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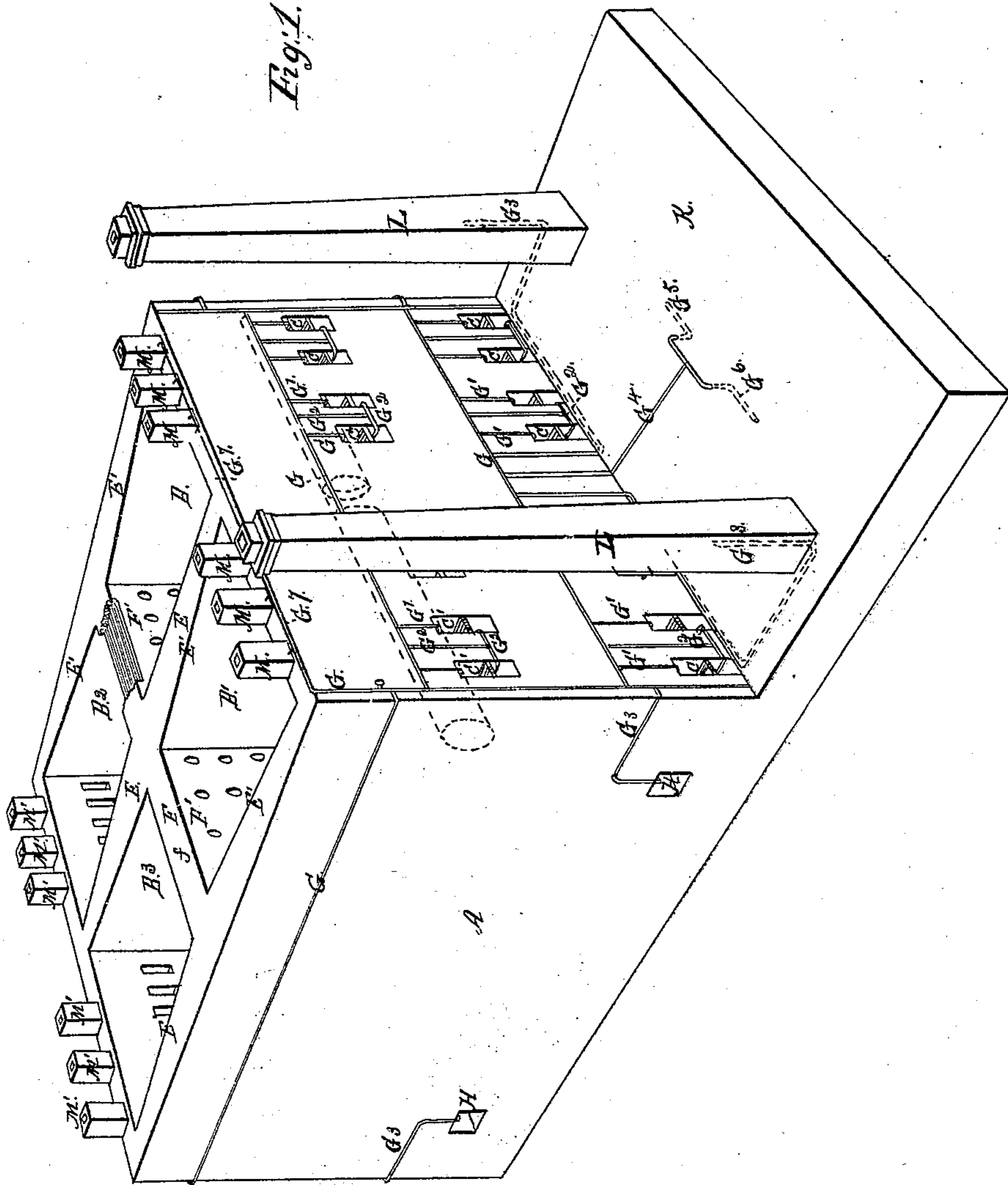
H. W. Adams.

Brick Kiln.

No. 92,770.

Patented Jul. 20, 1869.

Fig. 1.



Witnesses.

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Fig. 3.

