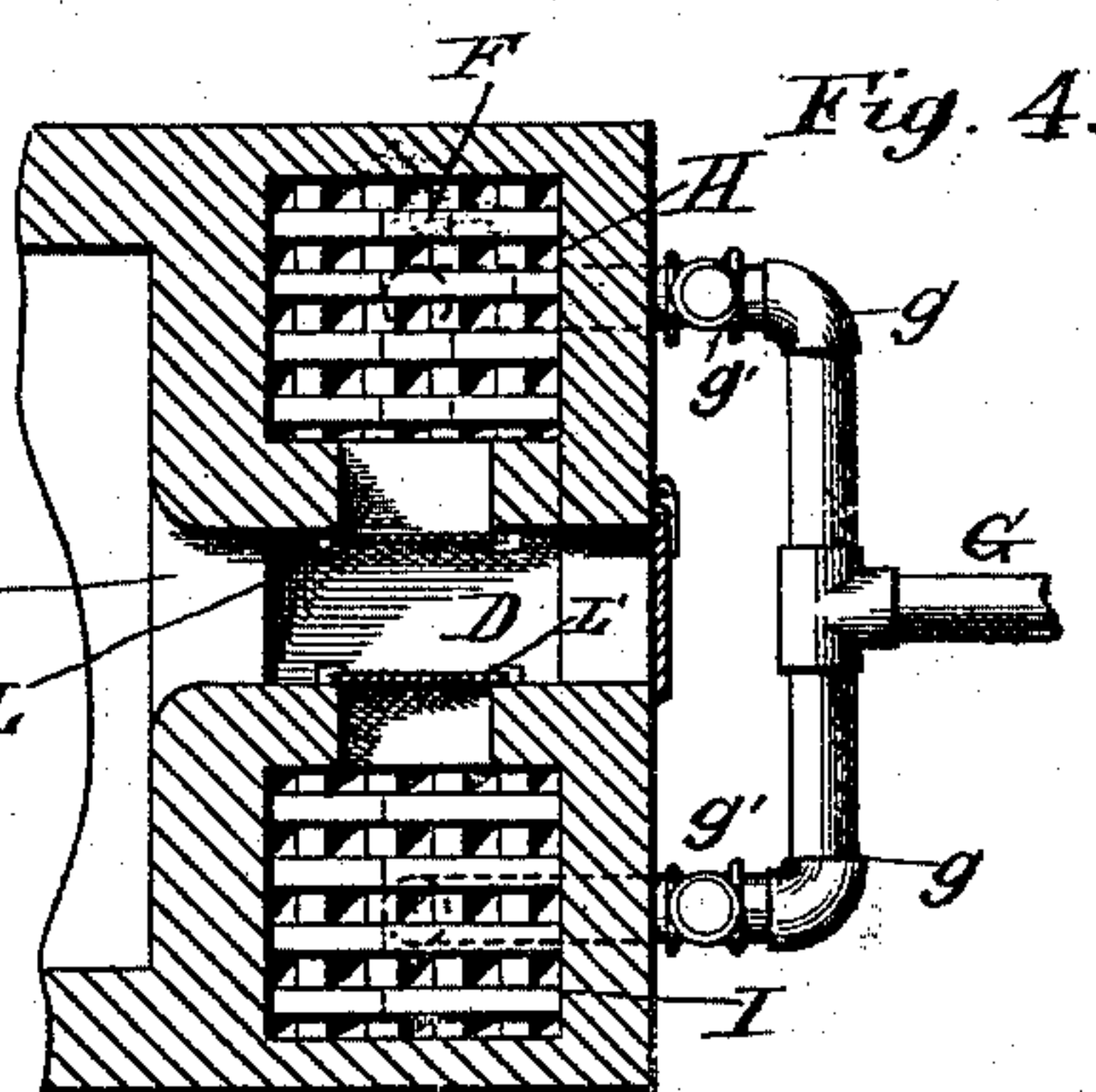
