

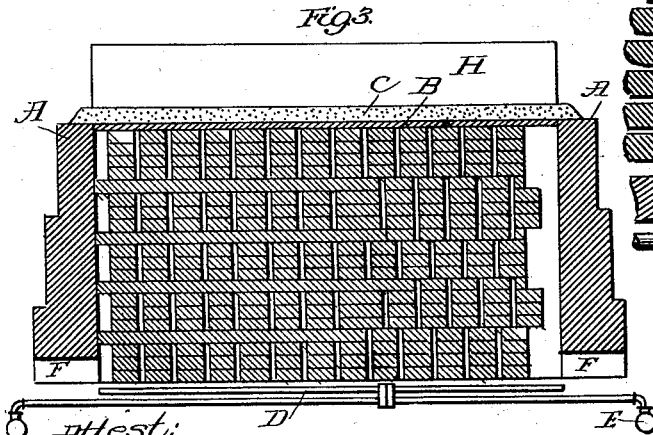
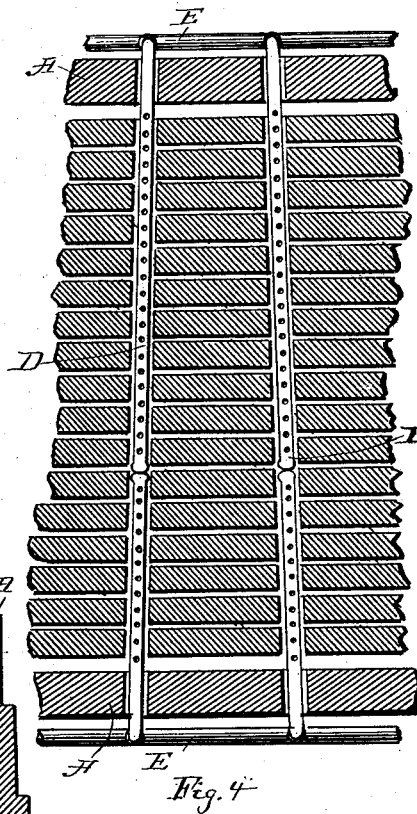
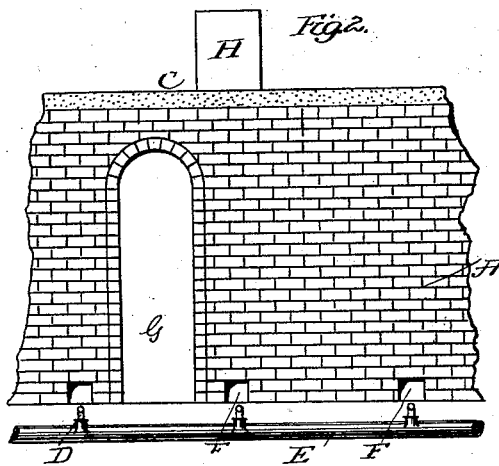
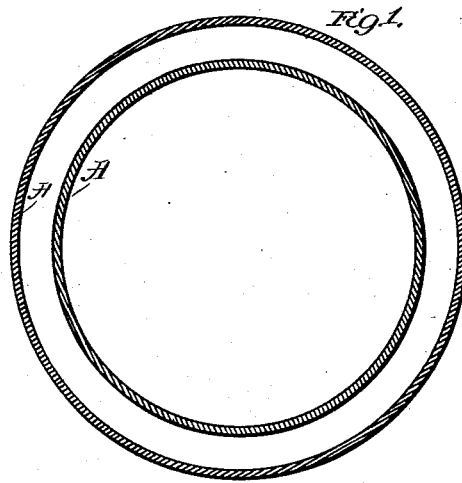
(No Model.)

2 Sheets—Sheet 1.

J. K. MACIVER.  
BURNING BRICK, TILE, &c.

No. 302,149.

Patented July 15, 1884.



