No. 640,246.

Patented Jan. 2, 1900.

H. A. WHEELER.

DOWNDRAFT KILN.

(Application filed Mar. 27, 1899.)

(No Model.)

2 Sheets—Sheet 1.

Fig. 1.

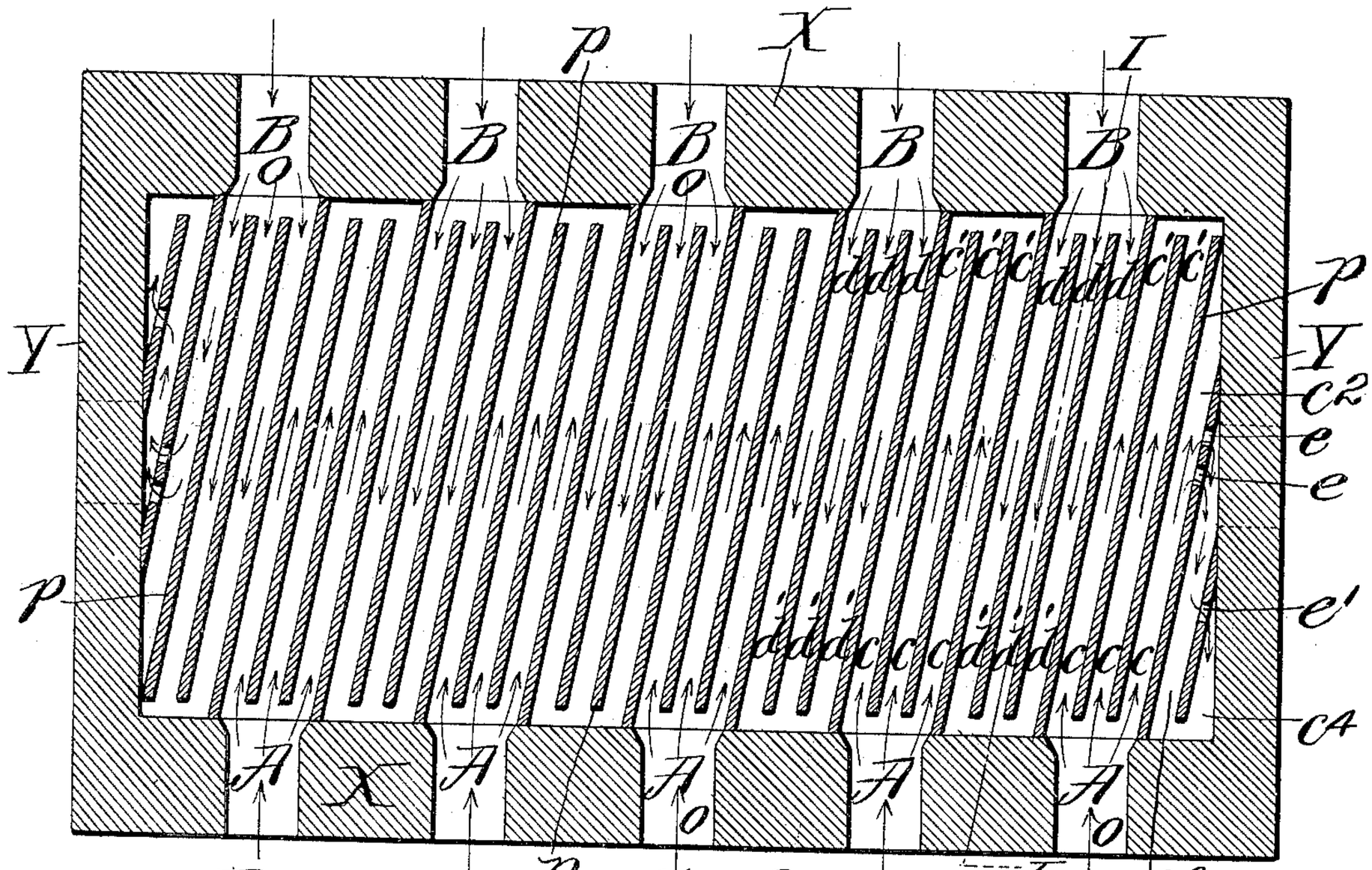

Fig. 2.