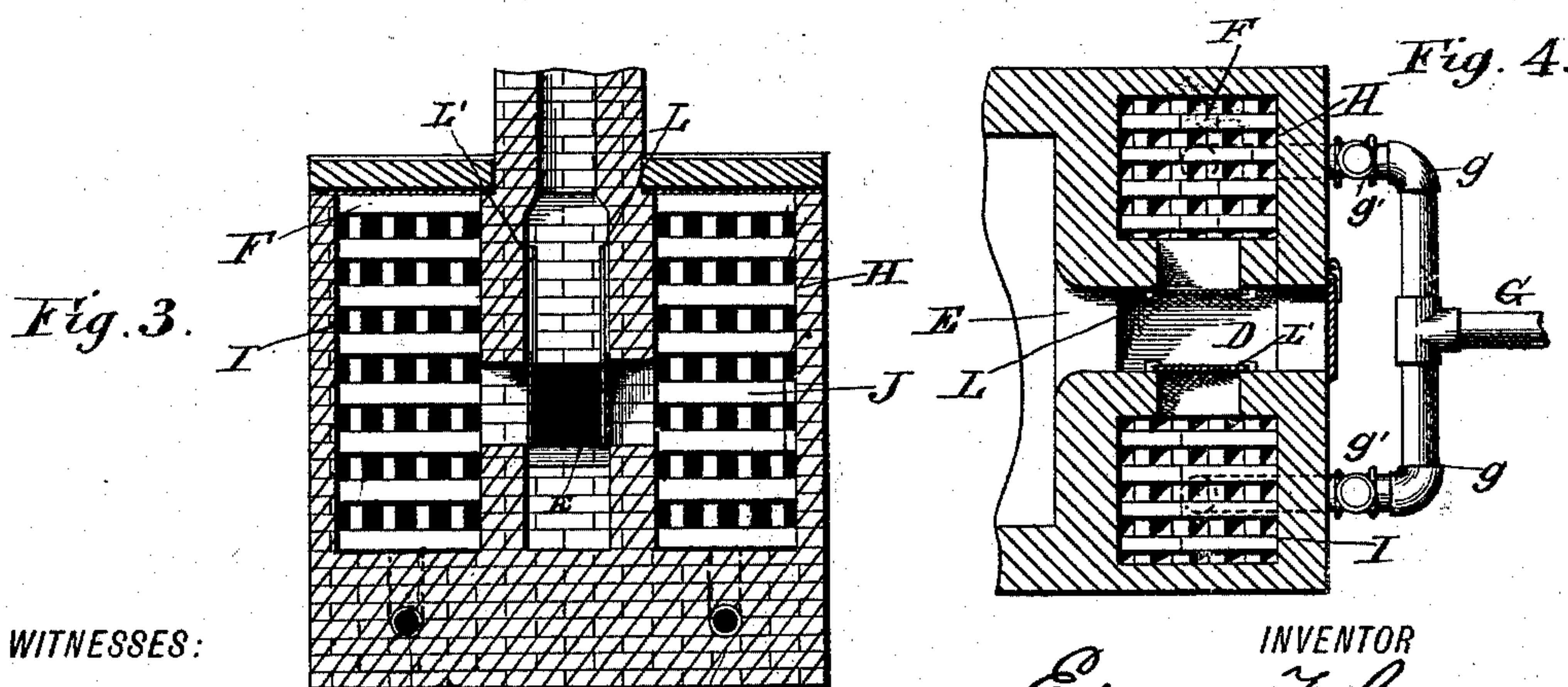
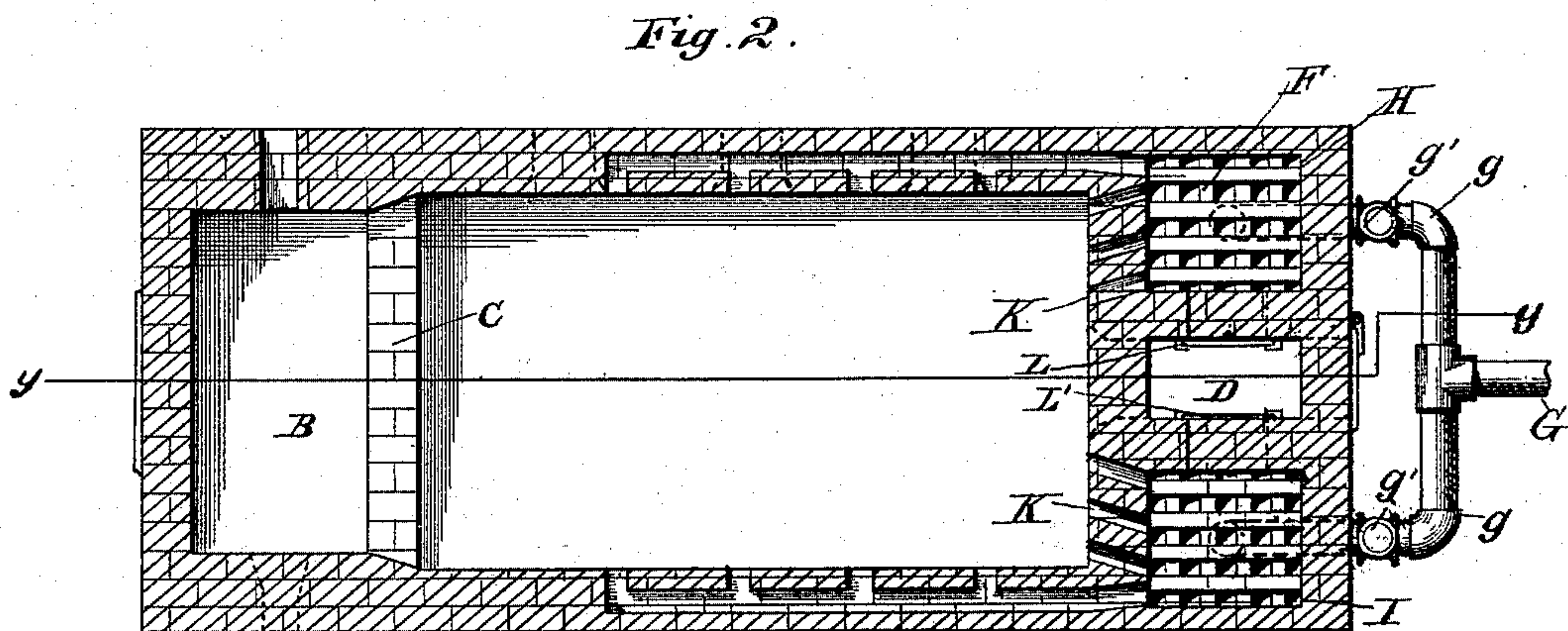
