

**H. McDONALD.**  
**Reverberatory-Furnaces.**

No. 139,683.

Patented June 10, 1873.

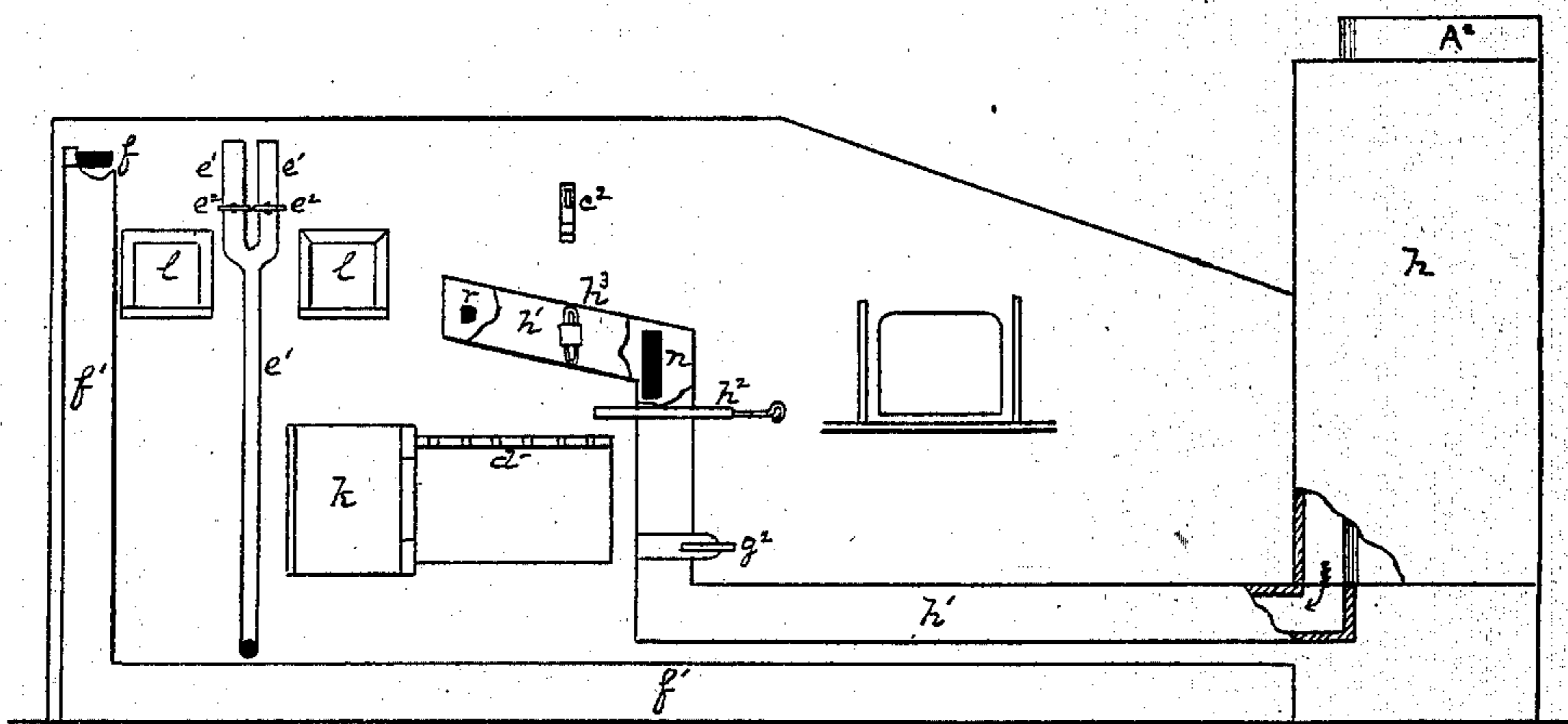


Fig. 1.

