Sheet No. 1.

B. R. Hawley, Manufacture of Bricks.

No. 118,364. Patented Aug. 22, 1871.

Fig: 3.

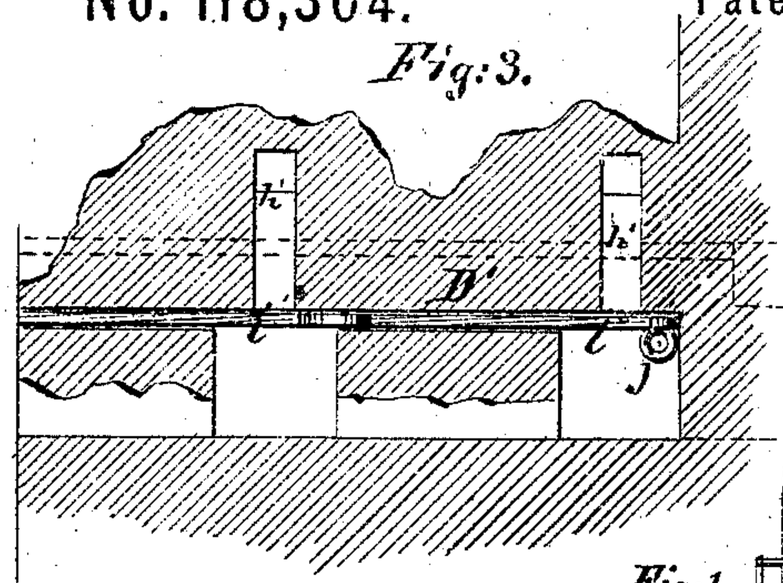


Fig: 4.

