

(No Model.)

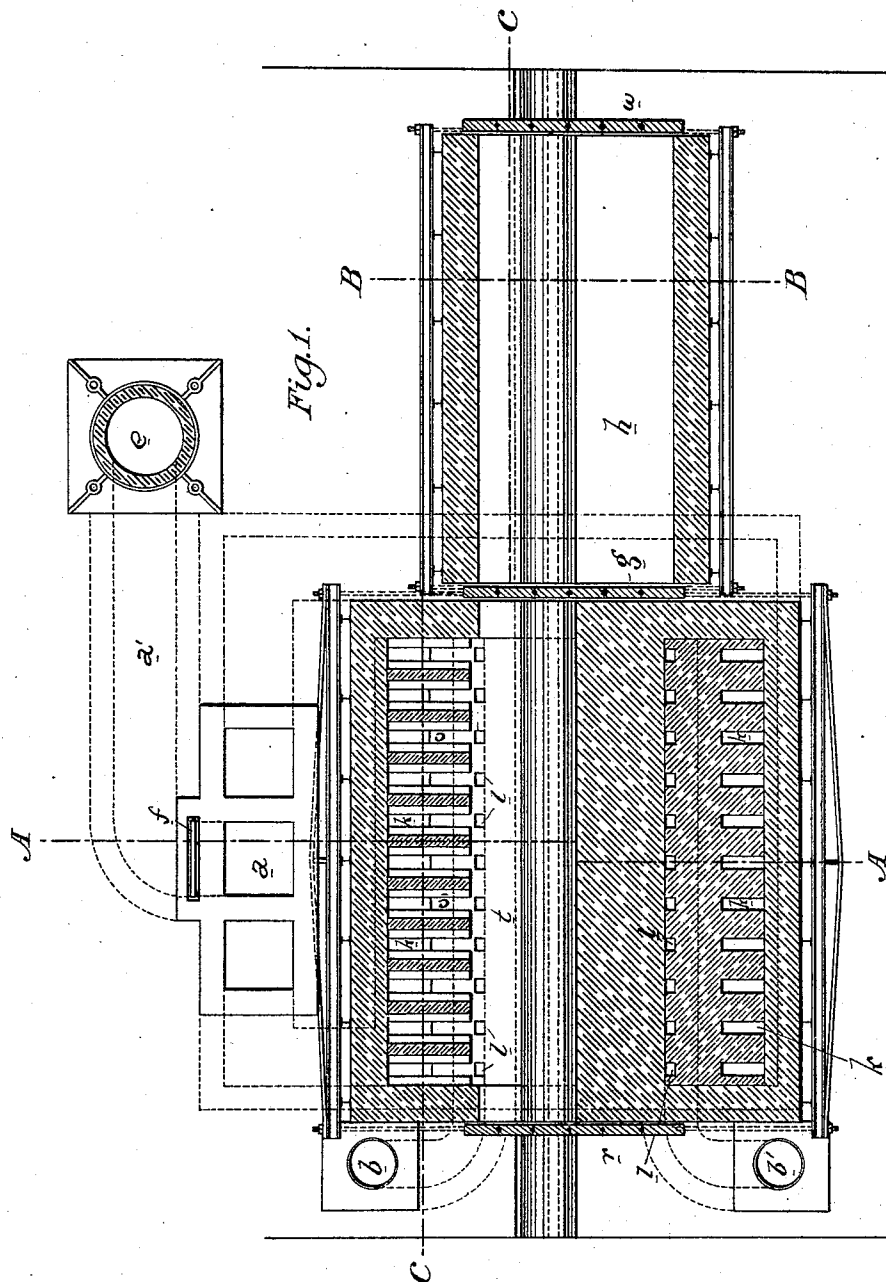
4 Sheets—Sheet 1.

H. WOOD.

METHOD OF ANNEALING AND APPARATUS THEREFOR.

No. 578,281

Patented Mar. 2, 1897.



WITNESSES:

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(No Model.)

4 Sheets—Sheet 2.

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Fig. 2.

