

No. 670,777.

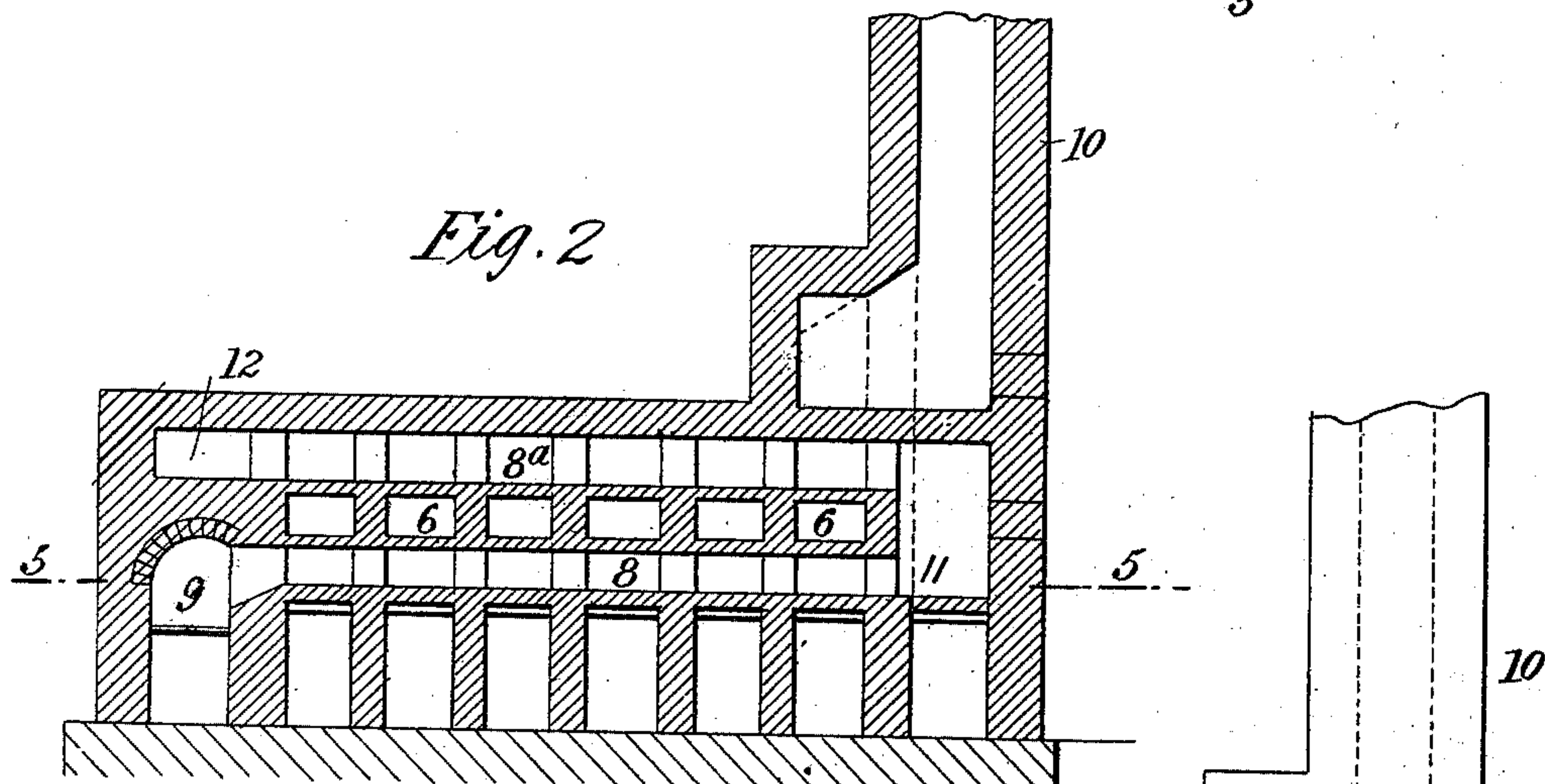
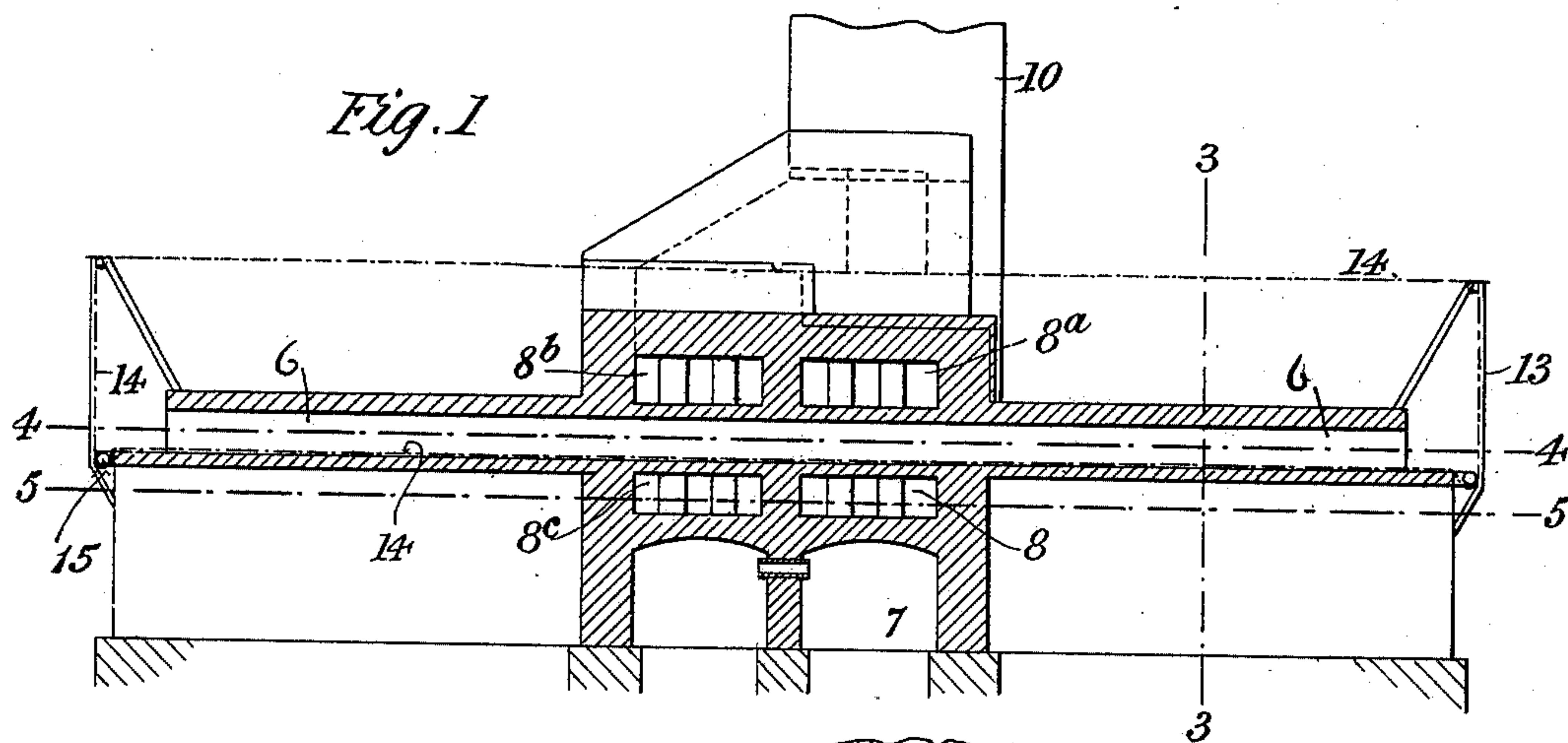
Patented Mar. 26, 1901.

