

(No Model.)

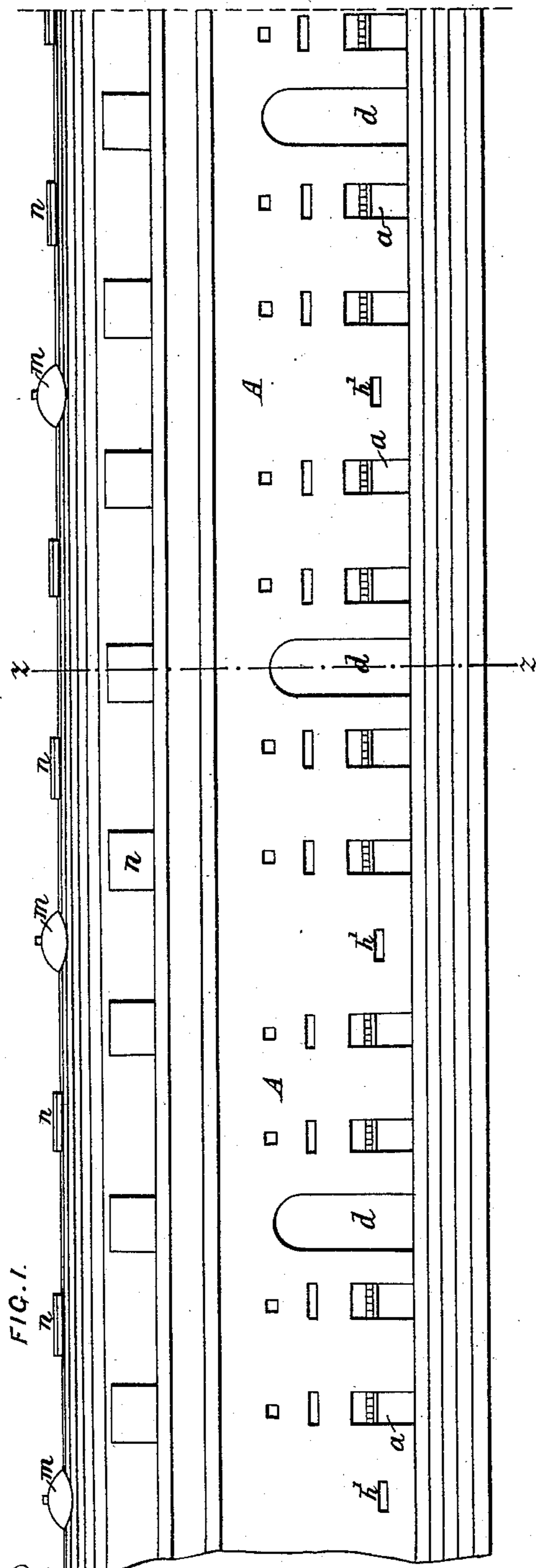
4 Sheets—Sheet 1.

H. KNOWLES.

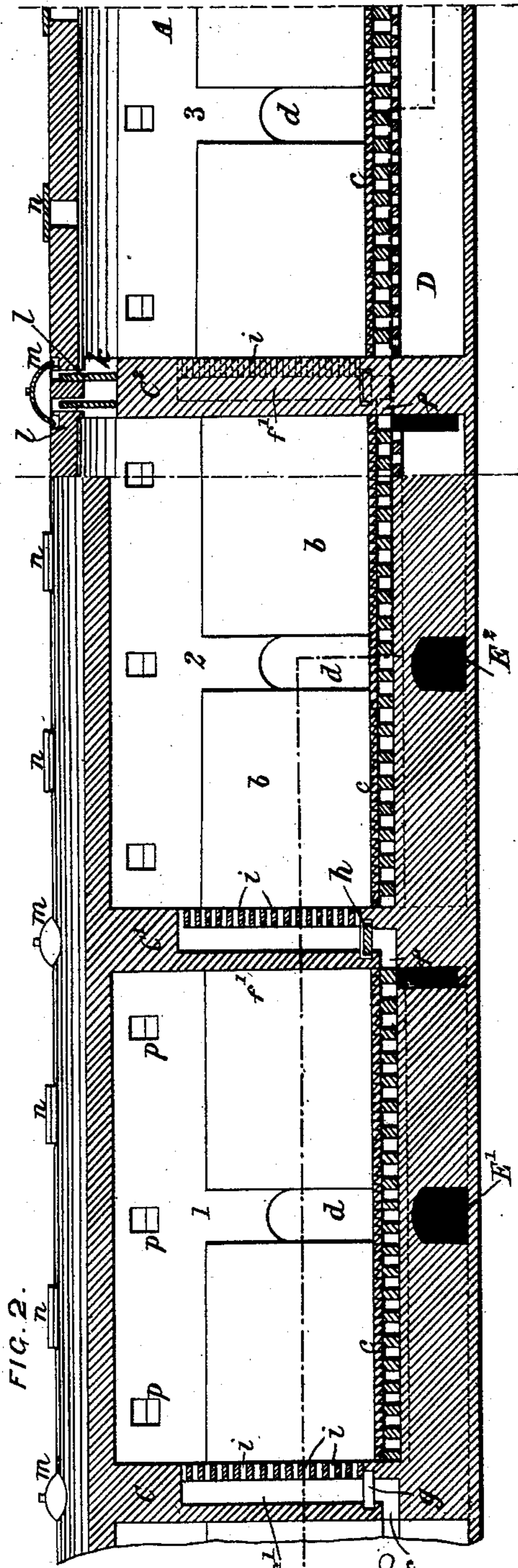
CONTINUOUS ACTION KILN FOR BURNING BRICKS, &c.