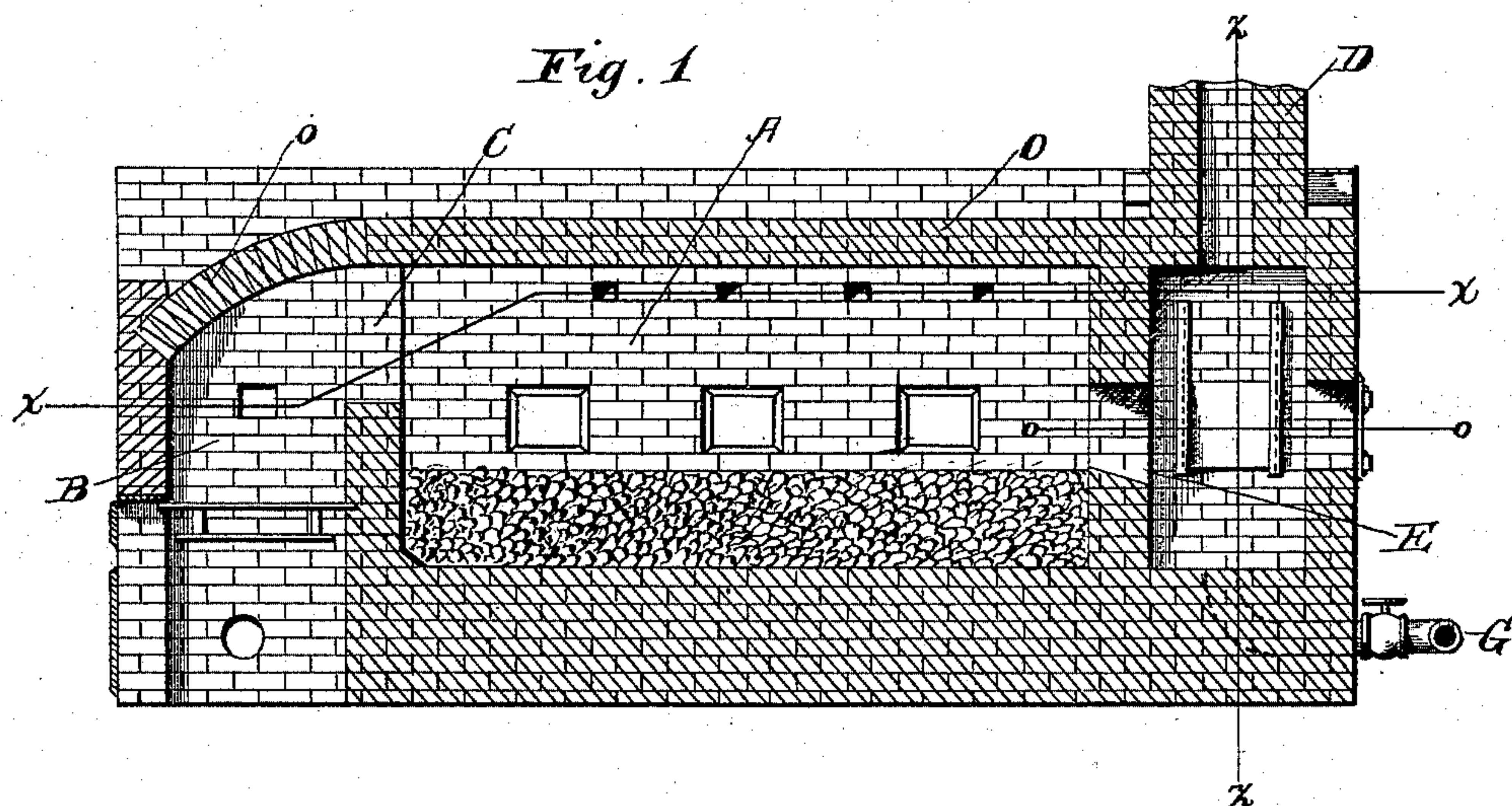