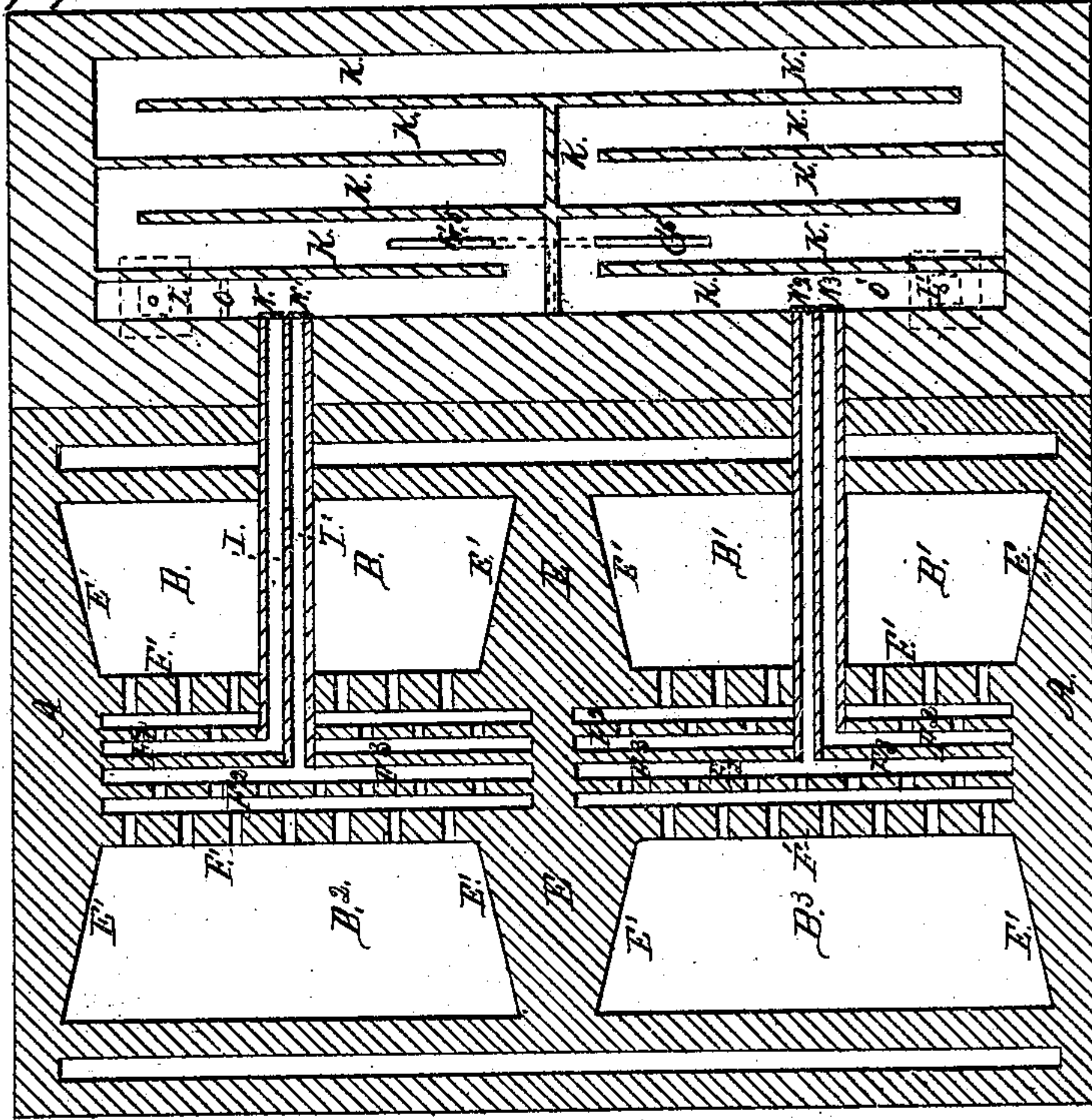