Attest:  
Haltermaiden  
F. L. Middleton

Inventor:  
John K. Maciver  
by Joyce & Spear

Atty.

(No Model.)

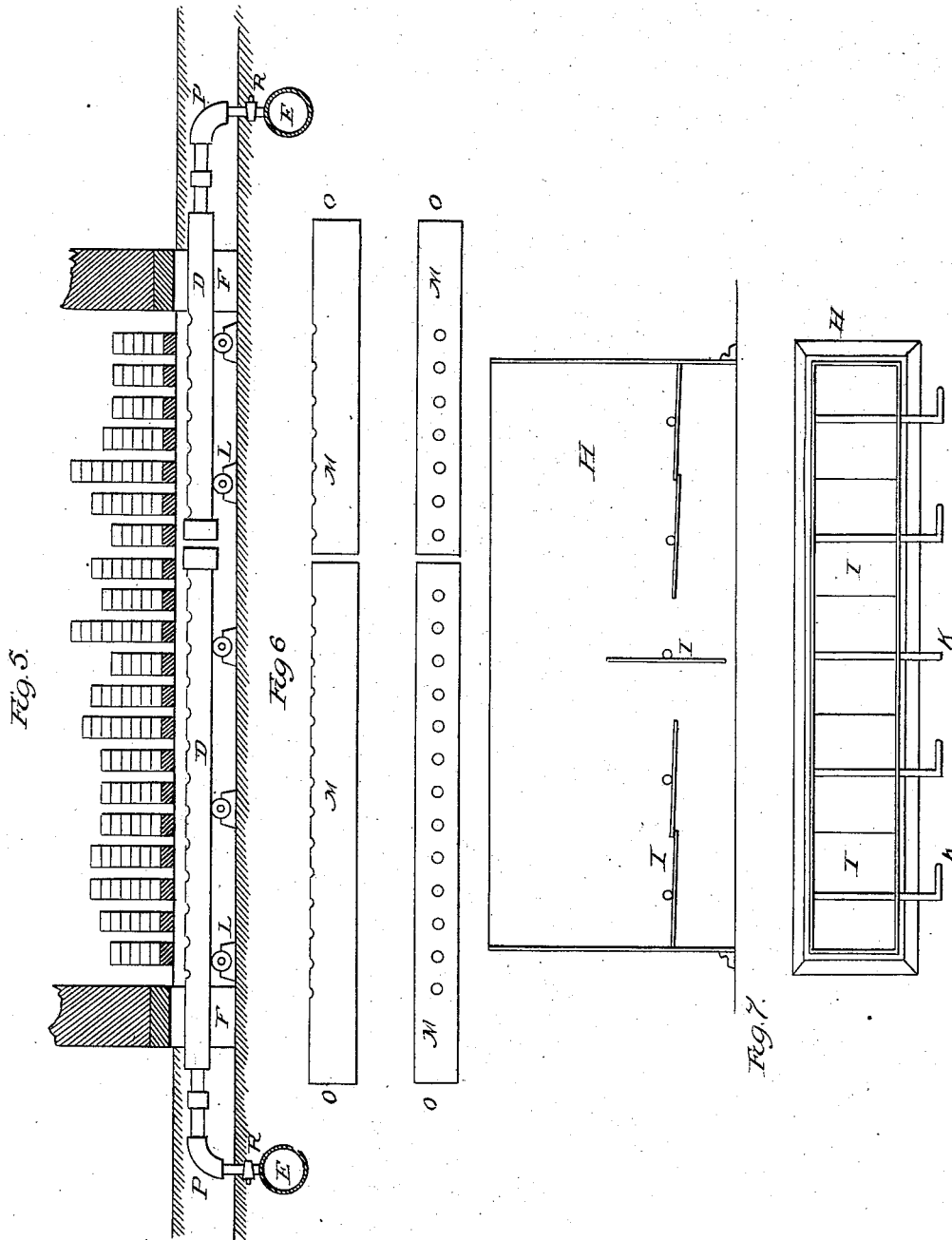
2 Sheets—Sheet 2.

