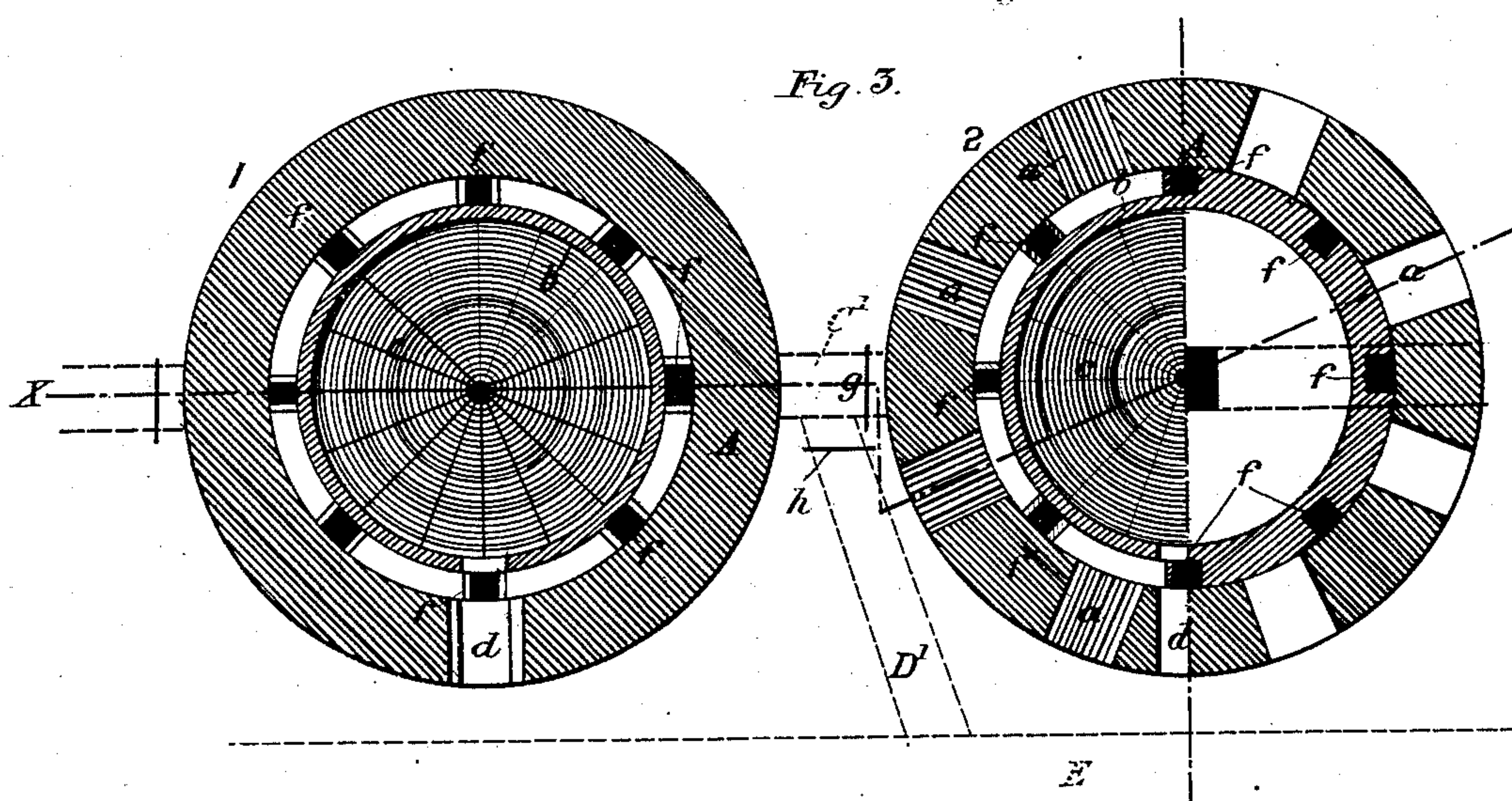
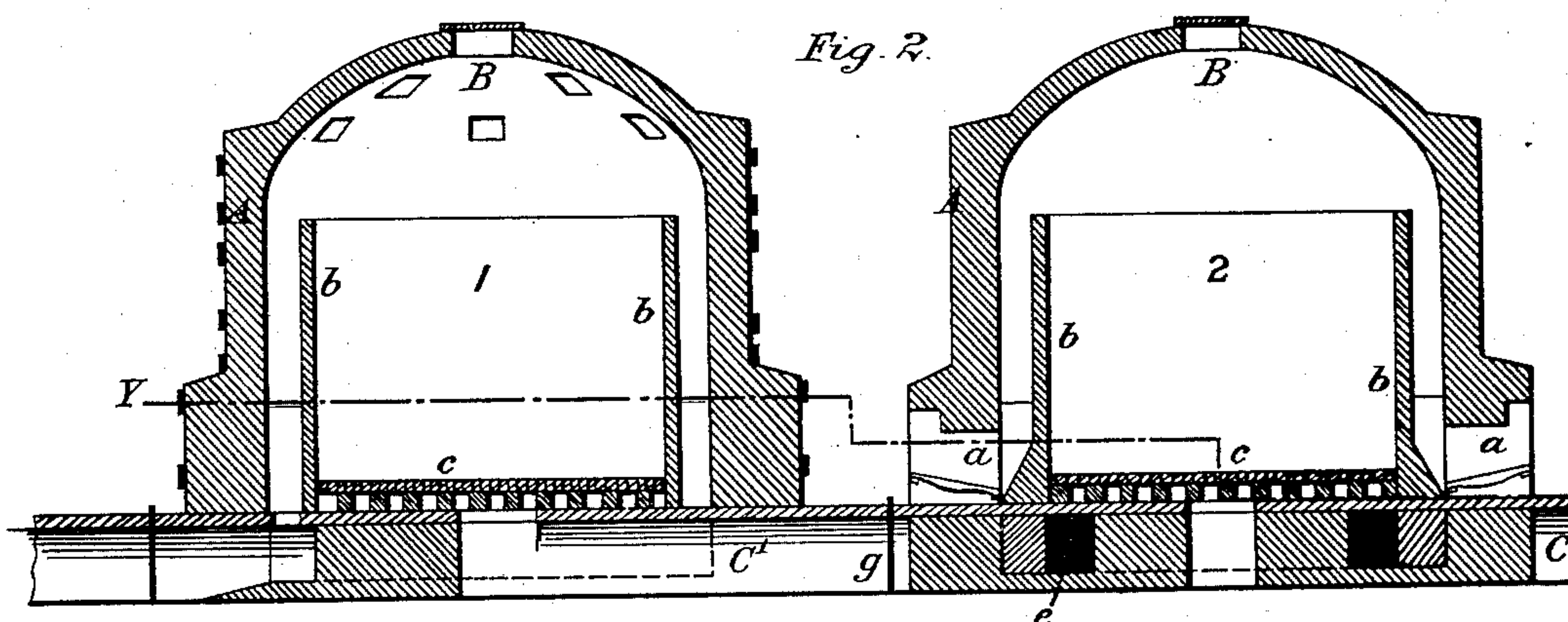
