

(No Model.)

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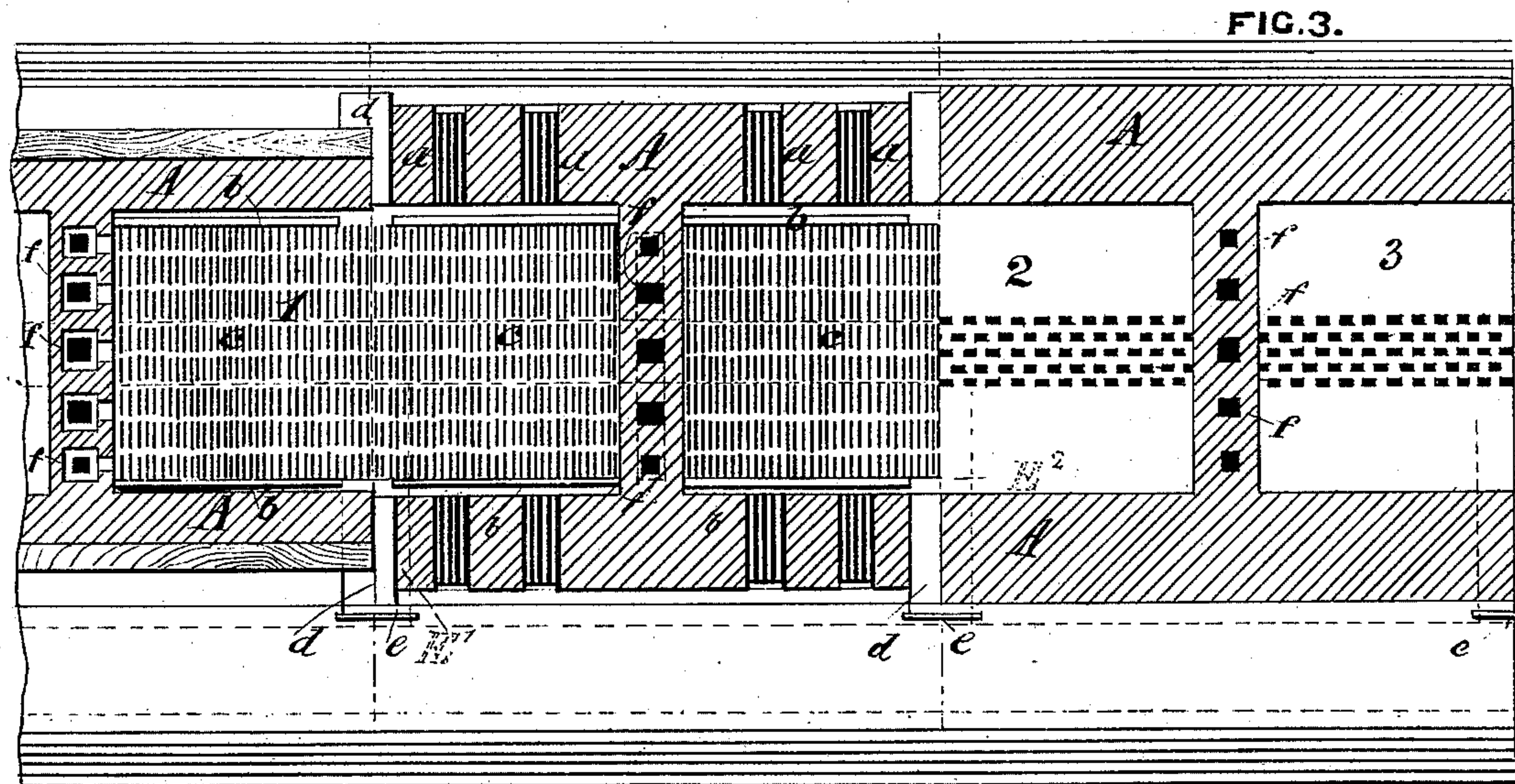