R. GUASTAVINO.  
KILN FOR GLAZING TILES, &c.

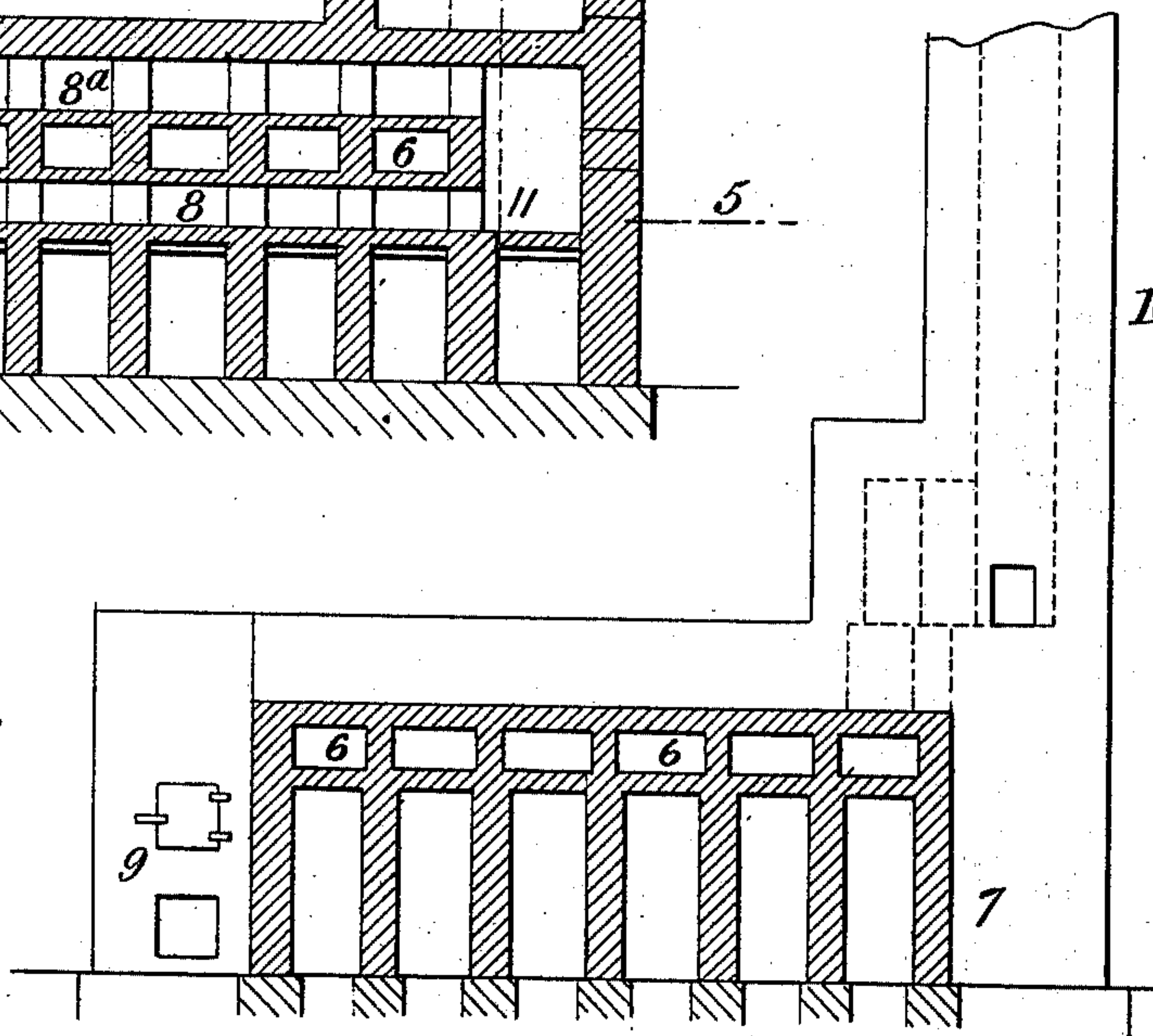
(Application filed May 24, 1899.)

(No Model.)