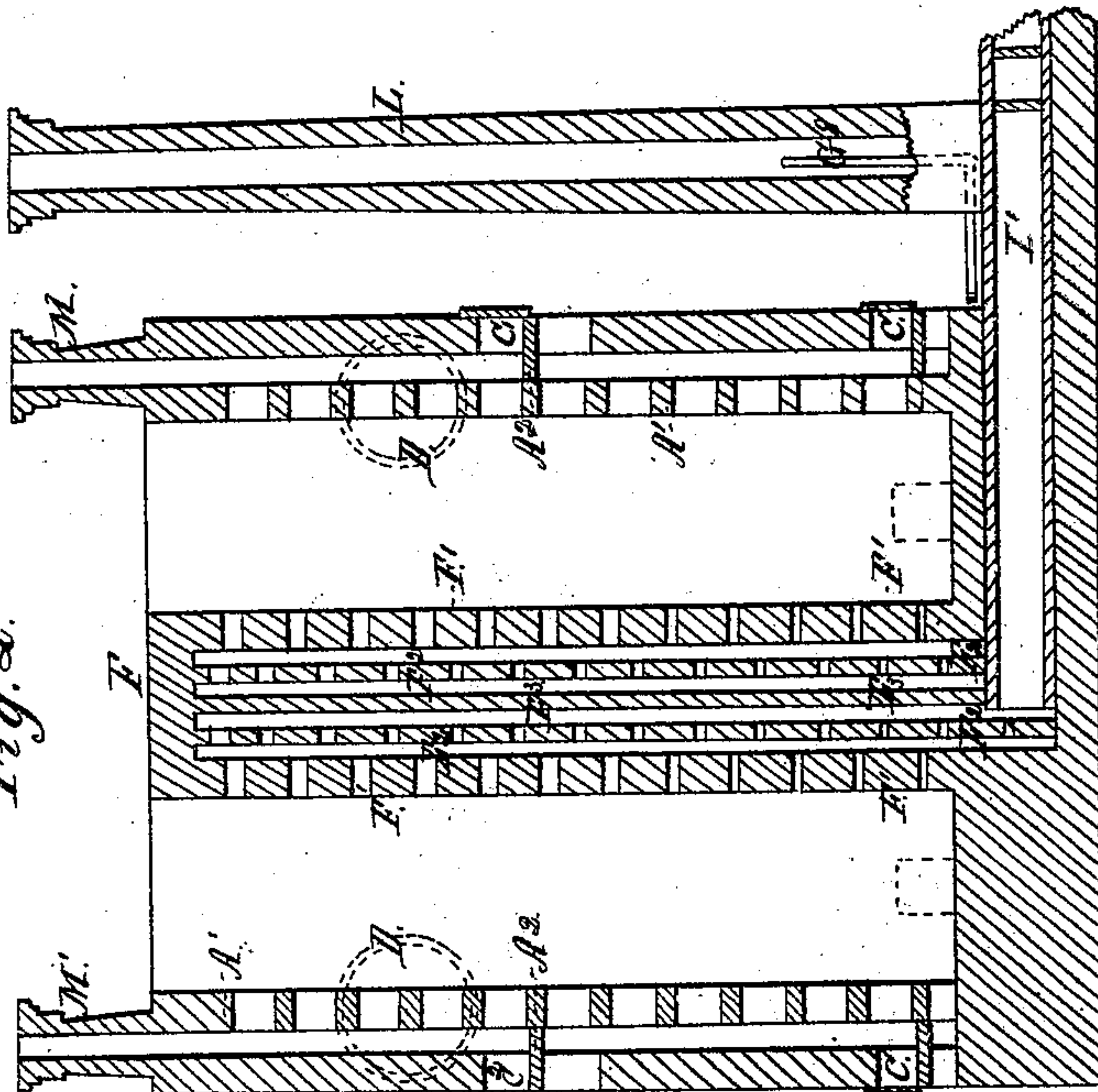