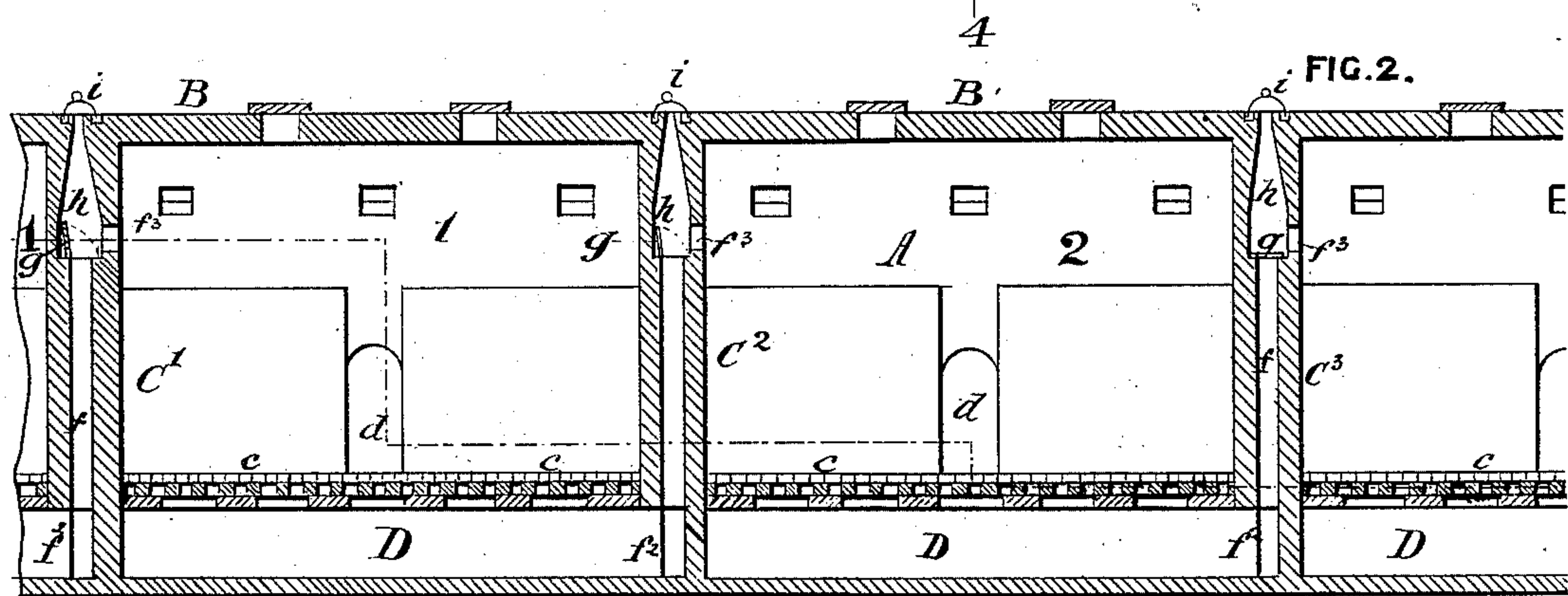
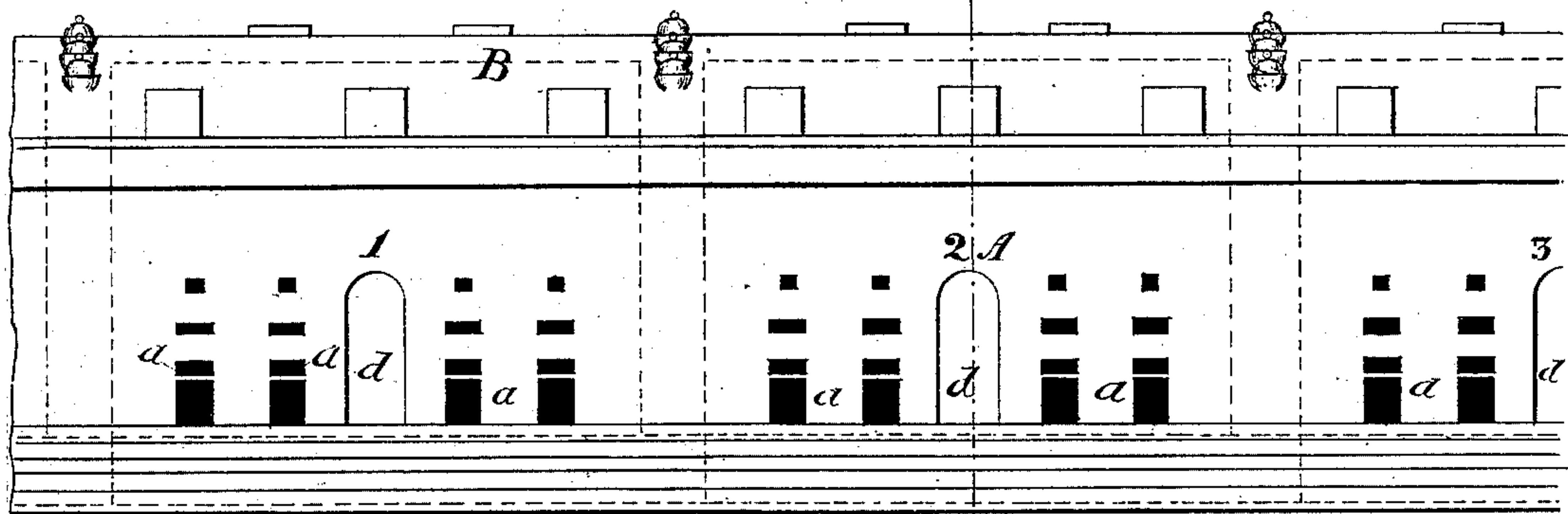
H. KNOWLES.