3 Sheets—Sheet 1.



*Fig. 3*



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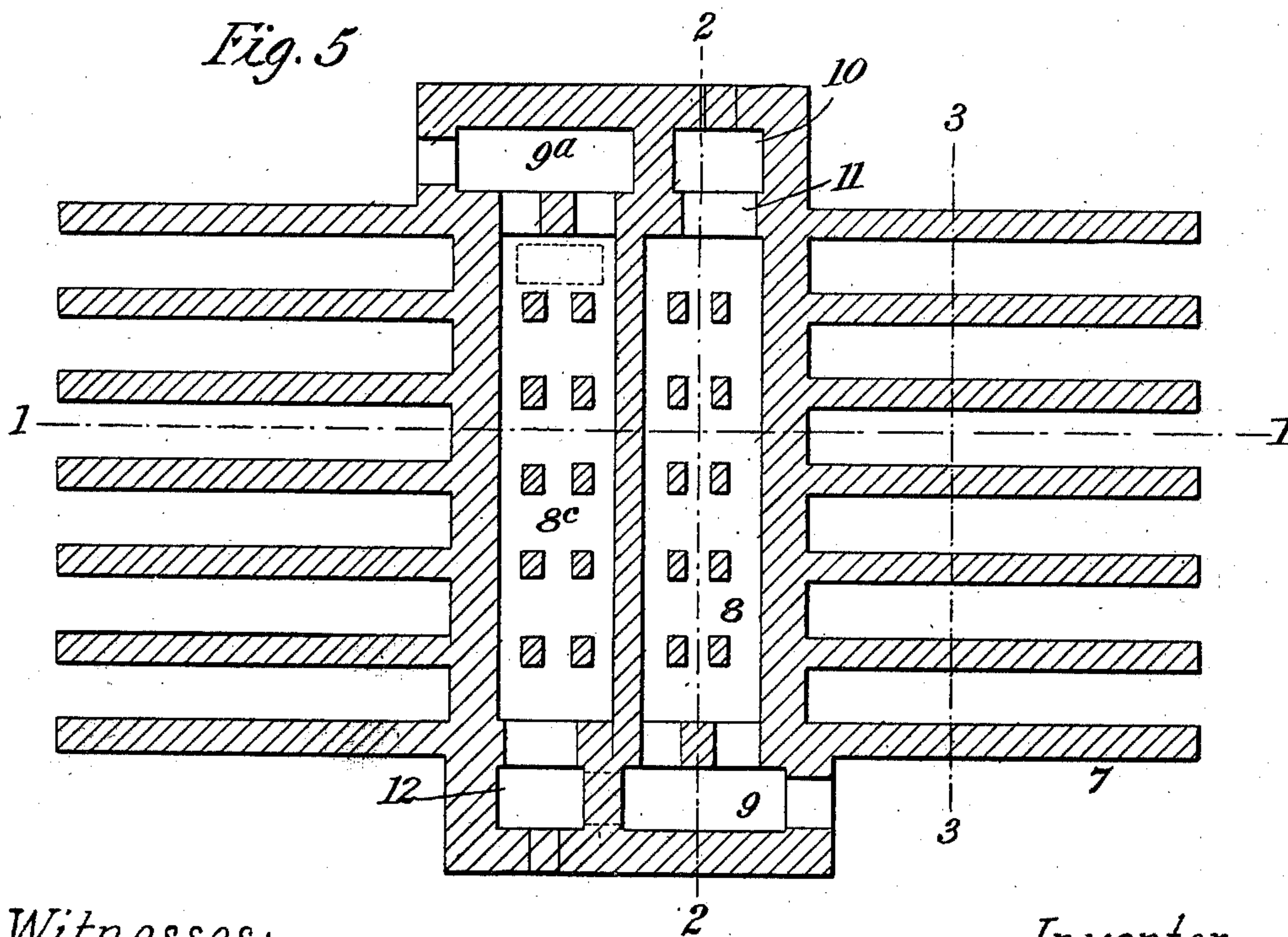
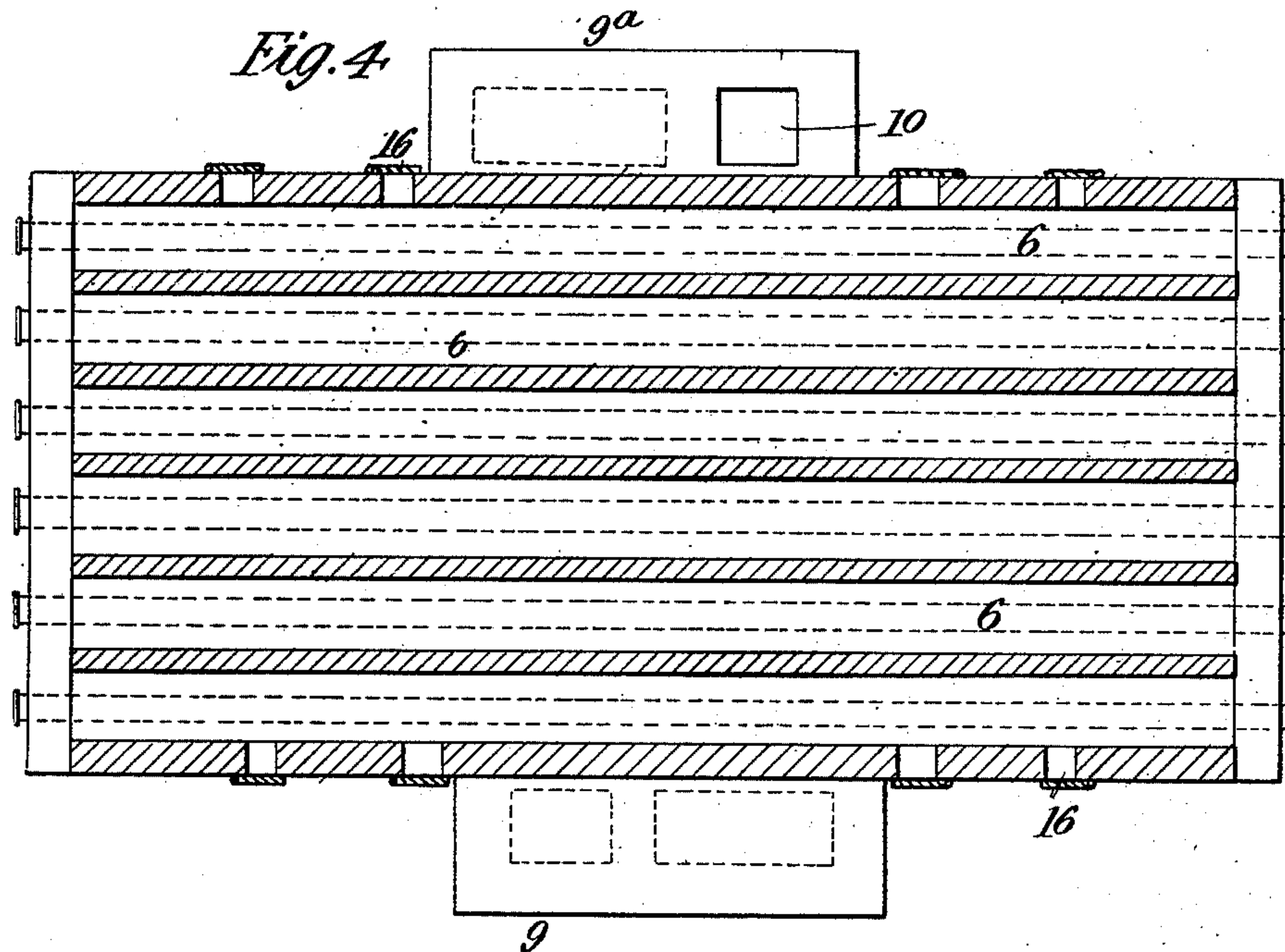
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