No. 318,265.

Patented May 19, 1885.



Witnesses:
John M. Clayton
Harry Drury



Inventor:
Henry Knowles
by his Attys.
Howell and Sons

(No Model.)

4 Sheets—Sheet 2.

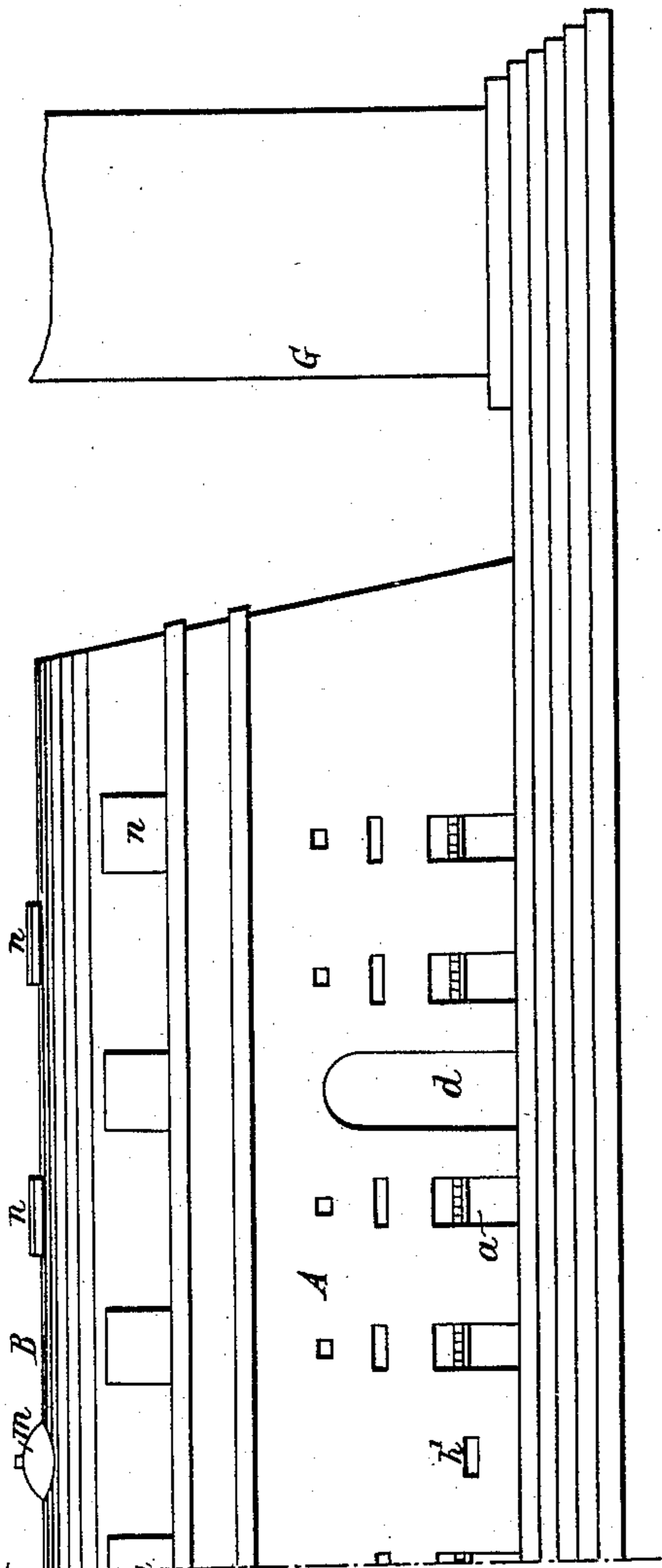
H. KNOWLES.

CONTINUOUS ACTION KILN FOR BURNING BRICKS, &c.

No. 318,265.

