

(No Model.)

2 Sheets—Sheet 1.

E. M. C. GONDOUIN.
PORCELAIN KILN.

No. 533,007.

Patented Jan. 22, 1895.

FIG. 1.

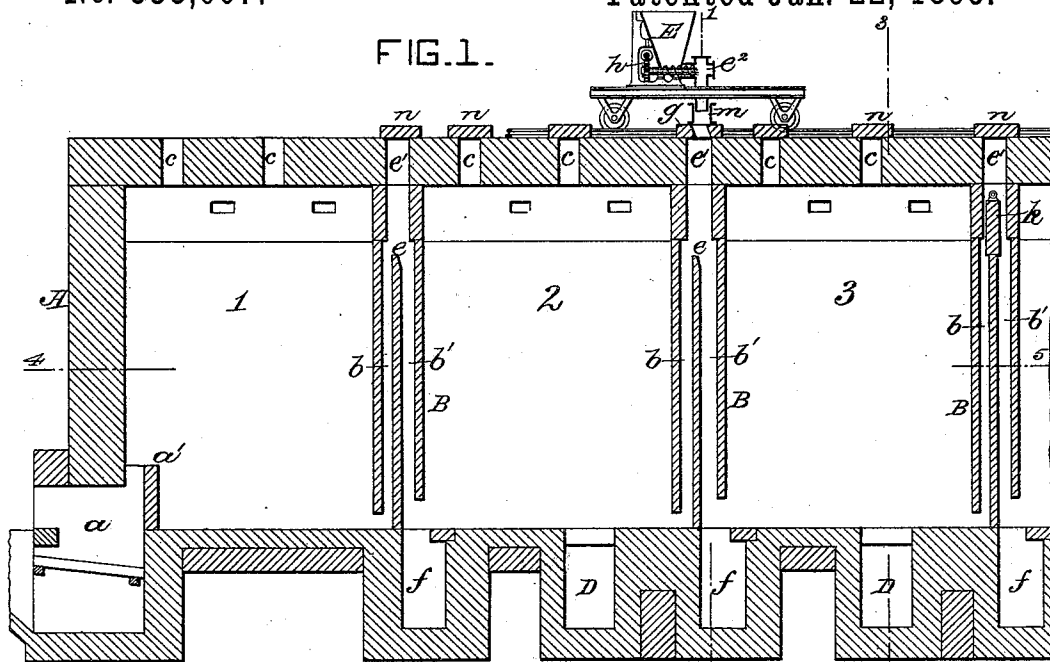
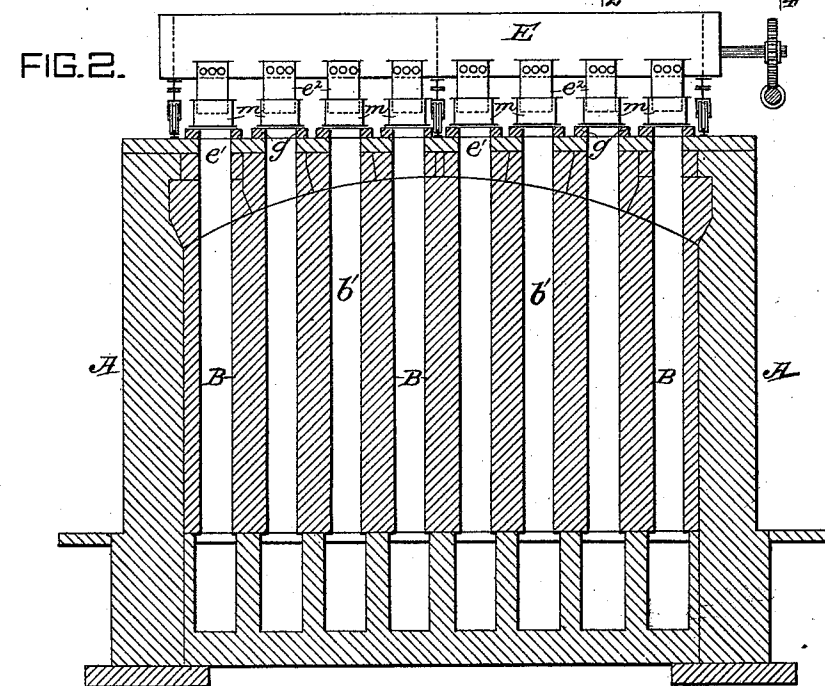


FIG. 2.



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(No Model.)

2 Sheets—Sheet 2.

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FIG. 4.