J. K. MACIVER.

BURNING BRICK, TILE, &c.

No. 302,149.

Patented July 15, 1884.



Attest:  
*Hall & Donaldson*  
*F. L. Middleton*

Inventor:  
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*Atty.*

# UNITED STATES PATENT OFFICE.

JOHN K. MACIVER, OF DETROIT, MICHIGAN.

## BURNING BRICK, TILE, &c.

SPECIFICATION forming part of Letters Patent No. 302,149, dated July 15, 1884.

Application filed May 17, 1883. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN K. MACIVER, of Detroit, in the county of Wayne and State of Michigan, have invented a new and useful  
5 Improvement in Burning Brick, Tile, &c.; and I do hereby declare that the following is a full, clear, and exact description of the same.

My invention relates to the improvements in burning brick, tile, or pottery in a continuous or other kiln by the use of gas as a fuel.

The mechanism is illustrated in the accompanying drawings, in which similar letters refer to similar parts.

Figure 1 is a ground plan on a small scale.  
15 Fig. 2 is an elevation showing the outside. Fig. 3 is a transverse vertical section, and Fig. 4 is a plan at the second layer of loading when bricks are to be burned. When other articles are to be burned the arrangement  
20 would be suitably changed. Fig. 5 shows an arrangement of the perforated gas-burners. Figs. 6 and 7 represent modifications of details.

These figures represent a circular kiln; but  
25 it may be made elliptical or oblong, as circumstances warrant.

In the figures, A A represent concentric circular walls built about sixteen feet apart and seven feet high. The annular space between  
30 them is made level and paved with brick. On this floor the green brick are built up in concentric walls with spaces left between them and bonded together, as shown in Figs. 3 and 4, these spaces constituting flues for the circulation of heat in burning. When the walls reach  
35 nearly the height of the kiln, they are covered with a course of brick laid flat, B, and then with a layer of earth, C.

Either at the floor or below it, as represented in the drawings, perforated pipes D are laid connecting with a gas-main, E, which  
40 passes inside and outside of the kiln. The size of these perforations is regulated by the amount of heat required in the different parts of the kiln. On the gas issuing from these  
45 perforations being ignited, the heated air and products of combustion pass through the flues formed between the walls of brick or other loading to the chimney. These flues may be  
50 formed by the brick being built into concentric walls tied together by binder-brick, as shown at the left of Fig. 3, or by having the walls

and spaces alternate, as shown at the right of the same figure.

At the bottom of the inside and outside  
55 walls of the kiln are the air-passages F, Figs. 2 and 3, over the gas-burners. These passages can be closed by a plate or by bricks when not needed, and they are best placed at intervals of about four feet. At convenient  
60 distances doorways G, Fig. 2, are left in the kiln-wall, which can be closed with an iron plate or built up when the kiln is burning. A movable chimney, made preferably of sheet-iron, is placed over openings in the kiln-covering  
65 at suitable distances from the fire.

The method of operation is as follows: The walls being built and the floor laid at any chosen point, a temporary transverse wall is  
70 built across the annular space, having in it air-openings which can be closed when not in use, and the loading is commenced beyond it. The green brick are built up in concentric walls, as shown, of one or more bricks in thickness, according to the size used, being about four  
75 inches from the exterior walls and about two inches apart. These walls are carried up to near the top of the kiln-walls, and covered with a course of bricks laid flat, and then  
80 with a layer of earth or equivalent about six inches to a foot in thickness. After about forty feet of the loading is put in, an opening is left in the covering, and necessary space in the walls for the escape of the products of combustion over which the movable chimney G is  
85 placed, and beyond it a screen of tarred paper or similar material is built across the annular space into the walls as a damper, and the loading is continued in the same manner. The kiln should be of sufficient size to have about  
90 one hundred burners at the above-mentioned distance (four feet) apart, and the firing is to be commenced in the first four from the temporary cross-wall, the air to support combustion being drawn through the air-spaces left  
95 in the said wall. After from twenty-four to thirty-six hours the fifth burner is lighted, and in, say, twelve hours more the sixth, and so on. When the seventh burner is lighted the first is shut off, and thus until within three  
100 or four burners of the chimney. Then the chimney is removed to the next opening, and the opening where it was closed and covered up, and fire put to the tarred paper

