

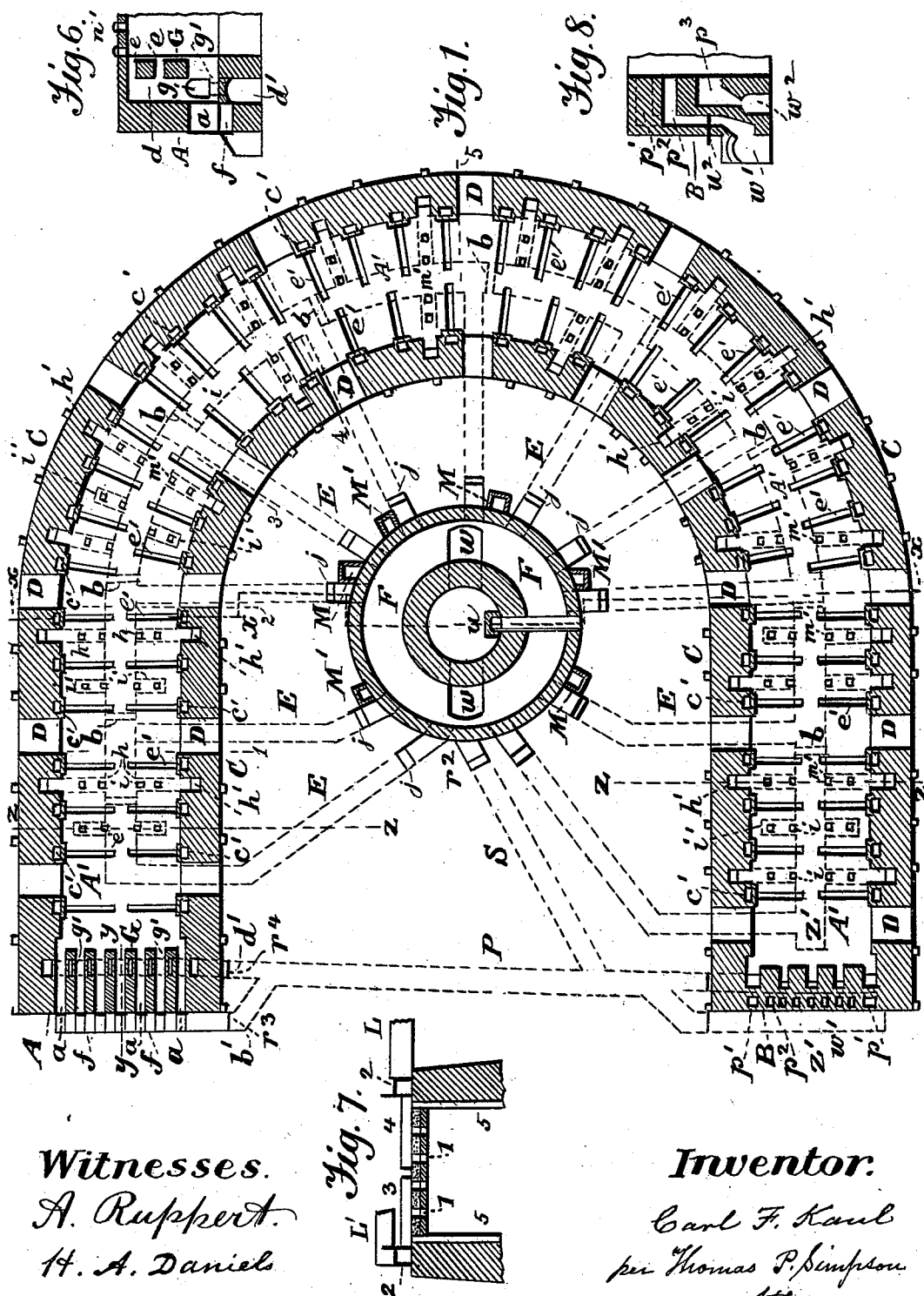
(No Model.)

3 Sheets—Sheet 1.

C. F. KAUL.  
KILN.

No. 534,509.

Patented Feb. 19, 1895.