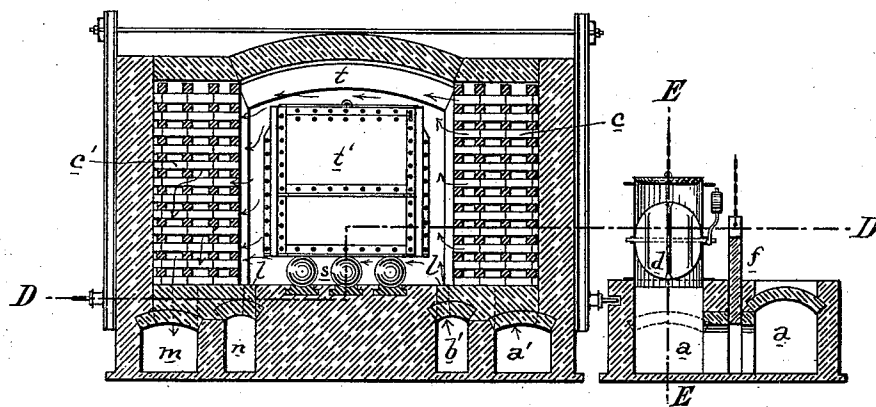


Fig. 4.

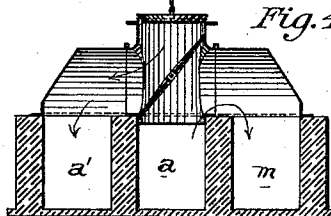
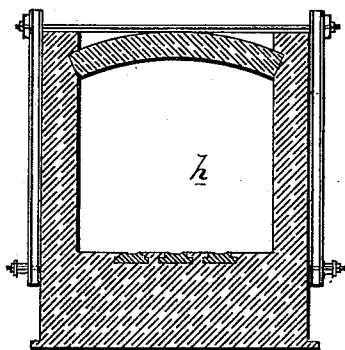


Fig. 3.



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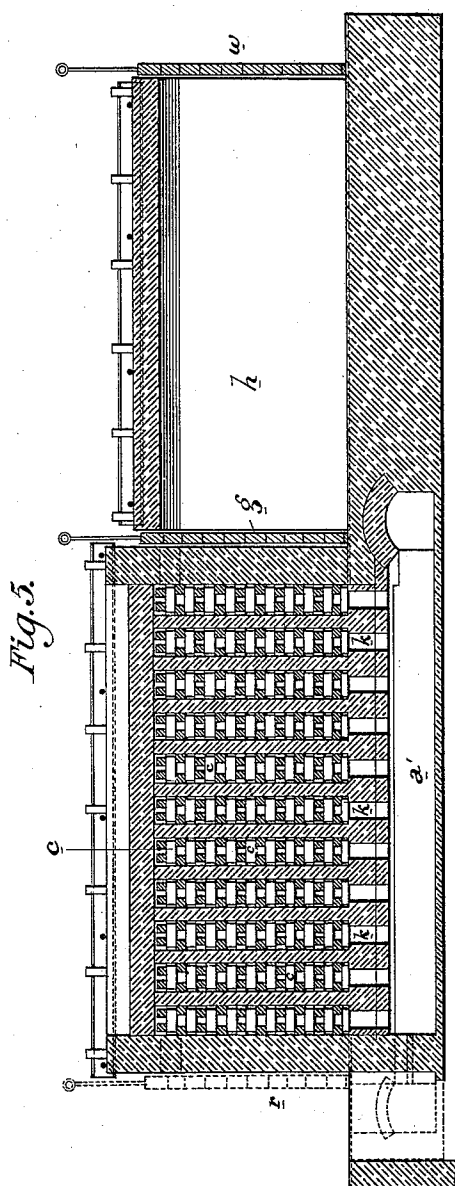
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H. WOOD.

METHOD OF ANNEALING AND APPARATUS THEREFOR.

No. 578,281.

