

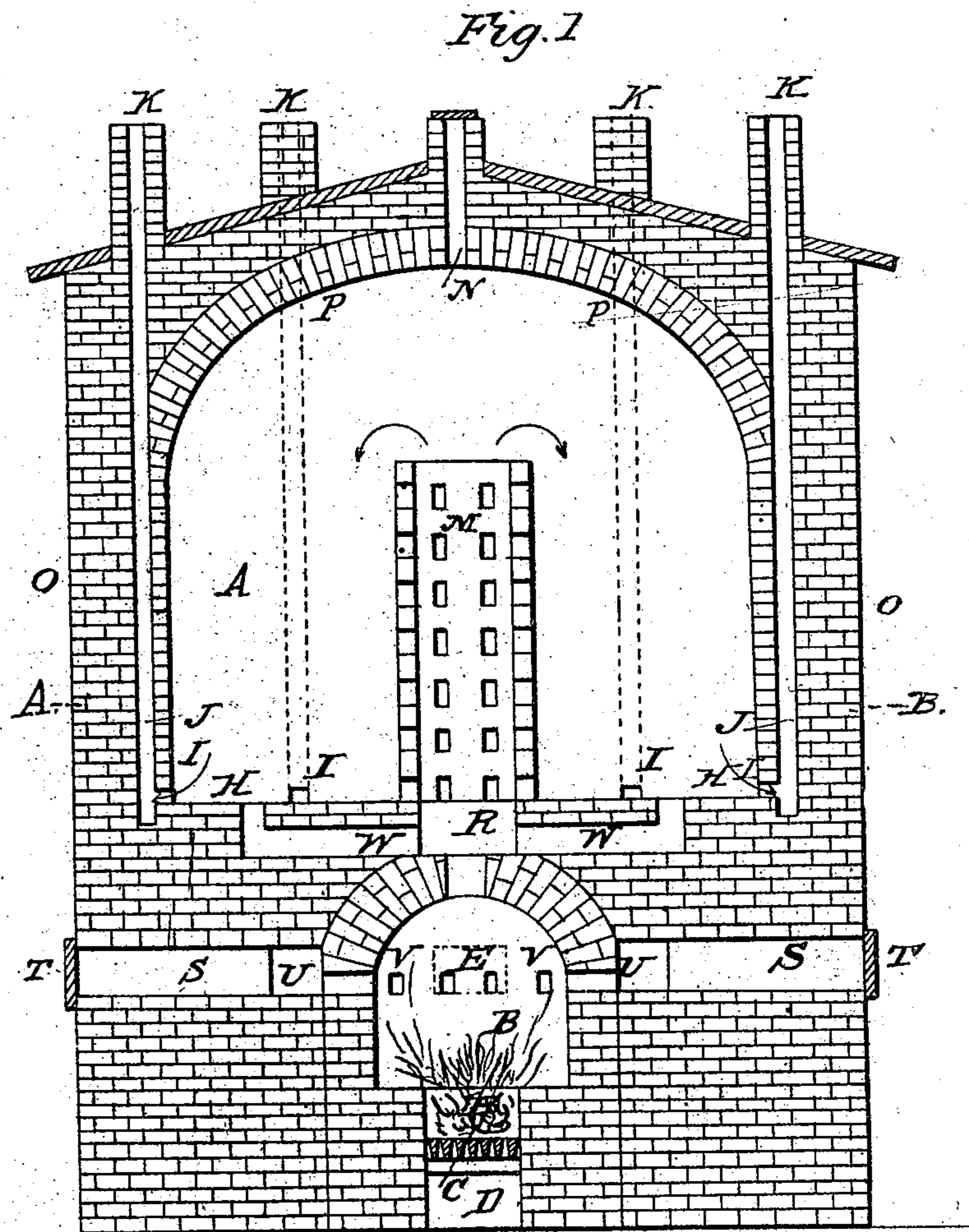
G. R. BOOTH.

Pottery Kiln.

2 Sheets—Sheet 1.

No. 9,230.

Patented Aug. 31. 1852.