KILN FOR BURNING BRICKS, &c.

No. 302,413.

Patented July 22, 1884.

FIG. 1.



Witnesses:
Harry L. Ashenfelter
David Williams

Inventor:
Henry Knowles
by His Attorneys
Howson & Sons

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FIG. 1. *cont'd*

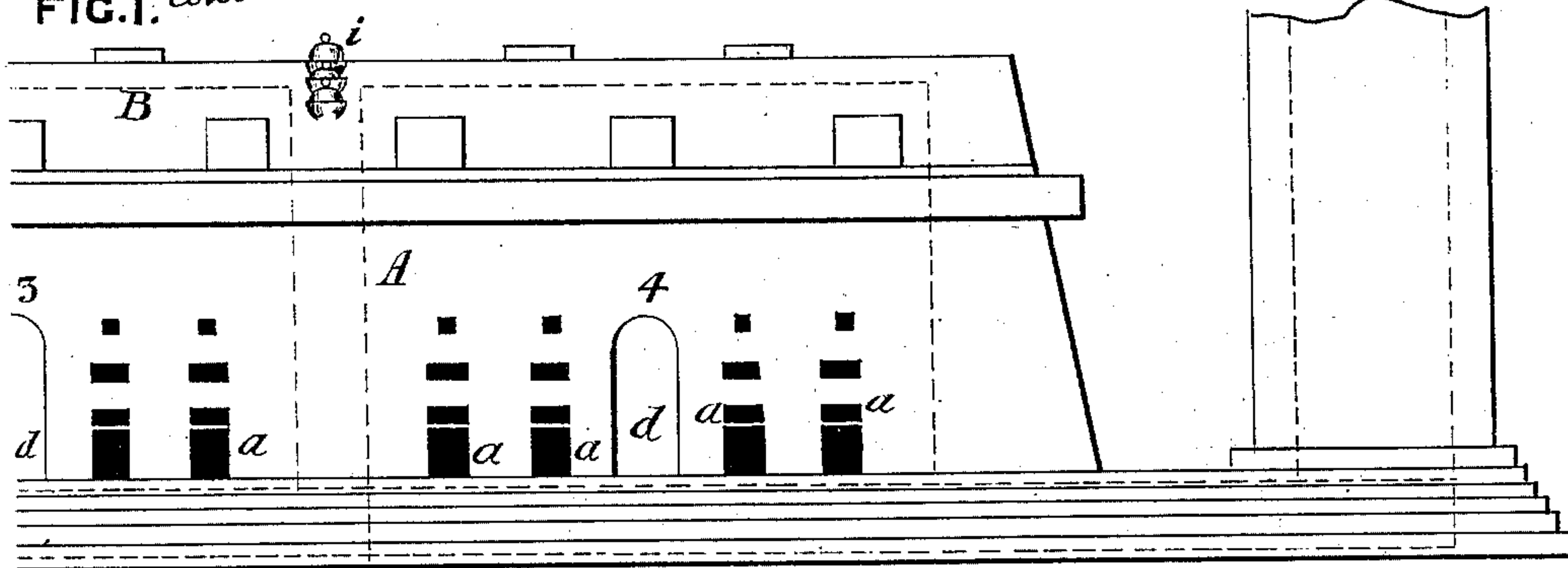


FIG. 2. *cont'd*

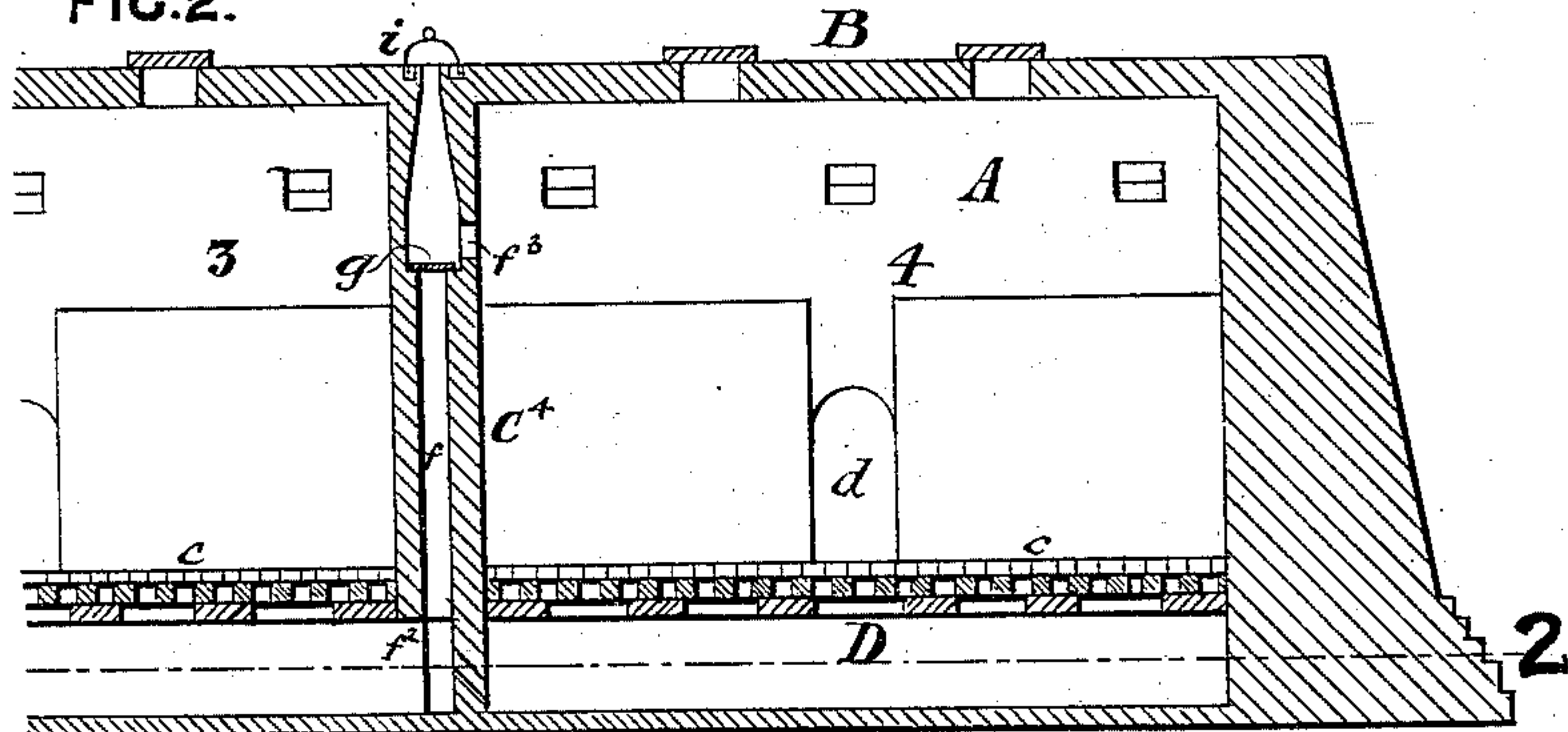
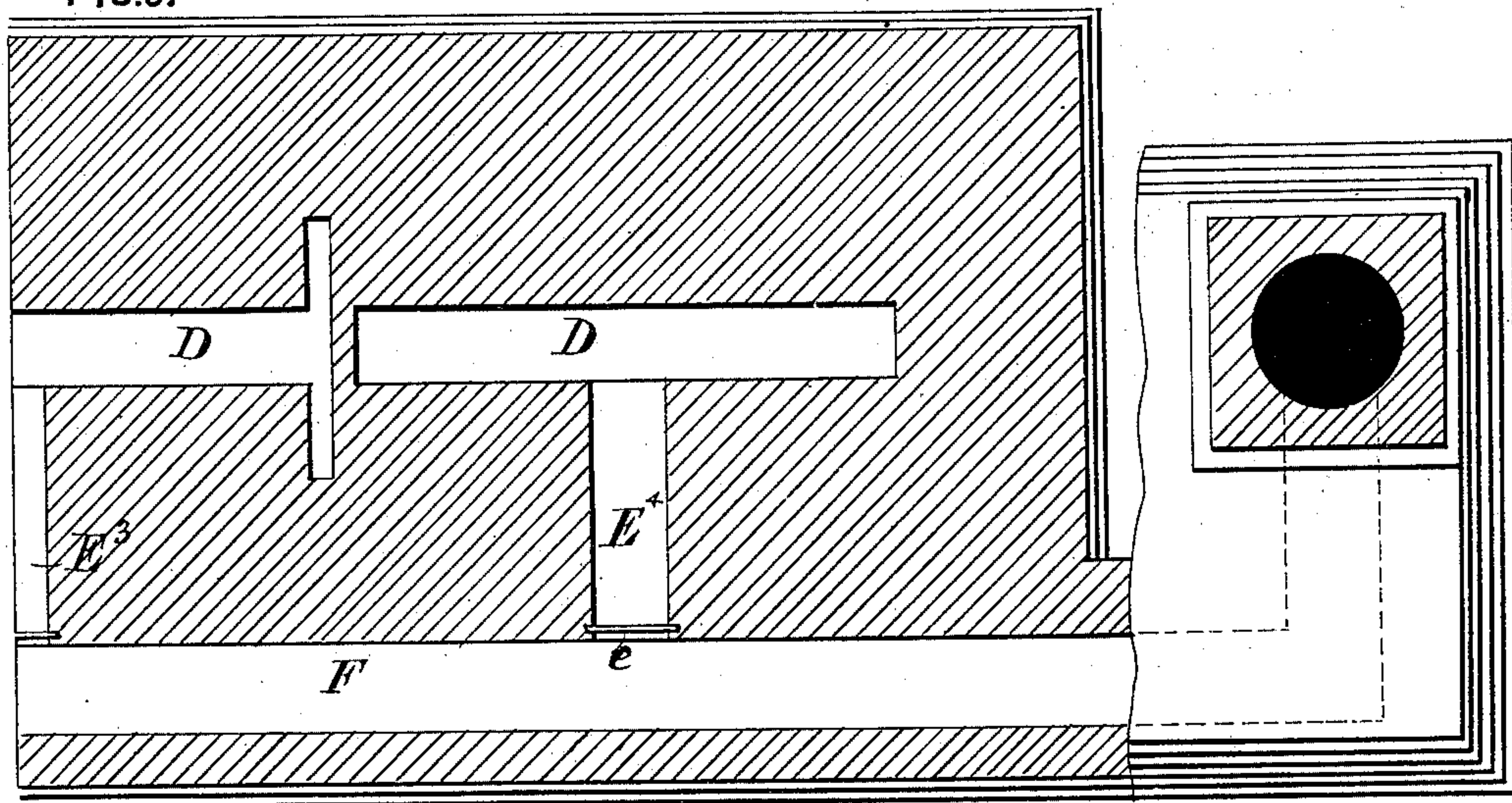


