

No. 832,473.

PATENTED OCT. 2, 1906.

L. G. FROMONT.
APPARATUS FOR DRYING HOLLOW ARTICLES.

APPLICATION FILED MAR. 14, 1904.

4 SHEETS—SHEET 1.

Fig. 1.

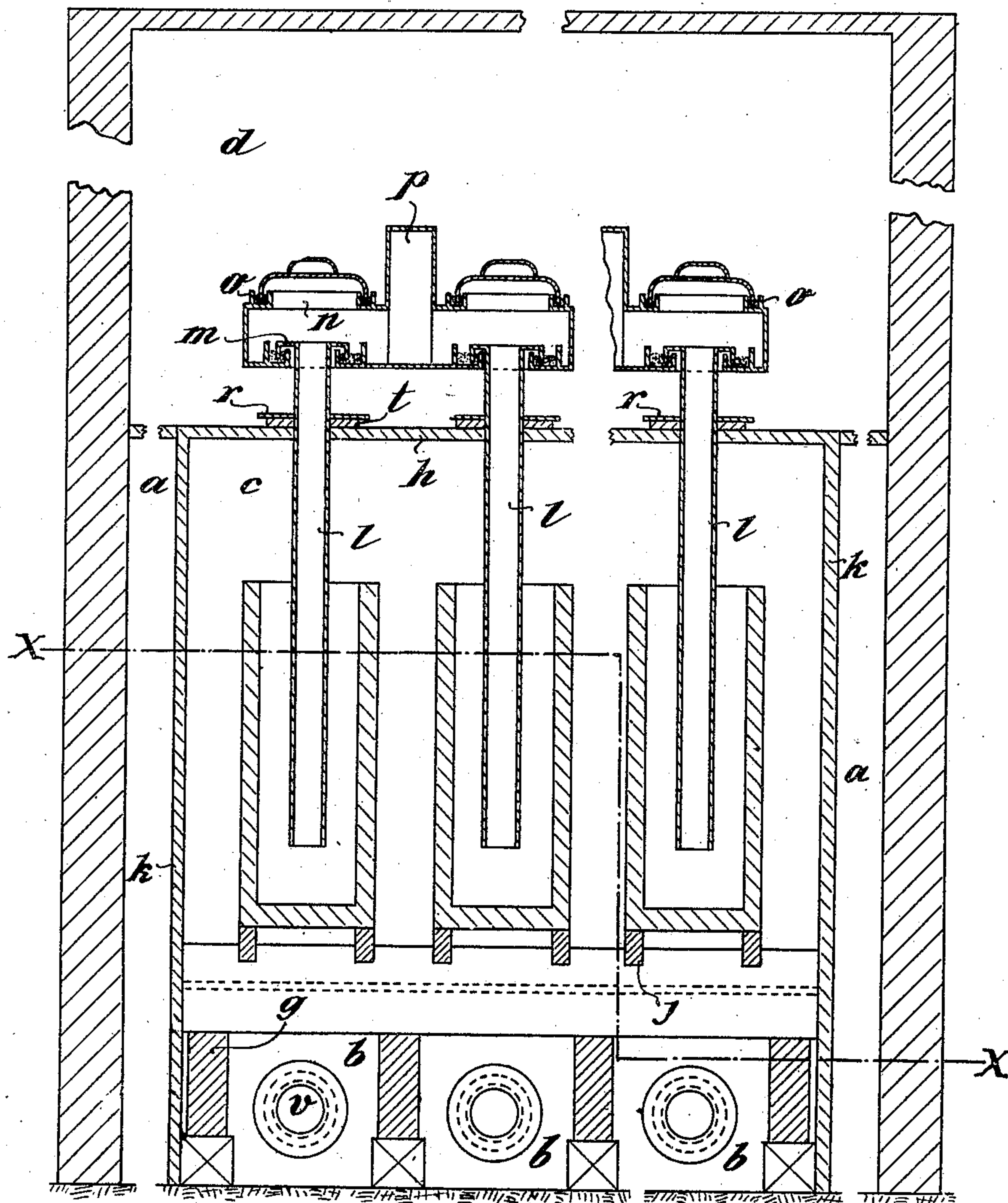


Fig. 4.