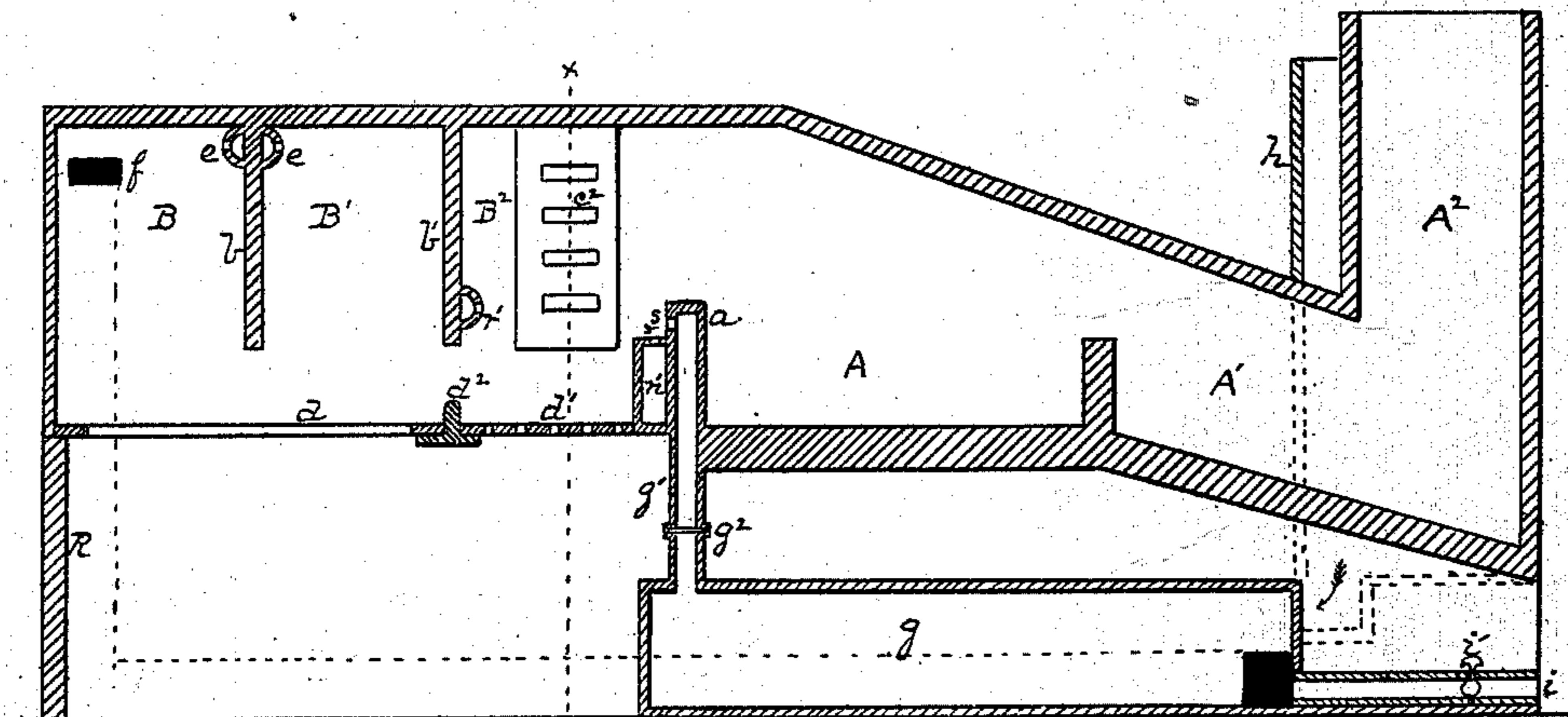


Fig. 2.

WITNESSES  
James D. Kay  
R. E. Henderson

INVENTOR  
Hugh McDonald,  
of Bakewell, Christy & Kerr,  
his Attys.