Witnesses  
John Davis  
John Ridgway

Inventor  
George Robins Booth

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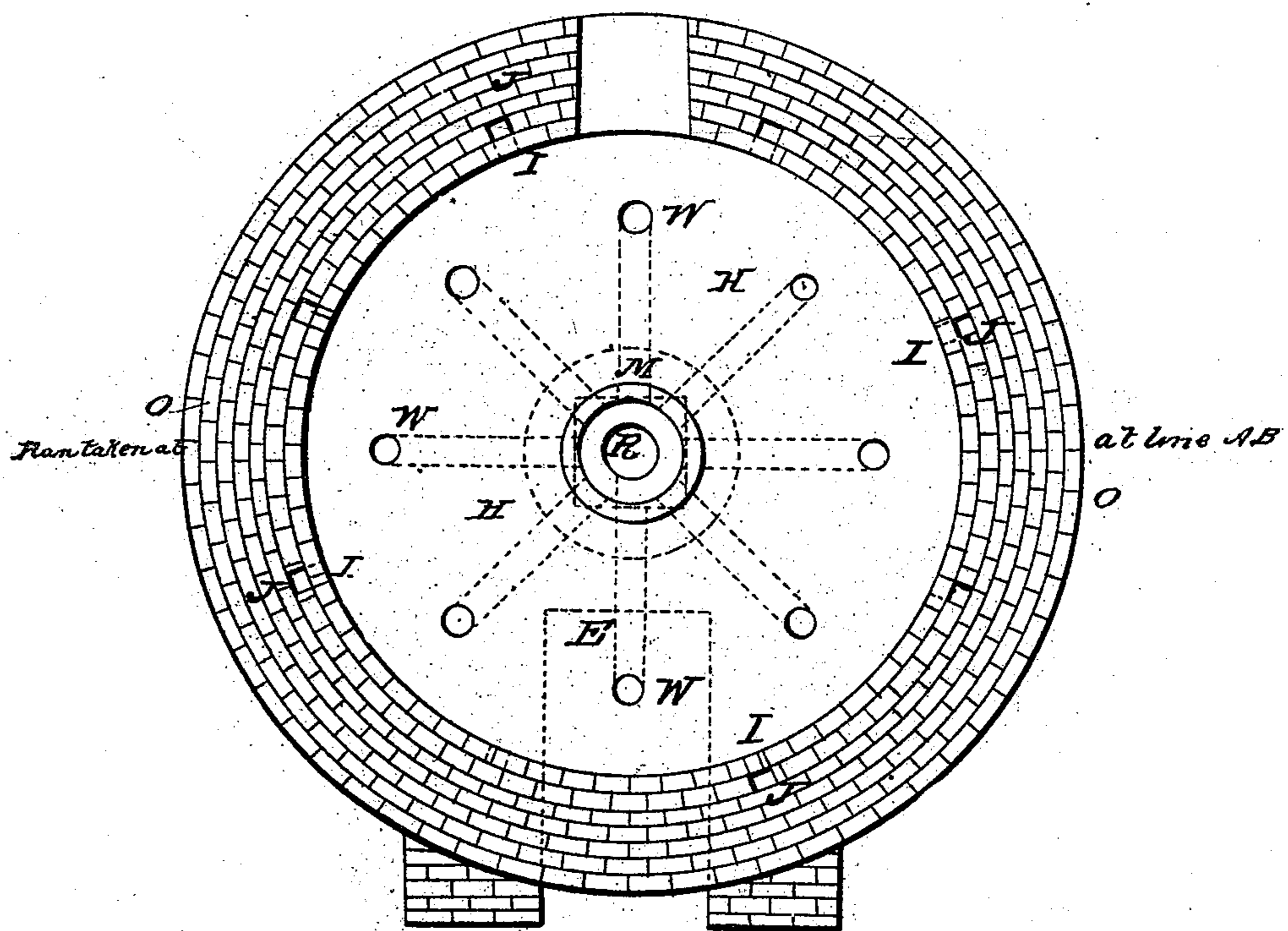
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*Fig. 2*



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# UNITED STATES PATENT OFFICE.

GEORGE ROBINS BOOTH, OF HANLEY, ENGLAND.

## IMPROVEMENT IN KILNS FOR POTTERY.

Specification forming part of Letters Patent No. 9,230, dated August 31, 1852.