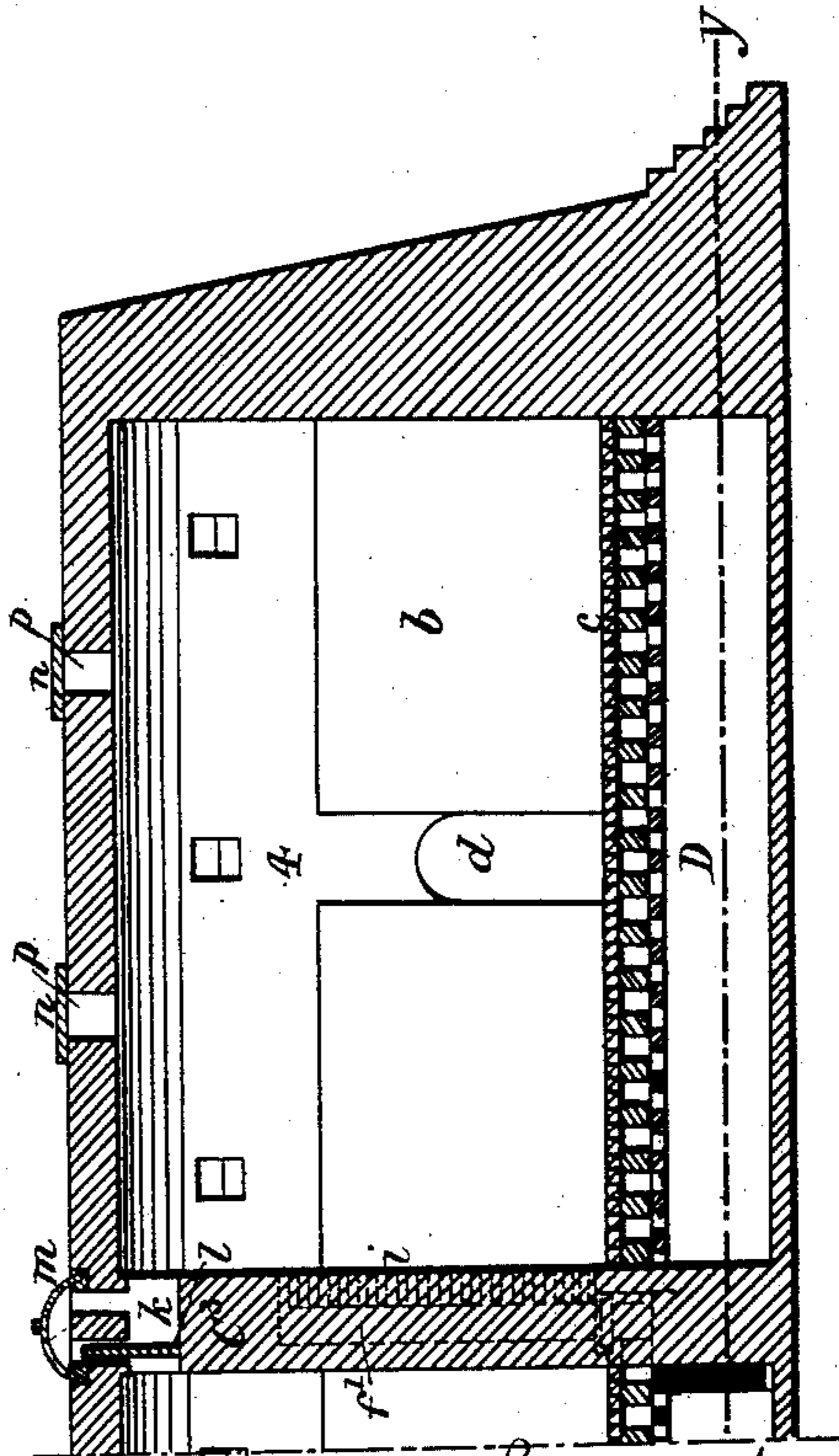
Patented May 19, 1885.

FIG. 1. (Cont'd.)