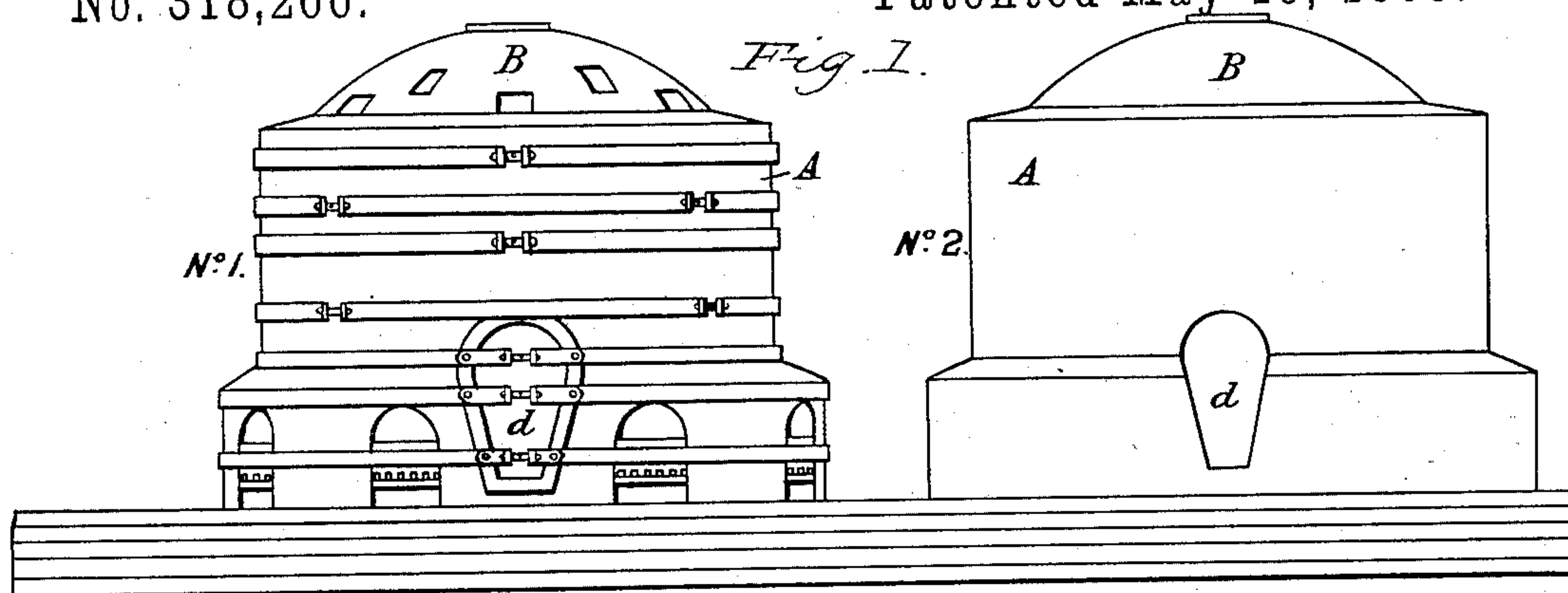