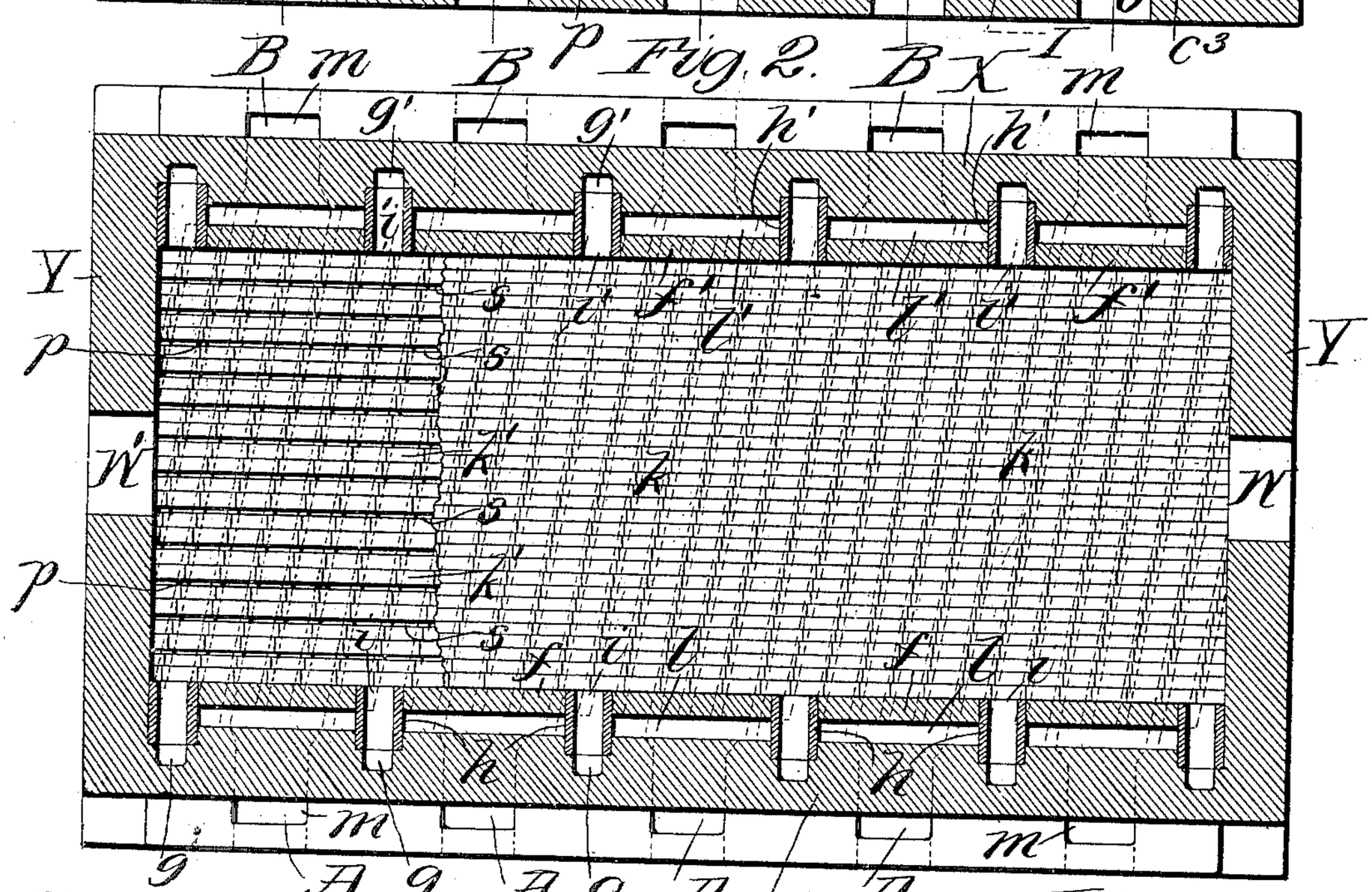

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Fig. 3.

