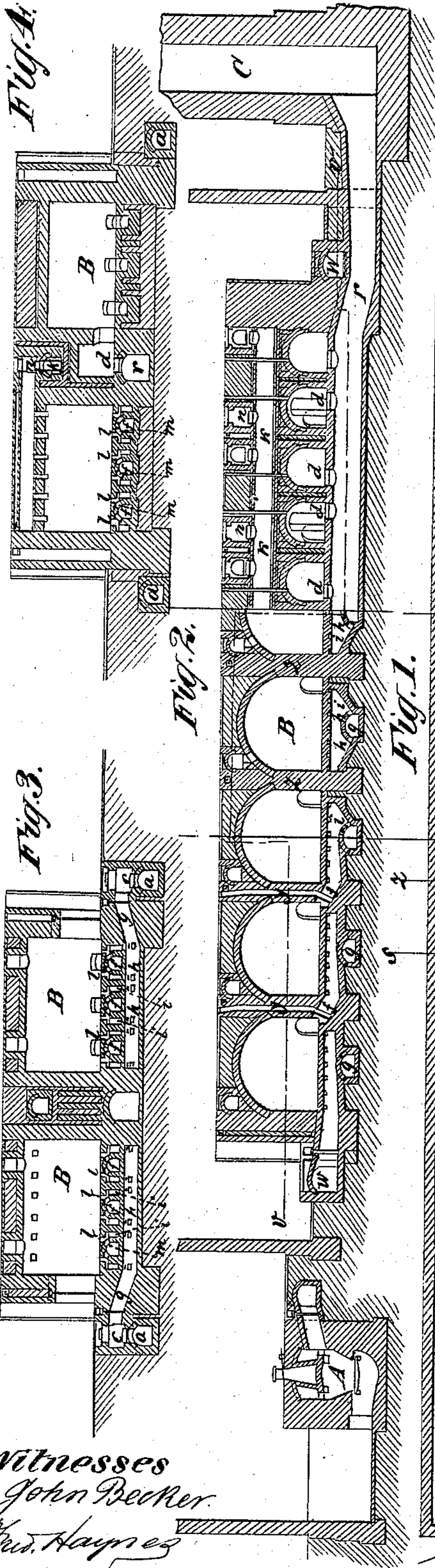
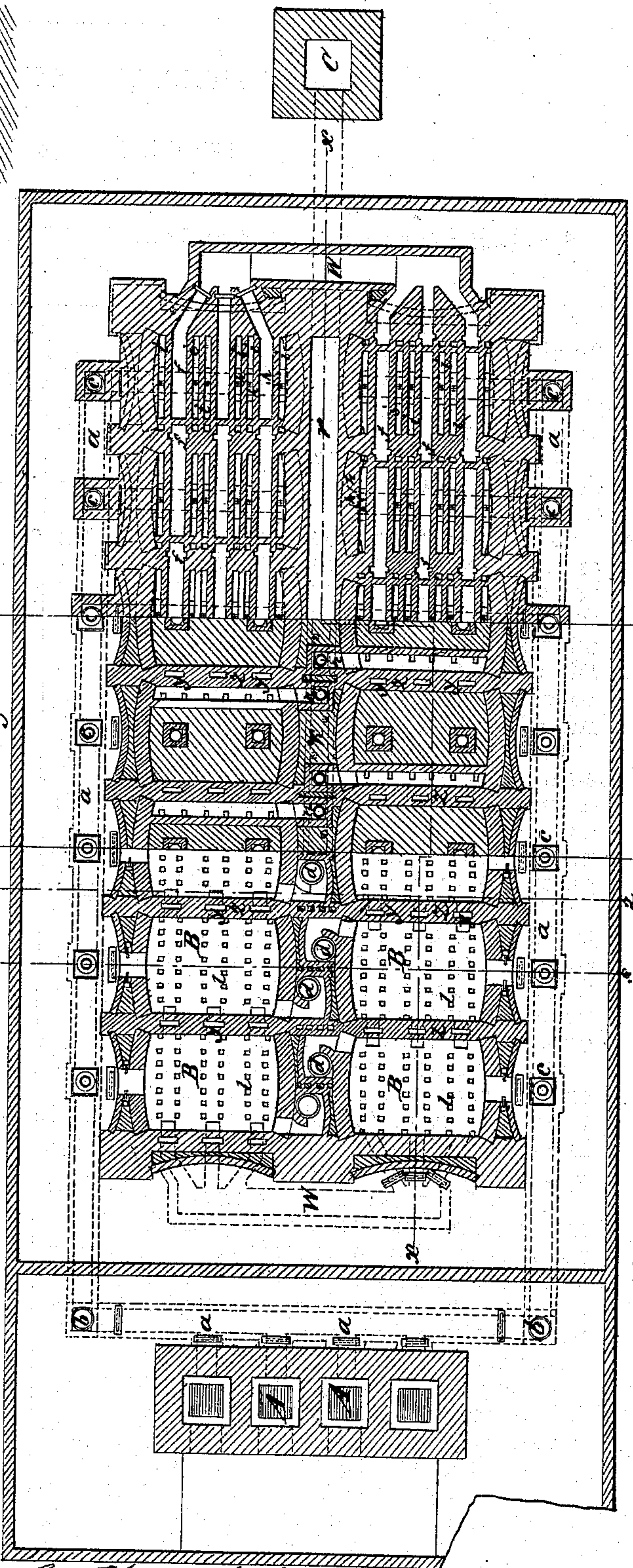


KILN.