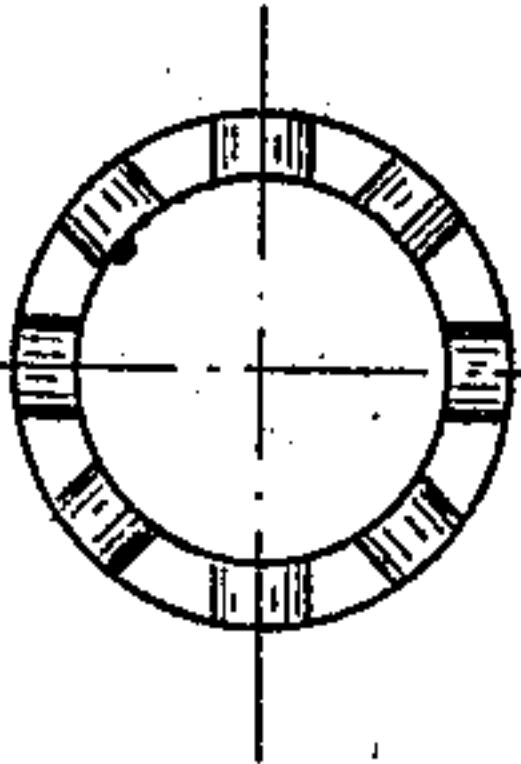


Fig. 5.



Witnesses

G. H. Freeman

J. M. Gellman Jr.

Inventor
Louis Georges Fromont
by
Jester, Freeman & Watson

Attorneys.

No. 832,473.

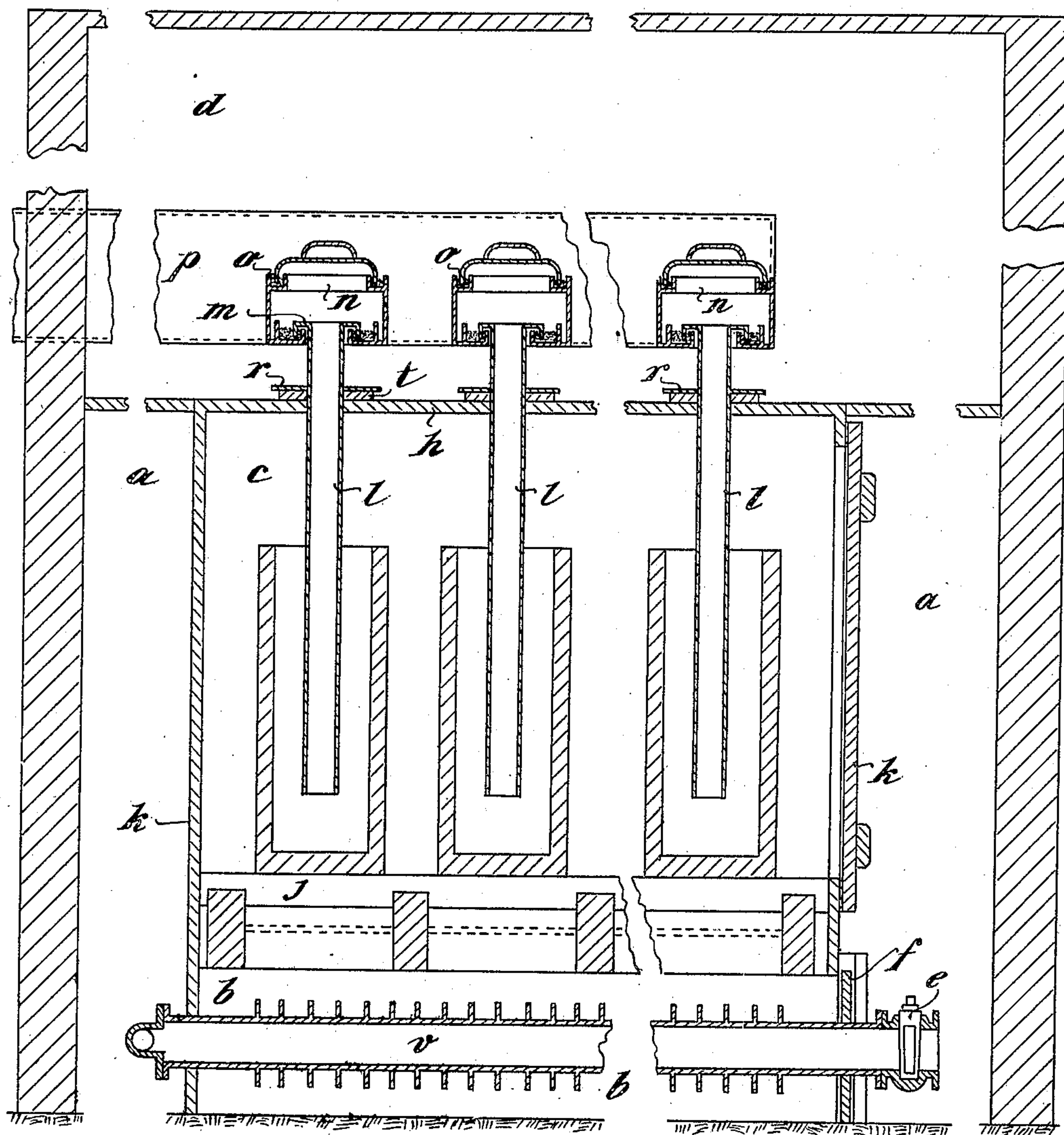
PATENTED OCT. 2, 1906.