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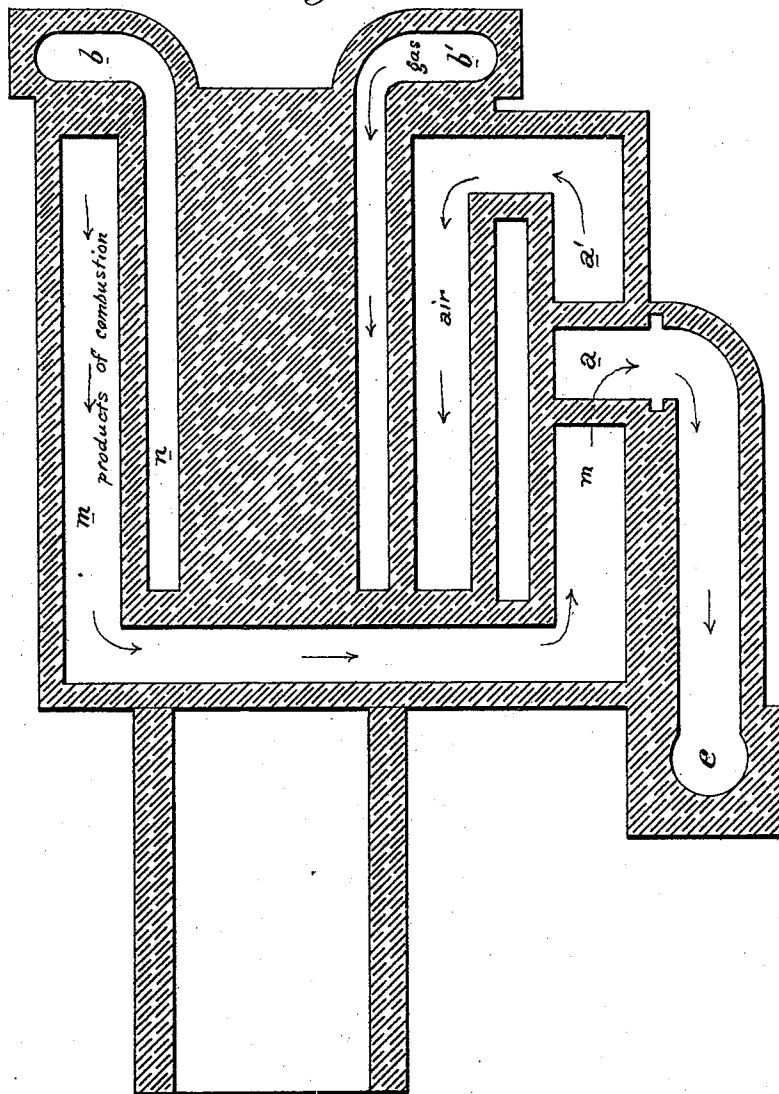
H. WOOD.

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No. 578,281.

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Fig. 6.



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# UNITED STATES PATENT OFFICE.

HOWARD WOOD, OF CONSHOHOCKEN, PENNSYLVANIA, ASSIGNOR TO THE  
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## METHOD OF ANNEALING AND APPARATUS THEREFOR.

SPECIFICATION forming part of Letters Patent No. 578,281, dated March 2, 1897.

Application filed March 31, 1896. Serial No. 585,537. (No model.)

*To all whom it may concern:*

Be it known that I, HOWARD WOOD, of Conshohocken, Montgomery county, and State of Pennsylvania, have invented an Improvement in Methods of Annealing and Apparatus Therefor, of which the following is a specification.

My invention has reference to methods of annealing and apparatus therefor; and it consists of certain improvements fully set out in the following specification and shown in the accompanying drawings, which form a part thereof.

My invention comprehends certain improvements in methods of and apparatus for annealing sheet-iron or light plate and known in the trade as "box-annealing."

The object of my invention is to use an air-regenerative furnace for heating and a separate furnace connected thereto for cooling the material or substance to be annealed, that is to say, I heat the annealing-box containing the charge of sheet-iron in one furnace, and after it has been fully heated I move it into a separate furnace especially designed for cooling, where the temperature of the box and contents is gradually reduced and finally cooled down.

My invention embodies, therefore, the combination of a heating-furnace and a cooling-furnace arranged in alinement or juxtaposition, whereby the heating operations as well as the cooling operations may be continuous. The method of carrying on this annealing process in such continuous manner is new as far as I am aware, and forms the subject-matter of another part of my invention, and is also hereinafter claimed.