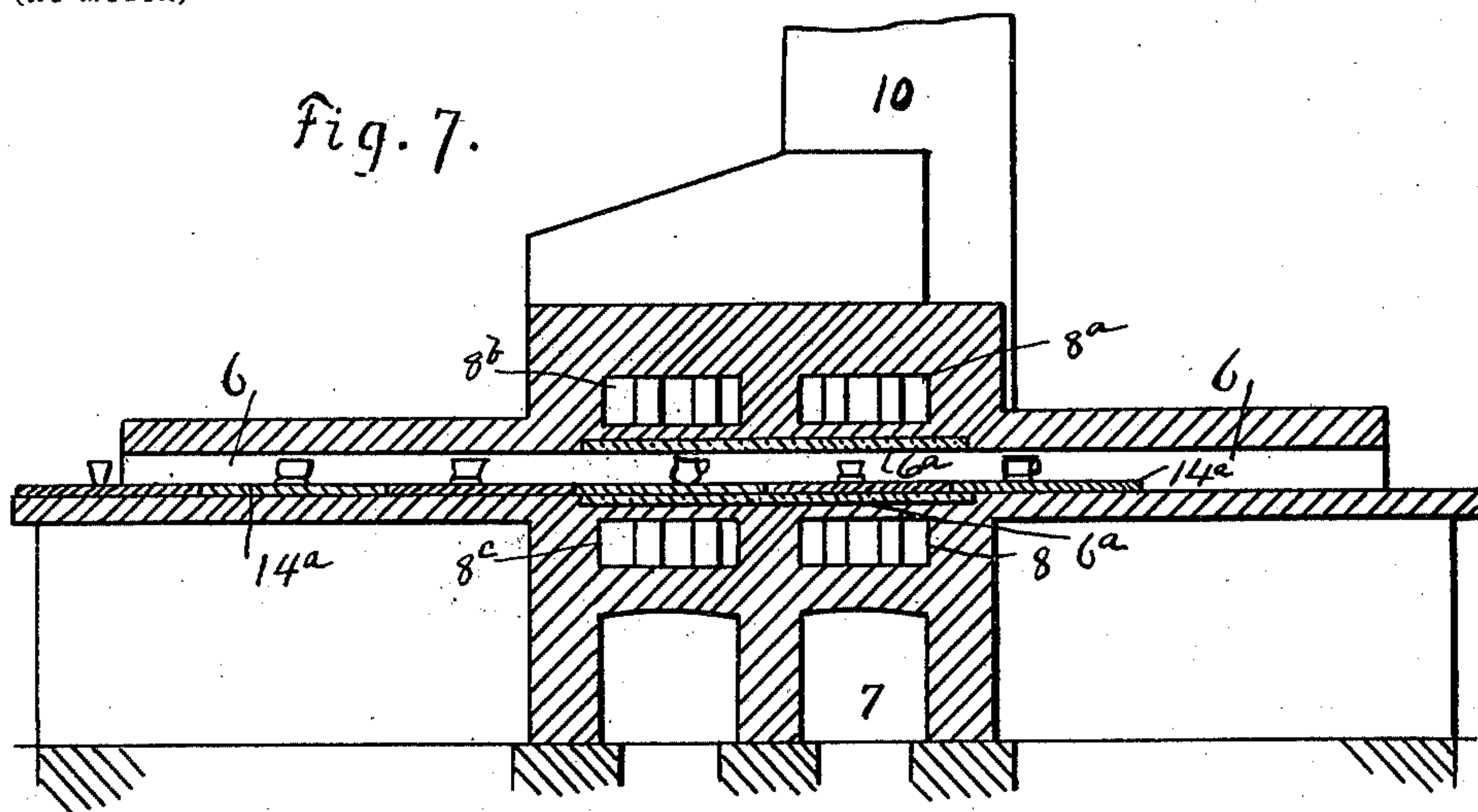
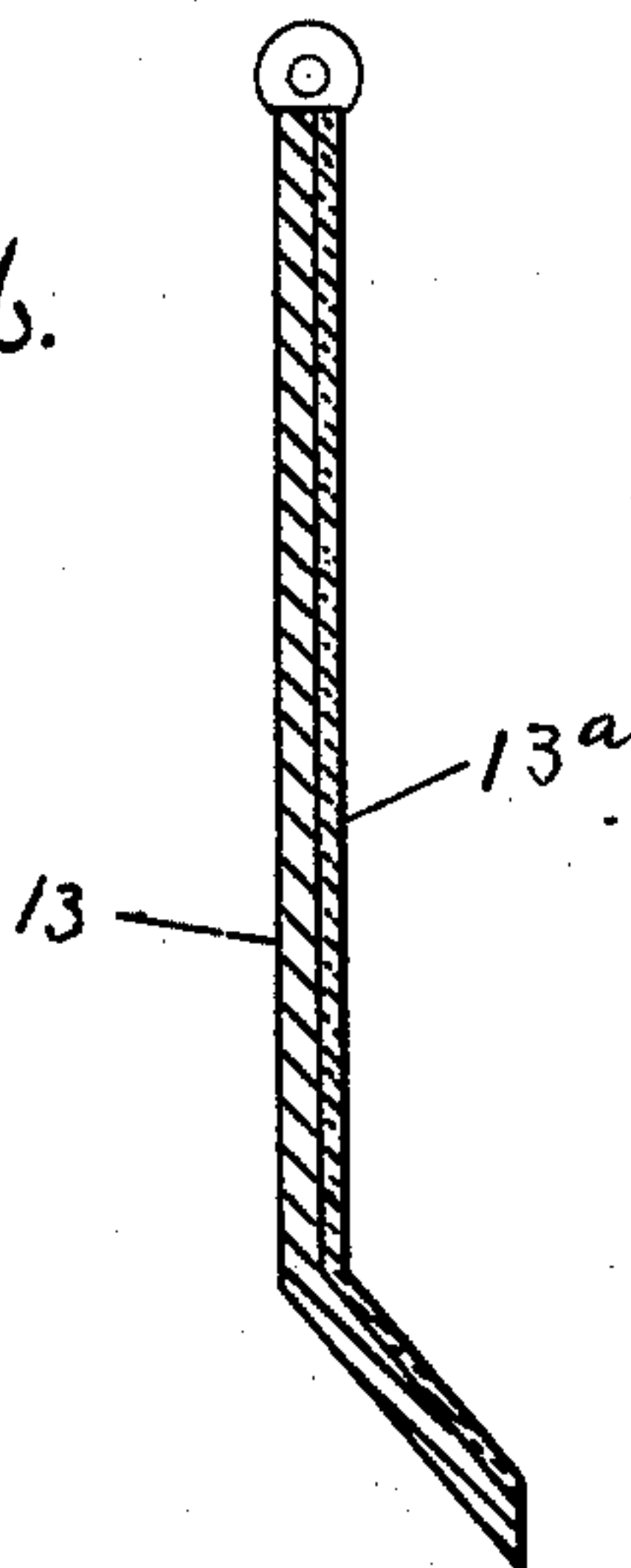