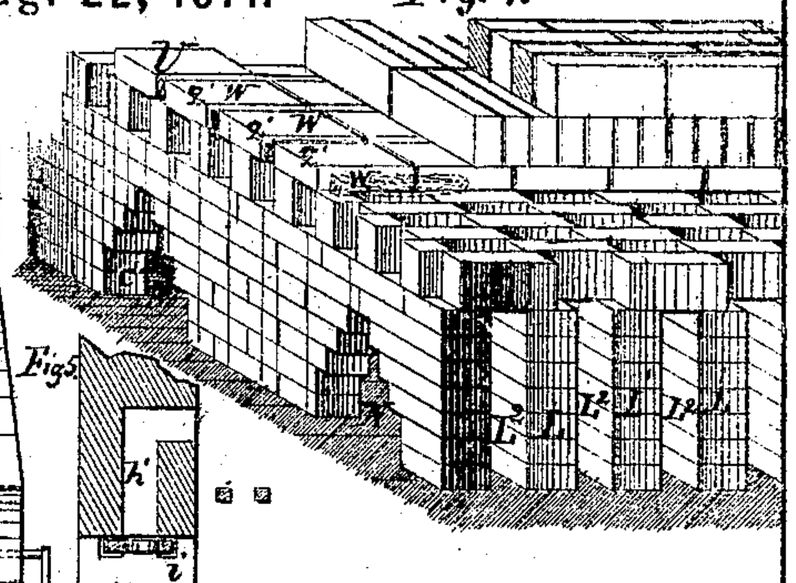


Fig: 1

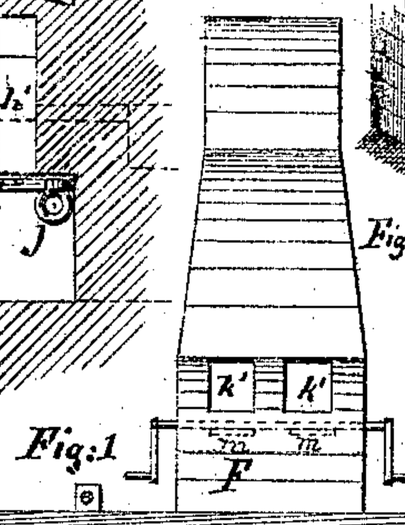
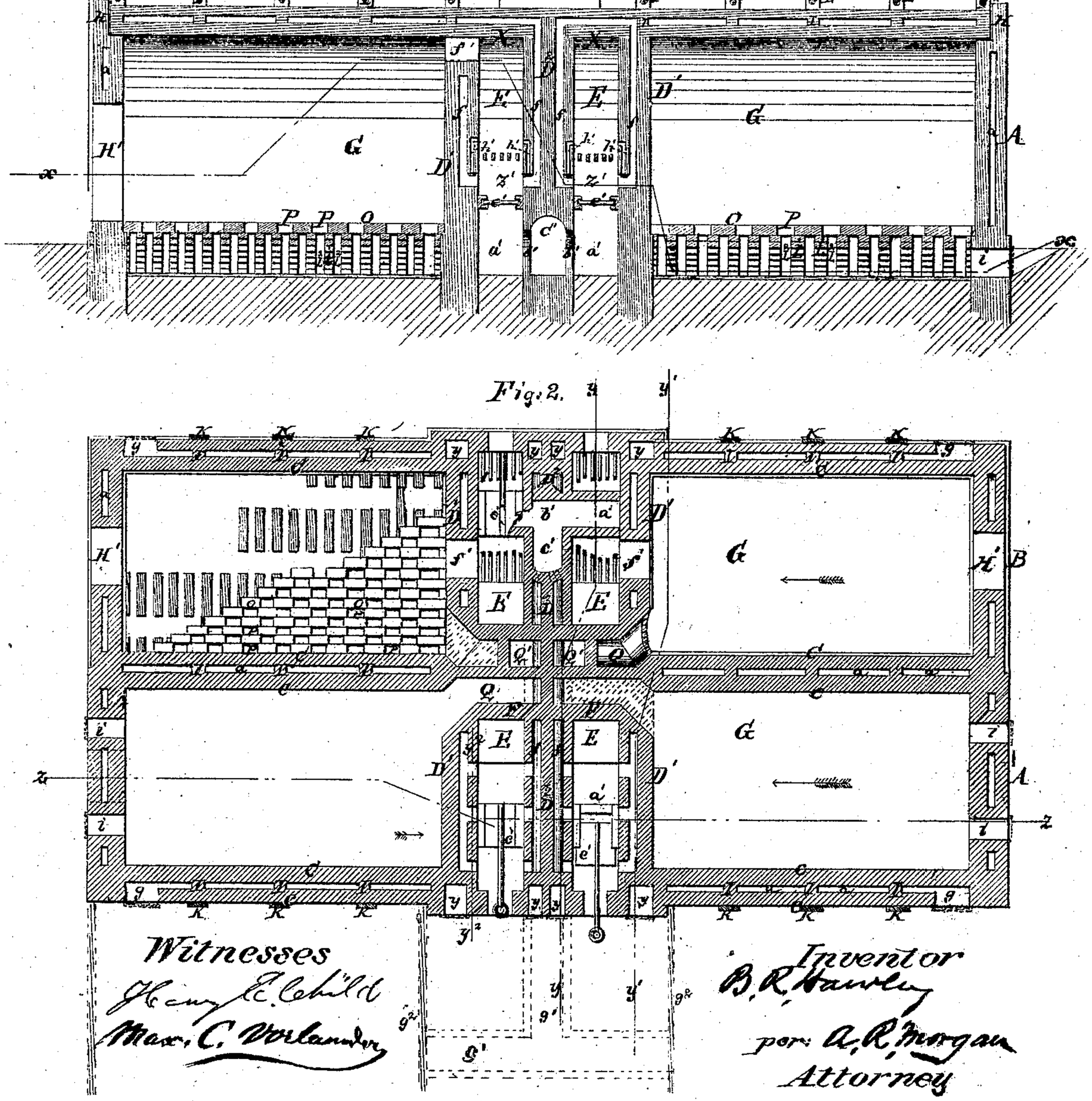


Fig: 5

Fig: 2.



Witnesses

Henry E. Child

Max. C. Wolcander

Inventor

B. R. Hawley

per: A. R. Morgan

Attorney

Sheet N°2.

B. R. Hawley, Manufacture of Bricks.

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Fig: 6.