Patented Sept. 19, 1876.



Witnesses  
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# UNITED STATES PATENT OFFICE.

GEORG MENDHEIM, OF BERLIN, PRUSSIA.

## IMPROVEMENT IN KILNS.

Specification forming part of Letters Patent No. **182,461**, dated September 19, 1876; application filed July 15, 1876.

*To all whom it may concern:*

Be it known that I, GEORG MENDHEIM, of the city of Berlin, Prussia, German Empire, have invented new and useful Improvements in Kilns for Firing Ceramic or other like ware or articles, of which the following is a specification:

This invention relates to kilns for burning or baking porcelain, stoneware, crockery-ware, and various articles of pottery, including terracotta, earthenware pipes, tiles, fire-brick, and other articles of like description, by heat obtained by the combustion of heating-gases, which are produced in suitable generators outside of the kiln.

The invention consists in a kiln divided into a series of connected or communicating firing-chambers, and having distinct and independent series of gas-flues and air-flues for supplying, in such manner, to said chambers the gases and the air necessary to promote their combustion, that the air may, before being introduced to the gases, be heated by its passage through firing-chambers in which the firing has been previously performed, and which it serves to cool preparatory to their reception of a new charge of ware.

The invention further consists in a novel arrangement of said gas and air flues and their dampers or valves and communications, in combination with the connected or communicating series of fire-chambers.

Figure 1 represents a horizontal section on the irregular line *vv* of a kiln constructed in accordance with my invention. Fig. 2 is a vertical longitudinal section on the irregular line *xx* of the same; Fig. 3, a vertical transverse section on the line *ss*; and Fig. 4, a vertical transverse section on the line *zz*.

*A A* are gas generators, of which there may be any desired number, and which supply the necessary gas for the firing or baking purposes. *B B* are a series of connected chambers for reception and baking of the ware or articles therein by the gas from the generators *A*. *C* is a chimney, common to all the chambers *B*, and serving to establish the necessary air-draft for combustion of the gas. Any other means of producing the necessary draft may be substituted, if desired, for the chimney. The gas may be produced in the gener-

ators *A* by any well-known process from coal, peat, wood, or other material, and is conveyed by means of flues *a*, provided with valves *b*, to either or opposite sides of the kiln when the chambers *B* are arranged in duplicate parallel rows, which is the arrangement preferred for them. In the flues *a*, on either side of the kiln, are also valves *c*, corresponding with the number of firing-chambers, and which, on being opened, admit the gas separately and respectively or collectively, as desired, into the chambers *B*. Each chamber in either row is separated from its succeeding one by a wall, *z*, and only communicate with each other by channels or flues *f* in the walls of the kiln, provided with dampers or valves, which are worked through slots *y*. These dampers are inserted within the slots *y*, and are closed or packed with clay before the heating of the chambers which they control commences. Accordingly, as these dampers are opened or closed, the chambers which they control are brought in communication with, or isolated from, each other.

The last chamber of each row of chambers *B* is connected in like manner by a flue, *W*, with the first chamber of the other or adjacent row, said flue *W* being also provided with a damper for establishing or breaking communication, as required.

The hearth or sole of each chamber *B* is constructed so that an equal or regular mixture and distribution of the gas and air is effected in the following manner: The gas is admitted into either chamber *B* through its respective valve *c* by means of a flue, *g*, and openings *h* in the arch of said flue into flues *i*, having a transverse relation with said chambers, and arranged directly under the hearths of the latter, and from whence it passes by means of numerous openings *l* in the hearths into the combustion-chambers of the kiln.

There are also small openings *m* in the arches of the flues *f*, which admit heated air to the gas, so that the air and gas are mingled and ignited at the openings *l*, or points of entrance within the chambers *B*. The direction of the flame within the chambers *B* may be regulated either by the peculiar arrangement of the charge in said chambers, as, for instance, when burning brick, or by means of



fire-bridges built up for the purpose, as, for instance, in burning pottery-ware or earthen pipes.