A special feature of this invention is that by the construction hereinafter described the gas enters the furnace between the air-regenerator and the annealing-box, whereby a sheet of gas between the box and the air is secured and the air caused to come in contact with the gas at various elevations and at an angle to its passage around the box. By this the loss of material by oxidation is very much reduced and more uniform heating effect produced.

My invention will be better understood by

reference to the accompanying drawings, in which—

Figure 1 is a horizontal section of the two furnace-stacks on line D D of Fig. 2. Fig. 2 is a section of same on line A A of Fig. 1, showing the air and gas flues below the floor-level. Fig. 3 is a section on line B B of Fig. 1, showing the cooling-furnace. Fig. 4 is a section on line E E of Fig. 2 and is a longitudinal vertical section of a four-way valve through which the air is supplied to the flues or conduits leading to the furnace and which also directs the current of the outgoing product of combustion from the air-regenerators to the chimney-flue. Fig. 5 is a longitudinal vertical section on line C C of Fig. 1, which shows the air-regenerator on one side of the furnace and arrangements of the air-flue and its ports; and Fig. 6 is a ground plan showing the relative position of the air and gas flues to the chimney-flue.

*a* represents the flue leading from the bottom of the valve to the chimney.

*a'* represents the flue leading from the top of the valve to the regenerator-chamber, the air following the line of the arrows.

*b'* represents the gas-flue which runs parallel to the air-flue.

*c c'* are the regenerators through which the air to supply the combustion of the furnace is supplied on one side of the furnace and through which the products of combustion on the opposite side are conveyed to the chimney. This operation is regulated by valve *d*, which is the ordinary form of the Siemens four-way reversing-valve.

*e* represents the chimney, connected with the furnace or furnaces by suitable flues or conduits located between the reversing-valve and governed by the damper *f*, which regulates the draft.

*g* represents a movable diaphragm or partition between the furnace *t*, in which the annealing-box is heated, and the furnace *h*, in which the box is cooled down.

*k* represents the ports through which the air is supplied to the regenerator and connects the air-conduit *a'* with the checker-work, and *l* represents the ports through which the gas enters the furnace *t* from the flue *b'*.

*m* and *n* represent, respectively, the air and gas flues, similar to *b'* and *a'*, but leading to the regenerator *c'* on the other side of the furnace *t*.

5 The furnace *t* is provided with a door *r*, of refractory material, through which the annealing-box *t'* is introduced into the furnace, and the furnace *h* is provided with a door *w*, of similar construction, through which the  
10 cooled box is discharged. The floors of the two furnaces *t h* are provided with longitudinal grooves for guiding the balls upon which the annealing-box moves. The operation of my invention will now be understood.

15 In operating my furnace it is best to bring the temperature of the working portion of the furnace and the regenerators to about 1,800° Fahrenheit, more or less, after which the box containing the substance to be annealed is  
20 pushed into the furnace, and this is facilitated by the use of metallic balls *s*, substantially as shown in Fig. 2. The gas may be supplied from any ordinary construction of producer and be admitted at *b'*, in which it  
25 passes under the regenerator and upward into the furnace by apertures *l*. The air is admitted through the valve *d* and following the line of arrows enters flue *a'*, and thence by apertures *k* finds its way into the regenerator

30 *c*. The air-ports *l* convey the gas to the combustion-chamber in a vertical line through the floor, so as to form a sheet of gas between the checkered work *c c'* and the box. The air entering the regenerators through ports *k*  
35 in the arch of the flue at *a'* becomes baffled as it rises in the checkered work; and owing to the expansion of gas by the heated checkers a current almost equal to a light fan-blast is produced. The air passes out of the re-

40 generator at right angles to the line in which the gas is traveling, and in meeting it supplies the oxygen and sustains combustion without oxidizing the iron casing of which the annealing-box is made. It is preferable to supply  
45 an excess of the gas at this place to form a reducing-flame. The products of combustion, with a small excess of gas, passes over the top of the box and down on the opposite side, and thence are drawn into the checkered work of