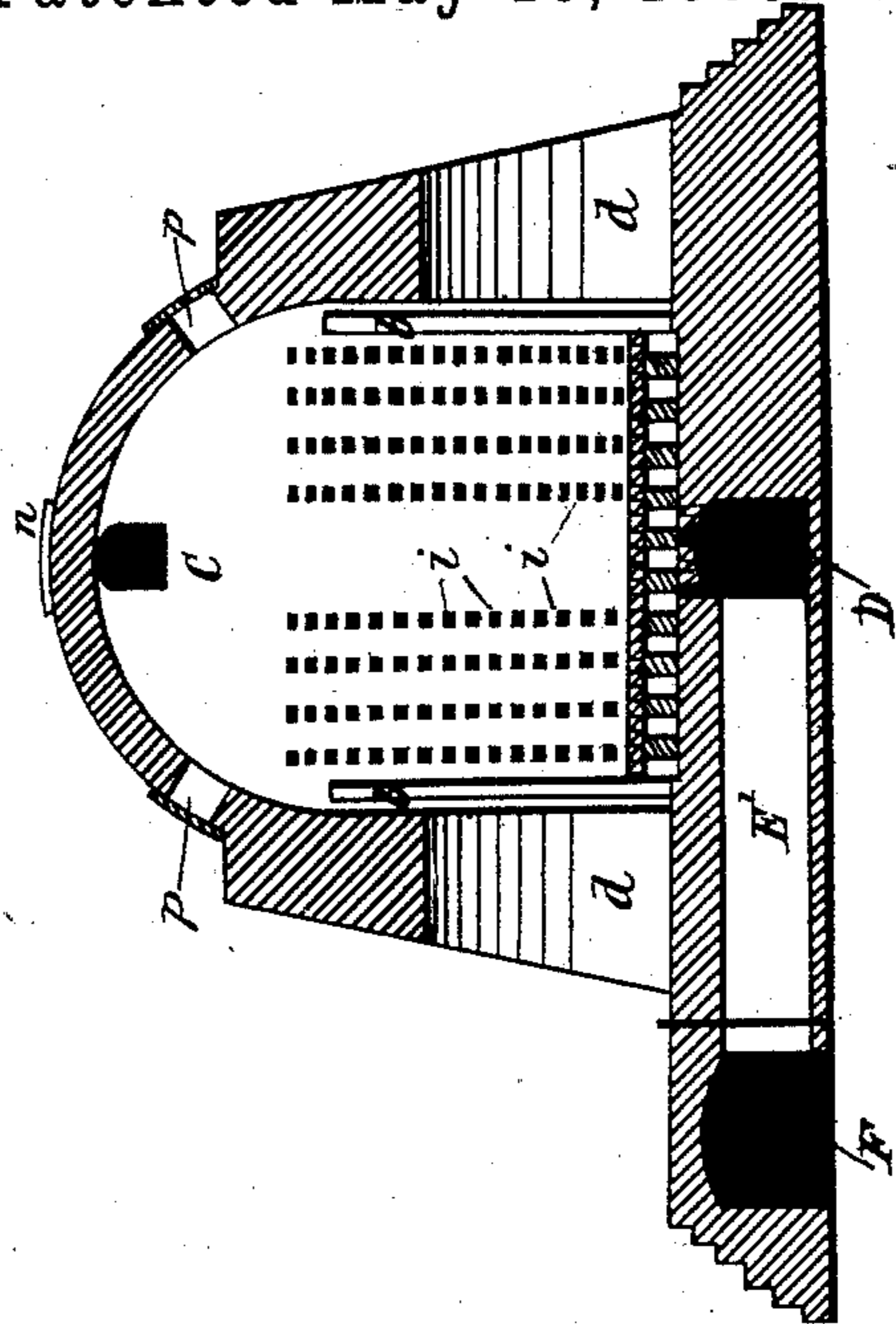
Witnesses:
John M. Clayton
Harry Drury

FIG. 2. (Cont'd.)



Inventor:
Henry Knowles
by his Attorneys
Howan and Co

FIG. 4.