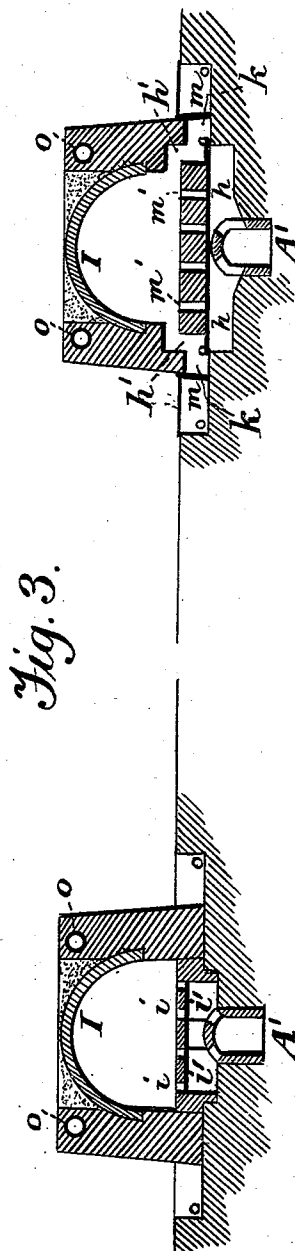
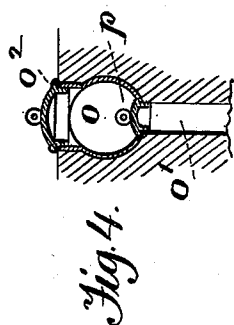
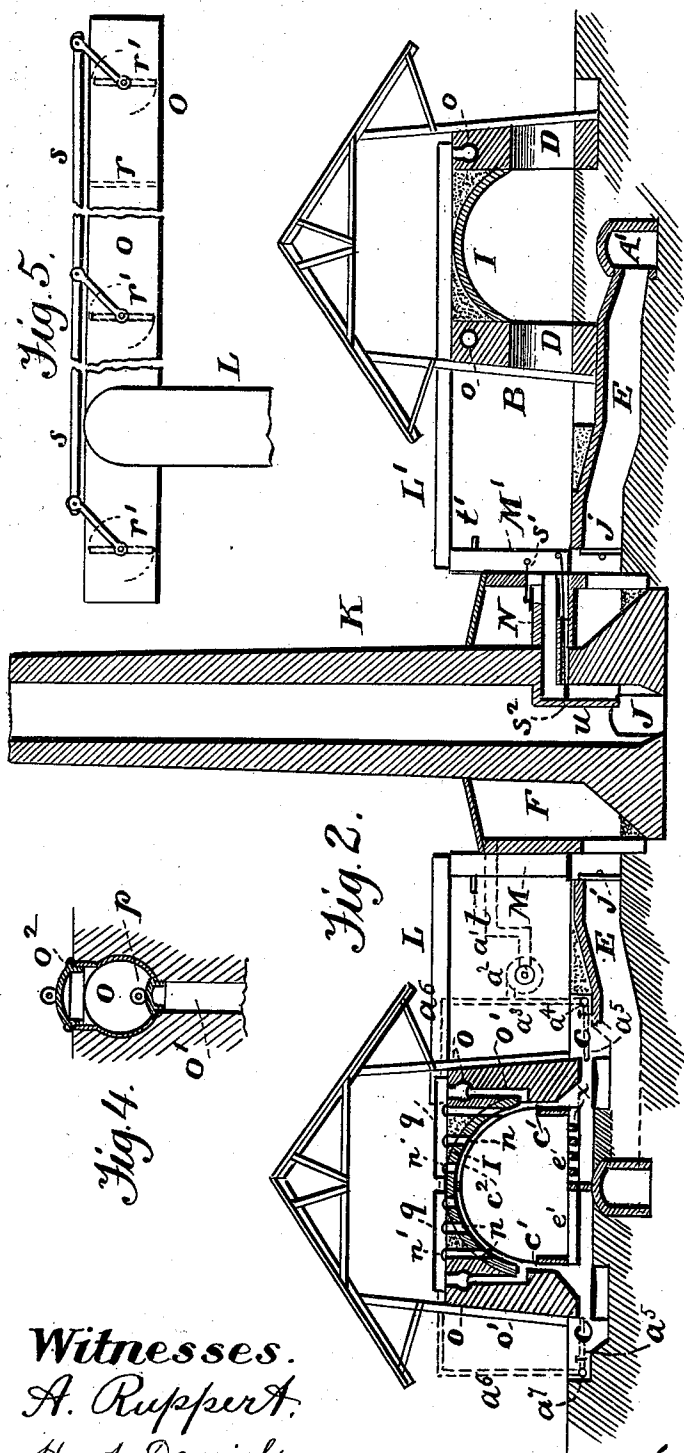
Witnesses.  
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**Inventor.**  
Carl F. Kaul  
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Fig. 9.