50 the regenerator *c'*, thence into the conduit *m*, following the line of the arrows, to chimney-flue *a*, and finally to the chimney *e*. While the products of combustion and gas are passing through the outgoing regenerator *c'* the  
55 heat which would otherwise be carried to the chimney is deposited on the brickwork forming the checkers of this regenerator *c'*. After running in this direction for about thirty minutes the direction of the currents is reversed,

60 and this is done by throwing over the valve *d*. This allows the air to enter at *m* and the gas at *n*, and the same reaction takes place as has been above described, but with the regenerators reversed, and hence the outgoing products of combustion pass up through the opposite  
65 regenerators. This reversing operation is continued until the annealing is completed

and the removal of the box is desired. The partition or division door *g* is then withdrawn, the box *t'* is rolled into the cooling-chamber *h*, and a fresh box supplied into the  
70 heating-chamber of the furnace through door *r*, and so on, making the process continuous in its operation of heating and cooling and reversible in the method of utilizing the waste  
75 heat and producing the desired calorific effect with as little loss in oxidation of the box as possible. The gas is supplied through pipes connecting the flues *b b'* in any suitable way, but I make no claims on the gas apparatus  
80 or its connection, as any gas-producing apparatus heretofore in use may be employed.

The important features of my invention comprehend supplying the air in the heated state to the rising layer of gas adjacent to the  
85 annealing-box, so as to exclude the atmosphere and its oxidizing influence from the box and its contents, and, secondly, to produce a uniform combustion and resulting heating of the box. In this connection it  
90 will be observed that the producer-gas as it rises from ports *l* meets at right angles the heated air, which is ejected from the checker-work under a gentle pressure due to its expansion, and the result is, first, the gas is consumed gradually, so as to retain its calorific  
95 value for a longer period, and, second, there is no possibility of the gas or products becoming oxidizing in its effects. The gases after ascending to the top of the box pass transversely over it and then downward upon the  
100 other side and out through the numerous apertures in the checker-work of the regenerator *c'*. As of necessity all of the products cannot get out of the upper apertures, it is  
105 required to distribute itself over the opposite side of the box. Some of the products pass under the box, but only to slight extent, the heating there being mainly due to conduction and the reverberatory effects. This latter  
110 action also largely heats the upper part of the box. Now when the operation of the apparatus is reversed it is seen that the actions upon the annealing-box are transposed, and consequently by continued reversing the action  
115 becomes uniform over the entire box and contents.

The principal feature of my invention is in having two furnaces bearing such relation to each other that the operator is enabled  
120 to heat a box containing sheet-iron in one furnace and then cooling it in another furnace. The work in annealing being done in slow cooling, the custom heretofore has been to put a box in the furnace, heat up box and  
125 furnace, and then allow box and furnace to cool down.

By my construction there is no cooling off of the heating-furnace, and by using gas in combination with my improvements we have  
130 a continuous working, which is very much more economical than the old method.

While I prefer the construction as shown, I do not confine myself to the details of the

structure, as they may be modified without departing from the spirit of my invention.

Having now described my invention, what I claim as new, and desire to secure by Letters

5 Patent, is—

1. An annealing-furnace consisting of a central chamber open at both ends, a regenerator arranged upon each side of the furnace and provided with a series of horizontal passages opening into the interior of the annealing-furnace, and a series of gas-flues arranged in the floor of the annealing-furnace and close to the base of the regenerators, in combination with a cooling-chamber of the same size as the annealing-chamber and arranged in line therewith, and removable doors for each end of the annealing-furnace and the distant end of the cooling-chamber.

2. An annealing-furnace consisting of a central chamber open at both ends, a regenerator arranged upon each side of the furnace and provided with a series of horizontal passages opening into the interior of the annealing-furnace, and a series of gas-flues arranged in the floor of the annealing-furnace and close to the base of the regenerators, in combination with a cooling-chamber of the same size as the annealing-chamber and arranged in line therewith, removable doors for each end of the annealing-furnace and the distant end of the cooling-chamber, and an annealing-box adapted to substantially fit the interior cross-section of the annealing-furnace, means to convey the box through the annealing-furnace into the cooling-chamber, a valve device for causing the air to pass through one regenerator and the products of combustion through the other regenerator together with gases from the gas-flues adjacent to the regenerator from which the air passes, and vice versa.