(No Model.)

2 Sheets—Sheet 1.

E. F. GRAY.  
REVERBERATORY AND REGENERATIVE FURNACE.  
No. 518,523. Patented Apr. 17, 1894.



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(No Model.)

2 Sheets—Sheet 2.

E. F. GRAY.

REVERBERATORY AND REGENERATIVE FURNACE.

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Fig. 5.

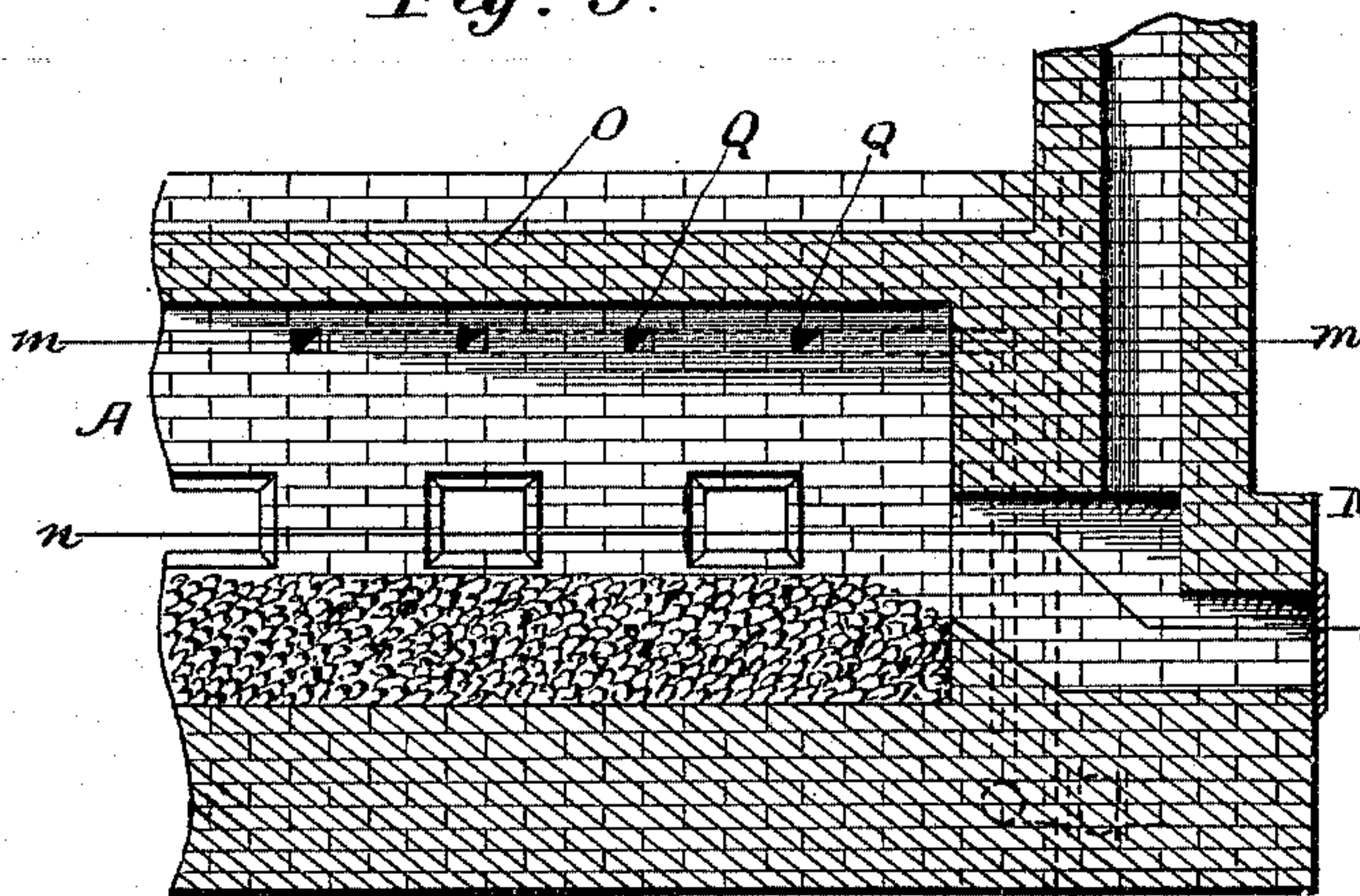


Fig. 6.