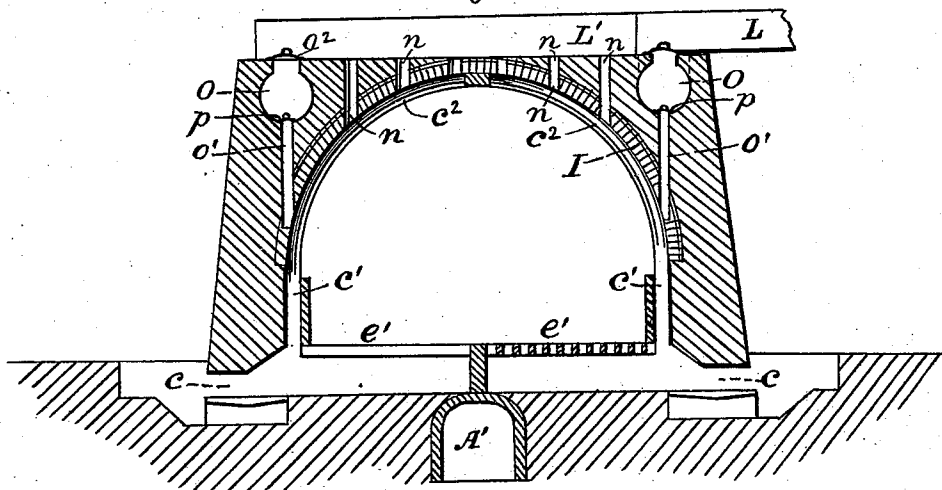
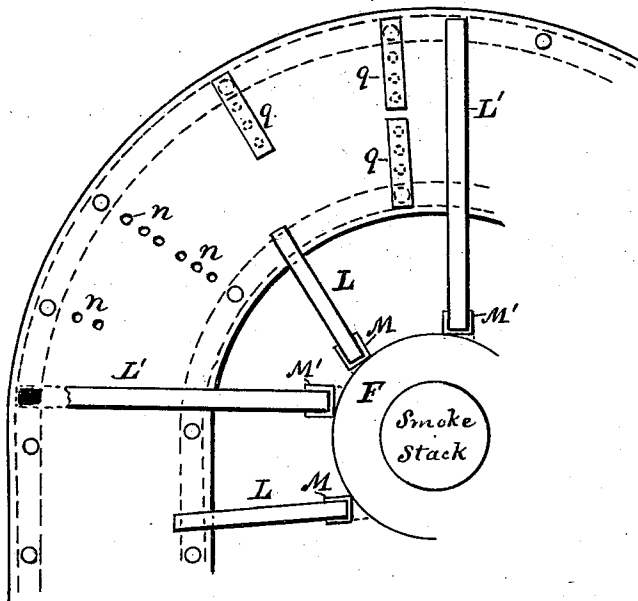


Fig. 10.



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# UNITED STATES PATENT OFFICE.

CARL F. KAUL, OF MADISON, NEBRASKA.

## KILN.

SPECIFICATION forming part of Letters Patent No. 534,509, dated February 19, 1895.

Application filed March 9, 1894. Serial No. 502,966. (No model.)

*To all whom it may concern:*

Be it known that I, CARL F. KAUL, a citizen of the United States, residing at Madison, in the county of Madison and State of Nebraska, have invented certain new and useful Improvements in Kilns; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to brick kilns and consists in certain improvements on the constructions described in Letters Patent Nos. 486,972 and 507,274, formerly issued to me.

In the accompanying drawings—Figure 1 represents a sectional plan view of a kiln provided with my improvements, the section being taken just above the floor line of the kiln. Fig. 2 is a section taken on line  $x-x$  of Fig. 1. Fig. 3 is a section taken on line  $z-z$  of Fig. 1. Fig. 4 illustrates in section one of the flues along the tops of the side walls of the kiln. Fig. 5 illustrates horizontal flues at the tops of walls. Fig. 6 is a vertical section of the front part of the kiln taken on line  $y-y$  of Fig. 1. Fig. 7 shows a modification in the construction of the upper part of the kiln. Fig. 8 illustrates the rear wall of the kiln in vertical section. Fig. 9 is a vertical, transverse section, taken through two opposite side-furnaces and grooves in the arched top of the kiln. Fig. 10 is a plan view of a part of the kiln, showing flues extending to the smoke-stack.