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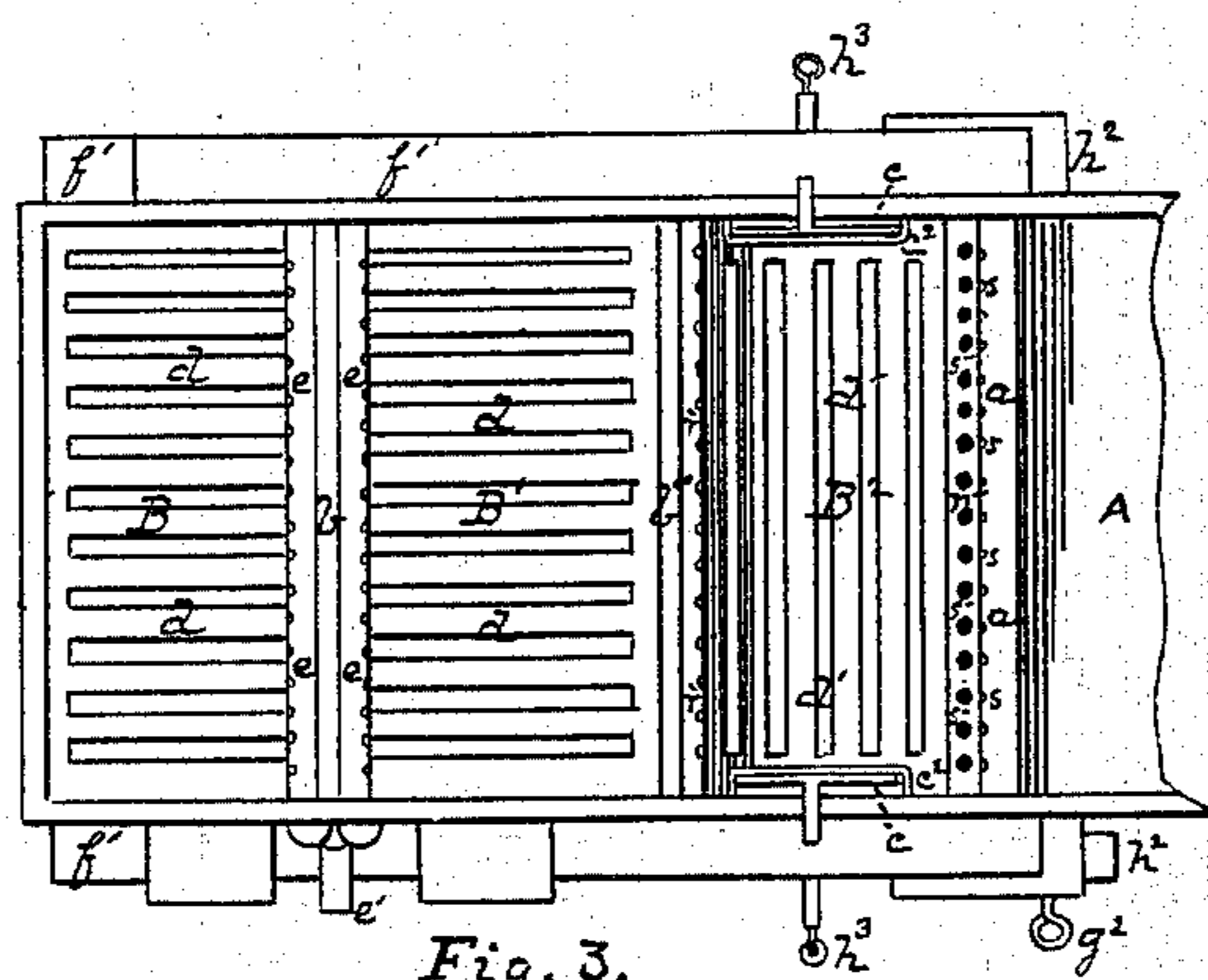


Fig. 3.