Fig. 6.



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# UNITED STATES PATENT OFFICE.

RAFAEL GUASTAVINO, OF BLACK MOUNTAIN, NORTH CAROLINA.

## KILN FOR GLAZING TILES, &c.

SPECIFICATION forming part of Letters Patent No. 670,777, dated March 26, 1901.

Application filed May 24, 1899. Serial No. 717,985. (No model.)

*To all whom it may concern:*

Be it known that I, RAFAEL GUASTAVINO, a citizen of the United States, and a resident of Black Mountain, county of Buncombe, State of North Carolina, have invented certain new and useful Improvements in Kilns for Glazing and Enameling Clays, &c., by a Continuous Operation, of which the following is a specification.

My invention relates to improvements in kilns for glazing and enameling clays, &c., by a continuous operation.

In the art of enameling and glazing tiles, majolica, faience, &c., as practiced today close kilns are used of the muffle type, or saggars are employed. A kiln of the muffle type is unsatisfactory and inconvenient, because unless the muffle is small it is difficult to heat it so as to obtain an even or uniform temperature throughout, which is essential for the best results. A suitable temperature should be maintained or the enamel or glaze on the ware will be good only in spots. Experience shows that a large percentage of the product treated in a muffle is of an inferior grade, and the muffle is measurably effective only for small articles.