The kiln building may be constructed partly on curved and partly on straight lines as shown in Fig. 1, the front wall A being at one end of the structure, the rear wall B at the opposite end, and the side walls C extending from the front to the rear end of the kiln. Doors D are made at intervals in the side walls for access to the interior. Furnaces  $a$  are located in the front wall of the kiln, the grates of said furnaces being on the same plane with the floor of the brick compartment which is continuous and extends from the front to the rear end of the building.

A' indicates a main, underground flue extending along under the center line of the brick chamber nearly from end to end, said flue being divided permanently into sections as indicated by  $b$ . The sections of main flue

A' are severally connected by underground flues E with a chamber F which is built around the smoke stack for the purpose hereinafter stated.

In rear of the front wall A of the kiln, is an inner wall G which has openings therein, which are on lines with the furnaces  $a$ , for the rearward passage of fire from said furnaces to the interior of the kiln. Vertical flues  $d$ , or open spaces, between the walls A and G, extend upward from the floor line and are connected with the interior by openings  $e$ . Ash pits  $f$  are located under the grates of the furnaces  $a$ . The flues  $d$  are connected laterally somewhat above the plane of the grate bars of furnaces  $a$ , by apertures  $g$ , from which short passages  $g'$  extend down to the underground flue  $d'$ .

Furnaces  $c$  are located at intervals in the side walls of the kiln below the plane of the floor and extend inward nearly to the center line of the floor. Over these inward extensions of the furnaces  $c$  are slots  $e'$  in the floor extending inward the same distance as the furnaces. The slots  $e'$  may be lined with fire brick, and the said slots may be braced by fire bricks placed across them at different points flush with the floor, as seen at  $x$  in Fig. 2.

Fire passages  $c'$  are formed in and along the side walls of the kiln, each of said passages being over and connecting with a furnace  $c$ , as shown. On the same vertical plane with the fire passages  $c'$  are grooves  $c''$  formed in an arch I which partly forms the top of the kiln, said grooves extending from points near the center of said arch, in opposite directions, to the fire passages, so that the fire from the furnaces  $c$  passes upward through passages  $c'$  and in and along said grooves to the top, and also through the slots  $e'$  in the floor to the interior of the kiln.

Draft holes  $i$  are made in the floor of the kiln connecting opposite parts of the interior of the kiln with the underground flue A' by branch flues  $i'$  which extend in opposite directions from flue A'.

Branch flues  $h$ , under the floor of the kiln, connect with the flue A', at opposite sides of said flue, and with opposite flues  $h'$  in the opposite walls, said flues  $h'$  connecting with the interior. Dampers  $m$  serve to open or close the passages from flues  $h'$  to branch flues  $h$ .

Apertures  $m'$  in the floor of the kiln connect the interior with the opposite branch flues  $h$ , a part of said apertures being at one side of the center line of the floor and a part at the other side.

Openings  $k$  are made in the side walls and are provided with removable covers for access to the dampers  $m$  to open or close them. During operation, the openings  $k$  are to be closed air-tight which may be effected by any suitable means.

The top of the kiln, partly formed by the arch I, is provided with apertures or short flues  $n$ , arranged in rows across the top and provided with removable covers  $n'$ .

O indicates horizontal flues extending along the tops of the side walls of the kiln and connected with the interior of the kiln by vertical flues  $o'$  in the side walls. The flues O have openings made in them at intervals, which openings may be closed by removable covers  $o^2$ , and the passages from flues  $o'$  to flues O may be closed by covers or removable dampers  $p$ . See Fig. 4.

$q$  indicates removable flues which are constructed to extend about half way across the top of the kiln and cover and connect with one half of a line of the flues  $n$  in the top of the kiln and an opening in one of the flues O. When the removable flues  $q$  are in position connecting with flues O,  $o'$  and  $n$ , the draft from the interior is upward and to the flues O, and from thence onward in said flues O; and when flues  $q$  are removed to be placed on other parts of the top, as the operation of the kiln progresses, the flues  $n$  and the openings in flues O are closed by the removable covers  $n'$  and  $o^2$ , the passage from flues  $o'$  to flues O being also closed by the damper  $p$ .