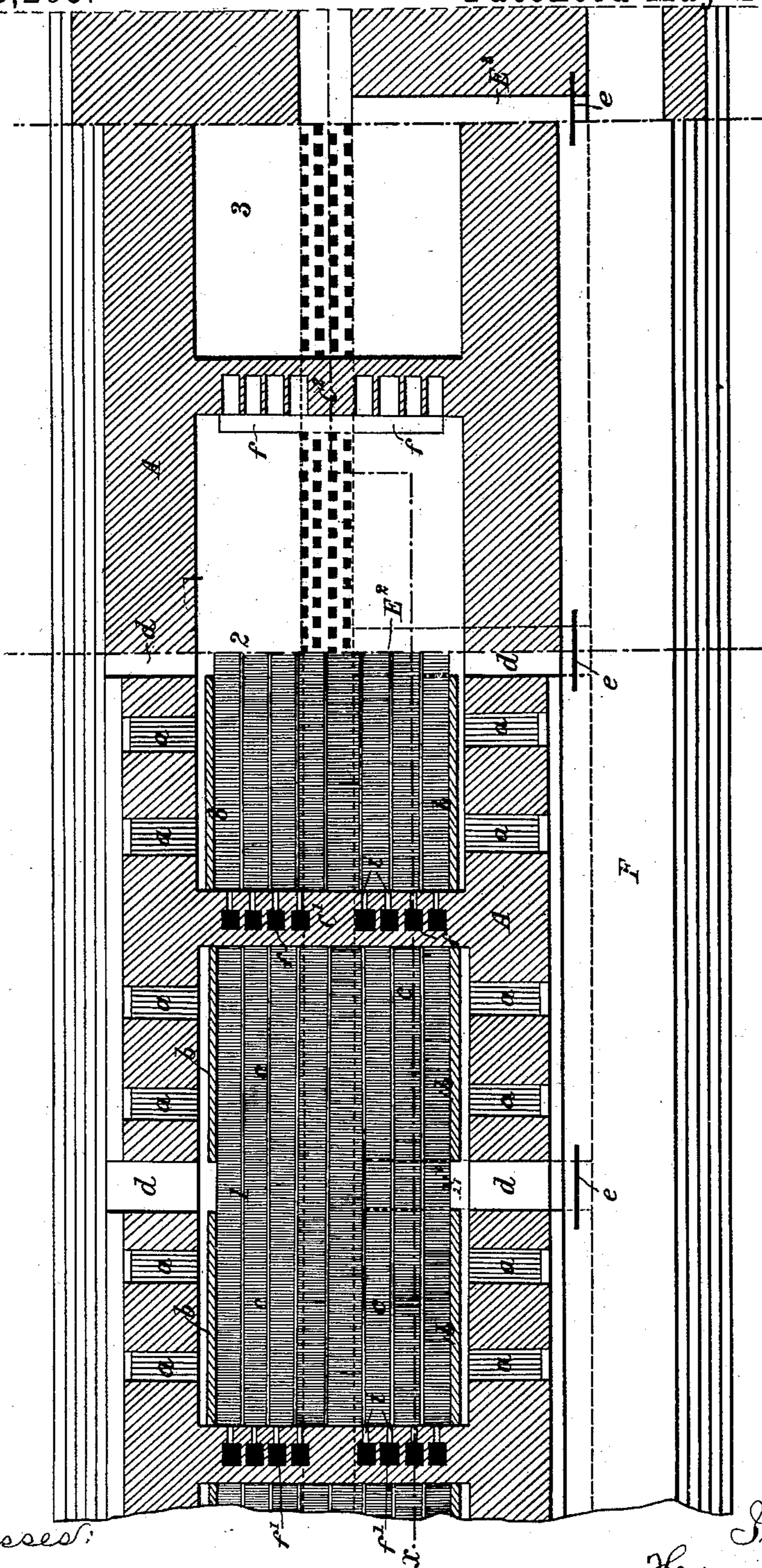
H. KNOWLES.

CONTINUOUS ACTION KILN FOR BURNING BRICKS, &c.

No. 318,265.

Patented May 19, 1885.

FIG. 3.



Witnesses:
John M. Clayton
Harry Drury

Inventor:
Henry Knowles
by his Attorneys
Horsman and Sons

(No Model.)

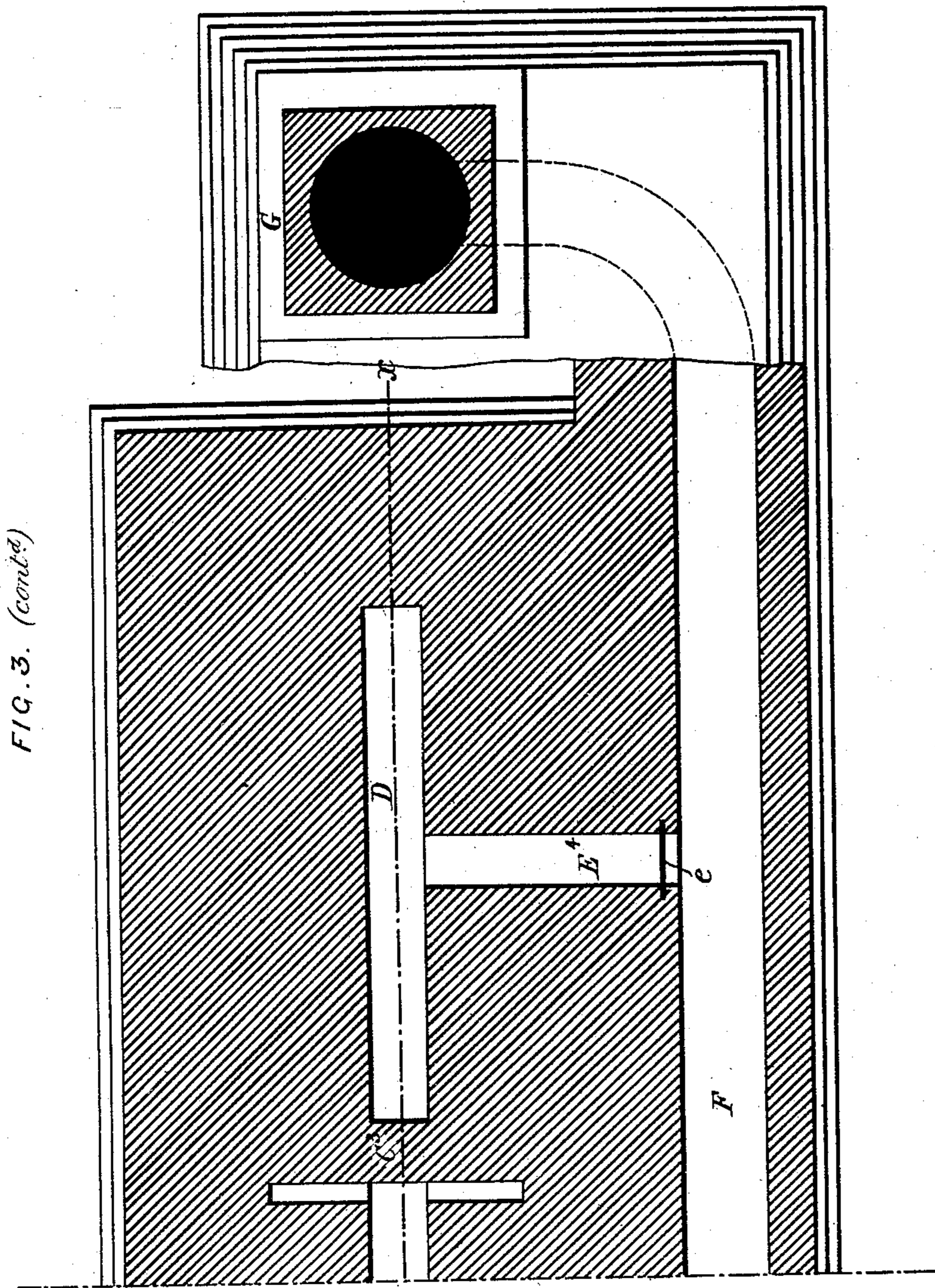
4 Sheets—Sheet 4.