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OVEN OR DETACHED KILN FOR BURNING BRICKS, POTTERY WARE, &c.

No. 318,266.

Patented May 19, 1885.



Witnesses:  
John E. Parker,  
Henry Bossert.

Inventor:  
Henry Knowles,  
by his Attorneys,  
Hawson & Sons

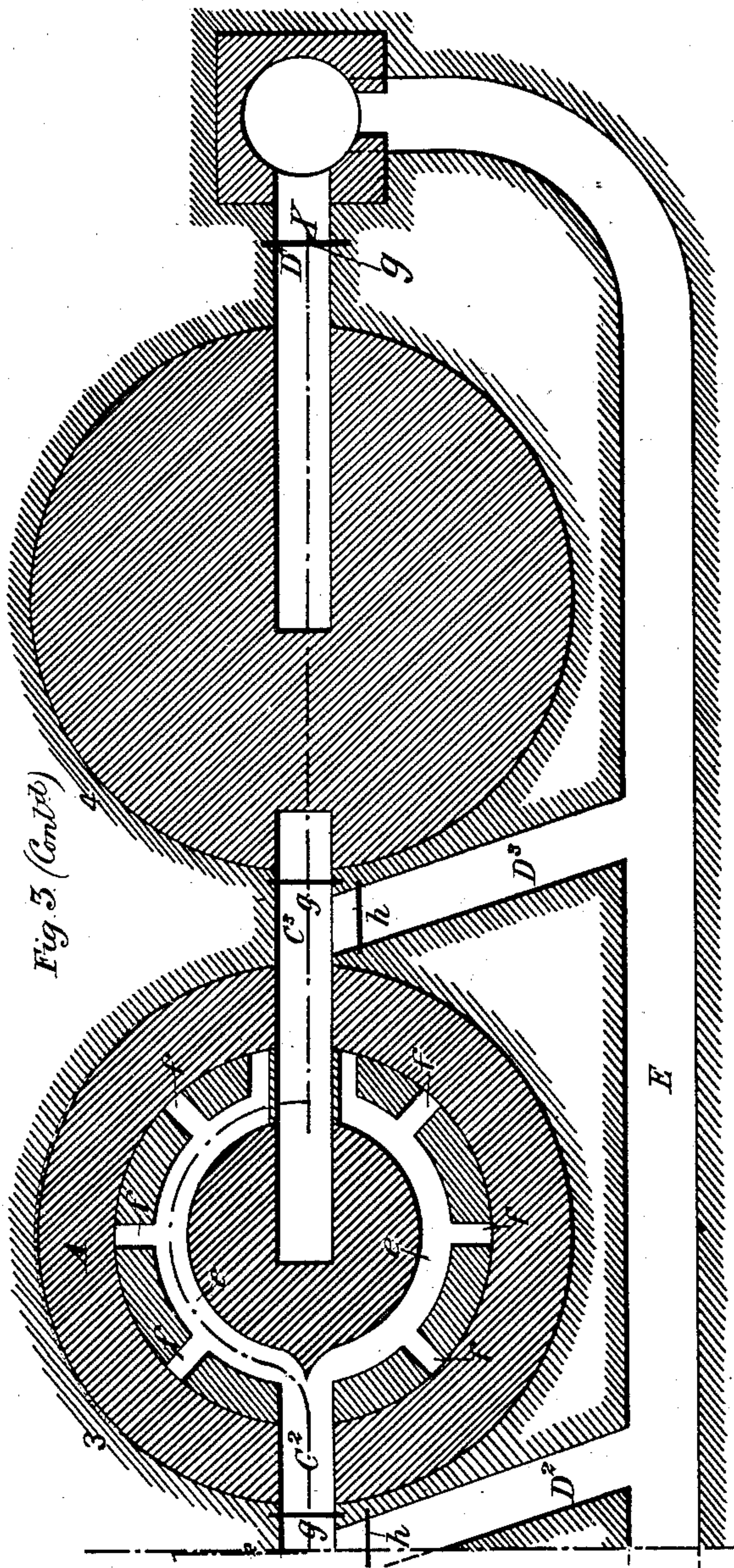
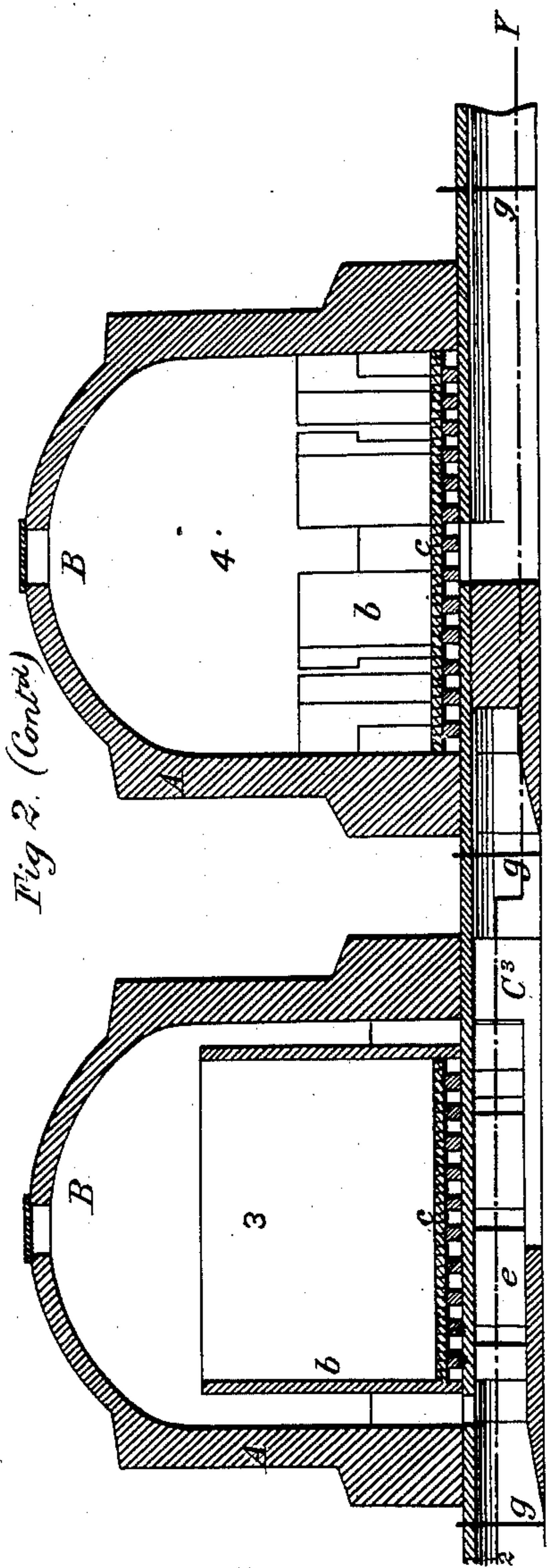