L indicates a series of flues which connect with the flue O, which is at the top of the inward wall of the kiln, and, extending toward the smoke stack, connect with vertical flues M which extend downward and connect with the chamber F which surrounds the smoke-stack.

$L'$  indicates flues similar to flues L, except the former connect with flue O, on the outer wall of the kiln and extend across the top of the kiln toward the smoke-stack and connect with vertical flues M' which extend downward and connect with the chamber F. Slide dampers  $t, t'$  are placed in flues M, M', to regulate the draft.

The flues O, on the walls of the kiln, extend around the kiln, nearly from end to end, and may be divided into sections, a division of sections being indicated at  $r$ , in Fig. 5, each section of said flues O, having independent connection with the interior of the kiln and also, through flues L,  $L'$ , with the smoke stack.

One or more dampers  $r'$  may be hung in each section of flues O, said dampers being intended for use especially when fuel is used which produces a great deal of smoke, which is the case when some kinds of coal are used. When the kiln is charged with fuel from time to time during operation, the dampers  $r'$ , are

opened and the accumulated smoke in parts of the kiln, where firing has been going on, is either consumed or discharged in a short time when the dampers may be closed and remain closed until another charge of fuel is made.

Several dampers in each section of a flue O, may be operated at once by means of a rod  $s$ , said rod having a crank connection with the shaft of each damper.

K indicates the smoke-stack, the base of which is a little below the floor line of the chamber F. Opposite openings J are made in the stack at its base, and sunken portions  $w$  are in the floor of said chamber, one at each opening J for the passage of draft.

N indicates a furnace placed in the chamber F and connecting at its rear end with the flue of the smoke-stack, and a flue  $u$  extends down within the stack toward the base or floor. In the top of the furnace N, is an opening which may be closed by a damper  $s'$ , and a damper  $s^2$  is placed in the flue  $u$ . When the damper  $s^2$  is closed, the damper  $s'$  being open, the draft passes up from the furnace directly into the chamber F, heating said chamber about the smoke-stack; and when the damper  $s'$  is closed and the damper  $s^2$  is open, the blast from the furnace is thrown through the flue  $u$  into the stack. Thus the heavy air and draft will go to the floor of chamber F, and the heat and smoke will rise to the upper part of said chamber and the smoke, to quite an extent, will be consumed.

In the rear wall B are flues  $p', p^2$  which connect with an underground flue  $w'$ , along said wall. The flues  $p'$  extend nearly to the top of the kiln and are then turned to connect with the interior, and flues  $p^2$  extend about half way to the top and are then turned to the interior of the kiln. (See Fig. 8.) The flues  $p', p^2$  are provided with dampers  $w^2$  for regulating the draft through them.

Across the kiln in the rear wall B, is a row of flues  $p^3$ , which connect the interior with an underground flue  $w^2$ , which connects with a flue P, which extends across from the rear end to the front end of the kiln and connects with the flue  $d'$ . The underground flue  $w'$  also connects with flue P. An underground flue  $b'$  connects with the underground flue P and extends along the front wall A of the kiln and connects with the ash-pits under the furnaces  $a$  for draft from the rear end to the furnaces in the front end of the kiln.

S indicates an underground flue connected with the flue P and extending therefrom to the chamber F. When the damper  $r^2$ , of the flue S is closed, the dampers  $r^3, r^4$ , of flues  $b'$  and  $d'$  are opened and the draft passes through flue P, from the rear end of the kiln to the front end; and when the damper  $r^2$ , of flue S is open, the dampers  $r^3, r^4$  are closed and the draft passes from flue P, through flue S, to the chamber F and to the smoke-stack.

In Fig. 7, a modification is shown in the construction of the kiln, the top cover, provided

with short flues 1, being made removable and to extend straight across the kiln, and the horizontal flues 2, in the tops of the side walls, being located on the tops of said walls and having horizontal flues, 3 and 4, connecting with flues 2 and extending inward toward the smoke-stack in a similar manner with flues L, L', shown in Fig. 2. Straight grooves 5 are made in the inner sides of the side walls and extend upward to short flues in the top of the kiln.