FIG. 3. *Cont'd*



Witnesses:

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Inventor:

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(No Model.)

3 Sheets—Sheet 3.

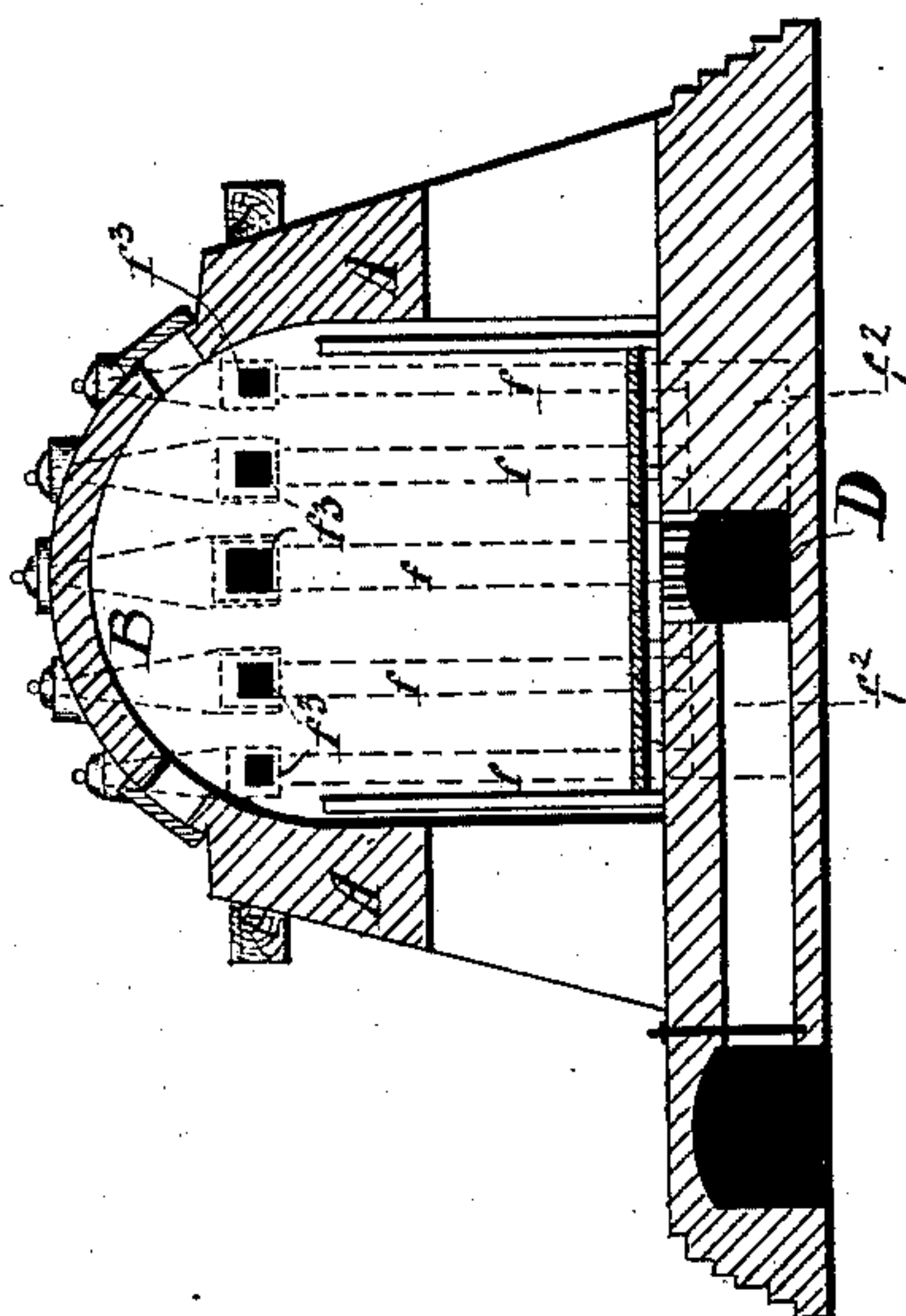
H. KNOWLES.

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FIG. 4.



Witnesses:
David S. Williams
Harry L. Ashenfelter.

Inventor:
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Howe & Sons

UNITED STATES PATENT OFFICE.

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

KILN FOR BURNING BRICKS, &c.

SPECIFICATION forming part of Letters Patent No. 302,413, dated July 22, 1884.

Application filed August 6, 1883. (No model.) Patented in England December 27, 1882, No. 6,172.

To all whom it may concern:

Be it known that I, HENRY KNOWLES, a subject of the Queen of Great Britain, and residing in Woodville, county of Leicester, England, and carrying on business at the Albion Works, Woodville aforesaid, have invented certain Improvements in Kilns for Burning Bricks, Pottery-Ware, or Lime, or for other like purposes, (for which I have obtained a patent in Great Britain, No. 6,172, dated December 27, 1882,) of which the following is a specification.

My invention relates to improvements in the construction of continuous or semi-continuous action kilns for drying and burning bricks, tiles, pipes, terra-cotta, pottery, lime, and other articles and substances for which such kilns are applicable.

My said invention applies to down-draft kilns, and has for its object to give the burner or operator more effectual control over the working of the kilns in transmitting the heat from one chamber to the other, and to secure greater economy of fuel and labor and the consumption of smoke, and to effectually close the connection between the chambers when necessary.