Fig. 2.



Witnesses.

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UNITED STATES PATENT OFFICE.

HENRY W. ADAMS, OF PHILADELPHIA, PENNSYLVANIA.

IMPROVEMENT IN BRICK-KILNS.

Specification forming part of Letters Patent No. 92,770, dated July 20, 1869.

To all whom it may concern:

Be it known that I, HENRY W. ADAMS, of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented new and useful Improvements in Brick-Kilns; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the annexed drawings, making part of this specification, in which—

Figure 1 is a perspective view of a kiln; Fig. 2, a vertical transverse section; and Fig. 3, a horizontal section near the bottom of the kiln.

The same letters in all the figures indicate identical parts.

My present invention relates to additional improvements in brick-kilns of the class shown in my Letters Patent dated July 21, 1868; and consists in certain alterations and improvements, to be specifically pointed out in the following specifications and claims.

In the annexed drawings, A is the body of the kiln, which is formed of a permanent wall of brick, with an interlining of fire-brick or other suitable refractory material, and which may be constructed with air-chambers between the walls to prevent the loss of heat by radiation. The kiln is subdivided into compartments. I have shown a kiln constructed with four compartments, which I regard as a convenient and economical number in practice. These compartments are indicated by the letters B, B¹, B², and B³. In the front and rear walls I construct two rows of furnaces, C C', furnished with grate-bars in the ordinary form, in which the fires are maintained, the heat passing back with the draft into and through the several compartments into which the furnaces respectively open, the draft passing through the perforated walls F¹ opposite to the furnaces. These grates are placed below the level of the hearth of the kiln, in the lower tier, and protected behind by bridge-walls in the upper tier, and immediately behind the grates, leaving an interval of, say, eighteen inches; I build the pigeon-hole wall A¹, forming between it and the front wall a chamber through which the heat rises from the furnace to be equally distributed through the kiln, which it enters through the pigeon-holes. A partition, A², across this chamber,

immediately below the upper furnaces, prevents the passage of heat or flame from one to the other tier. In order to facilitate and equalize the draft as much as possible, I pile the bricks in rows, made regular by placing a board between the rows as they are successively piled in the kiln, and when, say, two or three rows standing on edge have been added, and, when an entire layer has been completed, placing another row of bricks resting on their faces over these as riders, and then drawing out the boards, so as to form continuous flues extending in right lines entirely across the kiln. Narrow spaces left between the cross-bricks allow the heat to ascend from the furnaces through the mass of bricks piled in the kiln. Care should also be taken, in piling the bricks in the kiln, to leave a continuous vertical opening above the side furnaces H, for the rapid diffusion of the heat thereof, for purposes to be hereinafter explained.

Over the furnaces I propose to place steam-generators in such position that, receiving the action of the fires, steam may be generated therein. I have indicated in Fig. 2, at D, cylindrical boilers built into the walls across and immediately above the series of furnaces. It is obvious, however, that the form and location of these generators may be varied, and I do not confine myself to the use of any particular form or location of steam-generator.

E is a continuous partition extending across the entire length of the kiln, and F a transverse partition. The former is a solid wall, but the latter is composed of a series of walls. The outer wall F¹ forms the back of the compartment. It is perforated with a series of holes, through which the draft passes. These holes I prefer to make of a constantly increasing diameter from bottom to top, so that the holes at the top, where the draft and heat are least, may be the largest, thereby tending to produce a more uniform circulation and temperature through the entire body of the compartment. In large kilns, instead of making the wall E solid, it would be made of two walls, say, sixteen feet apart, to form a passage-way through the kiln and admit of the introduction of side furnaces opposite the furnaces H shown in the drawings. Perforated walls F² are built within the walls

F¹. The perforations in the walls F¹ and F² are respectively so arranged that the perforations of each shall be opposite the solid spaces of the other, so that the draft in passing through the perforations and through the chambers between the walls into the flue I, shall be thoroughly intermingled as it passes from different parts of the kiln, and the draft equalized thereby. The wall F² tends to form a vacuum-chamber behind it, and thereby equalize the draft at the bottom and top of the kiln. The pigeon-holes in the wall F² also increase in diameter from bottom to top.

The solid wall F³ divides entirely the compartments B and B¹ from the compartments B² and B³, except as the compartments B and B² and B¹ and B³ are respectively connected by flues I' opening through the said partition F³, for purposes to be hereinafter more fully explained.

The steam-generators supply steam which is carried to the various parts of the kiln through a system of steam-pipes, G. Branch pipes G¹ are carried from the main pipes, and so directed as to drive a jet of steam into the upper parts of the furnaces above the fuel, which jets force back the heat in a strong draft into the body of the kiln. The steam impinging against the walls and bricks forming the flues within the kiln most exposed to the heat takes up a portion of the surplus heat, and, becoming superheated, carries the heat to the more remote parts of the compartment and thus tends to produce a more perfect equilibrium of temperature. Another series of branch pipes, G², are so arranged as to direct jets of steam underneath the grates, for the purpose of producing an equilibrium of pressure below and above the grates, so as to prevent the action of the upper jets upon the fire to force the heat down upon the grates, and thereby destroy them.