The general operation is as follows: Supposing three or four chambers B to be charged with ware to be burned, and the last one of said chambers to be closed from communication with the remaining chambers by means of the dampers in the flues *f*; then a valve, *d*, in the last chamber of the row is opened to bring said chamber in communication with the chimney C by or through a flue, *r*. A temporary fire is then started in the flue *f* of the said chamber B, access being obtained to said flue through the preceding chamber of the series for the purpose. The requisite draft for this operation is produced by the chimney C, which draws the products of combustion of the temporary fire through all the chambers B in connection with each other, and through the open valve *d*.

As soon as the first chamber is sufficiently heated, gas is admitted through its valve *c*, and is ignited by the flame of the temporary fire and the air which is admitted at the same time. The heat of the burning gas, added to that of the temporary fire, completes the burning or hardening of the charge in the first of the charged chambers.

The heating of the next chamber in succession is then sufficiently advanced to cause the gas introduced into it to ignite when said gas comes in contact with the heated air introduced at the same time for the purpose upon the valve *c* of the chamber in which a charge has been burned being closed, and the valve *c* of the next succeeding chamber being opened. The air necessary to produce combustion of the gas in said succeeding chamber first passes by the openings *m* and *l* into the chamber in which the burning has been completed, and is heated by absorption in the same before passing to the next chamber, thereby increasing the intensity of the flame in the succeeding chamber. So soon as the burning or baking has been effected in this second or succeeding chamber, the flow of gas is checked or shut off from it by closing its valve *c*. The valve *c* of the next or third succeeding chamber is then opened to introduce gas into the same, while the air for producing combustion therein is, prior to its introduction, passed through the first and second chambers in which the burning or baking has been completed to produce a highly-heated condition of the air as or when it mixes with the gas.

In following out this operation each preceding chamber in which the burning or baking has been completed has its valve *d*, that controls the draft to the chimney, closed, and the valve *d* of the fresh chamber, containing the charge to be burned, open, the dampness in the flues *f* being previously withdrawn.

The operation is conducted so that when the kiln is fully working a current of air always passes through three or more highly-heated chambers before the same is consumed,

and so that the products of combustion from the burning-chamber are passed through from, say, two, four, or more chambers in advance of the burning-chamber, whereby the greatest proportion of the heat of the gases is absorbed before they enter the chimney. The flue W serves to continue the operation from the one row of chambers to the other by allowing the gases of combustion and heated air to thus circulate, and by supplying a sufficient number of baking-chambers a continuous operation may be kept up. The removal of the charges from the chambers, when sufficiently cooled, and the recharging of the same, will follow in regular order the firing of the chambers.

It is not necessary, however, even when two or more rows of baking-chambers are used, that a continuous operation should be kept up, and in case of a kiln having only a single row of chambers the action, though generally intermittent, may be continuous. In working a kiln of this latter description the firing of the chambers is effected successively, as in the continuously-operating kiln, by preliminarily firing the first or any other single chamber, the flame of the last chamber escaping directly into the chimney.

When a chamber has become so much cooled by passing air through it, and heating said air to a degree suitable for combustion, it still contains such a high temperature that the goods cannot immediately be withdrawn. Then by opening the valve *n* of this chamber a current of air is caused to pass through the channel *k*, and this air may either be carried into the atmosphere or into rooms that require heating or ventilating. This air thus heated may also be used for heating up the goods in a chamber freshly charged by opening the valve *n* and smoke-valve *d*, and by closing the valves *f* of said chamber, the air now passing through the chamber being cooled and through the chamber being heated into the chimney. In this way fresh goods may be heated to a temperature of 180° to 212° Fahrenheit, after which the gases can be admitted without any danger of steam condensing on the goods.

A kiln constructed as described effects the burning or baking in an unfailing and uniform manner; avoids the annoyance of ashes and the injurious tincturing of the ware or article being burned or baked. It also provides for the gradual heating and cooling of the charge, thereby avoiding breakages and refuse. A leading or conspicuous advantage of such a kiln, however, is the economy of fuel which results from its use, by reason of the utilization of the latent or remaining heat in the baking-chambers to heating the air which keeps up the combustion of the gas, and by using the flame and heat of one chamber or series of chambers for heating the others.

I claim—

1. In a kiln for firing ceramic or other like articles, provided with a series of connected firing-chambers, the combination with said



chambers of a distinct and independent series of gas-flues for supplying gaseous fuel to said chambers, and a distinct and independent series of air-flues for supplying heated air to said chambers to effect the combustion of said fuel therein, substantially as specified.

2. The combination, with the firing-chambers B, of the perforated, distinct, and independent gas-flues *g*, and dampers *c*, the flues *i*, with their openings *l* through the hearths of said chambers, and the distinct and inde-

pendent perforated air-flues *f*, provided with dampers, and connecting the series of firing-chambers with each other, essentially as shown and described.

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

GEORG MENDHEIM.

Witnesses:

EDWARD SCHMIDT,  
BERTHOLD ROE.