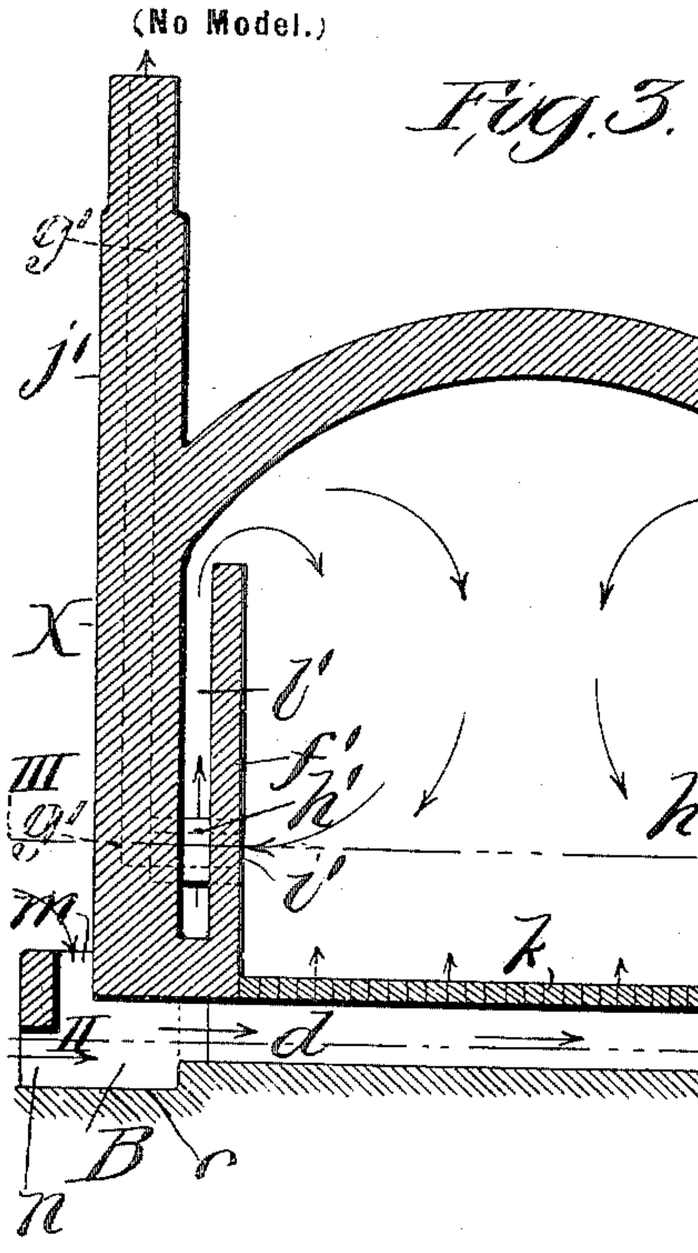


Fig. 5.