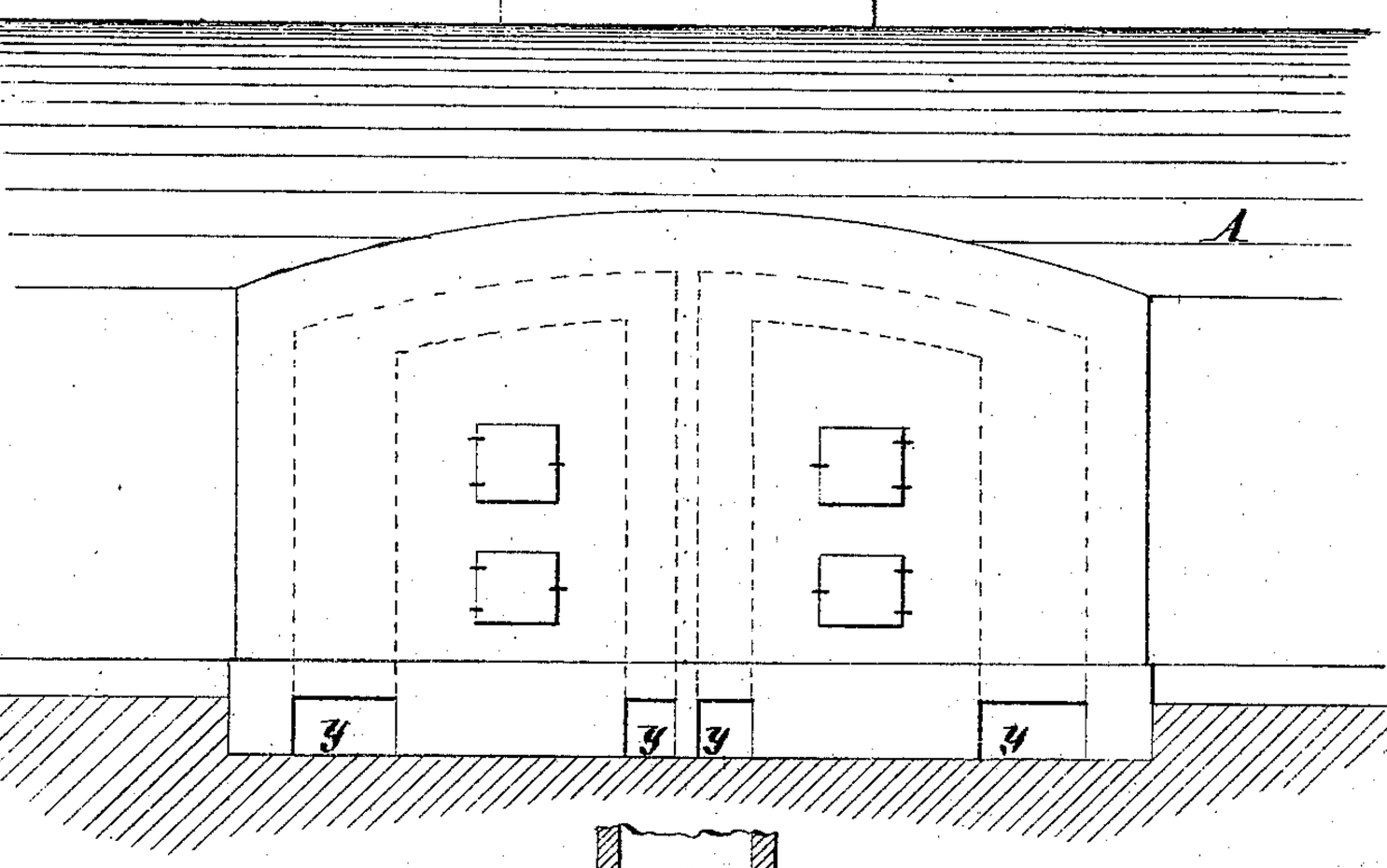


Fig: 7.

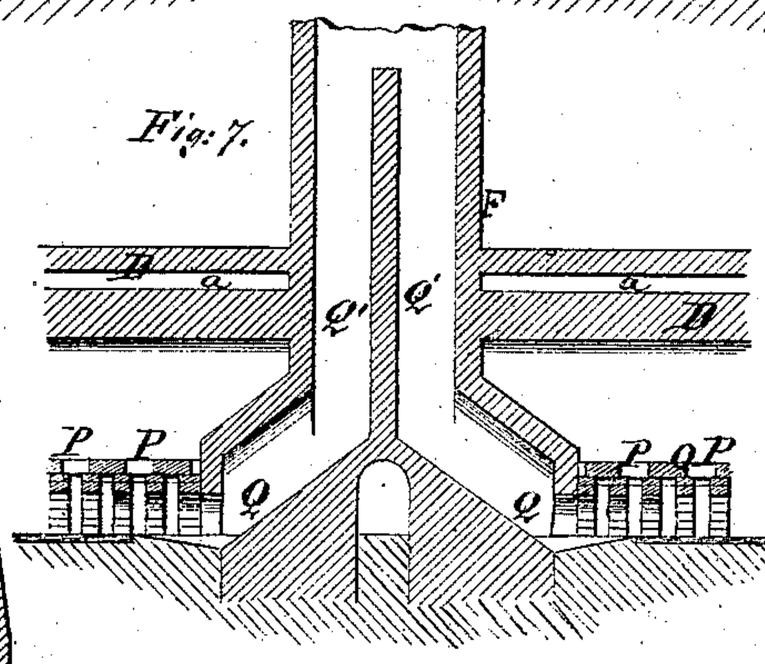
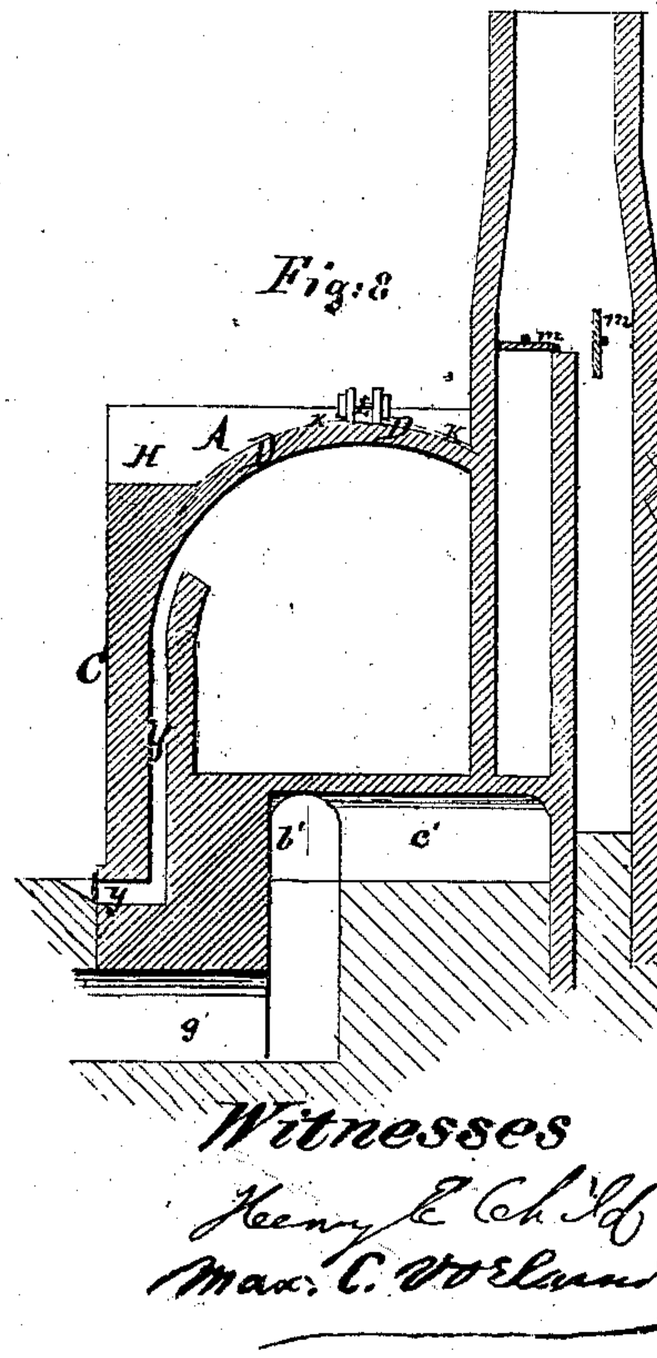