3. In an annealing-furnace structure a central annealing-chamber having adjacent to each side flues for admission of gas, and also regenerators forming the walls of the chamber and each furnished with a series of lateral apertures at different elevations for the admission of air formed at an angle to the flues for the gas, in combination with flues and valves for admitting air to either regenerator and connecting the other with the escape or chimney flue.

4. In an annealing-furnace structure a central annealing-chamber having adjacent to each side flues for admission of gas in a substantially vertical direction, and also regenerators furnished with a series of lateral apertures for the admission of air horizontally at an angle to the flues for the gas, in combination with flues and valves for admitting air to either regenerator and connecting the other with the escape or chimney flue, a cooling-furnace arranged in alinement with the annealing-furnace between the gas-flues, and a removable door or partition between the two furnaces.

5. An annealing-furnace formed of a tube

of refractory material of rectangular cross-section and provided with side walls furnished with a series of lateral air passages or flues and gas-flues in the floor, in combination with a gas-tight annealing-box substantially similar in shape to that of the furnace but of slightly smaller cubical capacity and supported above the floor of the furnace whereby the admixed air and gases may envelop the annealing-box with a uniform layer of heating-gases, a cooling-chamber of similar shape to the furnace and arranged in line with it, and a door between the annealing-furnace and cooling-chamber.

6. An annealing-furnace formed of a tube of refractory material of rectangular cross-section and provided with side walls furnished with a series of lateral air passages or flues and gas-flues in the floor, in combination with a gas-tight annealing-box substantially similar in shape to that of the furnace but of slightly smaller cubical capacity and supported above the floor of the furnace whereby the admixed air and gases may envelop the annealing-box with a uniform layer of heating-gases, a cooling-chamber of similar shape to the furnace and arranged in line with it, a door between the annealing-furnace and cooling-chamber, and valve devices for admitting gas through the floor of the furnace first on one side of the annealing-box and then on the other and simultaneously admitting air from the side wall adjacent to the incoming gas and delivering the resulting products of combustion from the series of flues or passages in the opposite side wall or the opposite side of the annealing-furnace, and vice versa, whereby the heating effect on the annealing-box is substantially uniform.

7. In an annealing-furnace the compartment *t* in which the articles to be annealed are placed provided with gas-flues *l* arranged in the floor near the bottom of the compartment in two rows one on each side of the center, and a series of laterally-directed air-apertures opening into the compartment from each side at a series of different elevations to the gas-apertures and at an angle thereto, in combination with valve devices for causing the air to pass into the furnace through one series of air-apertures and out of it by the other series of air-apertures, and vice versa.

8. In an annealing-furnace the compartment *t* in which the articles to be annealed are placed provided with gas-flues *l* arranged in two rows one on each side of the center, regenerators forming lateral walls of the compartment and each provided with a series of laterally-directed air-apertures opening into the compartment from each side at a series of different elevations to the gas-apertures and at an angle thereto and in combination with valve devices for causing the air to pass into the furnace through one series of air-apertures and out of it by the other series of air-apertures, and vice versa, whereby the regenerators are used alternately to heat the air.

9. An annealing-furnace combined with gas-inlets in its floor, two regenerators arranged on opposite sides of the furnace and forming the lateral walls thereof and having  
5 inlets therefrom into the furnace-chamber above the gas-inlets, and valve devices for causing the air to pass through either regenerator desired before passing into the furnace-chamber.
10. The method of heating a box in the process of annealing consisting in enveloping one side of the box with a fuel-gas, and projecting  
15 currents of air onto the said fuel-gas at an angle to its flow and at different elevations relatively to the box, whereby the fuel-gas is gradually consumed and caused to move closely over the surface of the annealing-box.

In testimony of which invention I have hereunto set my hand.

HOWARD WOOD.

Witnesses:

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GEO. W. REED.