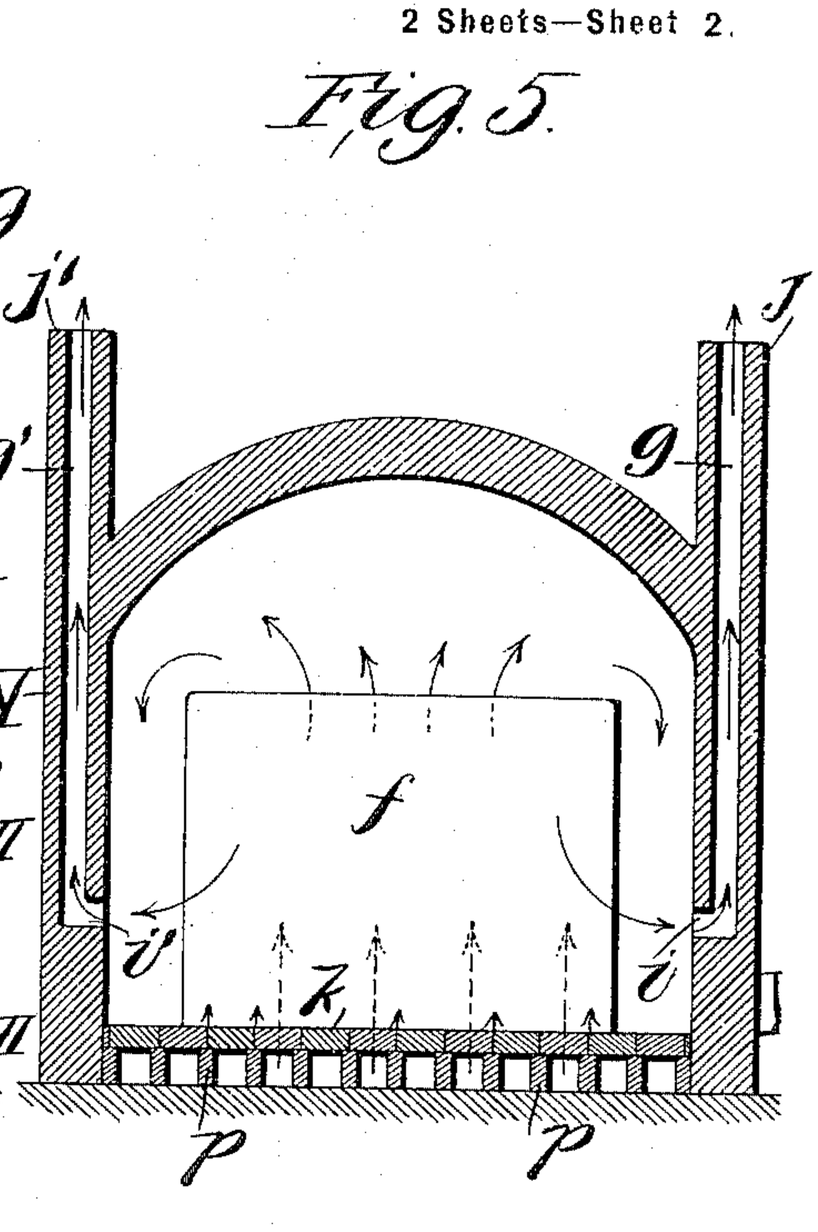


Fig. 4.