*To all whom it may concern:*

Be it known that I, GEORGE ROBINS BOOTH, engineer, of Hanley, in the Staffordshire potteries, England, a subject of the Queen of Great Britain, have invented certain Improvements in the Mode of Applying Heat to the Burning of Pottery, Bricks, Tiles, Pipes, and other Articles of Earthenware, Clay, or other Similar Plastic Materials, and for Hardening on of Printed Ware; and I do hereby declare that the following is a full and exact description of my said invention—that is to say:

My improved mode of applying heat from various combustibles relates to the drying and burning of pottery of all kinds, bricks, tiles, pipes, and other articles of clay or similar plastic materials; and it consists, principally, in the construction and arrangement of the hearth or fire-places, flues, chambers, &c., in which the combustibles are employed for the purposes of generating heat and the application thereof to the aforesaid manufactures.

The object of my invention is by an improved mode of applying heat from various combustibles to the above-named purposes, first, to effect a saving of fuel; secondly, a diminution of the losses sustained in the articles while being burned; thirdly, to lessen the ordinary wear and tear of the kiln; fourthly, to insure greater regularity in the heat.

This improved mode consists in the peculiar construction of the parts constituting the hearth or fire-place which contains the fuel; in the construction of the ovens, chambers, or kilns for confining the heat when evolved from the hearth or fire-place; in the construction of the apertures, flues, and tubes for the passage of the heat from the hearths to the said oven, chamber, or kiln, and, lastly, in the construction of the apertures, flues, and vents for the final exit of the hot air, smoke, and gases.

Such being the nature and object of the invention, I will proceed to describe the means of carrying the same into practical effect, and for this purpose I have attached to these presents drawings exhibiting the entire arrangements and construction of the apparatus con-

stituting this improved mode of applying heat and showing its particular application, in the first place, to firing ovens for pottery, bricks, tiles, &c., and, secondly, for hardening on, enameling, and drying.

The combustibles I use are coke, charcoal, coal, cannel, peat, or wood, either separately, all together, or variously combined. The hearth is to be built of fire-bricks or of fire-clay only, or of a mixture of fire-proof clay with fire-proof substances, which in this mixed state I call "pise." The fuel is to be supplied to the hearth at the top or sides. The chambers, ovens, or kilns are constructed of various forms—square, round, oblong, or polygonal. When a single hearth is used, I prefer placing it in the center of the floor of the chamber, oven, or kiln below the same; but when many hearths are required they will have to be placed at proportionate distances from each other. The heat in the chamber, oven, or kiln is not permitted in its ascent to escape through the chimney or other opening, but is drawn downward by the apertures and flues, which are placed in the sides of the chambers and at the bottom thereof. I first direct the heat toward the top of the chamber and then to descend, so that in its course the flame and heat may become applied to all objects within their range. The apertures through which the heat escapes into the vents are placed at or near the floor of the chamber or below it. The number and size of the apertures leading into the flues for the exit of the heated air, &c., depend upon the heat required, the dispatch that is wanted, the size of the hearth, &c., and especially upon the quantity of fuel which is used. The vertical flues are placed on the exterior or within the interior of the walls of the chamber or within the chamber, as may be preferred. They are only required to be of such a height above the top of the chamber as will place them a few feet (on the outside) above the crown of the oven within; but they may be carried and collected into one chimney in any direction or be left open.

In the drawings hereto annexed I show the application of this invention to the purposes of firing or burning and drying china and earthenware, coarse ware, bricks, tiles, &c., in their various stages of manufacture.

Similar letters of reference are marked upon corresponding parts in each of the figures.

Figure 1 is a sectional elevation of a potter's oven or a brick, tile, and coarse ware kiln. A is the chamber or oven, which may be either round, square, oblong, or polygonal; B, the hearth; C, the fire-bars; D, the ash-pit; E, the position of the feeding-door, which is made air-tight; H, the floor of the oven; I, apertures leading from the chamber A to the vertical flues J J, the vertical flues leading to the vents K; M, a tube in the center of the chamber to carry up the bulk of heat into the upper region, the holes in the sides of which may be closed when "seggars" or cases are not used; N, the gas-tube above the oven or chamber. This tube is kept open until the tube M becomes red-hot, whereby any light gases collected pass through it; O, the wall of the chamber, built of pisé or of brick; P, the arch or covering of the chamber having no aperture through it, except the small tube N; R, the tube leading from the hearth into the chamber. S S are tubes or flues placed at the front, back, or sides, with openings left on the outside of the oven. These are opened and closed, as required, by small doors at T, through which the air passes into the chamber U, which, being extended all around the hearth and connected therewith by the openings V V, supply air to the hearth. W W are flues for the admission of a portion of the heat from the hearth to bring up the heat at the lower part of the kiln.