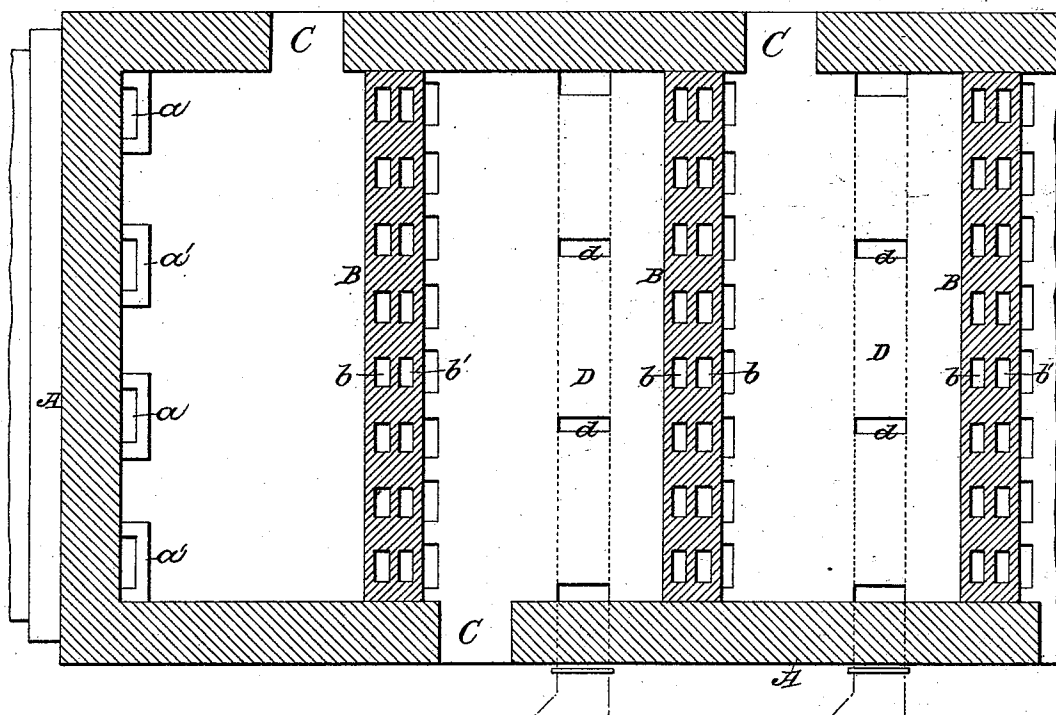
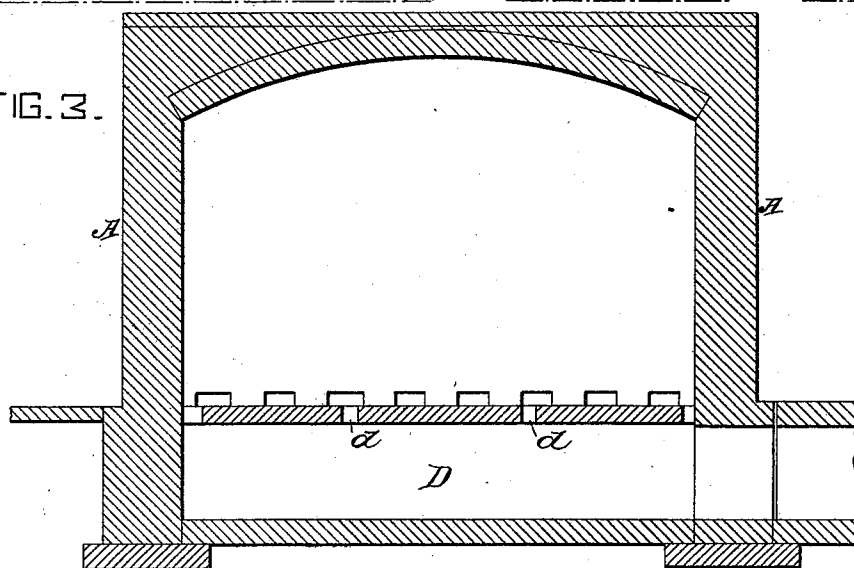


FIG. 3.



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UNITED STATES PATENT OFFICE.

EDME MARIE CHARLES GONDOUIN, OF GIEN, FRANCE, ASSIGNOR TO
FAIÉNCERIE DE GIEN, OF SAME PLACE.

PORCELAIN-KILN.

SPECIFICATION forming part of Letters Patent No. 533,007, dated January 22, 1895.

Application filed June 11, 1894. Serial No. 514,150. (No model.) Patented in France November 29, 1893, No. 234,414.