H. KNOWLES.

CONTINUOUS ACTION KILN FOR BURNING BRICKS, &c.

No. 318,265.

Patented May 19, 1885.



Witnesses:
John M. Clayton
Harry Drury

Inventor:
Henry Knowles
by his Attorneys
Horsman and Sons

UNITED STATES PATENT OFFICE.

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

CONTINUOUS-ACTION KILN FOR BURNING BRICKS, &c.

SPECIFICATION forming part of Letters Patent No. 318,265, dated May 19, 1885.

Application filed October 20, 1884. (No model.) Patented in England January 2, 1884, No. 351.

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 Continuous and Semi-Continuous Action Kilns for Burning Bricks, Pottery-Ware, or Lime, or for other like Purposes, (for which I have obtained a patent in Great Britain, No. 351, dated January 2, 1884,) of which the following is a specification.

My invention relates to improvements in the construction of continuous and semi-continuous action kilns for drying and burning bricks, tiles, pipes, terra-cotta, pottery-ware, lime, and other like articles and substances for which such kilns are applicable, my present invention consisting of improvements on the kiln for which I obtained Letters Patent No. 302,413, July 22, 1884. It applies to down-draft kilns, and has for its objects to give increased facility in controlling the working of the kilns in transmitting the heat from one chamber to another, and to secure the consumption of smoke and greater economy in fuel and labor by passing the heat and products of combustion from chamber to chamber in as direct a manner as possible, and to enable the connection between the chambers to be effectually closed when necessary.

According to my invention 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 of these parts depending on the class of goods to be burned. The adjacent chambers of the kilns are separated from each other by improved partition-walls, at the bottom of which and on one side thereof I construct flues, which lead into damper-chambers formed in the said partition-walls near to the sides of the kiln, and provided with dampers worked from the outside of the kiln for effectually closing the flues when necessary. Above and leading out of the said damper-chambers I construct flues in the partition-walls near to the upper part of the same, and from each of these

last-named flues I make a series of openings or perforations through the walls into the next or receiving chamber for the passage of the heat and products of combustion issuing from the other or preceding chamber. The products of combustion, passing through the said flues and issuing from the said openings or perforations, heat the goods on each side of the chamber, and by radiation and diffusion also heat the center parts of the chamber. To give strength and stability to the partition-wall I make it solid in the central part from the base to the upper part, and at the upper portion of the solid part I make an opening or openings of any suitable size and form through the wall from chamber to chamber for the direct passage of the heat and products of combustion from chamber to chamber. These openings are each provided with one or more dampers, arranged, as hereinafter described, for effectually closing the same when necessary. They are used either in conjunction with the before-named flues or separately when desirable.

By the above improved combination of flues and openings provided with dampers arranged to operate and to be worked as may be desired, according to circumstances depending mainly on the class of goods to be burned, I am enabled to secure free and easy transmission of the heat and products of combustion from one chamber to the other, and to effect great economy in fuel and labor, and to consume the smoke, which is especially desirable in burning the best class of goods.

The kiln may be built of an annular or other form suitable for the class of goods for which it is to be employed, and it may be divided by the partition-walls into any desired number of chambers.