Fig. 2 is a horizontal section of the same oven, showing the position and size of the flues, apertures, hearths, ovens, &c.

The method of firing and using the said oven for pottery or for bricks, tiles, &c., is as follows: The seggars, containing the china and earthenware, are placed in the usual manner and the door of the chamber is made close by building it up or otherwise closing it. The hearth is then charged with coke or charcoal, coal, or wood, or any of them combined, and this fuel is ignited at the top or bottom. When it is burned down the hearth is partially refilled and the contents of the hearth again allowed to burn down. As the heat of the oven increases, the fire-chamber is found more capable of consuming the smoke and more coal may be advantageously employed, but if the chamber is full of steam a sufficient supply of coal has been already used. Whenever the flame ceases a further supply of fuel must be added, and thus the process be continued until a sufficient heat is obtained. Furthermore, whenever a fresh supply of fuel is added, air must be admitted into the space above the hearth through V V to mix with and ignite the smoke till the quantity admitted is sufficient to cause complete combustion. If a large quantity of coal be used, then a much larger ingress of air must be admitted over and into the hearth.

The same figures and drawings will serve

to represent the application of my invention to the process of "hardening on," as it is termed in pottery manufactures, which consists in dissipating the oil which is used in the process of printing the ware, whereby it is prepared for the subsequent processes of dipping and of "glost" or glazed firing.

The following is the manner in which my improved mode of directing the heat to such purposes is applied. The chamber A (but of less dimensions than in drawings, say a cube of seven feet) or any other chamber or kiln of a more convenient form or size may be employed, and as a low heat only is required for this purpose (say the temperature at which lead melts) either coke, cinders, charcoal, or peat, or any other such combustible substances as do not emit smoke in combustion are used. The brick tube M, above the top of the hearth seen in the drawings, Fig. 1, may therefore be dispensed with, so as to allow more available room in the chamber or kiln, and instead thereof a round or square box made of earthenware, about two or three feet in height and square, with a perforated top to the same, may be substituted, on which also may be placed some broken "pitchers" to collect any dust that may pass through the holes at the top of the case.

To regulate the hardening-on chamber, I make use of what I term a "thermo-lever" to register the requisite heat. This instrument, which is well known in the arts and not necessary to be represented, is thus constructed: A lever is placed on the top of the chamber, having at one end a rod or wire descending into the chamber. To this a ladle is attached, perforated with holes. The other end of the lever is balanced with a weight on the outside of the kiln. Two flues are placed in the side walls of the kiln on the right hand, and on the left with apertures about three inches in diameter and eighteen inches from the top of the chamber. At the top of these vents dampers may be affixed. These vents are to permit the steam which rises from the ware to be carried off more readily. The chamber or kiln is fitted up with iron shelves, or with iron baskets or boxes, to contain the ware, and an iron door closes up the chamber; or the doorway may be bricked up and coated over in the usual way. The mode of using the kiln is as follows: Having filled the kiln with ware, (except over the fire-box for about one foot high and at the door,) a pound of lead is placed in the ladle of the "thermo-lever" and balanced at the other end. Then about eight bushels of coke or cinders are placed in the hearth and ignited. The front of the kiln is now set in and the door partially closed. Afterward, when the steam has disappeared from the ware, the door is fully closed and the two side vents also, (except within an inch,) leaving the vent (marked N) open to allow any remaining steam to escape. Simultaneously with the

fall of the arm of the thermo-lever on the outside of the chamber (owing to the lead being molten) the process of hardening on is completed. The dampers on the two side vents are then closed and the ware is allowed to cool, which when done the door may be opened and the ware removed.