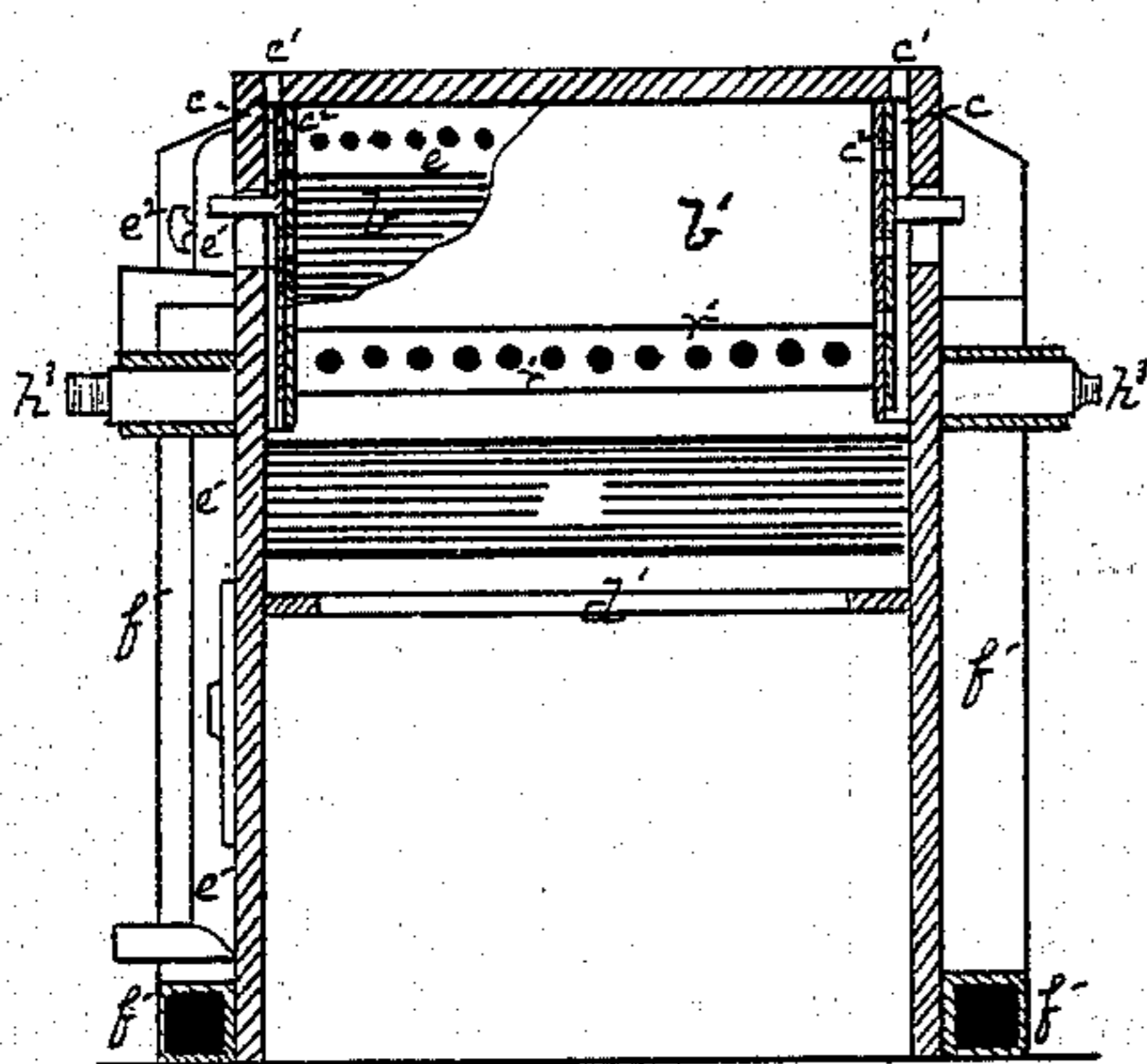


Fig. 5.