Fig: 8



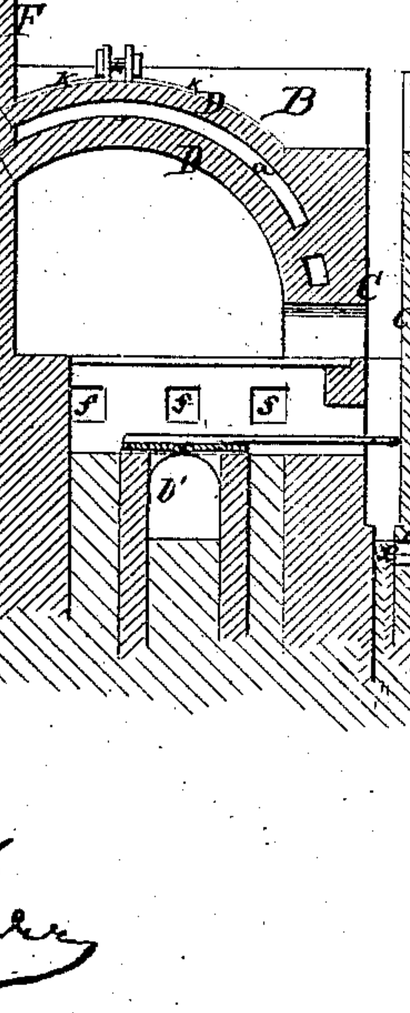
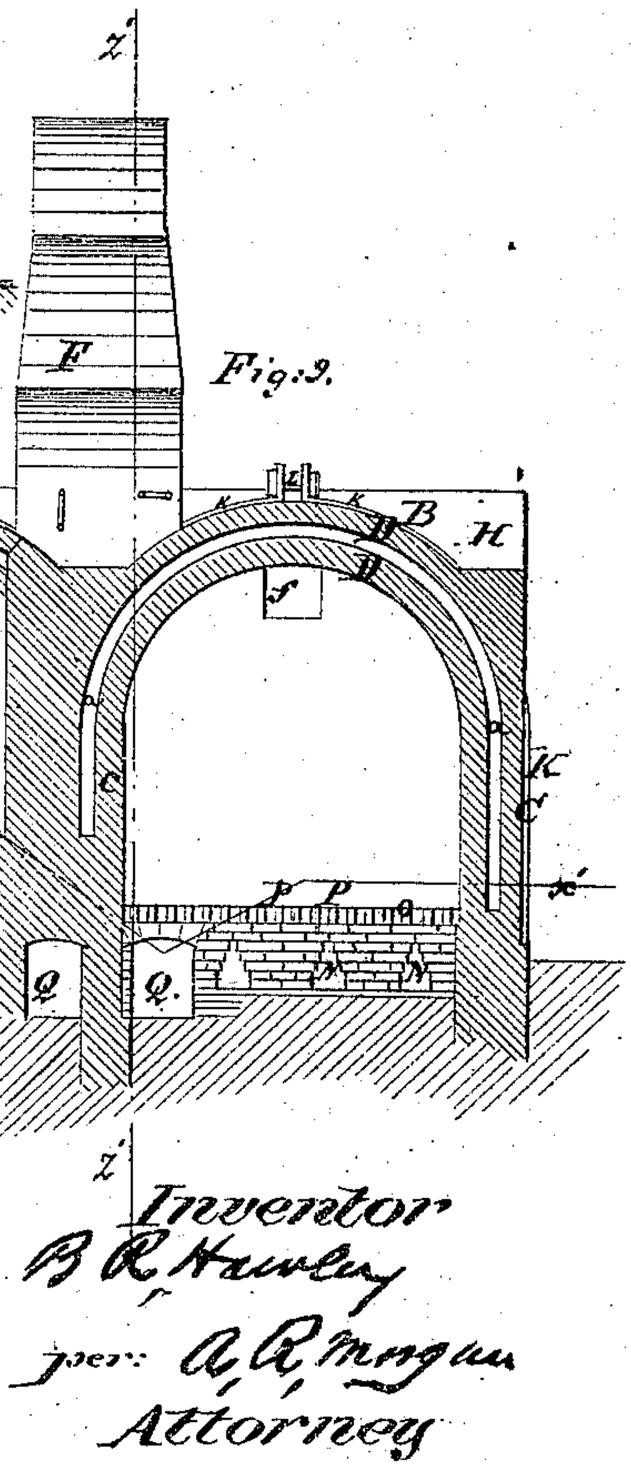