Another series of branch pipes, G³, lead in like manner into the side furnaces H. Another pipe, G⁴, with branches G⁵ and G⁶, leads under the hearth, discharging their jets in opposite directions, for purposes to be explained hereafter, while still other pipes G⁷ and G⁸ are arranged to discharge jets upward into the chimneys, for the purpose of increasing the draft. All of these pipes are fitted with stop-cocks to control the force of jets, or shut off the steam entirely.

Furnaces H are placed in the sides of the kiln, the object of which is to add to the heat of the back portion of the bricks in the kiln, for the purpose of more equally burning the same. The fires in these furnaces I do not propose to maintain continuously, but to kindle the same toward the latter part of the operation, in order that the bricks in the front part of the kiln may not be overburned while those in the back are being finished. The passage left for the ascent of the heat immediately above the side furnaces is intended to

facilitate the uniform and immediate transmission of the heat through the whole of the back part of the kiln. In order also to effect the uniform burning of the bricks, I propose to contract the back part of the compartments, as shown by the lines E' E', Figs. 1 and 3. By this means the heat, more diffused in the front part of the kiln, where its intensity is greatest, is concentrated in the back part of the kiln, by the contraction of the draft within narrower limits.

I and I' are two flues in each set of compartments, the former connecting from the space between the walls F¹ and F³ of the compartments B and B¹, so as to lead the draft from the said compartments under the hearth K, while the flues I' lead from the space between the walls F¹ and F³, communicating with the compartments B² and B³, and into the chamber under the hearth or drying-floor.

The hearth K is intended for use as a drying-floor for drying bricks. It is made of any suitable material, such as brick, stone, or metallic plates, and rests upon a series of walls, arranged, as clearly shown in Fig. 3, so that the current of heated gas passing from the kiln shall be made to traverse from side to side of the hearth, for the purpose of heating it uniformly, and, also, that as much as possible of the heat may be taken up by the hearth-plates.

The two chimneys L and L' are respectively placed, as shown in Figs. 1 and 3, so as to carry away the gas and cause a draft. To increase the force of this draft, the pipes G⁸ are placed in the chimney opening upward, so that the jet of steam passing therefrom may increase the draft by tending to produce a vacuum.

Other chimneys M M' are placed in the front and rear walls. They are built from the ground, passing up through the space between the furnaces, and between the exterior wall A, and interior pigeon-hole wall A¹. They serve to afford a natural draft in heating the furnaces before the water in the steam-generators is sufficiently heated, and also serve as partition-walls to separate the chambers formed in and between the double walls in front and rear into compartments, and prevent the greater pressure incident to an increase of the steam-jet in one of the furnaces over that of an adjoining one, from operating to force the gases from one into the other. These chimneys also serve as buttresses to support the wall A¹. They are constructed with pigeon-holes opening through their walls, so that the draft passing through the corresponding openings in the interlining A¹ of the walls may be conducted into the chimney. The pipes G⁷ are introduced into these chimneys to operate in the same manner, and for same purpose, as the similar pipes G⁸ in the chimneys L and L', as already explained. Instead of making these chimneys open upward,

I can close their tops and open their lower ends into under-ground flues, and draw the heat through the drying-floors.

Dampers are placed at N, N¹, N², and N³, Fig. 3, to close the flues I and I' when required. Other dampers are placed in the flues leading into the chimneys L and L', as shown at O and O', Fig. 3, so as to shut off either of the channels leading into these chimneys, as may be desired.

I cover the kilns, when filled, by laying on the top two plaiting courses of unburned bricks, breaking joints, and then a top plaiting course of burned bricks, breaking joints with the one beneath it, and then seal the joints of the top course with clay, made plastic with water, and then cover the whole with earth to the depth of, say, eight inches, which hermetically seals the kiln.