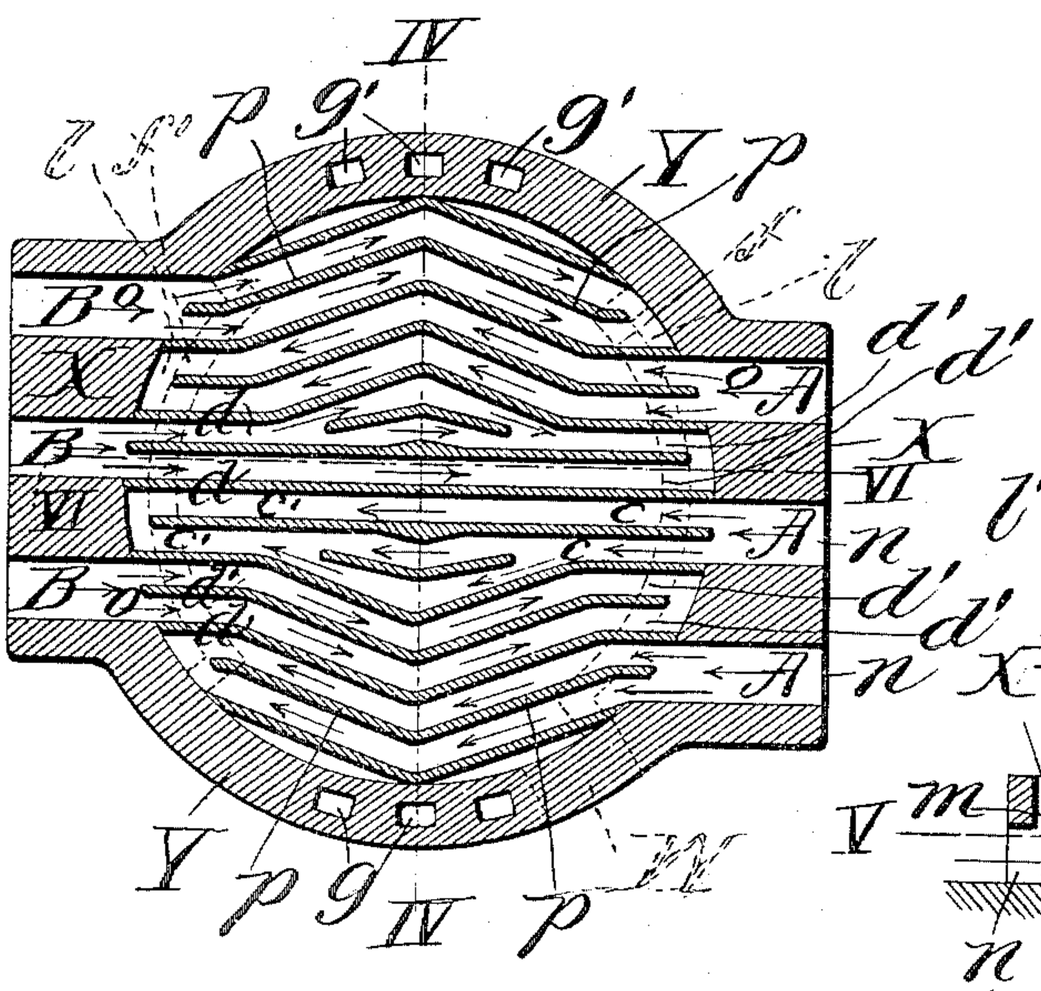
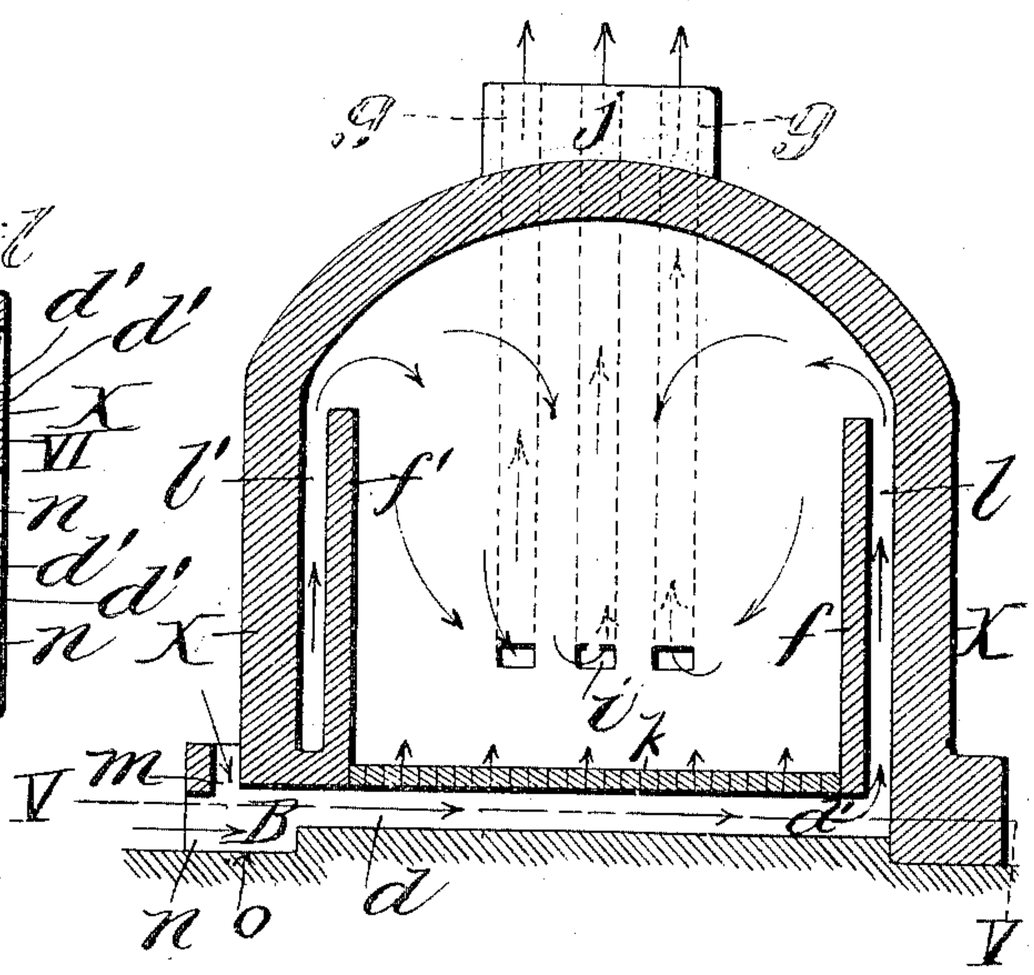


Fig. 6.



