waste products of combustion are received from the furnace series of pipes through which the waste products are passed, and over which the incoming air and gas move toward the furnace, and side chambers into which the waste products are discharged from the pipes on their way to the chimney, substantially as described.

3. As an improvement in the art of regenerating heat for furnaces, the combination of a central chamber, in which the waste products of combustion are received from a furnace, series of pipes through which the waste

products are discharged from the central receiving-chamber, side chambers into which these products are discharged by the pipes, and secondary series of the pipes through which the waste products pass to the chimney, or to a second central chamber connected with the chimney, while the incoming air and gas move toward the furnace over the pipes, substantially as described.

4. As an improvement in the art of regenerating heat for furnaces, the combination of a chamber in which the waste products of combustion are received directly from the furnace, with encompassing air and gas chambers, and air and gas flues, substantially as and for the purpose set forth.

5. As an improvement in the art of regenerating heat for furnaces, the combination, in vertical lines, of the chambers and series of pipes through which the products of combustion pass from the furnace to the chimney, with the chambers through which the gas and air pass from their respective entrance-flues to the furnace, substantially as and for the purposes described.

6. As an improvement in the art of regenerating heat for furnaces, the combination of series of chambers, and series of pipes extending from one chamber to another, with air and gas chambers, so that the pipes extend across the air and gas chambers, respectively, substantially as and for the purpose described.

WM. SELLERS.

Witnesses:

J. SNOWDEN BELL,
JNO. H. HOGAN.