The following modifications should be adopted with reference to the construction of large kilns:

It will be perceived that each kiln has a side fire-place. When I build large and long kilns I leave a gangway between each pair, the rear ends of which may unite or be separated by a gangway. This gangway is sixteen feet wide, more or less, to give room to pass and fire the sides. Then I put in a fire-place on both sides of each kiln. Sometimes I put in two or three fire-places on each side, one above the other, as shown in the front end. When my kilns are very long I put in several tiers of fire-places at different distances apart, one above the other, and on both sides of the kiln opposite each other. The first side fire-places are ten feet, more or less, from the front end of the kiln. The next ones are about the same distance from the first, and so on to the end of the kiln. I place them closer together or farther apart, according to the size, height, and length of my kilns. Across the kiln when set, from the fire-places on one side to those opposite, I leave a break or space about a foot wide, more or less, for the hot products of combustion to accumulate in from the opposite fire-places, and from thence to enter the honey-comb of the kiln in the direction of the rear end. In order to prevent these hot products of combustion from one tier of fire-place blowing through this break, space, or chamber into the opposite fire-places, and also to prevent them from rising up from the lower fire-places and flowing back out of the top ones immediately over them, I divide this chamber into four or more separate chambers, one for each fire-place, and thus cut off communication with each other. This I do by turning an arch over the bottom chamber about half way from the bottom to the top of the kiln, and between the two fire-places, and another one on the top of the kiln, and then by setting up a partition in the center of these arches, dividing them in the middle, the four or more (from the bottom to the top of the kiln) separate chambers are complete. The kilns are

set thus with unburned bricks, leaving the flues through all the sections from the front to the rear of the kiln continuous for draft. These chambers may be built with fire-bricks, and made permanent. When I do this I set two walls, with flues in them, about eighteen inches, more or less, apart, in the same method as I build the front pigeon-hole walls before the mouths of the fire-places in the front end of the kiln, to which reference is hereby made.

By building a partition between them, between the bottom and top fire-places, and also a division in the center from the bottom to the top of these walls, they form the four separate chambers, as described. Then the hot products of combustion drive into each separate chamber from each separate fire-place, and distribute themselves more diffusively and equably through the interstitial flues of the kiln in the direction of the draft.

The walls in front of the mouths of the end fire-places are pierced with flues, which represent the flues through the whole kiln when it is set. The unburned bricks are set up against these walls, so as to continue the flues shown in them through the whole kiln. These front walls I prefer to build permanently of fire-brick; their office is to prevent the front ends of the kilns from falling down into the fire-places, and also to protect them from the first intensity and damaging action of the heat—although the chimneys, or solid piers built in their places, would support the front end of the kiln from falling down, but would not protect them from the melting heat.

The mode of operating my improved brick-kiln is as follows: The compartments having been filled with bricks, arranged as already described, and the dampers all closed, a fire is to be built in the furnaces of the compartment B, and maintained with an open draft through its chimneys M, until steam has been raised in the boilers connected therewith. The dampers N and O', and the steam-jets into these furnaces, and the jets into chimney L', are then opened, and a strong draft thereby created, which forces the draft through the perforations in the back wall F¹ of kiln B, and down through the chamber within the wall F, and through the flue I, and open damper N into the space below the hearth. Traversing the tortuous flues under the hearth, the draft, consisting of what is called water-smoke, that is, the unconsumed products of combustion, mingled with steam produced by injection and by evaporation from the damp bricks, is carried forward and discharged through the chimney L'. The draft may be increased by opening the jet G³, and by opening the jet pipe G⁵, which discharges its jet into the flue in the direction of the draft. If the hearth is not to be heated by opening the damper O, and closing the damper O', the draft will pass out immediately through the chimney L. This operation is continued until the water-smoke ceases to pass by reason of

the drying of the bricks, which period can be readily determined by any one skilled in the art of observation. The dampers O and O' being then both closed, and the jets G⁵ G⁸ shut off, and the damper N¹ and the steam-jets in the chimneys M' of kiln B² opened, the draft will be carried out through the flue I, and back again through the flue I', which, passing through the partition-wall F³ and through the chambers between the latter and the perforated walls F² and F¹, emerges through the holes in the said walls and enters the compartment B².