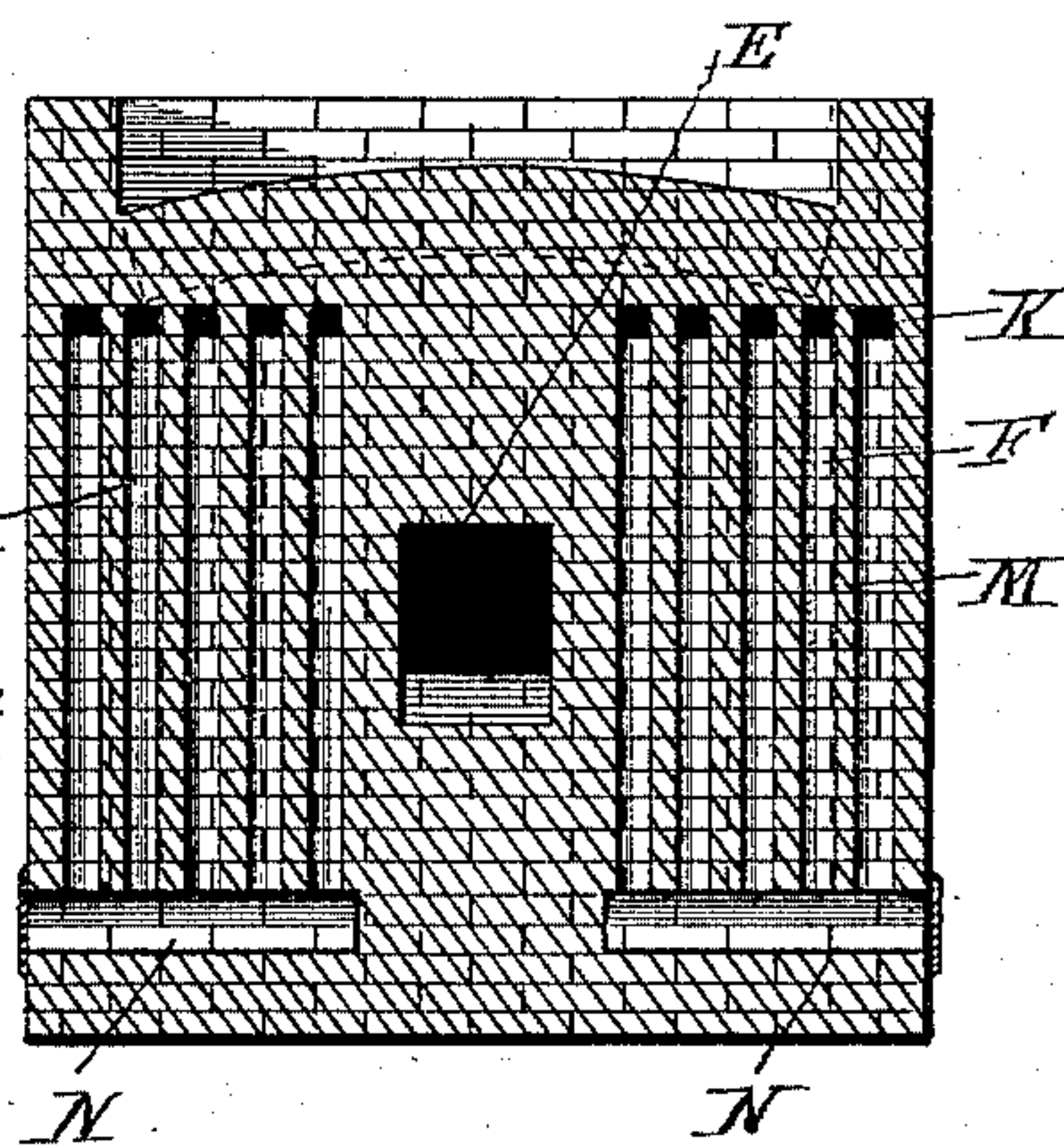


Fig. 7.