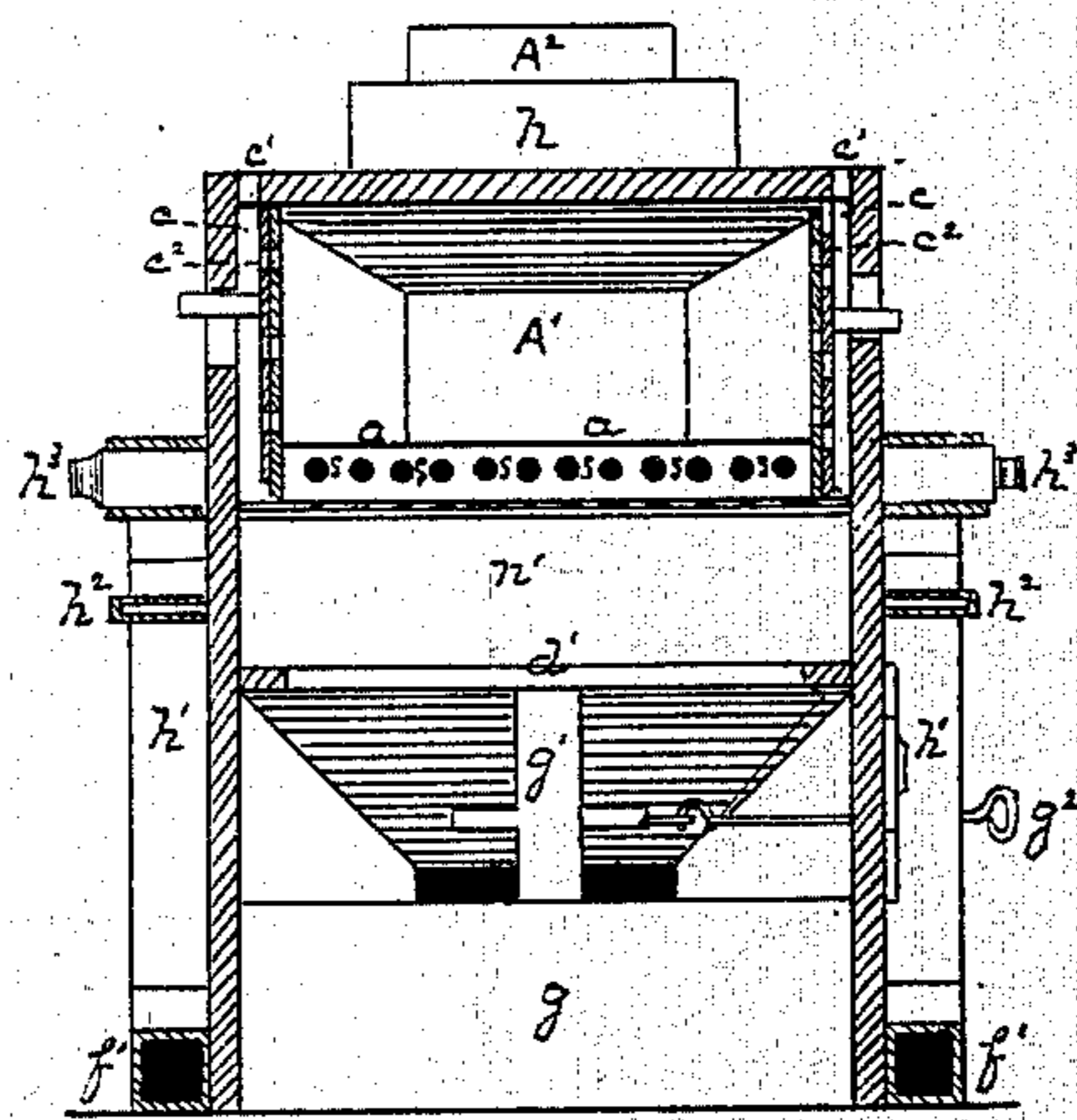


Fig. 4.

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# UNITED STATES PATENT OFFICE.

HUGH McDONALD, OF PITTSBURG, PENNSYLVANIA.

## IMPROVEMENT IN REVERBERATORY FURNACES.

Specification forming part of Letters Patent No. **139,683**, dated June 10, 1873; application filed February 27, 1873.

*To all whom it may concern:*

Be it known that I, HUGH McDONALD, of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Reverberatory Furnaces; and I do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the accompanying drawings, in two sheets, making a part of this specification, in which—

Figure 1, Sheet 1, is a side elevation of a puddling-furnace fitted with my improvements. Fig. 2, Sheet 2, shows a longitudinal vertical section thereof. Fig. 3, Sheet 2, is a top or plan view of the coking and combustion chambers and forward beyond the fire-bridge, (the top or cover being removed,) and Figs. 4 and 5, Sheet 2, are sectional views through the line *x x*, Fig. 2, but Fig. 4 showing the view toward the working-chamber, and Fig. 3 looking back in the opposite direction.

Like letters of reference indicate like parts in each.