Fig: 9.



Witnesses

Henry E. Chapin

Max. C. Wolcander

Inventor

B. R. Hawley

per: A. R. Morgan

Attorney

Reissued Apl. 2d 1872.

118,364

UNITED STATES PATENT OFFICE.

BENJAMIN R. HAWLEY, OF NORMAL, ILLINOIS.

IMPROVEMENT IN BRICK-KILNS.

Specification forming part of Letters Patent No. 118,364, dated August 22, 1871.

To all whom it may concern:

Be it known that I, BENJAMIN R. HAWLEY, of Normal, in the county of McLean and State of Illinois, have invented new and useful Improvements in the Manufacture of Bricks; and I do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the accompanying drawing and to the letters of reference marked thereon.

This invention relates to improvements in the manufacture of bricks; and it consists in certain improvements in the arrangements of the kilns and the bricks therein for burning, as hereinafter described.

Figure 1 is a longitudinal sectional elevation of my improved kiln, the section being taken on the line *z z* of Fig. 2. Fig. 2 is a horizontal section partly on line *x x* of Fig. 1 and partly on line *x x'* of Fig. 9. Fig. 3 is a partial transverse section taken on the line y^2 y^2 of Fig. 2. Fig. 4 is a perspective view of a part of the floor with some bricks upon it, showing the mode of equalizing the application of the heat. Fig. 5 is a detail, showing a damper and passage for admitting air above the grate when required. Fig. 6 is a partial side elevation, showing a plan for introducing the air to the furnaces through passages from the bottom to the top, and thence down over the arches of the furnaces to the spaces below the grates. Fig. 7 is a partial transverse section of Fig. 9 on the line *z' z'*. Fig. 8 is a transverse section of Fig. 2 on the line *y y*, and Fig. 9 is a transverse section of Fig. 2 on the line y^1 y^1.

The kiln which is the subject of the improvements hereinafter described is of that class in which the heated air and products of combustion are introduced to the chambers containing the bricks to be burned at top, and caused to flow downward through the bottom, and in which the heat escaping from one compartment in cooling off, after being burned, is utilized in another for heating the green bricks before the fire of the furnace is turned on, two or more compartments being arranged in a group for convenience in causing the heat to flow from one furnace to two or more compartments, and in conducting the remaining heat in a burned compartment to another compartment, to aid, if necessary, in drying the clay or green bricks preparatory to burning.