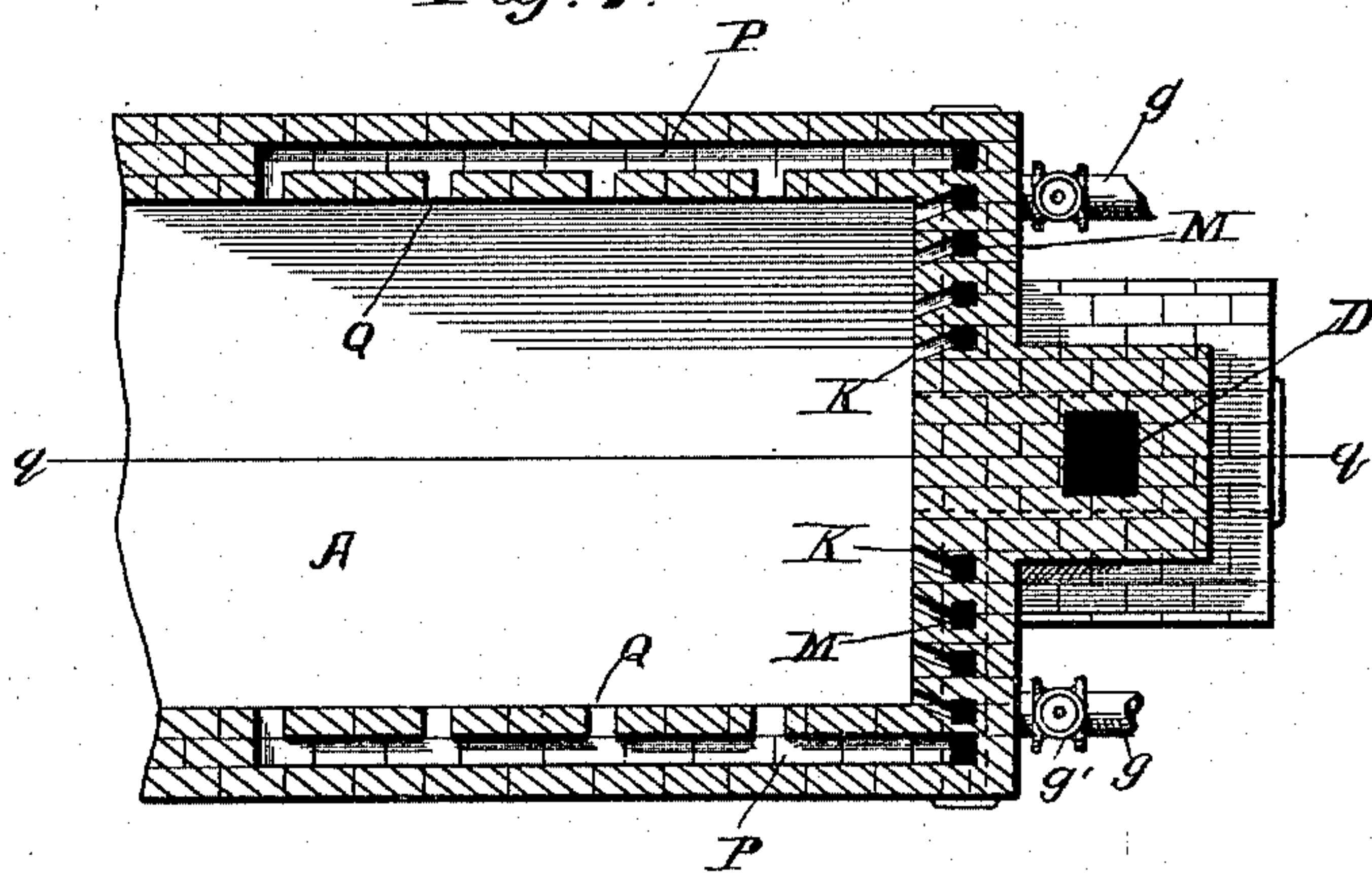
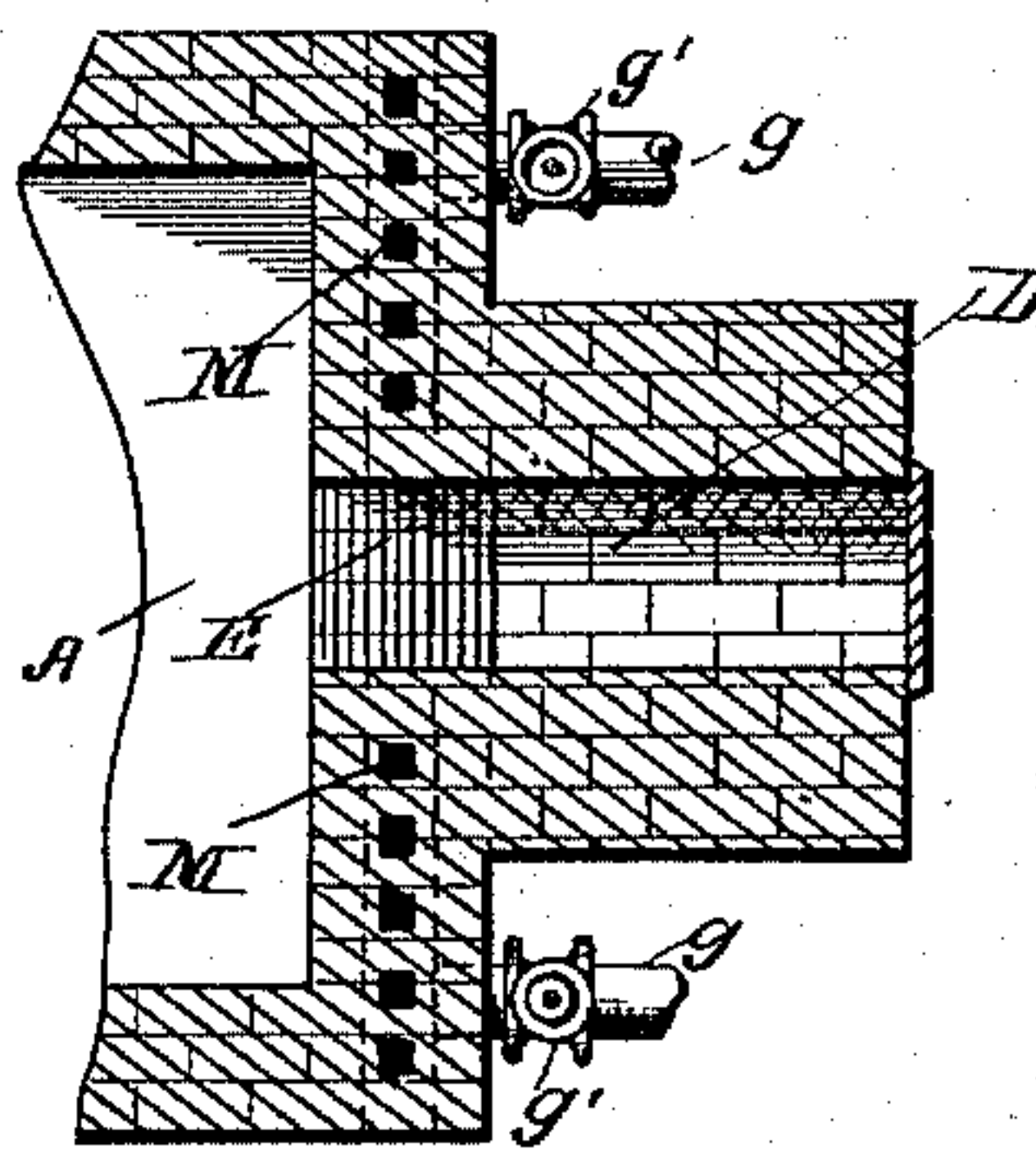


Fig. 8.



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## REVERBERATORY AND REGENERATIVE FURNACE.

SPECIFICATION forming part of Letters Patent No. 518,523, dated April 17, 1894.

Application filed June 21, 1893. Serial No. 478,406. (No model.)