My invention relates to improvements in the ordinary puddling, boiling, heating, or smelting furnace; and consists in the construction and combination of devices for effecting the more perfect combustion of the fuel, for the more complete utilization of the smoke and gases of combustion, and for supplying heated air, steam, or water to certain parts of the furnace to secure greater heat.

To enable others skilled in the art to make and use my invention, I will proceed to describe its construction and mode of operation.

The furnace shown is of the well-known reverberatory form, suitable for the operations of boiling, puddling, heating, or smelting of metals. The working-chamber A, neck A<sup>1</sup>, and chimney A<sup>2</sup> are of the usual construction. The part in which the combustion of the fuel is effected I divide, by transverse walls *b b'*, into three or more chambers, B B<sup>1</sup> B<sup>2</sup>. The lower edges of these walls are about even with or a little below the upper edge of the fire-bridge *a*. The usual or any suitable grate-bars *d* are arranged under the chambers B B<sup>1</sup>, and at their inner ends rest on and abut against a low bridge, *d*<sup>2</sup>. Under the chamber B<sup>2</sup> I arrange transversely across the grate bars *d*<sup>1</sup>, or other suitable grating, for the ad-

mission of air to that chamber. This grating is accessible, for cleaning or other purposes, at the side door *k*, which, in Fig. 1, is shown open.

The chambers B B<sup>1</sup> are to be charged with coal through the stop-holes *l l*, and as the fuel (usually soft or bituminous coal) becomes coked, and the smoke and other gases are driven off, it is either allowed to be consumed there or, as it reaches an incandescent condition, it may be worked forward under the wall *b'* into the chamber B<sup>2</sup>. Or, if so preferred, the fresh fuel may be fed only into the first chamber B, and, as it becomes coked, or partially coked, it may be worked forward into the next chamber B<sup>1</sup>.

In the sides of the furnace-wall at the chamber B<sup>2</sup> I arrange driving-flues *c c*, which take air through holes *c*<sup>1</sup> in the top, and, through sliding registers *c*<sup>2</sup>, admit the same into the chamber B<sup>2</sup>, the supply being regulated by the adjustment of the registers in the usual way. The smoke and unconsumed gases pass forward from the chambers B B<sup>1</sup>, one or both, into the chamber B<sup>2</sup>, where air is supplied to promote their combustion, either from below, through the grating *d*<sup>1</sup>, or laterally, through the registers *c*<sup>2</sup>, or both, as may be preferred. The flame passes over to the working-chamber A, and does its work in the usual manner.

It is a well-known fact that steam or watery vapor will, in some cases, facilitate materially the combustion of solid or gaseous carbons, if brought, at the proper temperature, into intimate contact or admixture therewith. To secure the presence and co-operation of such steam or vapor, I arrange on or in any one of the walls of the furnace, in the manner substantially as shown on the wall *b*, a pipe or pipes, *e*, with suitable jet-holes, as shown, and supply steam or water thereto by means of a pipe, *e*<sup>1</sup>, which is connected with any suitable heater or steam-generator. The supply is controlled at pleasure by cocks *e*<sup>2</sup>. If steam be introduced, it passes into the line of draft, is brought into intimate contact with the smoke and gases of combustion at a high temperature, and facilitates their combustion in accordance with well-known principles. But if water is introduced, the fuel is kept in a

moistened condition, and the moisture is by the heat converted into steam, with the beneficial result already mentioned.