The holes being, as already explained, larger at the top than at the bottom, there will be an equal amount of heat entering at all parts, as the smallest orifices are at the place of maximum pressure. The draft passing through the flues between the bricks in compartment B² escapes through the chimneys M', and this operation will be continued until the bricks in the compartment B are sufficiently burned and settled, by which time the water-smoke will have disappeared from the compartment B², when fires are kindled in the furnaces of compartment B², the flue N and the jets in the chimneys M' closed, and these chimneys closed by dampers and the damper N³, and the jets in the chimneys M of kiln B¹ opened, so that the draft of the compartment B², passing through flue I', shall traverse the flue under the hearth and pass through the flue I into compartment B¹, in which the bricks are dried, as before, until the fires are kindled in the furnace of this compartment, and the draft N² being opened, the waste heat be carried into compartment B³, as before described; then B¹ is fired. In the meantime, the compartment B having become cool, by opening the damper N, and been emptied, is again filled with green bricks, and the waste heat from compartment B³ used to dry the bricks therein, and so on in succession. The kilns may be used in series indefinitely. The jets G⁵ and G⁶ are used alternately, according as the draft is flowing in one direction or the other. The chimney not in use should also be closed by dampers.

When a kiln has been burned and settled, I utilize the heat contained therein by opening the flue leading therefrom, and drawing the heat therefrom under the drying-floor, by opening the jets in one of the chimneys, or drawing it through one of the other kilns filled with green brick, to draw off the water-smoke.

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

1. The arrangement, in a brick-kiln, of furnaces with jets of steam discharging into the furnaces, both above and below the fires, substantially as and for the purpose set forth.

2. In combination with the furnaces C C', arranged in tiers in the front of the several burning-compartments B B¹ B², &c., the furnaces

H, placed in the sides of the kiln, substantially as and for the purpose set forth.

3. The kiln, when constructed with the side walls E', converging from front to rear, and also with a rear pigeon-holed wall, substantially as set forth.

4. The wall F, when constructed of a tight partition, F³, and a series of perforated walls, F² F¹, substantially as and for the purpose set forth.

5. The construction and arrangement, with relation to each other, of the walls F¹ and F², so that the solid portions of each shall stand opposite to the perforations of the other, substantially in the manner set forth.

6. The arrangement of the compartments B, B¹, B², and B³, and flues I I', and flues under the hearth K, as shown, and dampers N N¹, &c., and O O', substantially as set forth.

7. The combination of a kiln or kilns and hearth K, under which the draft is made to pass, substantially as and for the purpose set forth.

8. The chimneys M M', constructed as described, arranged to serve not only as uptakes for the kilns, but also to form bulk-heads between the furnaces, and also buttresses to support the inner wall A, substantially as set forth.

9. The arrangement, within the flue under the hearth, of steam-jets G⁶ and G⁶, to discharge jets of steam in either direction, substantially as and for the purpose set forth.

10. The combination of a series of kilns with intercommunicating flues, and a series of steam-jets for carrying the surplus heat from one kiln into another, for utilization, substantially in the manner set forth.

11. The combination in a kiln, substantially as described, of a burning-chamber, as shown, and a draft-chamber, formed in the rear thereof, between the solid wall F³ and pigeon-holed wall F¹, substantially in the manner and for the purpose set forth.

12. The pigeon-hole wall A¹ and partitions A², arranged in relation to the front wall and furnaces substantially as set forth.

13. The arrangement, in connection with the furnaces of a kiln, of a steam-generator, so that the same fire which burns the brick shall generate the steam, when combined with the series of pipes to conduct the steam from said generator and discharge it into the series of furnaces and flues, substantially in the manner set forth.

14. In combination with two tiers or sets of furnaces, as herein shown, interposed partitions A², to form subdivisions of the draft-chamber, to prevent the interference of one furnace or set of furnaces with another, substantially as set forth.

15. The burning-chambers of a kiln, constructed with converging side walls, and having, also, communicating flues, through which the heat is conducted from the rear of one chamber, passing thence into the rear of an-

other burning-chamber, to escape at the combustion end of said last-named chamber, substantially as set forth.

16. The rear partition wall or walls, constructed with pigeon-holes increasing in diameter, in series, from bottom to top, substantially as and for the purpose set forth.

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

HENRY W. ADAMS.

Witnesses:

T. C. CONNOLLY,
C. F. CLAUSEN.