The first part of the present improvements relates to the construction of a kiln comprising a group of three, four, or more compartments grouped in twos or fours, with two or four furnaces and one smoke-stack, by which it is sought to improve the kiln in respect of permanence, simplicity, cost, efficiency, and economy of labor in attendance. To this end I arrange two long parallel structures, A B, having vertical side walls C rising a short distance from the ground, supporting the true semicircular arches D extending from end to end, and forming the coverings of the said structures. These arched structures are divided near the center by the two transverse walls D', between which space is provided for one or two furnaces, E, in each structure and part of the chimney F, which is built partly in said structures, between the said walls D^1, as shown in Figs. 1 and 2, and partly between them, as shown in Figs. 8 and 9. Both the vertical walls C and the arched walls D are built double, as indicated by the spaces *a*, the object being to prevent the cracks which may occur in the inner walls from extending through to the atmosphere and allowing the heat to escape or the cold air to draw in rapidly, as it would in some conditions of the draught, and chill the hot bricks adjacent to the cracks. It also provides dead-air spaces, which prevent the escape of heat, and, in the case of the walls between the compartments side by side, it prevents heating through from the one which is burning to the other, which would interfere with working in the one not burning to put in or remove the bricks while the adjoining compartment is burning. Another object is to enable me to repair the cracks without removing the whole of the wall, for in this arrangement it will only be the inner walls, as a general thing, that will suffer much damage. The arrangement of the hollow walls and semicircular arches is also desirable, because the walls exposed to the heat and subject to repair and renewal may thereby, as I have demonstrated in practice, be much thinner than when made solid, for the outer walls not exposed to the heat and to damage thereby remain intact and protect the inner ones from the counteraction of the atmosphere on them when heated and cooled; and in the arched form they are best adapted to retain their positions in expanding and contracting or resisting the action thereof. The inner and outer walls are

locked together at suitable distances, either by continuous or intermittent connections I and hoops or bands K anchored down in the ground, or in the foundation walls are stretched over the arches and connected, as at L, by a swivel or other means by which they may be tightened to prevent undue expansion. Instead of these metal bands I may use vertical posts by the sides of the vertical walls, with tie-rods extending across from one side to the other of the kiln. The said iron bands K pass under the vertical extensions H. The arched tops admit, also, of utilizing the top of the kiln as a drier for drying the sand used extensively in the manufacture of bricks, (in molding them,) for which I extend the side and end walls vertically as high, or thereabout, as the tops of the arches, as shown at H, to hold the sand upon the said arches. Thus I not only economize in the cost of sand-drying apparatus but I utilize the heat which would otherwise escape at the top for drying the sand. I also save the labor of attendance upon separate drying apparatus for firing.

The second part of my invention consists in a device for preventing the escape of hot air or admission of cold air to the interior at the joints of the end walls with the arches, which are liable to open by the expanding and springing outward of the ends and top of the end walls, under the action of the heat, which swells the inner sides more than the outer ones, by which the edges are curved outward and move away from the ends of the side and arch walls. I "break" the said joints by forming a rabbet in one or both, and lap one upon the other, as shown at *b*. In the case of the top of the end walls and the arches I arrange it so that this joint opens to the atmosphere vertically, as indicated in Fig. 1, whereby the sand placed on the top to dry will fall into it as it opens, and prevent the transmission of air, and it may be allowed to run down to the joints between the vertical parts and keep them closed, also, to a considerable extent. When the walls are cooled down, and the end walls spring back again, the sand will be forced from the joints to the interior of the kiln sufficiently to admit of the necessary return of the end walls. This device is more particularly applicable to the joints between the arches only and the end walls.

The third part of the invention relates to the construction of the floors of the kilns, which, for producing the most uniform results in this mode of applying the heat, should be as open as possible throughout the whole area to allow the heated air to settle down and pass off in all parts alike. For this purpose I provide parallel rows of brick walls L^1, the thickness of the width of one brick, with spaces L^2 between, of the same width, and having arches or openings of any kind, N, between them, on which I arrange an open floor of bricks O laid alternately, with spaces P in each direction of the same size, or nearly so, as the brick. In practice, the bricks will lap each other slightly, as indicated in Fig. 2, to prevent shifting about. The arched walls L^1 are preferably arranged parallel with the longest diameter of the furnaces and the passages formed by the arches perpendicular to them, but this is not essential; either way provides free passage below the floor for the air to find its way from all parts to the escape-passage Q into the smoke-stack F. It will be seen that this arrangement of the floor facilitates the application of the heat equally to the bricks set upon it in the lower part. The distribution of the heat in the upper part is effected by the tendency of the heated air admitted at the top to spread laterally when prevented from escaping upward, which is its natural course; but in practice, for certain reasons, the heated air is found to deviate somewhat from this tendency to spread at the top over the whole space, especially when exhausted from the bottom of the chamber, the said deviation being caused by the tendency, when the kiln is filled with green material, of the heated air to favor the most direct course from the passage *f'*, where it enters the compartments, from the furnaces to the bottom along the walls D', or thereabout, and to the escape-passage Q, so that the bricks near the outer end walls of the compartments will not be burned in the same measure as those in the other part. While this tendency may be modified somewhat by limiting the draught, by closing the dampers therefor, it cannot be completely overcome thereby and at the same time maintain a sufficient draught to meet the requirement for proper combustion, especially if the compartments have considerable length in this direction.