In kilns intended for burning glazed ware, and the best quality of bricks, tiles, and the like, I prefer to arrange the chambers in a straight line, each chamber having an equal number of fire-places on each side of the kiln, and a doorway for charging the chamber with green goods, and another doorway for discharging the goods when burned. I also provide the chambers with the usual shield walls

or bags, and with the necessary flues and dampers for conducting and regulating the passage of the products of combustion from one chamber to another and to the chimney.

5 The number and size of the flues in the partition-walls should be such that the collective capacity of the flues is sufficient to convey the whole of the products of combustion freely when the kiln is on "full fire," and the series
10 of openings or perforations leading from the said flues should be sufficient in number and size to insure the free passage of the products of combustion from one chamber into the next or receiving chamber. The dampers
15 should be fitted to slide freely over the flues which lead into the damper-chamber, and they should be sufficiently large to completely cover the said flues to close the connection between the chambers, sand or other suitable
20 material being employed, when necessary, to cover and close the joints as effectually as possible.

In burning goods which require very intense heat it will be in some cases advantageous to
25 have more than one opening or flue in the upper part of the partition-walls, each of less capacity than is required where one only is used, as when the flues are smaller and the dampers correspondingly small they are more
30 easily manipulated and less liable to damage.

In burning salt-glazed sanitary pipes or other similar goods, when the connection between the chambers is cut off it is important that the passage or passages or flue or flues in
35 the upper part of the partition-walls should be closed as completely as possible, and in order to effect this I use two dampers in each opening or flue arranged a short distance apart, and when both these dampers are closed
40 I fill the space between them with sand or other suitable material, so as to effectually close the passage between the chambers.

In burning fire-bricks or the like one damper only may be used for each opening or flue
45 in the upper part of the partition-wall, and I place the said damper in that part of the opening or flue nearest the chamber in which the burning is completed, and from which the heat passes, thereby leaving a space on the
50 opposite side of the damper sufficient to serve as a fire-place for burning fuel to assist the burning of the goods in the adjacent chamber. I admit the fuel to this fire-place through a feed-hole at the top of the kiln, provided with
55 a suitable cover, which in this and also in the case where two dampers are used serves as the means of closing over the openings through which the dampers are worked. The temperature of that part of the chamber farthest from
60 the ordinary fire-places is by this arrangement increased and greater uniformity of temperature throughout the chamber obtained and the burning accelerated, the goods near the partition-wall being equally well burned
65 with those situated in the other parts of the chamber, and with less damage to the goods

nearest the ordinary fire-places than when burning with only the ordinary fire-places by avoiding the necessity for forcing the fires to get sufficient heat to properly burn the goods
70 in the parts of the chamber farthest from the fire-places. The hot air passing from the chamber which is cooling is utilized for promoting the combustion of the fuel in the fire-place in the partition-wall; and in order that
75 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 annexed drawings, the same letters of reference indicating corresponding parts
80 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.
85 Fig. 2 is a longitudinal vertical section of the same, taken on the line X X, Fig. 3, showing the partition-walls with the damper-chambers and the flues with outlet-perforations and the opening or through-flue in the upper part,
90 the arrangements of double and single dampers being also here illustrated. Fig. 3 is a horizontal section taken along the line Y Y in Fig. 2, showing the partition-walls with the flues and perforations therein and the damper-chambers and lower or inlet flues. Fig. 4 is
95 a transverse section on the line Z Z, Fig. 1, showing the outlet-perforations and through opening or flue in the upper part of the partition-wall.
100

A A are the outer walls of the kiln. B is the roof or "crown."

C C' C² C³ are the partition-walls separating the chambers 1 2 3 4. The said partition-walls have formed therein the hereinbefore-
105 described flues to convey the surplus 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 G. Each chamber has fire-places *a*, shield-walls *b*, perforated bottoms *c*, and doorways
110 *d*. The branch flues have dampers *e*. The partition-walls have inlet-flues *f*, leading into damper-chambers *g*, provided with dampers
115 *h*, and upper flues, *f'*, having outlets or perforations *i* into the next chamber. The upper part of each of the partition-walls is provided with an opening or flue, (or openings or flues,) *k*, fitted with a damper, (or dampers,) *l*, and
120 cover *m*.