To all whom it may concern:

Be it known that I, EDME MARIE CHARLES GONDOUIN, engineer, a citizen of the Republic of France, and residing in Gien, (Loiret), France, have invented certain new and useful Improvements in the Kilns or Ovens for Use in Burning Porcelain (for which I have obtained a French patent, dated November 29, 1893, No. 234,414,) of which the following is a specification.

This invention relates to kilns or ovens for use in burning or baking porcelain or earthenware or like articles of pottery and it more particularly relates to the class of kilns known as "perpetual" or "semi-perpetual" kilns the interior of which is divided into a number of compartments; the object of the said improvements being to render this class of kilns fit to be employed as ovens or kilns for burning or baking porcelain or china goods, pottery, stoneware and the like.

The invention mainly consists in the peculiar construction of the partitions used for separating from each other the several compartments of the kiln and which are intended to serve as furnaces and to receive solid liquid or gaseous fuel whichever may be employed in burning or baking the goods with which the oven or kiln is charged.

In accordance with this invention the said partitions are made hollow so as to permit the air to circulate through them and the products of combustion to pass from one compartment to the next. They are arranged in such a manner that the air necessary for combustion having been heated beforehand by being caused to pass between the pottery already baked is conducted into the partition as it cools down and brought into contact with the fresh fuel which intimately mixes with the said air and is immediately ignited; the combustion taking place within the said partition in such a manner that the articles to be baked are protected from direct contact with the flame and cinders. The said hollow partition being moreover sub-divided into several series of separate chimneys fitted with dampers of fire proof clay, the fire may be readily controlled and regulated according to requirements, so that each portion of the kiln

may at any time be raised precisely to the required temperature. Where solid fuel is employed it is preferred to use it in a pulverulent condition as then its combustion within the hollow partitions or intermediate furnaces is facilitated owing to the readiness with which it may be distributed in thin layers and mixed with the hot air of the preceding compartments; so that this heat which would otherwise be lost, is here turned to account and enabled to produce a useful effect. The resulting advantage is considerable enhancement in the value of the goods which in no case are mixed with the fuel. The pulverulent fuel is introduced through the outer parts of the partitions and this can be done by means of a mechanical distribution adapted to effect its distribution in a uniform manner. When the fuel is in the condition of either gas or liquid, its admission into the interior of the said hollow partitions or intermediate furnaces may be effected by any suitable means.

By referring to the accompanying drawings it will be seen in what manner this invention may be applied to "perpetual" or "semi-perpetual" kilns and how in consequence these kilns are converted into porcelain or earthenware baking kilns or ovens, capable of replacing the apparatus hitherto used for the purpose the heating of which is a lengthy and expensive operation.

In the drawings Figure 1 is a longitudinal section of a fragment of an oven or kiln constructed in accordance with this invention. Fig. 2 is a cross section thereof on line 1—2 Fig. 1. Fig. 3 is another cross section thereof on line 3—4, Fig. 1; and Fig. 4 is a horizontal section on line 4—5, Fig. 1.

In the several figures A designates the properly strengthened external walls of the head of a rectilinear kiln, the length of which may be proportionate to requirements and which may be of rectangular, circular or elliptic or other desired shape the preferred form being that which extends on a straight line that is to say the form of a "semi perpetual" kiln.

B are the partitions whereby the kiln is sub-divided into a number of compartments independent of each other.

Care doors for the introduction of the goods to be baked in the respective compartments of the kiln.

D are flues the orifices *d* of which open into the corresponding compartments,—excepting however the compartments of the head of the kiln, and which are connected to a main conduit or channel leading to the chimney which may be situated at any convenient distance.

a are furnaces provided in the head-compartment only and having sufficiently high bridges *a'* to prevent the flame from acting directly upon the goods to be baked.

c are air-inlets leading into the several compartments.

The partitions B of the arrangement are hollow and comprise two series of vertical chimneys or chutes *b, b'*, arranged in pairs and communicating with each other at the top through apertures or ports *e*; each chimney being moreover open at its lower part. The port or channel of each of these chimneys may be closed by means of a damper *k* made of fireproof clay. The chimneys or chutes *b'* communicate with the external atmosphere through top extensions or openings *e'* formed in the kiln-roof through which openings they receive fuel from time to time; and (as hereinafter more fully explained), there are arranged beneath these chimneys, ash boxes *f* partially covered over with a removable slab. On the top of the kiln there is arranged to travel,—on rails, for example,—a distributing device adapted by any suitable means, to convey the pulverulent fuel down the chimneys or chutes *b'* in a continuous and uniform manner (assuming, of course, that the fuel used is solid).