I have therefore devised the following arrangement to counteract this tendency, which said arrangement constitutes the fourth part of the invention: I lay the lower tier of bricks *z'* flatwise, as shown at *u* in Fig. 4, in continuous rows end to end, parallel with the walls D^1, but with a narrow space between each row; and for about two-thirds (more or less) of the distance from the walls D^1 to the end walls of the compartments I pack each space with a narrow strip, *w*, of wood, like the laths used in plastering, or it may be any other combustible material, for stopping the draught temporarily through the spaces above and compelling the heated air to flow to the outer end of the compartment during the first part of the burning and until the green bricks having the lath-strips between them become sufficiently heated to set the strips on fire and burn them out, after which the heat descending through the formerly-obstructed part will do its work therein and at the part most distant from the side where it enters and escapes alike. When the said most distant part has been heated up in this way the draught will continue through it after the wood strips have been burned out for a considerable time, because of the greater heat thereat, to which the inflowing heat naturally tends. The distribution of the heat in this way may be regulated to any practical requirement by varying the distance of the rows of bricks apart and the size of the strips.

The fifth part of the invention consists in devices for introducing into the kiln a current of external air for the purpose of protecting the fur-

nace-arches from the action of the intense heat, and to furnish heated air for combustion. This air from without is admitted to the tops of the arches X through passages or flues beginning at the bottom of the kiln, the furnaces being closed thereat for preventing the escape of heat through the supply-passages, which occurs in the arrangements heretofore used, in which the air is admitted to the said space from the top of the kiln when the furnaces are opened for supplying fuel. For this purpose I provide passages or flues *y*, by any suitable construction of the walls leading from the ground on a level with or below the furnace-doors up to the arches X over the furnaces, for the air to pass over and cool them, and to convey the heat taken from them to the fire. From the spaces above the walls X the air passes down to the ash-pits *z'* through the passages *f*. Instead of employing the flues *y* for thus admitting the air I may provide openings *g* through the outer walls of the kilns, admitting the cold air to the spaces *a* between the outer and inner semicircular walls D to flow thence to the chambers over the furnaces, if preferred, to protect the said inner walls of the kilns from too great heat and to heat the air more before entering the fire, but in this case the inner walls should be free from cracks which would admit the air directly to the compartments containing the bricks. Heretofore the air has been admitted to the arches X over the furnaces through passages at the top of the kiln. This is very objectionable in practice, for, as before stated, when the furnace-doors are opened so that the cold air can flow in thereat, the draught turns backward through the passages *f* and the heat escapes through said openings and is lost. The openings *i* are for admitting cold air into the bottom of a compartment for cooling off after burning.

The sixth part of the invention relates to an arrangement of passages and dampers with the two furnaces between the two compartments of each structure divided by a wall, D^2, whereby a most simple and efficient means is provided, in connection with the air-passages to the furnaces and the passages for admitting air to the compartments for cooling them, for causing the remaining heat in a burned compartment to flow into any other compartment in the group for utilizing it to dry and heat the green bricks as much as it will before turning on the heat of the furnaces; also, for feeding the fires with heated air when required; all of which is accomplished with the chambers or passages *a'* under the ash-pits *z'*, the passages *b'* connecting the two chambers *a'* of the furnaces on one side of the chimney, the passages *c'* connecting these two with those of the furnaces on the other side of the chimney, and the dampers *e'*, to be used in connection with the passages *f'*, leading from the furnaces to the brick-burning compartments G, passages *i*, and passages *y*. When one of the compartments G has been charged, (for which an opening, H', is provided to each,) and a fire started in a furnace adjacent to it, the heat passes into it through the passage *f'*, thence down between the bricks through the compartment containing them and the floor, the passages under the floor, to the passages Q, escaping into the chimney, which is divided vertically for a suitable distance into as many passages Q' as there are passages Q entering it, each passage being controlled by its appropriate damper, *m*, for preventing the draught from one compartment interfering with that of another. The damper *e'*, under the burning-furnace, is kept closed while this operation is going on; but when the bricks have become sufficiently burned, and it is necessary to cool them off, the heat is conveyed from it back through passage *f'* and the furnace down through the chambers *a'*, passage *b'*, up through the other furnace and its passage *f'* into the adjoining compartment containing green bricks, when the next one to be burned is on the same side of the chimney or in the same structure A or B that the last one burned is; but if on the other side of the chimney, it is conveyed along the passage *c'*, under or around the chimney to the opposite side, and up through the furnace in the same way. For accomplishing this the damper *m* in the passage Q' of the chamber to be burned is opened, the damper *m* of the passage Q' of the chamber to be cooled is closed, and the damper of the passages *y* are closed, dampers of passages *i* of the compartment to be cooled opened, the dampers *e'* of the furnaces through which the air admitted through passages *i* to take up the heat in the burned compartment must pass opened, while the others are closed. At this time the passages *i* of the compartment having the green bricks to be dried and heated will be closed. When the compartment having the green bricks has been heated to equal that of the one cooling off, so that it cannot be further benefitted thereby, the remaining heat will be utilized by feeding the fire, which will then be started in the furnace, discharging into the compartment containing the green bricks and supplying it with heated air from the one cooling off as long as heat remains in it, thereby economizing all the remaining heat. After this remaining heat is all taken up the air will be supplied to the furnace through its passage *y* in the regular way, and the draught through the cooled compartment stopped. It will thus be seen that the operation of the kiln, so far as the shifting of the flow of cold and heated air is concerned, for burning and cooling off, is controlled by the dampers of passages Q', *y*, *i*, and *a'*, all of which, excepting Q in the chimney, are at the bottoms of the kilns, where they can be most readily reached; but a much more important feature is that they are all so arranged as not to be subject to any material degree of heat, and are therefore not subject to injury by it; consequently they may be made of light and cheap material, and will not have to be removed as often as when arranged in positions more exposed to heat. An under-ground passage, *g'*, is arranged in connection with the chambers *a'* and passages *b' c'* for conducting the heat when required to dry-houses, (see Fig. 2,) through which the heat will be caused to flow by having all the dampers *e'* closed except the one admitting heat to it. Openings *k'*, giving access to dampers *m*, may be placed in