In working the kiln, assuming all the chambers to be empty and the dampers of the flues in the partition-walls to be all closed, I first charge No. 1 chamber with green goods, after
125 which the doorways and openings of the said chamber are closed. The fires are lighted in the fire-places *a* of this chamber and burning commenced in the ordinary way, the damper
130 *e* in the branch flue E' being opened for the passage of the steam or vapor from the green goods into the main flue F, leading to the

chimney, the dampers *e* in the other branch flues being closed, the next or No. 2 chamber is meanwhile being charged with green goods, and when charged the doorways, fire-places, and all other openings thereof are closed to exclude cold air, preparatory to receiving the surplus heat from No. 1 chamber. When the steam or vapor from the goods in No. 1 chamber has been driven off, the damper *e* in the branch flue *E'* is closed, and the dampers *h h* in the partition-wall *C'* are drawn so as to allow the heat from No. 1 chamber to pass directly through the connecting flues and chambers *f g f'* and perforations *i* into No. 2 chamber, to be utilized for drying and burning the goods therein, the damper-openings *h'* being closed to exclude cold air and the damper *e* in the branch flue *E''* is opened for the passage of the steam or vapor from the goods now being dried in 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 surplus heat from No. 2 chamber being utilized in drying and burning the goods in No. 3 chamber, and that from No. 3 chamber in drying and burning the goods in No. 4 chamber, and so on through any number of chambers that there may be in the series. The whole of the chambers Nos. 1, 2, 3, and 4 are now in operation, No. 1 being in full fire, and Nos. 2 and 3 at different stages getting up heat and No. 4 drying. It will be observed that fires have only been lighted in No. 1 chamber, the otherwise 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 and 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 *d*, fire-places *a*, and other openings in Nos. 2, 3, and 4 being closed, except the damper *e* in the branch flue *E'* and the passage through the flues, chambers, and perforations *f g f'* and *i* in each of the partition-walls for the passage of the heat from chamber to chamber. When the burning of the goods in No. 1 chamber is completed, I close the fire-holes *a* of that chamber, remove the cover *m*, and raise the damper or dampers in the flue *k* in the upper part of the partition-wall *C'* to allow the heat from No. 1 chamber to pass direct into No. 2 chamber, among the goods therein, and thence through the perforated bottom to the flues *f*, leading forward into No. 3, and afterward in like manner to No. 4 chamber. When all the surplus heat of No. 1 chamber has been utilized by passing it into No. 2 chamber until the temperature thereof is nearly equal to that of No. 1 chamber, the connection between the two chambers is cut off by closing the dampers *h h* in the flues *f f'* and the damper or dampers *l* of the flue *k* in the partition-wall *C'* and replacing the cover *m*. The burning in No. 1 chamber having been completed and the surplus heat therefrom having been utilized

by passing it into No. 2 chamber, the covers *n* of the openings *p* in the crown of No. 1 are removed and that chamber is left to cool. Shortly before the completion of the passing of the surplus heat from No. 1 chamber into No. 2 chamber the fire-places *a* of the latter are partially opened and the fires lighted and made up to complete the burning. When the burning of No. 2 chamber is completed and the surplus heat from it has been utilized by passing it into No. 3 chamber in the same manner as before described with reference to the No. 2 chamber, and the connection between the two chambers has been cut off, the burning of No. 3 chamber is in a similar manner completed. The same process is carried out with No. 4 chamber, and so on through any number of chambers which there may be in a series.

It will be evident that the kiln may be constructed so that the end or last chamber of the series may be made to communicate with the first chamber, so that the surplus heat from the said last chamber may be conveyed to the said first chamber, as described hereinbefore with reference to the conveyance of heat from chamber to chamber, and so worked continuously.

When burning common bricks, lime, or the like, the fire-places, shield-walls, and perforated bottoms may be dispensed with, and the burning be effected in the ordinary way through feed-holes in the crown and the branch flues *E*, and the doorways *d* may be at the end of the chambers next the partition-walls in the direction the kiln is working. After the burning is completed in one chamber on full fire and all the heat it is possible to utilize has passed into the adjoining chamber and thence forward to the other chambers, then the dampers of the flues connecting it with the next chamber are closed, and it is left to cool, and the burning is carried on and completed in the next chamber, and so on through any number of a series of terminal kilns, or continuously if the kilns be annular.

My invention may be applied to any continuous or semi-continuous arrangement of kilns having chambers separated by partition-walls, or to kilns which may be divided into chambers by my improved partition-walls having flues and dampers arranged and made to operate as hereinbefore described.

I claim as my invention—

1. A continuous or semi-continuous action kiln divided into a series of adjoining chambers separated by partition-walls containing connecting-flues *f g f'*, provided with perforations *i* throughout the length of the flue *f'*, as set forth.

2. A continuous or semi-continuous action kiln divided into a series of adjoining chambers by partition-walls having connecting-flues *f g f'* therein from the floor of one to the next chamber, with direct connecting-flues *k*, having dampers, substantially as set forth.

3. A continuous or semi-continuous action kiln divided into a series of adjoining chambers by a partition-wall having flues $f g f'$ therein from the floor of one chamber to the main portion of the next, and direct connecting-flues k at the top, with two dampers, $l l$, substantially as described.

4. The combination of the adjoining chambers with intermediate partition having connecting-flues $f g f'$, damper h , and perforations i , with direct flues k at the top, and dampers l , all substantially as specified.

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.