*To all whom it may concern:*

Be it known that I, EDWARD F. GRAY, a citizen of the United States, residing at Bethlehem, in the county of Northampton and State of Pennsylvania, have invented certain new and useful Improvements in Reverberatory and Regenerative Furnaces; 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 an improved reverberatory and regenerative furnace for metallurgical operations which will be hereinafter fully described.

One of the improvements that I have in view is to insure a more perfect combustion of the gases in the working chamber of the furnace by the introduction of counter currents or blasts of air, either hot or cold, steam or gas, injected into the working chamber from the rear flue wall or from the side walls near said flue wall, whereby the escape of the gases and heat from the working chamber into the neck and thence to the uptake or stack will be "damped" or partially arrested to utilize the heat more perfectly and effect economy in the operation of the furnace. To the accomplishment of this end, I provide in the rear flue wall, on opposite sides of the neck or uptake of the furnace, a series of flues, passages or checker work which extends from the base of the stack up to about the level of the roof, and the blast is conveyed to these flues, passages or checker-work by a suitable valved pipe which has branches leading to opposite sides of the uptake and neck, and as the blast passes through the flues, passages or checker-work it is heated and is discharged through ports which open through the rear flue wall, just below the roof, into the rear part of the working chamber. I prefer to use checker-work in the rear flue wall, and to provide openings, closed by suitable doors, on opposite sides of the stack at the base thereof. These doors can be opened to admit heat to the checker-work in order to bring the latter to the required temperature, after which the doors should be closed before turning on the blast from the pipe through the checker-work.

In the accompanying drawings, forming a part of this specification, I have illustrated

two different embodiments of the means for heating and discharging the blast through the rear flue wall into the working chamber, and in which—

Figure 1 is a vertical longitudinal sectional view on the plane indicated by the dotted line, *y y* of Fig. 2 showing the checkerwork in the rear flue wall. Fig. 2 is a horizontal sectional view on the plane indicated by the dotted line *x x* of Fig. 1. Fig. 3 is a vertical cross sectional view through the rear flue wall, the stack and checker-work, on the line *z z* of Fig. 1. Fig. 4 is a horizontal sectional view on the line *o o* of Fig. 1 through the uptake and the checkerwork. Fig. 5 is a longitudinal vertical sectional view on the line *q q* of Fig. 7 of another embodiment of my furnace employing a series of vertical flues in the rear flue wall in lieu of the checker-work. Fig. 6 is a vertical transverse sectional view through the rear flue wall of the furnace shown by Fig. 5. Fig. 7 is a horizontal sectional view on the line *m m* of Fig. 5. Fig. 8 is a detail horizontal sectional view through the rear flue wall and uptake, the plane of the section being indicated by the dotted line *n n* of Fig. 5.

Like letters of reference denote corresponding parts in all the figures of the drawings, referring to which—

A designates the working chamber of the furnace; B is the primary combustion chamber, C is the bridge wall provided between the working and combustion chambers, D is the stack or uptake and E is the neck which connects the rear end of the working chamber and said stack or uptake, all of which are of the usual or any preferred construction and arrangement.

The rear flue wall F of the furnace is constructed to contain the flues, passages or checker-work and to receive a blast from the pipe G and discharge the blast in a heated condition, into the upper rear part of the working chamber to "dam" or arrest the rapid escape of the heat and gases from the rear part of the working chamber into the stack.

In the preferred embodiment of the invention illustrated by Figs. 1, 2 and 3, the rear flue wall is made hollow to provide two chambers H, I, which lie on opposite sides of the



neck and uptake of the furnace but which do not receive heat or products of combustion from said working chamber, neck or uptake, or either of them, during the operation of the furnace; and said chambers H, I, extend from the base of the stack up to about the level of the roof of the furnace, at which points they are closed by suitable roofs or covers, see Fig. 3. Each chamber is filled with checker-work J from its lower to its upper part, constructed in any approved or preferred manner, and to these chambers are coupled the branches *g, g*, of the blast pipe G, the latter having a valve *g'* by which the supply of the blast to the checker-work in the chambers can be controlled or shut off. The hot blast from the checker-work chambers is discharged into the upper rear part of the working chamber A through the series of converging ports K which are formed in the rear flue wall just below the roof of the furnace and which are designed to receive from the chambers H, I, and to discharge counter currents in converging lines into the working chamber, as will be understood.

For the purpose of heating the checker-work to the required temperature before admitting the blast into the chambers H, I, I provide the doors L, L', in opposite sides of the bottom of the stack. These doors may be of any suitable variety, accessible from the rear side of the stack through a suitable rear door, and by opening the doors L, L', when the furnace is first started, heat from the working chamber and stack can be admitted to the side chambers H, I, to heat up the checker-work, after which the doors L, L', should be securely closed so that heat and products of combustion from the furnace will not pass into either of the side chambers during the operation of the furnace.

In the modified construction of the furnace shown by Figs. 5 to 8, I dispense with the chambers and checker-work and construct the rear flue wall with the series of passages or flues M. These flues or passages extend vertically from the base of the stack up to the roof of the furnace, and they are arranged in parallel positions and isolated so that they do not communicate with each other or with the neck or uptake of the furnace. The lower ends of the flues or passages are connected by a lateral horizontal passage N which is common to a series of vertical passages or flues, and to this lateral passage N are coupled the branches *g, g*, of the valved blast pipe G. Each vertical passage or flue has a single discharge port K which extends through or over the rear flue wall to discharge the blast from the passage flue M into the upper rear part of the working chamber.