L. G. FROMONT.
APPARATUS FOR DRYING HOLLOW ARTICLES.

APPLICATION FILED MAR. 14, 1904.

4 SHEETS—SHEET 2.

Fig. 2.



Witnesses
G. H. Freeman
Am. Gillman, Jr.

Inventor
Louis Georges Fromont
Atty, Freeman Watson
Attorneys.

No. 832,473.

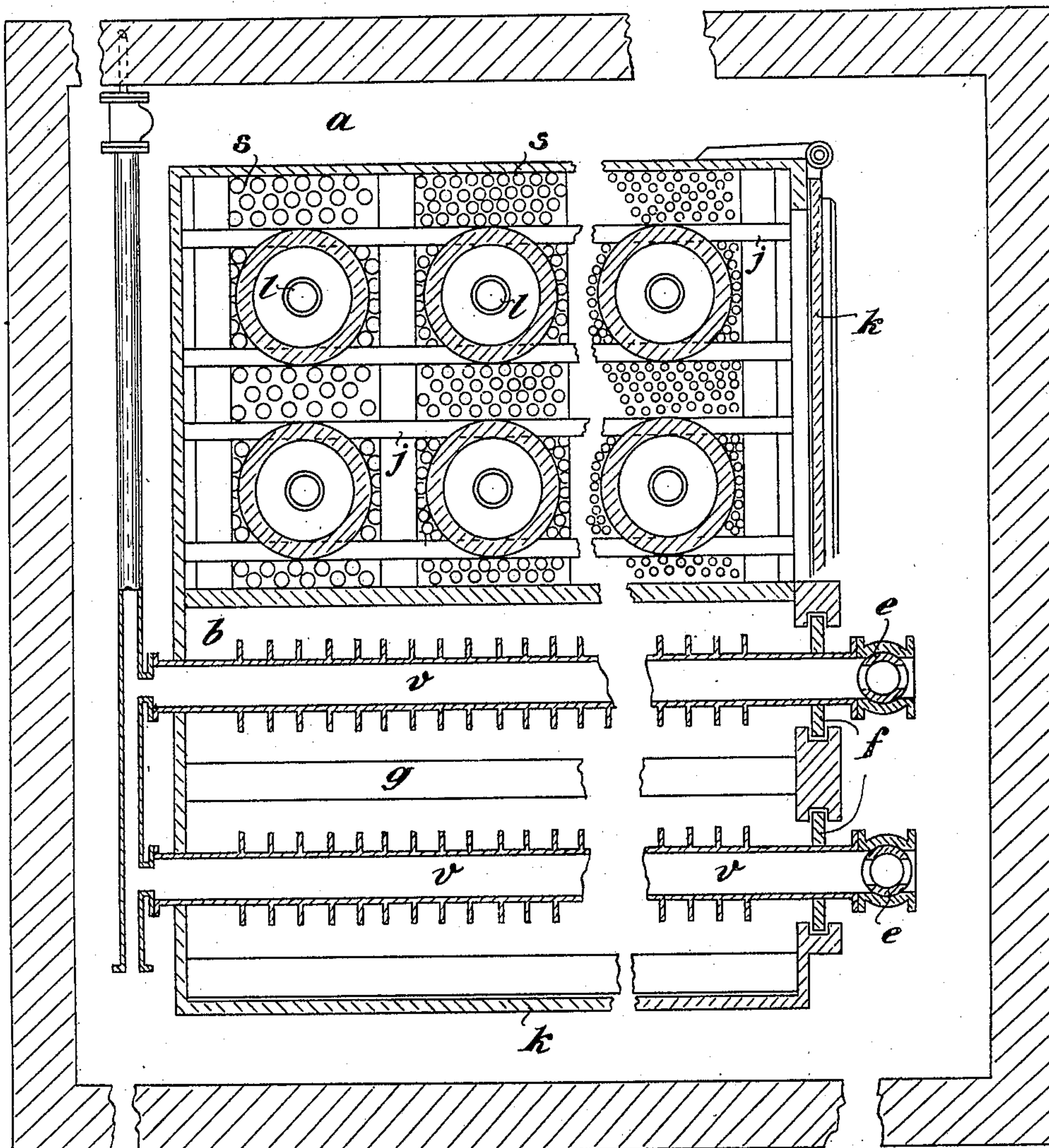
PATENTED OCT. 2, 1906.