The fuel distributor represented by way of example in Figs. 1 and 2 of the accompanying drawings mainly consists of a large sized hopper E filled with fuel and at the bottom of which are situated conveyer-screws or worms *h* arranged at right angles and in groups of three being operated in relation to each other by driving gear which may consist of a worm wheel and an endless screw or worm or may be of any other suitable construction. Each group or series of three conveyer screws *h* carries the fuel into a vertical conduit or channel *e²* integral with the hopper and which by means of a removable mouth piece *m* adapted to rest upon the slab *g* of each chimney allows the fuel to drop in the condition of fine powder or dust, and in a regular and continuous flow into the upper part of each of the chimneys or chutes *b'*.

Although the distributor herein exemplified is preferable it will be understood that any other mechanism fulfilling the same conditions—that is to say insuring the descent of the fuel into the kiln in the condition of a uniform current of fine powder, and in quantities graduated in accordance with requirements, may be employed for the purpose.

The distributor whatever its construction is mounted upon a carriage movable on roll-

ers along the kiln and adapted to keep the air out of the fuel admitting orifices.

It will be understood that there may be as many series of three conveyer screws each as there are chutes or shafts in the partitions and that each series, moreover may in case of need comprise a number of conveyers either greater or less than three.

Before and after the distribution of fuel to the hollow partitions or intermediate furnaces their respective chutes are, of course, kept closed by a slab of stone, brick, or other material *n*.

In the case of gaseous or liquid fuel the same chutes or channels *b'* are similarly fed with fuel by means of suitably arranged tubing.

The operation of the kiln or oven thus constructed is as follows: Suppose that the compartments 1 and 2 are filled with the goods to be baked and it will be noted by the way that they may either be arranged therein in a pile one piece upon the other, or be incased in seggars according to the usual practice. The doors of the several compartments are closed and the fires kept going in the furnaces *a* while the cut away portions *e* of the second hollow partition or furnace are covered over for the time being by dampers. The gases arising from the furnaces *a* become diffused in the compartment 1 and thence pass into the compartment 2 circulating on their way through the vertical chimneys or chutes *b* *b'* of the partition intermediate between the two compartments referred to. These hot gases are drawn off by the chimney while they pass through the orifices *d* and the corresponding flue D. While this takes place in the compartments named the next compartments receive batches of goods to be baked and when the temperature in the compartments 1 and 2 has risen to a sufficient degree, the hot gases are conducted into the compartments 3 being allowed to pass for the purpose through the break or cut away part of the partition 2. Thus as many compartments are started at the same time as is compatible with the maintenance of the draft of air sufficient to keep up combustion. By the time the batch of goods in the first compartment have been sufficiently baked or burned, the chimneys in the partition 1 are heated to a high temperature. The solid slabs are then removed from the top orifices and replaced by perforated slabs *g* and the carriage on which the fuel distributor is erected is moved to such a position that the mouths *m* exactly coincide with or cover over the perforations in the slabs *g* and the chimney orifices *b'*. It now remains only to set in operation the conveyer-worm *h* so as to cause a current of coal dust to descend into the hollow partitions or furnaces. The temperature of these partitions having by that time become very high, the fuel will at once commence to distill in the upper parts thereof and the gases resulting from such distillation as well as the fixed

bodies forming a species of coke dust meet somewhat lower down a current of hot air arriving through the grate or aperture *e* after having passed in contact with the baked products cooling in the compartment 1. In coming into contact with this air, the gas and coke-dust are ignited, so that combustion takes place throughout the whole lower part of the chimney or chute *b'*. The cinders or ashes of the burned coal are collected in the ash-box *f* while the very hot products of combustion bake the goods contained in the compartment 2. When this compartment has attained the required temperature, the distributor-carriage is brought up to and placed over the partition 3 into which the fuel is fed and lighted in the manner just described with reference to the preceding partition for the purpose of baking the batch of goods in the compartment 3.

It will be understood that the slab covering the air admitting orifices *c* should be removed at proper times and places from over the compartments wherein the baking is completed.

From the foregoing it will be clear that while the oven or kiln is kept in operation, there is at all times one compartment under the action of the fire, one or more compartments cooling and one or more other compartments in the act of utilizing the products of combustion from the preceding compartment or compartments. The flames as will be seen are transmitted from compartment to compartment in succession without however coming into direct contact with the articles being baked or treated in the several compartments.