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(No Model.)

3 Sheets—Sheet 3.

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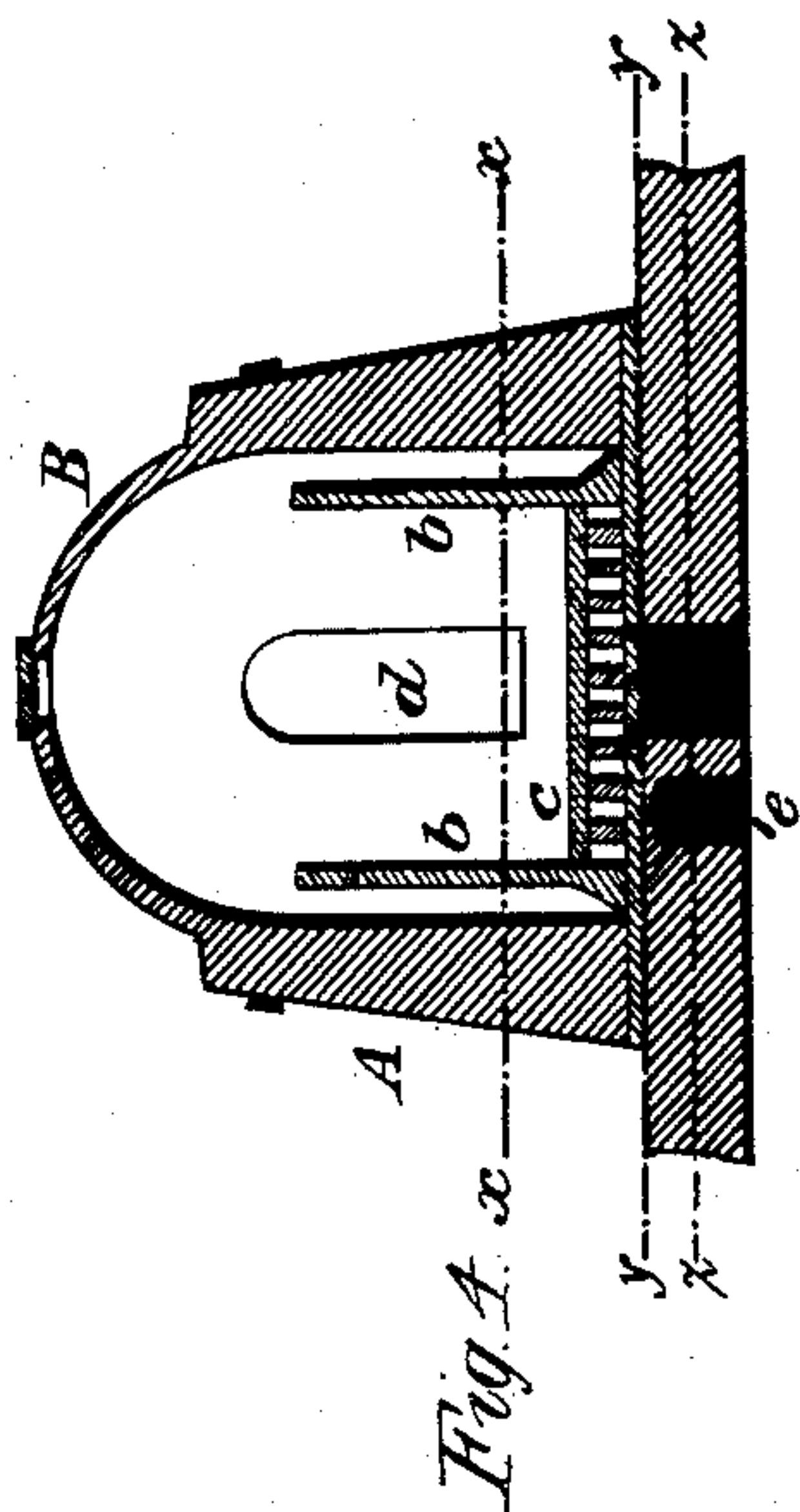
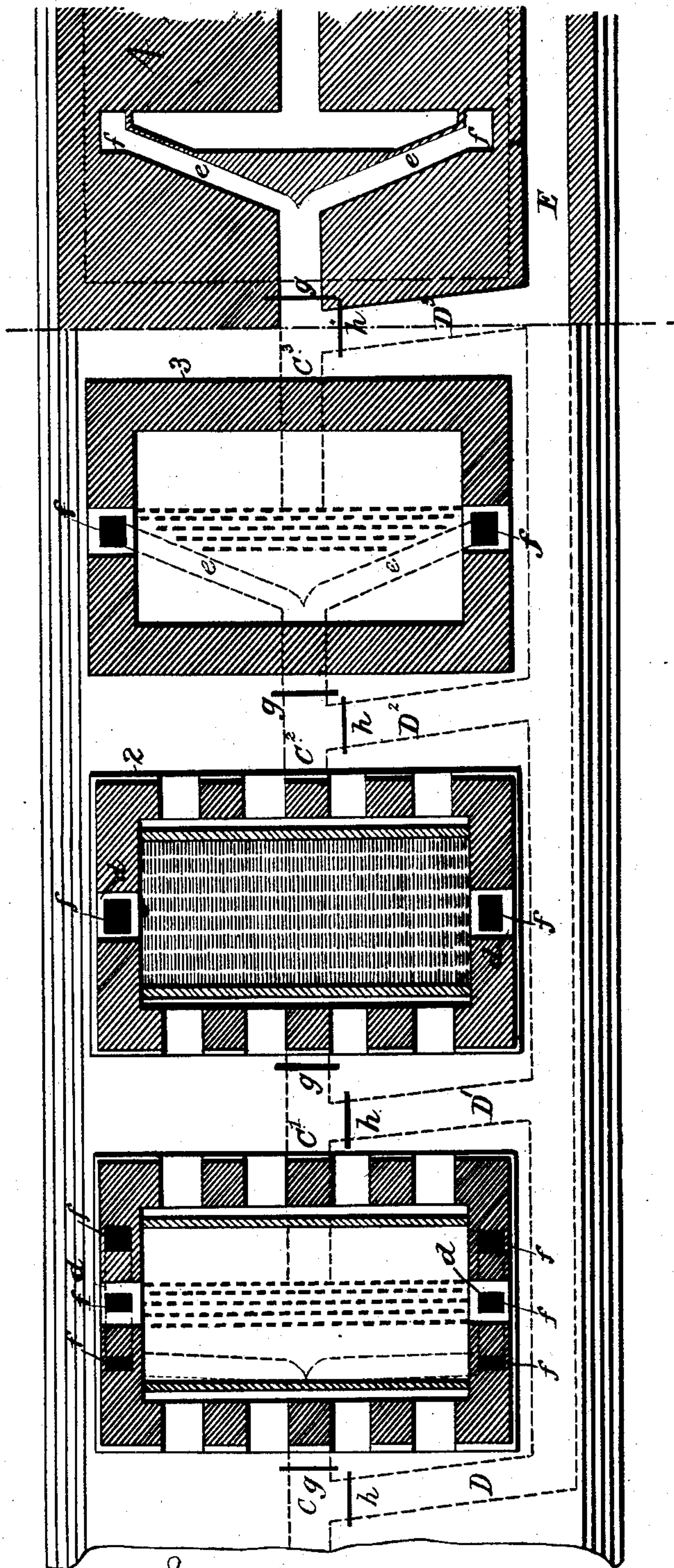