L. G. FROMONT.
APPARATUS FOR DRYING HOLLOW ARTICLES.

APPLICATION FILED MAR. 14, 1904.

4 SHEETS—SHEET 3.

Fig. 3.



Witnesses

G. H. Freeman

Am. Gilman, Jr.

Inventor
Louis Georges Fromont
By J. H. Freeman & Watson

Attorneys.

No. 832,473.

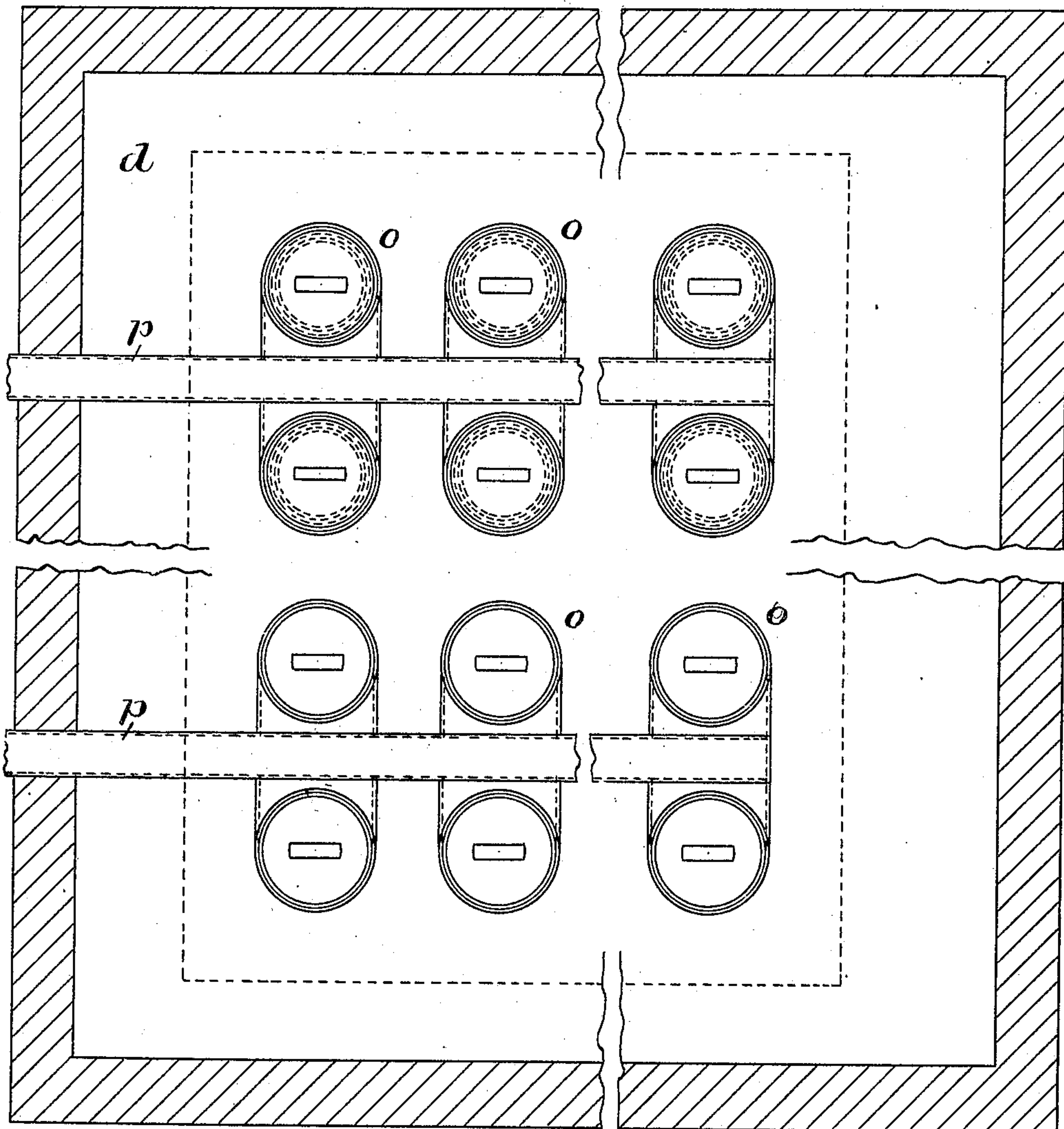
PATENTED OCT. 2, 1906.