From the upper part of the chamber F which surrounds the smoke-stack extends a suction pipe  $a'$ , to a fan-blower  $a^2$ , these being indicated in broken lines in Fig. 2. A force pipe  $a^3$  extends from said fan-blower down to a main pipe  $a^4$ , which extends along on a line opposite the mouths of the furnaces  $c$ , on one side of the kiln, and branch pipes  $a^5$ , extend from pipe  $a^4$ , to said furnaces. A branch pipe  $a^6$ , extends from the pipe  $a^3$ , to the other side of the kiln and connects with a pipe  $a^7$  having branches which extend to the mouths of the furnaces  $c$ , on the opposite side of the kiln.

The fan-blower is generally operated through ordinary mechanism and is generally used when hard fuel is being burned, said fan-blower serving to send a blast through each furnace  $c$ , so that the fire in said furnaces is driven into the interior of the kiln.

Valves are provided for the branch pipes which direct the blast into the furnaces  $c$ .

The kiln is well adapted for the use of vapor fuel or hydrocarbon, such fuel being driven into the furnaces  $c$  through pipes similar to pipes  $a^4$ , through burners, not shown, extending from said pipes, the latter having steam pipes and also pipes for hydrocarbon connected with them, so that the steam and hydrocarbon will be driven together through said burners.

The kiln described is well adapted for various wares which are to be burned with the heat at a very high temperature.

In operation the heating chamber of the kiln is charged with green brick by sections, the first section to be filled extending from furnaces  $a$ , as far rearward as indicated by a dotted line 1, in Fig. 1; the next section being indicated by a dotted line 2, and so on. The first section being filled and the brick being piled so as to leave vertical flues in the mass, a paper facing is secured to the rear of the pile in the ordinary manner. The vertical flues in the mass enable the attendant to inspect the brick being burned from time to time. The side doors D, and openings  $k$ , to the first section are closed; also the doors of the side furnaces  $c$  are closed, and the dampers  $m$ , are opened. The covers or caps  $n'$  are removed from one or more rows of flues  $n$ , in the top; the covers  $o^2$ , and  $p$ , are removed from the sections of the flues O, which are connected with said first section of the heating chamber, and removable flues  $q$ , are placed in po-

sition to cover the flues  $n$ , and the openings in flues O, from which the covers have been removed. The dampers  $j$ , in the underground, branch flues extending from main flue  $A'$ , to smoke chamber F, are opened successively for connection of each section of the heating chamber with the smoke chamber as such section is charged with green brick. The dampers  $r'$ , in opposite flues O, are opened in the first sections of said flues. Dampers in vertical flues M, M', which lead from flues L, L', to the chamber F, about the smoke stack are also opened. Thus drafts upward, rearward and downward, and side drafts from the interior are formed. Fire is then started in the furnaces  $a$ . Meanwhile another section, 2, of the heating chamber has been charged with green brick, in like manner with the first, and a paper facing is secured to the pile of brick at the rear end. The side doors D, of said section are closed; also the doors to furnaces  $c$ , and the openings  $k$ . The dampers  $m$ , are opened; the caps or covers  $n'$ , are removed from one or more rows of flues  $n$ , in the top, and covers  $o^2$ , and  $p$ , are removed from flues O, and flues  $q$ , are placed as before, over the uncovered flues  $n$ , and the openings in flues O. The paper facing on the brick in the first section is then torn away at the lower part, where it adjoins the floor, making a draft passage from the first to the second section. Another section 3 of the heating chamber is then charged with green brick in the same manner as before in sections 1 and 2, and doors D, of said section are closed, dampers, flues and other details being adjusted in the same manner as before in other sections. By this time the brick in the first section have become dry and a portion of the brick in said section have become hot. Another section 4, is then charged with green brick which is provided with a paper facing as before, and doors, flues and dampers adjusted as previously stated with reference to other sections. Removable flues  $q$ , are then taken from flues  $n$ , and O, of section 1, and such uncovered flues are closed by covers or caps  $n'$ ,  $o^2$ , and  $p$ , and said flues  $q$ , are placed over flues  $n$ , of section 4, and over the openings in flues O, in line with them. The dampers in the sections of flues O, opposite to section 4, may then be regulated. The dampers  $j$ , in flues E, connecting with section 1, and regulating dampers  $m$ , are now closed. The brick in section 1, for some distance from the rear of furnaces  $a$ , and beyond the line of the first couple of the furnaces  $c$ , are now red hot and fire is now started in the first couple of side furnaces  $c$ . These furnaces  $c$ , are kept closed during operation, the only opening of them being for the admission of fuel and air necessary for combustion. After a while, the brick in section 1, have got red hot beyond the line of the second couple of side furnaces  $c$ , and fire is then started in said second couple, as was done in the first couple. The dampers