screen, and the firing continued. After the fortieth burner is lighted the air-passages in the temporary wall are closed, and the air-passage over the first burner opened, and so following each burner lighted, the air for combustion being drawn through the cooling brick, and when the sixtieth burner is lighted the brick in the first section should be cool enough to handle. These brick are then taken out and the temporary wall removed and the loading, burning, and unloading then becomes continuous, a burner being lighted every four or six hours, or as often as found best. Of course these times and numbers depend upon the quality of the clay, articles, and degree of burning needed.

The doorways G serve for setting and taking out the loading, and the brick can be handled outside on a little railway laid around the kiln.

The progress of the burning can be ascertained by the settling of the covering, as it should lower about two inches in a kiln of this size, by breaking the cover and removing a brick, or by small openings being left in the walls closed with clay through which a test-brick can be taken. The firing being under perfect control, it can be made light or heavy, as desired, or the material to be burned requires, or can be directed to any portion of the kiln where most needed.

Tiles of all descriptions can be very perfectly burned with little waste in this kiln, by putting them in place of the upper courses of brick in the walls, and other objects can be burned to the degree required by properly placing them in the kiln.

The advantages of this form of kiln are, first, its lowness reduces very much the pressure on the bottom courses of green brick; second, the utilization of the heat of firing by causing it to pass around the walls of green brick before it reaches the chimney, thus depriving them of much of their moisture before the fire reaches them; third, the utilization of the waste heat in the already-burned brick behind the fire by passing around them the air needed for combustion, thus raising it to quite a high temperature before it reaches the fire, and also aiding in the cooling of the brick as soon as it is safe to pass air around them.

Fig. 5 shows the arrangements of the perforated gas-burners D. There are preferably two of these—one to be inserted from the outside and the other from the inside of the kiln. Below the floor of the kiln, in line of the opening F, small tunnels are run, lined with brick and covered where the green-brick walls cross them with tiles or plates. These tunnels are extended a sufficient distance from the walls to enter the burners. On bottom are the rollers L, on which the burners D can be run in and out of the kiln through the openings F in the kiln-wall. These openings F, after the burners are entered, are closed around them by a door, or by being built up with bricks or clay, so that no air is permitted to enter, ex-

cept through the ends N of the pipe, which can be more or less closed with a plate, the same as in an ordinary Bunsen burner. The gas is brought from the mains E by the short pipes P, which are coupled, so as to be easily disconnected, and having a cock or valve, R, by which the gas can be shut off from the burners D. The gas is brought through the pipes P in the center of the burner D, and, mingling with the air which enters at the ends N, passes out through the perforations, and then is burned. These perforations are placed beneath passages between the green-brick walls, so that the flame does not impinge directly on the bricks, but is carried up between them. With this arrangement it is not necessary to provide the burners D for every opening E in the kiln, but only so many as are needed for number needed to be lighted at one time, as after the bricks at one point are properly burned they can be run out, the opening F closed and placed in the openings ahead. By making them in two parts, another purpose is served. In a circular kiln the brick near the interior wall are burned sooner than those near the exterior wall, and therefore the heat needs to be often shut off from the interior before the exterior is ready. These burners D being in two parts, the one on the interior being the shorter, this can be very easily accomplished by shutting off this one before the other. These burners can be lighted by allowing only the gas to enter and igniting that escaping from the perforations nearest the openings F, or, if the perforations are too far apart for the flame to jump from one to the other, by a long torch passed into the tunnel above the burners.