L. G. FROMONT.
APPARATUS FOR DRYING HOLLOW ARTICLES.

APPLICATION FILED MAR. 14, 1904.

4 SHEETS—SHEET 4.

Fig. 6.



Witnesses.
J. J. McCarthy.
B. C. Rust.

Inventor
L. G. Fromont
Forster, Krumm and Walser
attys

UNITED STATES PATENT OFFICE.

LOUIS GEORGES FROMONT, OF LIEGE, BELGIUM.

APPARATUS FOR DRYING HOLLOW ARTICLES.

No. 832,473.

Specification of Letters Patent.

Patented Oct. 2, 1906.

Application filed March 14, 1904. Serial No. 198 097.

To all whom it may concern:

Be it known that I, LOUIS GEORGES FROMONT, a subject of the King of Belgium, residing at Liege, Belgium, have invented certain new and useful Improvements in Apparatus for Drying Hollow Articles; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The present invention relates to a method of and apparatus for drying hollow vessels, and is equally applicable to the drying of crucibles to be used in the reduction of zinc ores and also generally to various other crucibles, muffles, retorts, pots, vases, and other hollow bodies made of refractory material for resisting the action of heat or fire or corrosive vapors, liquids, or solids, or of ceramic products, or any other material whatsoever. A grave inconvenience attendant upon the manufacture of such pots, retorts, muffles, and crucibles, and particularly crucibles to be used in connection with the reduction of zinc ores, is the slowness with which these objects can be dried, such slowness resulting generally from their form, but principally due to the fact that the interiors of these vessels are not accessible to circulating air, and the consequence in the systems ordinarily employed is that the air does not remove the humidity from the outer walls of the vessels, and consequently humidity from the inner walls is not evacuated through the pores in the thickness of the walls. It therefore follows that in addition to the slowness of the process there is a sensible difference between the rates of drying of the inner walls, in the vicinity of which the humid air is stagnant, and the outer walls, on which the air plays with more or less intensity, and consequently the articles become deformed and fissures or cracks appear during the drying operation. By the old method of drying it also results that the material becomes irregular in texture owing to the unequal molecular structure and which militates very considerably against the high-resisting and refractory qualities of the vessels which are sought to be attained.

The present system of drying and the apparatus to be used in connection therewith are designed with a view to obviating the disadvantages above referred to, and the accompanying drawings show, by way of example, one type of the said apparatus.

Figures 1 and 2 represent two vertical sec-

tions taken in planes at right angles to one another. Fig. 3 is a horizontal section upon the dotted line xx , Fig. 1; and Fig. 4 is a detail view upon an enlarged scale. Fig. 5 is a transverse section of the detail shown in Fig. 4. Fig. 6 is a cross-section of the drying apparatus above the conduits p .