There is an advantage in the use of saggars over the muffle in that the heat is better distributed; but even with the use of saggars it is not possible to obtain a uniform heat. A disadvantage incident to the use of saggars is that the saggars in which the wares are placed while being burned or baked—in bulk largely exceeding the contained wares to be enameled or glazed and occupying from fifty to seventy per cent. of the capacity of the kiln—must be heated in order to heat the contents, thus requiring a great amount of heat for that purpose alone. Whether the muffle system is made use of or saggars employed the drawback exists that no inspection of the operation is possible during the period allowed for the firing, which is from five to fifteen days. In either case the result of the firing cannot be definitely known until the kiln is opened. One reason for the long period required for the firing according to either of the modes mentioned is that the temperature has to be raised slowly, and after the firing a gradual cooling is required, and finally the wares have to be removed, all of which consumes a great deal of time. The

several inconveniences of the muffle and the saggars systems are attached to any system where the kiln is closed—as, for example, where packing in the form of pigeonholes forming small muffles is employed.

By my invention I overcome the disadvantages incident to the modes now practiced in glazing and enameling ceramics. I am able while the continuous operation is going on to determine the condition and progress of the work and to correct any difficulties without stopping the operation of the kiln. Besides, in my method no muffle is necessary and saggars are not employed. My method is both economical and expeditious, because there is no waste of heat and the operation is a continuous one.

I illustrate in the accompanying drawings a kiln adapted to carry out this invention.

In the drawings, Figure 1 is a longitudinal vertical section of the kiln on the line 1 1 of Fig. 5. Fig. 2 is a vertical transverse section on the line 2 2 of Fig. 5. Fig. 3 is a cross-section on the line 3 3 of Figs. 1 and 5. Fig. 4 is a horizontal section through the galleries on line 4 4 of Fig. 1. Fig. 5 is a horizontal section on the line 5 5 of Figs. 1 and 2. Fig. 6 is a central vertical section of a door, and Fig. 7 is a sectional view of a modification, showing lined galleries.

My improvement in glazing and enameling clays is distinguished from the common methods, in which muffles or saggars are made use of, in that my apparatus is a continuously-operating one, by which I mean that the tiles or other articles to be glazed or enameled pass through the kiln progressively and intermittently, the zone of intense heat being centrally between the ends of the kiln and at a sufficient distance from such ends to permit the articles to become gradually heated before reaching the greatest heat and to be gradually cooled or reduced in temperature before reaching the opposite end of the kiln, where they are removed, and the tiles or other articles are not brought in direct contact with flame, which is an advantage my method has over the use of saggars and the muffle type of kiln. Moreover, as the present kiln is a continuously-operating one it is economical, since the output is much larger than is possible with the methods heretofore practiced,



and less fuel is required for a definite amount of work, and, besides, defective firing, with consequent loss, is reduced to a minimum, if not wholly obviated. Referring to the drawings, the kiln illustrated therein is more especially intended for glazing and enameling tiles. It may be about twenty-five feet long, and, as shown, it is constructed with six galleries or ovens of a width corresponding to the tiles to be fired.

Extending transversely of the kiln structure centrally between the ends of the galleries 6, which are built of fire-brick, are the heating-flues, supported on the arches or pillars 7 and consisting of two passages, each having lower and upper flues 8<sup>a</sup> 8<sup>b</sup> 8<sup>c</sup>. At the ends of the heating-flues are furnaces 9<sup>a</sup>, with a single chimney 10, and in these furnaces fires are maintained at the same time. The products of combustion pass from the furnace 9 through the lower flues 8, Figs. 2 and 5, to the chamber 11, and from thence through the upper flues 8<sup>a</sup> of the same passage to the chamber 12, and thence through the upper flues 8<sup>b</sup> of the other passage to the chimney 10. The products of combustion from furnace 9<sup>a</sup> pass through the lower flues 8<sup>c</sup> into the chamber 12 and thence through the upper flues 8<sup>b</sup> to the chimney 10. There is consequently a continuous circulation of heating medium through the entire series of flues, and this serves to intensely heat those portions of the galleries or ovens that pass through that portion of the kiln occupied by the heating-flues, the heating-flues being below and above the galleries, as shown. The described arrangement of flues and furnaces causes the hot products of said furnace to pass successively below and above the galleries, intensely heating them, and avoids waste of heat. It also enables me to conveniently use several furnaces and a single chimney.

The ends of the galleries or ovens 6 are closed by iron doors 13, which are provided with asbestos lining 13, Fig. 6. When one of the doors of a gallery is opened to admit tile or to remove it, the other is always shut, so as to avoid drafts. The tiles or other wares to be glazed or enameled are placed on chains of suitable construction and width, which are adapted to travel along the floors of the galleries intermittently. The chains, (indicated at 14,) one for each gallery, are endless and pass under suitable rollers, as 15, at the ends of the galleries and over suitable supports and across the top of the kiln. The chains are moved by any suitable hand appliance, or a suitable motor may be employed for that purpose.