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UNITED STATES PATENT OFFICE.

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DOWNDRAFT-KILN.

SPECIFICATION forming part of Letters Patent No. 640,246, dated January 2, 1900.

Application filed March 27, 1899. Serial No. 710,683. (No model.)

To all whom it may concern:

Be it known that I, HERBERT ALLEN WHEELER, a citizen of the United States, residing at St. Louis, in the State of Missouri, have invented new and useful Improvements in Downdraft-Kilns, of which the following is a specification.

My invention relates to improvements in downdraft-kilns that can be operated as a semimuffle-kiln for burning brick, tile, terra-cotta, sewer-pipe, pottery, and other wares that require burning; and the objects of my invention are to secure much greater uniformity in the ware burned in the kiln, to reduce the time and labor in burning, to economize in fuel, and to reduce the cost of construction and maintenance of the kiln; and with these objects in view my invention consists of the novel process and combinations hereinafter described and specifically set forth.

In the downdraft-kilns now in common use, in which the heat and gases from the fire-boxes rise through bags or flash-wall passage-ways up the sides to the top of the kiln and thence down through the ware to a perforated floor or open bottom, from whence they are led away by flues to one or more chimneys or stacks, there is a great difference in the temperature between the top and bottom of the kiln, and consequently in the quality of the ware, so that if the ware in the upper portion of the kiln is properly burned the ware near and at the bottom is usually too soft and has to be reburned again, or if the kiln is run long enough to secure well-burned ware in the bottom of the kiln the top of the kiln is usually spoiled by being overburned. While great skill in burning the usual downdraft-kilns may reduce the loss from overburned to underburned ware, it still requires a prolonged time, with an excessive cost for fuel and labor, and there is still such a marked difference in the quality of the ware between the top and bottom of the kiln as to require careful sorting into different grades or shades. This difficulty arises partly from the poor heat conductivity of clay goods, but mainly from applying the heat only at the top of the kiln and then drawing it down to the bottom of a kiln of ware that may be from six to sixteen feet in thickness, by which process the ware at the bottom of the kiln where the heat escapes must manifestly be much cooler after passing down through a thick body of clay goods than at the top of the kiln. In my improved kiln I employ a new principle or process, the semimuffle process, in which the heat is first applied at the bottom before it passes to the top, so that the ware is heated equally from both top and bottom at the same time, and hence the great trouble of underburned ware in the lower part of the kiln or overburned ware at the top of the kiln is eliminated, while a great saving in time, fuel, and labor results in consequence of the heat entering the ware from both the bottom and top at the same time. Furthermore, in applying this new process of heating the bottom by means of under-bottom flues a solid tight bottom or floor is employed, which materially lessens the cost of construction and operation of the usual perforated or open-bottom kiln, as the special floor-tile are no longer necessary, which constantly break in use and necessitate frequent cleaning out of the flues from the sand and dirt that falls through the openings in the floor and clogs up the flues. In applying the heat first along the bottom of the kiln the escape-flues for the discharge of the gases are placed at a distance or horizon of, say, one-third to one-half the depth of the ware, more or less, in either the side walls or end walls of the kiln, above which escape-ports the ware is heated by direct contact with the heated gases, whereas the ware below these escape-ports is not thus heated, but receives its heat, as in a muffle-kiln, by radiation from the hot floor mainly and to a slight extent by the hot flash-walls. Thus the lower portion of the kiln is heated on the muffle principle, as to all intents and purposes it is a muffle below the escape-flues, whereas above the escape-flues the kiln operates on the usual downdraft principle by the heated gases passing through and coming in direct contact with the ware.