In carrying my invention into effect, I construct a kiln having a series of chambers with or without outer fire-holes, and having the other parts which are common to such kilns, the construction depending on the class of goods to be burned. The chambers are separated from each other by a partition or division wall, in which I construct vertical flues having inlet-passages at the bottom of one side of the partition-wall, the said passages opening into one chamber, and outlet-passages at the upper part of the other side of the said wall opening into the adjoining chamber, through which flues and passages the waste heat and products of combustion from one chamber are conveyed to the other chamber and utilized in drying and burning the goods in the last-named chamber. The said flues are provided with dampers at the top or outlet part to regulate the heat as it passes from chamber to chamber, and to effectually cut it off and close the connection when necessary. In communication with and above the top of the said flues I form openings in the division-wall ex-

tending to the top thereof, through which openings I can regulate the flue-dampers. The said openings are provided with covers to effectually close them and exclude cold air when the flue-dampers have been regulated. They are also used to admit cold air to lower the temperature when necessary. The number and size of the flues can be varied according to circumstances. For example, when an intense heat is required, as in the burning of glazed sanitary pipes, it is advantageous to make the flues small, so that the partition-wall may not be too much weakened, and the dampers being correspondingly small, they are more easily manipulated and less liable to damage from the intense heat than they would be if they were larger. I also vary the size of the flues, for the better distribution of the heat as it passes from one chamber to the other, and also to assist the draft in those parts of the kiln where the greatest body of heat is required. When the kiln is built with the chambers in a straight line, I make the center flue of the series of flues in the division-walls the largest and gradually decrease the size of the flues on each side thereof to the outer or side walls of the kiln. When my invention is applied to an annular kiln, I prefer to make the flue which is situated next the outer wall the largest and gradually decrease the sizes of the flues to the inner wall of the kiln. The kiln may be divided by the partition-walls into any requisite number of chambers of any suitable size or form; but for convenience and regularity of working in burning glazed ware and the best quality of bricks, tiles, or the like, I prefer to arrange the chambers in a straight line, and with an equal number of fire-holes on each side and a doorway for charging on one side, and another for discharging on the opposite side, and also with the usual shield-walls, and with or without perforated bottoms, and with a central flue and an outlet-flue (provided with a damper) leading to the main flue and chimney. For burning common quality of bricks or the like, the fire-holes and shield-walls and perforated bottoms may be dispensed with and the burning be carried on through feed-holes in the crown, as in the Hoffman kiln.

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 sheet of drawings, the same letters of reference indicating corresponding parts in all the figures.

Figure 1 represents a side elevation of four chambers constituting a portion of a kiln constructed according to my invention, the said chambers being arranged in a straight line. Fig. 2 is a vertical section through the longitudinal center line, showing the center flue in the partition-wall with an inlet at bottom and an outlet at the upper part, and the openings extending from the said flues to the top, through which openings the flue-dampers are regulated. Fig. 3 is a horizontal section taken along the line 1 2, Fig. 2, showing the partition-walls with the flues, the shield-walls, fire-places, and doorways for charging and discharging, and the central and outlet flues of the chambers. Fig. 4 is a transverse section on the line 3 4, Fig. 1, showing the outlets of the flues at the upper part of the partition-wall.

A A are the outer walls of the kiln; B, the roof or crown; C' C² C³ C⁴, the division or partition walls separating the chambers, the four of which chambers shown are marked 1, 2, 3, and 4 in Fig. 2. The said division or partition walls have formed therein the hereinbefore-described flues and passages to convey the waste heat from one chamber to the other.

D are the central flues of the chambers. E' E² E³ E⁴ are branch flues from the chambers to the main flue F, leading to the chimney. Each chamber has fire-places *a*, shield-walls *b*, perforated bottoms *c*, and doorways *d*. The branch flues have dampers *e*. The flues *f* in the partition-walls have dampers *g*, and the openings *h* above the said flues have covers *i*. *f*² are the inlet-passages leading from the one chamber at the lower part of the partition-walls to the flues *f*, and *f*³ are the outlet-passages leading from the said flues *f* at the upper part of the partition-walls and openings into the next chamber.

In working the kiln, I first charge No. 1 chamber, being that farthest from the chimney, with green goods. The doorways and openings of the said chamber are then closed, the fires are lighted, and burning commenced in the ordinary way, the dampers *g* of the flues *f* in the division-walls being closed, so that the chamber is isolated from the other chambers, and the damper *e* in the branch flue E' is opened for the passage of the steam or vapor from the green goods into the main flue F, to be carried off by the chimney. The next or No. 2 chamber is meanwhile charged, and when it is charged the doorways and openings thereof are all closed to exclude cold air. The dampers *g* of the flues *f* in the division-wall C³ are also closed. When the vapor from the goods in No. 1 chamber has all been driven off, the damper *e* in the branch flue E' is closed, and the dampers *g* in the flues *f* in the di-