to flues connecting with the second section of the heating chamber are then closed; one or more flues *g*, are removed from the top over section 2, and replaced by caps *n'*, and the covers *o*<sup>2</sup>, and *p*, of flues *O*, are also put in place, as to section 2. The dampers *m*, of flues *h*, and the dampers *j*, of underground flue *E*, connecting with section 2, are also closed. Section 5, of the heating chamber is now charged with green brick and the operation is continued as before stated in regard to sections 1 and 2. The bricks are now red hot beyond the line of third couple of furnaces *c*, and fire is now started in said furnaces. After a while, the heat being drawn rearward and the brick getting red-hot beyond the line of another couple of side-furnaces *c*, fire is started in said furnaces. The brick in section 1, in rear of furnaces *a*, are now burned and the fire in said furnaces begins to slacken up slowly and fire is started in another couple of side furnaces *c*. By this time the fire in furnaces *a*, is dying out, and as the furnaces *c*, are fired up rearward, from time to time, the fire in the furnaces *c*, opposite those sections in which the brick is sufficiently burned, is allowed to go out. Thus the charging of the burning chamber with green brick is carried on rearward and is kept up in the same ratio as the firing goes rearward. The operation being continued to the rear end of the kiln, the brick having become hot at said rear end, the brick in the front part of the burning chamber has become sufficiently cool; the heat therefrom having been drawn rearward, so that it is now only necessary to use sufficient fuel to keep up the same degree of heat for the materials to be burned. Now the cooled brick in the front part may be removed and said part may be again charged with green brick; and the operation is continued as before stated in regard to section 1. Now close the dampers in flues connecting the rear part of the kiln with the smoke stack, so that communication between said rear part and the smoke-stack is entirely cut off, and the doors to furnaces *a*, at the front of the kiln, which have been left open heretofore, are now closed. Now open the dampers of flues which connect the rear end of the kiln with the front end, a draft being thus formed from the rear to the front end of the kiln. When the material in the rear part of the kiln is burned, and by the time fire is again started in furnaces *a*, at the front end of the kiln for another operation, the heat, being drawn from the burned brick in the rear part of the kiln to the front part, is utilized for further combustion and heating, no outside, cold air being used for com-

bustion in furnaces *a* and the operation is continued as before set forth.

I claim—

1. The combination, in a kiln, of a series of furnaces, located along the side walls of the kiln, vertical fire passages from said furnaces, at the inner sides of said walls, and grooves in said walls, extending upward from said fire passages to the top of the kiln chamber, substantially as set forth and described.

2. The combination, with the side walls of a kiln, of horizontal flues extending along the tops of said walls and having communication with the interior of the kiln, flues *n*, in rows across the top of the kiln and connecting with the interior, removable flues, extending from opposite sides, so that each removable flue may connect with one of said horizontal flues and one half of the flues *n* in one row, stationary flues, connecting alternately with each of said horizontal flues at the tops of said walls, said stationary flues extending inward and downward to connect with a chamber surrounding the smoke-stack of the kiln, substantially as set forth and described.

3. The combination, with the side walls of a kiln, of horizontal flues located at and along the tops of said walls, flues connecting said horizontal flues with the interior of the kiln, removable flues extending partly across the top of the kiln from opposite sides, removable covers for closing the passages from said horizontal flues to said removable flues, and devices for closing the passages from the interior of the kiln to said horizontal flues, substantially as set forth and described.

4. The combination, with a chamber surrounding the smoke stack of a kiln, of a fan blower, a suction pipe connecting said fan-blower with said chamber, force pipes connected with said fan-blower, main pipes and blast pipes in position to discharge into furnaces of the kiln, substantially as set forth and described.

5. The combination with the side walls of a kiln, of horizontal flues, provided with dampers and extending along the tops of said walls, each of said flues being divided into sections, flues connecting said sections severally with the interior of the kiln, and other flues, one of which extends from each section of said horizontal flues to and has connection with the smoke stack, substantially as set forth and described.

In testimony whereof I have affixed my signature in presence of two witnesses.

CARL F. KAUL.

Witnesses:

D. G. STUART,  
A. RUPPERT.