In previous efforts to heat the floor of downdraft-kilns the escape-flues have been placed in the end walls at the bottom of the kiln, by which the value of the hot bottom was largely lost by the escaping gases passing along the heated floor on their way to the escape-flues in the end walls, thus carrying the heat from the

hot floor out of the kiln and wasting it, as well as nullifying the benefit of heating the bottom. Furthermore, by having the escape-flues in the end walls the kiln cannot be of more than moderate length or the central portion of the kiln will not be hard-burned, whereas in my system of placing the escape-flues in the side walls the length of travel for the gases is always short, and hence the kiln can be of any length or one hundred feet or more, as in brick-kilns.

In the accompanying drawings I have shown the improvements applied to both a rectangular and a round design of kiln, as it is applicable to either.

Figure 1 is a horizontal section through the under-bottom flues on the line II II, Fig. 2 is a horizontal section through the escape-flues on the line III III, and Fig. 3 is a vertical cross-section through a fire-box on the line I I, of a rectangular kiln. Fig. 4 is a horizontal section on the line V V, Fig. 5 is a vertical section on the line IV IV, and Fig. 6 is a vertical section on the line VI VI, of a round kiln.

Similar letters refer to similar parts in all the drawings.

A and B are the fire-boxes or furnaces in the side walls X X, and Y Y are the end walls, of the kiln. The backs of the fire-boxes or furnaces B open into the fire-flues *d* between the flue-walls *p*, that pass under the solid bottom or tight floor *k* to the opposite side of the kiln *d'*, whence the heat and gases rise up, through the passage-ways *l* between the side walls X and the flash-wall *f*, to the top of the kiln, as shown by the long arrows, while the heat of radiation and conductivity that passes through the solid floor *k* up into the ware in the lower or muffle portion of the kiln is shown by the short arrows.

The heat and gases pass down through about two-thirds of the ware to the side or escape flues *i*, which connect with the chimney-flues *g* and escape into the air by the stacks *j*. Similarly the furnaces A discharge into the fire-flues *c*, which pass under the tight floor *k* to the opposite side of the kiln *c'*. Thence the heat and gases rise up, through the passage-ways *l'*, to the top of the kiln, and thence down, through more than half of the ware, to the side or escape flues *i'*, that open into the chimney-flues *g'* in the stacks or chimneys *j'*.

The side flues *i i'* through the flash-walls *f f'* into the chimney-flues *g g'* are carried across the space *l l'* by Roman brick or tiles or any suitable material *h h'* for spanning these passage-ways.

The bottom flues C C', that pass from the furnaces A to the opposite side of the kiln, and the bottom flues *d d'*, that pass from the furnaces B to the opposite side of the kiln, or in alternate directions, completely underlie the entire bottom of the kiln *k*, and thus insure its thorough heating to the same degree as the top of the kiln. These bottom flues are tightly and completely covered by ordinary fire-brick or Roman brick or tiles, as may be found preferable for given conditions, which are set solidly or tightly against one another, or what is known in the trade as a "solid" floor, without leaving any slots or slits or openings, as is done with ordinary down-draft-kilns, and which is known in the trade as an "open" or "perforated" floor. These latter openings through the open floors are obtained by leaving spaces of one-fourth to one-half inch or so between each tile or brick or else using tile or brick made with special slots or openings, which openings allow the passage of the gases and heat through the floor and also admit the falling of sand, dirt, and rubbish through the floor into the flues below when the kiln is being filled or emptied. The solid or tight bottom that I employ prevents the passage of the gases through the floor and also prevents the fouling of the flues underneath from sand, dirt, &c.

The illustrations are shown with the furnaces A and B opposite one another or vis-à-vis in the rectangular kiln, as is the usual arrangement in present kiln practice, and I have selected this condition to show that my improvements can be readily adapted to kilns now in use. This, however, necessitates carrying the bottom flues obliquely across the kiln, as shown, and in order to secure a hot bottom in front of the door W and the corner C^3 C^4 of the kiln the flue C C^2 opens by ports or passage-ways *e e* into the flue C^3, and this flue opens by the port *e'* into the flue C^4, thus returning the heat and gases to the corner C^3 C^4 and so securing a complete heating of the entire bottom.