Fig. 5.



Witnesses.  
John E. Parker,  
Henry Bossert.

Inventor:  
Henry Knowles,  
by his Attorneys,  
Hosmer & Sons



# UNITED STATES PATENT OFFICE.

HENRY KNOWLES, OF WOODVILLE, COUNTY OF LEICESTER, ENGLAND.

OVEN OR DETACHED KILN FOR BURNING BRICKS, POTTERY-WARE, &c.

SPECIFICATION forming part of Letters Patent No. 318,266, dated May 19, 1885.

Application filed December 22, 1884. (No model.) Patented in England January 2, 1884, No. 352.

*To all whom it may concern:*

Be it known that I, HENRY KNOWLES, fire-brick and sanitary-pipe manufacturer, a subject of the Queen of Great Britain and Ireland, and residing at Albion Works, Woodville, in the county of Leicester, England, have invented certain Improvements in Ovens or Detached Kilns for Burning Bricks, Pottery-Ware, or Lime, or for other like Purposes, (for which I have obtained a patent in Great Britain No. 352, dated January 2, 1884,) of which the following is a specification.

My invention relates to improvements in the construction of ovens or detached kilns by which the waste heat issuing from one oven or kiln is conveyed to another, and thereby utilized in drying and burning bricks, tiles, pipes, terra-cotta, pottery, lime, or other articles and substances for which such ovens or kilns are applicable. It has for its object to secure greater economy in fuel and labor and more complete consumption of smoke than is possible in working the ovens or kilns separately; and to effect this in the most direct and simple manner, so that the continuous system of burning may be applied with advantage in working detached downdraft ovens or kilns without interfering with their efficiency when circumstances make it desirable or necessary to work them separately.

According to my invention I construct two or more detached ovens or kilns, round, square, or of other suitable shape, each having all the ordinary parts which are common to such ovens or kilns for working with a downdraft, the construction of the said parts depending on the class of goods to be burned. From the center or central flue of each oven or kiln I construct an outlet-flue direct to the next oven or kiln, and at the entrance to this last-named oven or kiln I divide the said outlet or connecting flue into two branch terminal flues, one leading to the right and the other to the left. In round ovens or kilns each of the branch flues is continued round the oven or kiln, either under the walls or inside the oven or kiln near to the wall, and to a point near to the line or side walls of the outlet-flue of the oven or kiln, where it terminates, and out of the branch flues in round ovens or kilns, I make openings or outlets between each fire-hole for the passage of the heat and products

of combustion from the said branch flues into the oven or kiln, and I vary the size of the said openings, making those nearest the junction or entrance to the oven or kiln the smallest, gradually increasing the size of the said openings to the end of the flues, making those at the end the largest, so that the heat absorbed or lost in passing along the flues is compensated for by the provision of larger outlets as they approach the end of the flues for the passage of greater volume, by which the heat of the oven or kiln is uniformly maintained throughout its interior. In rectangular ovens or kilns I make the branch flues lead directly to flues in the "dead" ends of the oven or kiln, where there are no fire-holes, and there make at each of the said dead ends one or more outlets opening into the oven or kiln, so that the heat and products of combustion issuing from the end of each of these flues pass through the goods from both ends of the oven or kiln and meet in the center, where they enter the outlet-flue of the oven or kiln and are conducted either into the next oven or kiln or to the chimney. Out of each connecting-flue I construct a branch flue communicating with the main flue leading to the chimney. Both the connecting and branch flues of each oven or kiln are provided with a damper common to both (or separate dampers may be employed, if preferred) for regulating the heat as it passes from one oven or kiln to another oven or kiln, or to cut it off when necessary.