In the Hoffman continuous kiln the air for cooling the burned brick for supporting combustion and for drying the green brick is admitted at openings near the base of the outside walls and passes out of an opening or openings on the inside of the kiln to the chimney. This is very liable to create currents on certain lines and dead-spaces, thus making its action imperfect. In the Bull kiln the intakes are both in the outside and inside walls, and the exit through a chimney which crosses the kiln. This is much better, but still the effect of these currents is not wholly prevented, and there is no way of concentrating the heat at any point where it is needed. The improvement in the kiln is shown in Figs. 6 and 7. In the first, M is a perforated pipe or pipes, of metal or other suitable material, which can be run into the openings F whenever it is desired to admit air, and the space around them closed. These pipes M are open at the outer ends, O, and have perforations opposite the passages between the walls of brick, so that the air coming in at the free end will pass equally through all the passages between the walls, and thus surround the burned brick and effectually carry away the heat, and also equally distribute itself among the gas-flames to support combustion.

The drawing of the heat where most needed is accomplished by the improvement on the movable chimney H. (Shown in Fig. 7.) Dampers I I are placed in the movable chimney H, which can be opened and closed by the handles K, and by means of which any tendency of the heated air to draw to one part of the kiln can be checked and turned to where it is wanted. By thus regulating the entrance and exit of the air the brick can be more uniformly and effectually burned.

The continuous kiln possesses the following advantages over older forms: Its lowness, allowing brick to be loaded almost as soon as molded; the utilization of the heat in burned brick; in raising the temperature of the air needed for combustion; the drying of the green brick by the waste heat passing to the chimney, and, in the Bull kiln, its simplicity, cheapness, and having merely encircling walls to absorb and retain the heat. The main disadvantages are the direct action of flame on the material, causing much loss, and the impossibility of properly regulating the distribution of heat.

The proposed improved gas-burning kiln has all the advantages and none of the disadvantages above mentioned, for it is simple and cheap, costing but little more than the Bull kiln, and, besides, the flame can be so regulated, the admission and exit of air so well controlled, and so little heat wasted that the cost of fuel would be very much less and the output of first-class brick much greater, while almost perfectly green brick can be loaded, so gradual may be the application of heat, and the regular burning would be but little affected by high winds, as the distribution of the heat is so perfectly under control.

I am aware that a continuous kiln similar in many respects to the construction described has been used, the firing having, however, been done with solid fuel; also, that brick-kilns have heretofore been adapted to the use

of gaseous fuel conveyed in pipes to said kiln, and I do not broadly claim such; but

What I claim, and desire to secure by Letters Patent, is—

1. In a continuous kiln, the combination of the permanent exterior and interior walls, green-brick inside walls, covering-layer with openings at suitable intervals, temporary wall, combustible screen, doorways, and movable chimney with dampers, with perforated gas-burners, with inlets at the outer end extending across the kiln at proper intervals, for the combustion of a mixture of air and gas, substantially as described.

2. In a continuous kiln, the combination of gas-mains running preferably parallel to the encircling walls, having branch pipes at suitable intervals, which allow the gas to escape into the outer ends of movable perforated gas-burners extending beneath the green-brick walls, and so arranged as to admit a regulated quantity of gas and atmospheric air into their outer ends, which mixes before its issuance from the perforations, and all under control, substantially as described.

3. In a continuous kiln, the combination of the openings in the temporary wall or in the encircling walls, and the movable chimney, with dampers arranged for the regulated admission and discharge of atmospheric air, with the gas-mains having branch pipes at suitable intervals properly connected to the outer end of the movable perforated gas-burners, fitted for the regulated combustion of a mixture of gas and atmospheric air, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOHN K. MACIVER.

Witnesses:

THOS. G. CRAIG,  
JOHN WYNNE, Jr.