Where a kiln is specially built with my improvements, it will be more convenient to build the furnaces staggered or alternating instead of opposite to one another, as is shown in the round kiln, Fig. 4, which will enable the bottom or fire flues to be carried straight across the kiln in a rectangular design instead of obliquely, as shown, and to dispense with the special arrangement shown of the corner-flues C C^2 C^3 C^4, and the arrangement illustrated is shown to demonstrate that my improvements can be equally as well applied to the old kilns now in use as to new ones. In the round kiln it is preferable to arrange the bottom flues of the side furnaces obliquely, as shown, or else in a curved direction, to carry the heat under the bottom near the sides Y Y on account of the shape of the round design of kiln.

While each furnace is shown as opening into three bottom flues in the rectangular kiln and into two flues in the round kiln, the number of these flues per furnace can be varied to suit given conditions or from one to three or more per furnace.

The particular distance of the side or escape flues *i i'* above the floor will vary according to the detail design and use of a particular kiln, as the thinner the floor-bottom the higher

up the radiated and conducted heat through the floor will pass, and consequently the higher up should be placed the side flues, and the higher a kiln is set the higher up should these side flues be placed, as some wares are only set as high as the flash-walls or bags, while other wares are set to the crown of the arch. In general it will probably be found that about one-third of the height of the side walls is the place where the heat arising from the bottom will burn the ware as hard as that burned by the heat conveyed down from the top of the kiln through the ware by the heated gases, or, in other words, the lower third of the kiln, more or less, will be practically a muffle or burned on the muffle principle, whereas the upper portion will be burned by direct contact with the heated furnace-gases.

The illustrations show the flash-wall type of design for forming the passage-way for the gases from the bottom to the top of the kiln along the side walls; but if the bag or pocket system is preferred it can be even more favorably employed, and the side flues *i i'* then become mere port-holes in the side walls between the bags for the escape of the gases into the chimney-flues *g g'*, and the bridging brick or tile *h h'* are then no longer necessary.

The furnaces A and B are shown to be of the downdraft solid-bottom type, in which the air passes down through the neck or firing-hole *m* of the furnace as well as through the ash-pit arch *n*, while the fuel rests on the solid bottom O. This type of furnace is very simple and economical in construction and maintenance, is very economical in fuel, and is smokeless; but any other design of furnace as may be found preferable can be used.

To enable the gases to reach the side flues *i i'*, the ware is so set in the kiln as to leave open spaces or small flues through the ware that communicate with the side or escape flues *i i'*.

Where rectangular kilns now in use do not have side stacks built into them, the chimneys can be built on the outside of the kiln against the side walls, being held against the side walls by the usual side bracing, or they may be built in the corners of the furnace or in the end walls where the kilns are not too long to successfully burn the central portion of the kiln.

In round kilns the diameter is rarely, if ever, too large to prevent the successful use of the arrangement shown, and in applying my improvement to old kilns the chimney-flues can either be built inside or outside of the side walls, though in new kilns it will be found more economical to build them within the side walls.

By using a solid or tight bottom the cost of construction and maintenance of the kiln is materially reduced under the present practice of using an open or perforated floor, as the extra expense of the special brick or tile required for the perforated bottom, their frequent breakage, the necessity of protecting them with planking each time the kiln is emptied, and the filling up of the flues from sand, dirt, &c., that fall through the perforations is entirely avoided by making the floor a smooth, continuous, solid bottom out of common sizes of brick or tile. The thickness of these floor-bricks can be varied to suit the local conditions.

I have shown the furnaces as being located on both sides of the kiln, which results in the heat and gases traversing the bottom flues in alternately opposite directions, and thus insures an equal heating of the entire bottom of the kiln; but the furnaces can be all located on one side of the kiln, if preferred, though generally this arrangement will not be found satisfactory for equalizing the heat, which latter is usually such a very important feature in the successful burning of most wares.

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

In a downdraft-kiln, the combination of under-floor flues with a solid bottom, the transverse flues C C^2, the return corner-flues C^3 and C^4, openings *c* from C C^2 to C^3, openings *c'* from C^3 to C^4, with escape-flues located above the floor, substantially as shown.

HERBERT ALLEN WHEELER.

Witnesses:

HUGH K. WAGNER,

RALPH KALISH.