As I find it sometimes advantageous to do so, I have devised and shown means for conducting the excess or any desired proportion of the smoke and unconsumed gases from the coking-chamber B (or other coking-chamber) to the fire-bridge by another route. For this purpose I make one or more openings,  $f$ , in one or both sides of the coking-chamber, and thence by flues  $f'$  conduct such part of the smoke and gases forward to a gas holder,  $g$ , under the furnace. A pipe,  $g^1$ , opened and closed by a damper or cock,  $g^2$ , leads from this holder up into the fire-bridge  $a$ , which fire-bridge is so made that, by a series of jet-holes,  $s$   $s$ , or other suitable opening or openings, the smoke may at pleasure be discharged into the path of the flame or heat which passes over the fire-bridge, and there be consumed. I also make on one or more sides of the chimney  $A^2$ , at its lower end, or what is in effect the same thing, on one or more sides of the neck of the furnace, an outer case,  $h$ , inside which air is admitted at the upper end, and from which, after being heated, it is conducted by pipes  $h^1$  back along the side of the furnace. The backward flow of heated air is controlled by dampers or cocks  $h^2$   $h^3$ . At  $n$  a side pipe leads into a hollow part,  $n'$ , of the fire-bridge  $a$ , or into a hollow chamber which is built across in close contiguity thereto. Thence it escapes by jet-holes  $s'$  into the path of the flame so as to unite intimately with the escaping smoke and gases which emerge from the jet-holes  $s$ , and thus supply heated oxygen to facilitate their combustion. As another or additional means of securing the same end, I supply steam to the smoke and gases while in the holder  $g$  by means of a steam-pipe,  $i$ , fitted with a cock,  $i'$ , for regulating the flow. In such case the steam is mixed with the smoke and gases while in the holder, and, so intermingled, they escape at the jet-holes  $s$ , as already described. The position of all these devices is such that they are kept in a heated state by heat from the furnace. I also supply heated air to the smoke and unconsumed gases which pass forward under the wall  $b'$ . For this purpose I extend the flue  $h^1$  back to a suitable point, where, by a lateral connection,  $r$ , it opens into a pipe,  $r'$ , arranged transversely across the chamber on or near the lower edge of the wall  $b'$ . This pipe  $r'$  has also a series of jet-holes, or other suitable opening or openings, by which the heated air is permitted to escape into the chamber  $B^2$ , where it unites with the smoke and gases to secure their more perfect combustion. Instead of heated air, water, heated to near a vaporizing temperature, or steam itself, may be introduced into the chamber  $B^2$  by the pipe  $r'$ ;

and the pipe  $r'$  may be arranged across the chamber  $B^2$  at any other desired point with beneficial result from the air, steam, or water thus introduced. Many of these devices may be separately combined with a furnace with beneficial result. The number of walls  $b$   $b'$  may be increased at pleasure, and the steam, water, or hot-air pipes applied to each or all of them, as may be desired. The ash-pit may have doors  $R$ , or be left open in front, at pleasure.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In combination with the coking-chamber or furnace, a steam or water pipe suitably arranged therein for supplying moisture to the smoke and gases evolved in the operation of coking, substantially as set forth.

2. In combination with a series of chambers,  $B^1$   $B^2$ , two or more in number, a pipe,  $r'$ , arranged transversely across the chamber  $B^2$  at a suitable point for supplying air or steam to the smoke and gases of combustion at or near the point of their entrance into the said chamber, substantially as set forth.

3. In combination with a fuel-coking chamber,  $B$ , of a furnace of the class indicated, a smoke-flue or smoke-flues,  $f'$ , suitably arranged for conveying any desired portion of the smoke and gases from the coking-chamber out of the line of the draft, and causing them to re-enter again the line of the draft in a separate combustion-chamber,  $B^2$ , and at or near the fire bridge, either directly or through an intermediate gas-holder,  $g$ , substantially as set forth.

4. The combination of case  $h$ , pipe or pipes  $h^1$ , and chambered fire-bridge, with openings thence into the combustion-chamber  $B^2$ , substantially as and for the purposes set forth.

5. The combination of the air-openings from the pipe  $n'$ , and the smoke-openings from the fire-bridge, arranged to discharge in close contiguity into the path of the flame from the combustion-chamber to the working-chamber, substantially as set forth.

6. The steam-pipe  $i$  and smoke-flues  $f'$  uniting and leading to the chambered fire-bridge, so as to discharge the smoke and gases of combustion intermingled with steam into the combustion-chamber, the combination being substantially as set forth.

7. The openings  $c^1$  in the upper part of the chamber  $B^2$ , and registers  $c^2$  for supplying air laterally to the fire in the chamber, substantially as set forth.

In testimony whereof I, the said HUGH McDONALD, have hereunto set my hand.

HUGH McDONALD.

Witnesses:

A. S. NICHOLSON,  
G. H. CHRISTY.