By this improved combination of flues and dampers, arranged as described, and made to operate in working detached oven or kilns, I am enabled to utilize more effectually than hitherto the waste or surplus heat issuing from a detached oven or kiln by conducting it into the next or adjacent one thereby securing great economy in fuel and labor and the consumption of smoke, while maintaining the full efficiency of the ovens or kilns in burning the best quality of goods when worked either separately or in connection with each other.

In order that my said invention may be fully understood, I shall now proceed more particularly to describe the same, and for that purpose shall refer to the several figures on the annexed drawings, the same letters of reference indicating corresponding parts in all the figures.



Figure 1 represents in elevation four round ovens or kilns, showing the application of my invention thereto. Fig. 2 represents vertical sections of the same through the line X X in Fig. 3. Fig. 3 represents horizontal sections of the same through the line Y Y in Fig. 2. Fig. 4 is a vertical transverse section, and Fig. 5 is a horizontal section, showing the application of the invention to rectangular ovens or kilns.

Referring to the kilns shown in Figs. 1, 2, and 3, A A are the outer walls. B B are the arches or crowns. C' C<sup>2</sup> C<sup>3</sup> are the connecting-flues through which the surplus heat from one oven or kiln is passed to the next oven or kiln. The said flues are provided with dampers *g*.

D' D<sup>2</sup> D<sup>3</sup> D<sup>4</sup> are the branch flues leading into the main flue E, each being provided with dampers *h*.

Each oven or kiln has fire-places *a*, shield walls or "bags" *b*, perforated bottoms *c*, and doorways *d*, and branch terminal flues leading out of the connecting-flues C' C<sup>2</sup> C<sup>3</sup>, and having openings or outlets *f* of a capacity enlarging as they recede from the connecting-flues through which they receive the heat.

In working the kilns I charge No. 1 or the first oven or kiln of the series with goods. The doorways and openings are then closed and the burning is commenced in the ordinary way, and the dampers *g* in the connecting-flue C' is closed, and the damper *h* in the branch flue D' is opened for the passage of the steam or vapor from the green goods through the perforated bottom of the oven or kiln, and thence by the flues C' and D' into the main flue E, and thence to the chimney. The next oven or kiln No. 2 is meanwhile being charged with goods, and when it is charged the doorways and all other openings thereof are closed to exclude cold air, and the damper *g* in the connecting-flue C<sup>2</sup> is closed. When the steam or vapor from the goods in No. 1 oven or kiln has all been driven off, the damper *h* in the branch flue D' is closed, and the damper *g* in the connecting-flue C' is opened, so that the surplus heat from No. 1 oven or kiln passes direct into No. 2 oven or kiln, and is utilized in drying and burning the goods in the same, the damper *h* in the branch flue D<sup>2</sup> being opened for the passage of the steam or vapor from No. 2 oven or kiln to the main flue and thence to the chimney. The same process is repeated in No. 3 oven or kiln, and then in No. 4 oven or kiln, the surplus heat from No. 2 being utilized in drying and burning the goods in No. 3, and the surplus heat from No. 3 being utilized in drying and burning the goods in No. 4, and so on through any number of ovens or kilns that there may be in the series. The whole of the kilns Nos. 1, 2, 3, and 4 are now in operation, No. 1 being on full fire and Nos. 2 and 3 at different stages toward full fire, and No. 4 drying. The fires have been lighted only in No. 1 oven or kiln, the surplus heat from which has been utilized by be-

ing made to pass successively through the ovens or kilns Nos. 2, 3, and 4, so that while the fires have been lighted and are burning in one kiln only, the drying and burning has been proceeding at different stages in the whole of the kilns of the series. The doorways and fire-holes of Nos. 2, 3, and 4 are all closed to exclude cold air, and the dampers *h* in the branch flues D' D<sup>2</sup> D<sup>3</sup> are all closed to avoid loss of heat, and the dampers *g* in the connecting-flues C' C<sup>2</sup> C<sup>3</sup> are all open for the free passage of the surplus heat from oven or kiln to oven or kiln, the only damper open being that in the flue D<sup>4</sup>, through which the steam or vapor from No. 4 oven or kiln is passing to the chimney. When the burning of the goods in No. 1 oven or kiln is completed and all or practically all the surplus heat thereof has been utilized by passing it into No. 2 oven or kiln, the connection between these two ovens or kilns is cut off by closing the damper *g* in the connecting-flue C', and No. 1 oven or kiln is allowed to cool. When No. 2 oven or kiln has received from No. 1 all the heat it is possible to utilize, the fire-holes of No. 2 are opened and the fires made up to complete the burning in that oven or kiln. After the burning in No. 2 oven or kiln is completed and practically all the surplus heat from it has been utilized by passing it into No. 3 oven or kiln, the connection between these two kilns is cut off by closing the damper *g* in the connecting-flue C<sup>2</sup> in the same manner as before described with regard to the other oven or kiln, and the fire-holes in No. 3 are opened and the fires made up to complete the burning in that oven or kiln. The same process is carried on with No. 4 oven or kiln, and similarly through any number of kilns which there may be in a series.