The peculiar method of arranging partitions containing furnaces and chimneys offers the following chief advantages: It enables pulverulent fuel, such as may be obtained at comparatively little cost and is commonly used now in brick kilns to be made use of in baking or burning porcelain, glazed or other earthenware and like articles the treatment of which is of a very delicate nature; whereby a considerable saving is realized in the cost of the process. Furthermore, it permits the heat stored up in the goods already baked to be utilized in heating the air necessary to assist combustion; and finally, it insures the discharge of the gases through the chimney at the lowest possible temperature. These advantages which are obtained not only owing to the manner in which combustion takes place within the partitions—which only allow hot gases free from anything that is likely to injure articles as delicate as china goods or pottery to enter the compartments—but also owing to the manner in which the chimneys independent of each other and fitted with dampers enabling the temperature to be made exactly equal in all parts of the kiln, are arranged in series or groups the temperature being equally controllable, both when the combustion is stopped or the fire slackened in those chimneys which

are opposite to the parts appearing at the time to be hottest and when, on the contrary, it is desired to increase the intensity of the fire in the chimneys facing the portions which happen to be least heated.

The employment of a mechanical appliance for distributing the fuel necessary more especially in the case of solid fuel offers the advantage besides of reducing to a minimum the cost of labor in keeping up the fires with more than ordinary regularity.

It will be obvious that the vertical chimneys or chutes *b, b'* may be arranged in any suitable number within the width of the partitions and that the partitions themselves may be constructed in any convenient manner, the material used for the purpose being either brick or specially prepared blocks the main object being that it should be fire-proof. The chimneys within the partitions which are preferred to be doubled and which are intended to take up the hot gases from below may if desired, be single, in which case they will receive the gases at the top and discharge them below. Again, in the case of double chimneys an orifice may be provided in their upper parts, so that in certain cases they may receive the gases at the top instead of below which orifices may then be closed by means of dampers easy to operate. These upper orifices may in such a case be used if required after using the lower orifices.

The whole or part of the fuel may be sent down the chimney or shaft *b* if necessary, in which case the fuel will descend in the direction opposite to that in which the air flows, but the flames would be carried off into the chimneys *b'*. In this case too the break or aperture *e* connecting the said chimneys or shafts *b b'* need not be necessarily at the very top of these chimneys. The same remark applies also to the similar connecting break between the chimney *b'* and the following compartment which need not be exactly flush with the bottom of the kiln or oven.

I claim—

1. A furnace for baking or burning porcelain, faience, stoneware and the like, comprising a series of compartments separated by partitions, the said partitions being provided with two series of chimneys one chimney of each series communicating at the top with one chimney of the other series, one of the series of chimneys opening at the bottom into one compartment and the other series of chimneys opening at the bottom into the adjacent compartment, substantially as set forth.

2. A furnace for baking or burning porcelain and the like, comprising a series of compartments separated by partitions, the said partitions having therein two series of chimneys, a series of apertures *e*, each aperture connecting the top of one chimney of one series to the top of one chimney of the other series, one series of chimneys opening at the bottom into one compartment, and the other series into the adjacent compartment and a se-

ries of chambers *e'* in the roof of the furnace, the said chambers *e'* communicating with the apertures *e* and open at the top, substantially as and for the purposes set forth.

5 3. A furnace for baking or burning porcelain or the like, comprising a series of compartments separated by partitions, the said partitions being provided with two series of chimneys, one chimney of each series communicating at the top with one chimney of the
10 other series, one of the series of chimneys opening at the bottom into one compartment and the other series into the adjacent compartment and each compartment being provided with one series of ash boxes *f* beneath
15 the openings of one of the series of chimneys, substantially as and for the purposes set forth.

4. A furnace for baking or burning porcelain or the like, comprising a series of compartments separated by partitions having two
20 series of chimneys and a series of apertures, each aperture connecting one chimney of one series to one chimney of the other series, the said chimneys opening at the bottom, one series into one compartment and the other series into the adjacent compartment, in com-

bination with an automatic fuel distributor to feed the fuel to the said apertures, as and for the purposes set forth.

5. A furnace for baking or burning porcelain or the like, comprising a series of compartments separated by partitions, the said partitions being provided with chimneys and openings in the roof of the furnace above the said chimneys, in combination with an automatic fuel distributor adapted to be moved
35 over the said openings in the roof of the furnace, the said distributor comprising a hopper, a series of vertical conduits and a series of conveyer-screws to convey the fuel from
40 the hopper to the said conduits and movable mouth pieces at the bottom of said conduits, all substantially as and for the purposes set forth.

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

EDME MARIE CHARLES GONDOUIN.

Witnesses:

LÉON FRANCKENS,
DAVID T. S. FULLER.