O is the roof of the furnace which extends in a substantially horizontal direction over the working chamber to the stack or uptake; but the front part of this roof *o* is curved or inclined in a downward direction over the primary combustion chamber B, said curved

or inclined part *o* of the roof extending substantially from the bridge wall C to the front wall *a* of the furnace. This form of the roof over the primary combustion chamber causes the ascending gases and products of combustion to be deflected over the bridge wall and to speedily pass from the combustion chamber into the working chamber, in which latter chamber the gases and products of combustion are more thoroughly consumed and the heat utilized to better advantage.

The operation of my furnace may be briefly described as follows:—The fire is started in the combustion chamber B and the ascending gases and products of combustion are deflected by the curved roof *o* and quickly pass into the working chamber, thence through the neck and drawn up into the stack. The heat raises the temperature of the walls, particularly the rear flue wall, and to more expeditiously heat the checker-work in the embodiment of the furnace shown by Figs. 1 to 3 inclusive, the doors L, L', are opened to permit heat to pass from the stack into the checker-work, after which the doors are closed.

When the furnace is in working condition, the valve in the blast pipe G is opened to admit the air—hot or cold—steam or gas to pass through the branches *g, g*, into the checker-work or flues, and as the blast passes upward through the flues or checker-work, it is heated to the proper temperature and discharged through the series of ports K. As the air is discharged in a heated condition, under pressure into the upper rear part of the working chamber, the passage of the heat, gases and products of combustion from the working chamber into the neck and uptake is partially retarded or “dammed” and thus combustion is more thoroughly effected in the working chamber and the heat utilized to better advantage. The blast may also be introduced through the side walls of the furnace, near the rear flue walls thereof, and to this end I provide the longitudinal flues P and the discharge ports Q in the side walls as shown more clearly in Figs. 2 and 7 of the drawings. Each longitudinal flue is located in the side wall near the roof O, and the rear end thereof communicates with one of the vertical flues or the checkerwork to receive the blast therefrom, and the ports Q extend from the flue into the working chamber, as shown.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a furnace, the combination with a working chamber, an uptake, and a neck, of the rear flue-wall constructed with two series of blast-flues situated respectively on opposite sides of the neck and uptake and converging, in the line of discharge of the blast, into the rear part of the working chamber, flues or checker-work within said flue-wall, and a blast-pipe connected with said flue-wall, to discharge thereto, whereby the blast is heated during its passage through the flues



or checker-work and divided by the series of blast-flues to produce counter currents in the rear part of the working chamber, substantially as described.

2. In a furnace, substantially such as described, the combination with a working chamber, an uptake, and a neck, of the rear flue-wall constructed with vertical flues or checkerwork on opposite sides of the neck and uptake, and with discharge ports which are situated below the roof and lead from said flues or checkerwork into the working chamber to discharge counter currents into said chamber, and a branched blast-pipe connected to the flue-wall on opposite sides of the uptake to supply the blast to said vertical checkerwork or flues, substantially as and for the purpose described.

3. In a furnace, substantially such as herein shown and described, the combination with a working chamber, an uptake, and a neck, of the checker-work arranged in separate chambers formed in the rear flue wall on opposite sides of the uptake and neck, the blast pipe arranged to discharge into the lower part of said checker-work, and the series of discharge ports K formed in the rear flue wall and adapted to discharge the heated blast from the checker-work into the working chamber at the upper rear part thereof, substantially as and for the purposes described.

4. In a furnace, substantially such as herein described, the combination with a working chamber, an uptake, and a neck, of the flues or checkerwork formed in the rear flue wall on opposite sides of the neck and uptake, the series of discharge ports which converge toward the central line of the furnace and discharge blast from the flues or checkerwork into the upper rear part of the working cham-

ber, and the blast pipe connected with the lower part of the checker-work or flues, as and for the purpose described.

5. In a furnace, substantially such as herein shown and described, the combination with a working chamber, an uptake, and the neck, of the side chambers formed in the rear flue wall on opposite sides of the neck and uptake and having the doors L, L', on opposite sides of the stack normally closed, the checkerwork situated in said side chambers, the converging discharge ports K, K, formed in the rear flue wall to discharge the blast from the checker-work into the upper rear part of the working chamber, and the valved blast pipe having its branches connected to the lower parts of the side chambers, substantially as and for the purposes described.

6. In a furnace, substantially such as described, the combination with a working chamber, an uptake, and a neck, of the rear flue wall constructed with vertical flues or checkerwork and with discharge ports which lead counter currents from said flues or checkerwork into the upper rear part of the working chamber, the longitudinal flues in the side walls of the furnace which are connected to receive the blast from the flues or checkerwork and provided with discharge ports which lead the blast into the working chamber at the sides thereof, and a blast-pipe arranged to discharge to the flues or checkerwork of the rear flue-wall, substantially as and for the purpose described.

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

EDWARD F. GRAY.

Witnesses:

HENRY KRAUSKOPF,  
JOSEPH BAKER.