Referring to Figs. 4 and 5, showing the application of my invention to rectangular ovens or kilns, it will be seen that the flues, passages, and dampers are arranged substantially after the same manner as explained with regard to Figs. 1, 2, and 3, and corresponding parts are marked with the same letters of reference. The sections of the three ovens or kilns 2, 3, and 4, (shown in Fig. 5,) are taken, respectively, on different lines shown in Fig. 4, No. 2 being taken on the line *x x*, No. 3 on the line *y y*, and No. 4 on the line *z z*.

The connecting-flues C' C<sup>2</sup> C<sup>3</sup> lead into branch flues *e*, each of which lead direct into one or more flues or outlets, *f*, in the dead ends of the oven or kiln, and these lead up the walls, as shown in No. 1 oven or kiln, and terminate in outlets, preferably toward the upper part of the said walls, or each branch flue may terminate in a single flue or outlet passing into the doorway of the oven or kiln, as at Nos. 2 and 3. The heated air and products of combustion pass through the perforated floor and connecting-flues in substantially the same way as described with regard to the ovens or kilns, Figs. 1, 2, and 3.

My invention is applicable to all kinds of



detached ovens or kilns, round, square, or of other shape, which are worked with a down-draft, and they may be placed either in a straight line or otherwise. When erecting  
5 new works, I prefer to arrange the ovens or kilns in a straight line at regular distances apart, as shown in the drawings.

When the improvements are applied to ovens or kilns of existing works, and where  
10 such ovens or kilns do not stand in regular order and are too far apart from each other to be easily connected, it will be advisable to erect other ovens or kilns between them where the intermediate space is sufficient to admit of  
15 this being done, so that the connecting-flues may be made as short as possible to avoid loss of heat and interference with the draft, which would result from heated products of combustion having to pass through long flues.

Where existing kilns do not stand near enough in line to be readily connected with one direct flue, it will be advisable in some cases to make use of the existing outlet-flues, either by continuing them to the next kiln as  
25 connecting-flues or as branch flues to the main flue, and constructing an independent connecting-flue from kiln to kiln; but generally I prefer to make only one outlet-flue from each kiln, and to take the branch flue out of this to  
30 the main flue, as shown in the drawings.

My invention can be applied to two or more ovens or kilns, and therefore is applicable to small works in districts, where the trade is limited, as well as to large manufactories,  
35 where the trade is extensive, and new ovens or kilns may be added to the series at any time when an increasing trade may make it necessary.

Where the chimney is not large enough to  
40 work a series of kilns, the draft may be increased by using an exhaust-fan in connection with the main flue.

To insure the fullest economy in fuel and labor and the consumption of smoke it is essential that a powerful draft be maintained to  
45 draw freely through the series of ovens or kilns in operation, which draft, by promoting rapid combustion, accelerates the burning, thereby saving time and enabling a better quality of goods to be produced with a mini-  
50 mum of loss.

It will be observed that the improvements constituting this invention are such as not to interfere with the working of the kilns or ovens separately when circumstances make it  
55 advisable or necessary to do so, as in the case of repairs or slackness of trade.

I claim as my invention—

1. The combination of adjoining ovens or kilns and branch and main flues leading to the  
60 chimney, with connecting-flues between the ovens or kilns, and branch terminal flues *e*, leading from the connecting-flue up into the oven or kiln, substantially as set forth.

2. The combination of adjoining ovens or  
65 kilns and branch and main flues leading to the chimney, with connecting-flues between the ovens or kilns, and branch terminal flues *e*, having outlets varying in size, substantially  
70 as described.

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

HENRY KNOWLES.

Witnesses:

GEO. W. REYNOLDS,  
4 Belvoir Terrace, Normanton Road, Derby,  
J. W. ROWBOTHAM,  
15 Newland Street, Derby,  
Clerks with Messrs. Moody & Woolley, Solicitors,  
Derby.