vision-wall C² are opened, so that the waste heat from No. 1 chamber passes direct through the connecting passages and flues *f*² *f* *f*³ into No. 2 chamber, and is utilized for drying and burning the goods in the same, the damper *e* in the branch flue E² being opened for the passage of the vapor from No. 2 chamber to the main flue and chimney. The same process is repeated in No. 3 chamber and then in No. 4 chamber, the waste heat from No. 2 being utilized in drying and burning No. 3, and that from No. 3 in drying and burning No. 4 chamber, and so on through any number of chambers in a series. The whole of the chambers Nos. 1, 2, 3, and 4, as shown in the drawings, are now in operation, No. 1 being on full fire, and Nos. 2 and 3 at different stages getting up, and No. 4 drying. It will be observed that fires have only been lighted in No. 1 chamber the waste heat from which is utilized by being made to pass successively through the chambers 2, 3, and 4, so that while the fires are only lighted or burning in one chamber the drying and burning is proceeding at different stages in the whole of the chambers 1, 2, 3, and 4, all the doorways and fire-holes of Nos. 2, 3, and 4 being closed, and the dampers *g* of the connecting-flues *f* *f* in the division-walls C² C³ C⁴ being all open for the free passage of the waste heat from chamber to chamber. All the dampers *e* in the branch flues E' E² E³ are closed, the only damper open in the branch flues being that in E⁴, through which the vapor from No. 4 chamber is passing to the main flue and chimney. When the burning of the goods in No. 1 chamber is completed and all the waste heat from which has been utilized by passing it into No. 2 chamber until the temperature of No. 2 chamber is equal, or nearly equal, to that of No. 1 chamber, the connection between the two chambers is cut off by closing (through the openings *h* *h*) the dampers *g* *g* in the connecting-flues *f* *f* in the division-wall C², and the covers *i* *i* are then replaced over the openings *h* *h*, the dampers *g* *g* and the covers *i* *i* being as effectually closed as possible by being embedded in or covered with sand or other suitable material. The burning of No. 1 chamber being completed and its connection with No. 2 chamber cut off, it is left to cool. After No. 2 chamber has received from No. 1 chamber all the heat that it is possible to utilize, and the connection between the two chambers has been cut off by closing the connecting-flues *f* in the division-wall C², the fire-holes of No. 2 chamber are opened and the fires made up to complete the burning. After the burning of No. 2 is completed and all the waste heat from it has been utilized by passing it into No. 3 chamber, the connection between the two chambers is cut off by closing the connecting-flues *f* in the division-wall C³ in the same manner as before described with regard to the other chamber, and then the fire-holes of No. 3 chamber are opened and the fires made up to complete the burning, as be-

fore. The same process is carried on with No. 4 chamber, and similarly through any number of chambers which there may be in a series.

5 In the Hoffman or other kiln in which only common bricks, lime, and the like are burned, the fire-holes, shield-walls, and perforated bottoms may be dispensed with and the firing be effected, in the ordinary way, through feed-holes
10 in the crown of the kiln. In kilns of this class the dampers in the connecting-flues in the partition-walls will merely require to be opened at the proper time after the chambers are successively charged and the doorways built up,
15 and the vapor from the preceding chamber has all been driven off to the chimney and the branch-flue damper closed and others opened in the order as hereinbefore described. After the burning is completed in the cham-
20 ber in full fire and all the heat it is possible to utilize has passed into the adjoining chamber, then the dampers of the connecting-flues are closed, and the chamber in which the burning is completed is left to cool, and so on
25 through any number of a series, or continuously if the kilns are annular.

My invention may be applied to annular or other shaped kilns having a partition or di-

vision wall in which the hereinbefore-described flues and passages can be constructed 30 and dampers be arranged in connection therewith substantially as hereinbefore described.

I claim as my invention—

1. In continuous or semi-continuous down-draft kilns, the combination of the separate 35 chambers divided from each other by partition-walls having vertical flues and passages of varying capacity formed therein, the said flues forming communications between the chambers, and being provided with dampers 40 *g*, all substantially as set forth.

2. In continuous or semi-continuous down-draft kilns, the combination of the flues *f*, passages *f*² *f*³, dampers *g*, openings *h*, covers *i*, and the flues leading to the chimney and 45 controlled by dampers, all substantially as described.

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

HENRY KNOWLES.

Witnesses:

C. B. HOBBS,

THOMAS RENSCHAW,

Both of 41 Norfolk Street, Sheffield, England,
Solicitor's Clerks.