the chimney above the kiln for repairs; but they are not essential.

The seventh part of the invention relates to an arrangement of passages and dampers for admitting a large amount of air to the furnaces above the grate when fresh fuel is added to supply adequate quantities of oxygen at such times when the gases are liberated from the coal in greater quantities than after burning a short time, when the air may be shut off again gradually as the liberation of the gases subsides. For thus admitting the air passages *h'* are provided in the walls D^1 D^2 leading from the mouths of passages *f* upward and into the furnaces E, as clearly indicated in Fig. 1, the point of discharging into the furnaces being about as high or a little higher above the grates than the top of the fuel when charged, and the sliding dampers *i'* are suitably arranged in connection with them for closing and opening them. Said dampers may be reached by a hooked rod presented through the door of the furnace and engaging an eye, *j'*, or they may have a rod extending through the wall to the front. The object of arranging the passages *h'* to extend from the mouths of passages *f* below the grates upward to the furnaces is to prevent the reaction of the draught up through passages *f*, that would occur when the furnace-doors are opened to supply fuel if the passages were made directly through to passages *f* horizontally, which would establish a direct passage from the door up through *f*, but as arranged by me, the entrance to said passages being as low or lower than the furnace doors, such draught will not take place. In some cases it may be found advantageous to place the smoke-stack, or at least the principal part of the vertical portion thereof, in some other position than the one here indicated—that is, at the center, between the two structures A B. For example: In building very extensive works requiring eight of the burning-compartments, which would require duplicate structures A B, they might be placed end to end with a space between, and the stack built therein with under-ground flues extending from the center, where the smoke-stack now stands, to a larger one between the said structures for accommodating the whole; or the said duplicate structures might be placed side by side, with a space between for the smoke-stack, with flues passing under one-half of each of said duplicate structures to it; and other modifications of this character may be employed, while the principle of the arrangement would not be changed or affected in any way, for the entering point of the heated air and gases to the flue would be at the same place; and the arrangement would be the same, except that in one case, on entering the chimney, the passage would be directly upward, while in the other it would be downward for a short distance, and then in a lateral direction to the part of the stack, allowing it finally to escape upward. I therefore consider any arrangement of this kind but the equivalent or obvious modification of what I have here represented in the drawing, and propose to avail myself of any such as circumstances may require.

Having thus fully described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The combination of the two parallel arched structures A B, four furnaces E, and the stack F, all constructed and arranged as and for the purpose herein shown and described.

2. The arrangement of the rabbet joint connecting the roof and sides of the kiln with the superimposed charge of sand, as and for the purpose described.

3. The arrangement of the open floor, composed of bricks O and spaces P, with arched walls L and their intervening spaces, as and for the purpose set forth.

4. The arrangement of the arched walls L, open floor O, superimposed course of bricks, and combustible filling W, as and for the purpose set forth.

5. The arrangement of air-passages *y*, *f*, and *z'*, as and for the purpose set forth.

6. The arrangement in the adjoining burning-chambers, as herein shown and described, of the adjacent furnaces, the flues *f*, passages *f'*, *a'*, *b'*, and C', and their governing dampers, for the purpose of reversing the current of heated air, after the completion of the burning in one compartment, backward from such compartment through its furnace into any other compartment, as herein set forth.

7. The arrangement of air-passages *y*, *f*, and *h'*, as herein shown and described, for the purpose of admitting hot air to the furnace above the grates, as set forth.

BENJAMIN R. HAWLEY.

Witnesses:

J. ALEX. WYMAN,

S. W. KNEVALS.