The ovens or galleries 6 are preferably lined with fire-clay plates 6<sup>a</sup>, Fig. 7, although in some cases this is unnecessary, and in the operation of the kiln these plates in those portions of the galleries which pass through and between the passages containing the heating-flues 8 8<sup>a</sup> 8<sup>b</sup> 8<sup>c</sup> become heated to a white heat

or heated to the degree required to glaze or enamel the tiles, and in the passage of the tiles through these portions of the galleries they are heated to the melting-point of glazing and are permitted to remain in this intense heat a longer or shorter time, according to the movements of the chains.

The chains 14 will always be used for low-heat enameling or glazing; but for high-heat enameling or glazing the chains will preferably be dispensed with, and the tiles or other articles will be placed on thin fire-clay plates 14<sup>a</sup> in contact with one another and pushed or moved through the galleries by a screw. This latter plan of moving the tiles through the galleries is only made use of when the heat required is approximately that of the melting-point of cast-steel. Such a degree of heat is never, however, required for majolica or faience.

In the operation of the kiln the tiles or other wares are placed on the chains at one end of the kiln one by one and the chains moved the length of a tile, and after a suitable interval, which permits the tiles which have entered the kiln to be heated to some degree, other tiles are placed on the chains and the chains again moved to bring the fresh tiles into the galleries and advance to the length of one tile the tiles first introduced into the galleries. This manipulation is repeated at suitable intervals until the tiles first placed on the chains have reached the opposite end of the kiln, when they are in condition to be removed. It will be seen that the tiles when placed in the galleries 6 are gradually heated until they reach those portions of the galleries that pass through the heating-flues and in which they are subjected to an intense heat during the period required to move the tiles through those portions of the galleries surrounded by such heating-flues. As the tiles are moved out of the intensely-heated portions of the galleries they pass farther and farther away from the intense heat and gradually become reduced in temperature, so that they are in condition to be removed from the kiln when they reach the ends of the galleries opposite the ends at which they were entered.

When the kiln is in operation and the length of each gallery or oven is about twenty-five feet, the chain may be moved on an average six inches every fifteen minutes. Thus when the kiln is filled to its capacity a tile may be removed from each of the galleries once in fifteen minutes. The output of the kiln will therefore exceed five hundred tiles or pieces in twenty-four hours.

The numeral 16 indicates doors adapted to be opened as occasion may require to inspect the progress of the operation of the kiln.

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

1. In a kiln for enameling or glazing tiles, &c., the combination with a series of galleries or ovens, of chambers arranged transversely



of said galleries with the galleries extending through said chambers, fire-flues traversing said chambers above and below the galleries, the flues above and below being connected so  
5 that the hot products from the furnaces pass under the galleries then over the same in reverse direction, and furnaces in communication with the fire-flues, substantially as set forth.

10 2. In a kiln for enameling or glazing tiles, the combination with a series of galleries or ovens and chambers arranged transversely of the galleries with the galleries extending through said chambers, fire-flues traversing  
15 said chambers above and below the galleries, the flues above and below being connected so that the hot products from the furnaces pass under the galleries then over the same in reverse direction, furnaces communicating with  
20 said fire-flues, and endless chains adapted to carry the tiles through the galleries and to be moved intermittently.

3. The combination with the galleries 6, lined with fire-brick, of passages arranged  
25 transversely of said galleries at an equal distance from their ends, with the galleries passing through said passages, a series of fire-flues 8, 8<sup>c</sup> within said passages below the galleries, a series of fire-flues 8<sup>a</sup>, 8<sup>b</sup> also within  
30 said passages and above the galleries, com-

partments 11, 12 within said passages and in communication with said fire-flues, furnaces at each end of said passages and in communication with said fire-flues, so that the hot products from the furnace pass successively 35 below and above galleries 6, whereby intense heat is produced economically in said galleries, and the chimney 10, substantially as set forth.

4. The combination with the galleries 6, 40 lined with fire-brick, of passages arranged transversely of said galleries at an equal distance from their ends, with the galleries passing through said passages, a series of fire-flues 8, 8<sup>c</sup> within said passages below the gal- 45 leries, a series of fire-flues 8<sup>a</sup>, 8<sup>b</sup> also within said passages and above the galleries, compartments 11, 12 within said passages and in communication with said fire-flues, furnaces at each end of said passages and in commu- 50 nication with said fire-flues, iron doors at the ends of the galleries provided with asbestos curtains, and a chimney 10, substantially as set forth.

Signed at New York, N. Y., this 12th day 55 of May, 1899.

RAFAEL GUASTAVINO.

Witnesses:

J. E. M. BOWEN,  
M. C. PINCKNEY.