Further, I employ this improved mode of applying heat to firing enameled ware, which consists in burning or firing the colors or gold which have been painted or printed on the glaze, and enabling the latter to admit of being burnished. For this purpose I proceed to adjust the kiln Fig. 1 in the following manner, or I take a kiln of some other shape, but after the same mode of construction as Fig. 1, and fit it up with an enameling box or case, as described below, which is placed within it, resting it upon a brick frame-work that is made to encircle the top of the hearth, and thus forms an inclosed space round the top of the hearth. The size of the case is adapted to the quantity of ware to be fired thereon and is made of iron, fire-brick, or quarries after the manner of making the linings for the common enameling-kilns. The tube in Fig. 1 is raised up to and passes through the top of the case; or, instead of one tube, a number of tubes, less in size than the center one, are placed in a similar manner in different parts of the case. The heat, when supplied, will thus have a direct course through the tubes, and, passing over the top of the case, will descend down the outside thereof, and will thus heat the whole kiln. The width of the passage of the heat between the case and the outer walls of the kiln Fig. 1 is regulated by the size of the case itself, which the experienced workman will know how to regulate. Finally, after the heat has descended to the bottom of the case or frame-work upon which it stands it will pass into the vents in the same manner as it does in the plan Fig. 1 for firing pottery. The fuel-hearth and mode of feeding the fires are also the same as those given under the direction of firing pottery, the heat being adjusted to the degree requisite for the process. In all other respects the same plan of burning is pursued which is followed in enameling-kilns of the ordinary construction.

Besides the foregoing processes of burning, whether the mode be applied to the first processes of firing or to the subsequent processes of glazing, hardening, or enamel firing, my improvements are applicable to the various drying processes of the first-named articles of manufacture in many of the stages through which they pass from first to last before or after they are ready for the firing process.

The invention is also applicable for the drying of the clay for marketable purposes at the pits, for drying simple or compound bodies, and for drying other materials and articles used in and required for the pitting trade and general drying purposes. This portion of my invention may therefore properly be termed a part of the process of firing

or burning, being only tempered by the different amount of heat required either in induration or desiccation. It may be expedient, therefore, in many cases as a matter of economy to separate the drying processes from the burning.

Drying-stoves then become an appendage to such operation. My invention therefore would be incomplete without a suitable plan for drying was given, particularly so since the invention itself affords all requisite facilities for erecting and constructing drying-stoves, which I now proceed to describe. The improved and economic drying-stove may be formed after the manner of a large kiln or chamber like Fig. 1; or a chamber of any other shape or size, upon the same principle, may be fitted up with iron doors to the entrance and with iron shelves against the walls if much heat is required, upon which pottery bricks, tiles, pipes, or any other goods can be dried. A hearth of small dimensions will only be required. Another modification upon these principles will be thus: By placing an apparatus like the fire-box described, for the hardening-kiln in the center of a room, erected upon the mode last described, and like Fig. 1 in principle, all kinds of pottery and goods may be dried thereon with economy and effect, this plan being simply the hardening-kiln applied to drying purposes, having a large chamber instead of a small one, and requiring a less degree of heat. Lastly, if a kiln or stove like Fig. 1 were made of iron plates about seven feet size cube, with a hearth within it like B and placed in a large room or chamber of one thousand cubic feet or more and fitted up with shelves, trellis, &c., as before named or as otherwise suitable for the purpose in hand, there would be constructed another drying-stove upon a useful and most economic principle. In this last case the vents or chimneys attached to the iron stove, and marked K in Fig. 1, must be continued until they pass through the roof of the drying-chamber, or they must be carried to and through or into the walls of the said chamber in some convenient direction. Thus in the first two examples of these drying-stoves the heat would be applied directly to the goods for the purpose of desiccation as in the plan of firing, and in the latter cases the drying process will be conducted by the radiation of heat alone. Thus these different plans constitute a variety of modes of drying apparatus suitable to the quality, nature, and state of every article that may require such processes and treatment.

Having thus described the nature and objects of my said improvements, together with the manner of carrying the same into effect, I have to add that what I claim as my invention, and desire to secure by Letters Patent, is—

The arrangement of the fire-hearth below the oven-bottom and provided with suitable apertures for the admission of air to regulate

the combustion, substantially as described, when this is combined with the oven or heating-chamber, provided with a tube or the equivalent thereof, as specified, for discharging the heat above the bottom of the oven and diffusing it in the oven, and also provided with outlet flues or apertures at or near the bottom, and with apertures or tubes

at or near the top for the discharge of gases or steam, all substantially as herein described, and for the purpose specified.

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Witnesses:

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