The drying apparatus comprises four principal parts—viz., the preliminary heating-chamber a , the final heating-chamber b , the drying-chamber c , and a chamber d to provide for the manipulation of the air-twyersystem and ventilation arrangements. The preliminary heating-chamber a is a closed space in which the drier is established, and the air therein can be heated by any suitable heating system whatsoever. In the present instance the connections for the hot drying fluid pass through the chamber a , as shown most clearly in Fig. 3, and serve to heat the air therein. The final heating-chamber b is arranged at an appropriate height and is inclosed on four sides by partitions which are air-tight and also impermeable to heat; but one of the upright partitions permits, by means of suitable openings, of the disposition within the said heating-chamber of steam-pipes v , having gills or radiator-fins or other heating appliances provided with valves e or equivalent devices for controlling the heat and which are disposed on the outside of the said chamber for facilitating access thereto. Within the inside of the chamber the gilled pipes are separated from one another by vertical partitions g , designed to render each of them, as far as possible, independent in its action from the adjacent pipes. In the partition of the heating-chamber which is penetrated by the gilled pipes a series of air-inlet holes are formed, and the larger of these may be provided with a register f for the purpose of regulating the distribution of air in the drier and controlling the quantity of air to be admitted therein.

The heating-chamber is covered by a sheet-iron or wooden plate s , perforated with holes which are varying sizes according to their disposition and have for their function to insure an equal distribution of the air entering the drier. The floor-beams j of the drying-chamber are located directly upon the heating-chamber, and the walls k of the said chamber are air-tight, as also is the lid h , which is pierced with holes disposed vertically above the positions occupied by the goods being dried within the chamber. The handling-

chamber *d* is situated above the drying-chamber. Directed through the holes in the lid or roof of the drying-chamber (and which also constitutes the floor of the handling-chamber) are a series of vertical pipes *l* of a section corresponding to the shape of the holes and suitable to the form of the vessels to be dried, so that an equal distance between the outsides of the pipes and the insides of the vessels may be arranged for and obtained. These pipes are of such a length as will provide for the adjustment at will of the distance between their lower ends and the bottoms of the vessels, and their upper ends are turned over into circumferential peripheral collars, such as indicated in section at *m* in the drawings and which are capable of being engaged within corresponding channels arranged within the bottom of an air-collector or exhausting-conduit *p*. This collecting-conduit is arranged within the handling-chamber, being fixed to the floor thereof, and is pierced with a series of holes surrounded by the junction-channels of the vertical pipes. When the said pipes are engaged with the channels, the latter are filled with sand which forms a joint having the same effect as a hydraulic joint in which sand replaces the water. These sealed joints are hereinafter referred to as "sand-joints," and they provide means of insuring a sound sealed connection between the fixed conduit and the movable pipes and at the same time admit of the latter being rapidly removed and replaced. The holes in the wall *h*, wherethrough the pipes *l* are passed, may be sealed by collars *r*, soldered to the pipes and resting upon rings *t*, of felt or similar material, or by means of sand-joints, which render the bottom of the collecting-conduit *p* and the partition *h* air-tight, and preferably the whole of these parts are arranged in such a way that the pipes *l* in being pushed down are guided at two separated points, and thereby prevented from deviating from the vertical position, and thus the liability to damage the articles being dried by the insertion and removal of the pipes is obviated. The top of the fixed conduit is pierced with holes *n*, sufficiently large to admit of the insertion and removal of the air-pipes *l*. These holes are closed by means of lids which are sealed or rendered air-tight by sand-joints. The fixed collecting-conduit is connected either with an exhauster or a ventilator or an air-shaft or chimney or other aspiration arrangement for drawing air through the drier. While in the great majority of cases air will be employed as the drying fluid, superheated steam may be used for this purpose.

In the drying systems at present practiced parts of the crucibles or articles surrounding the bottoms thereof are not submitted to the drying action under the same conditions as the other parts, and to remedy this object the

crucibles are usually supported upon porous rings which are of the same shape as the section of the crucibles to be dried and pierced with horizontal holes for the circulation of air. These rings may be made either of plaster or porous ceramic material, or felt, or any other porous material.

According to the present invention in order to create a better circulation of air under the bottoms of the crucibles or vessels and to facilitate the manufacture of the porous rings they are given the form of two superimposed and separated rings, as shown in Fig. 3. The crucibles on being removed from the press are placed on their porous rings, and the whole are inclosed in a specially-constructed wooden case designed to prevent the deformation of the goods during transport. The crucibles are then placed in the drier, the cases removed, and the air-pipes *l* pushed down, respectively, thereinto. The said joints for sealing the junctions of the tubes to the air-collector are then rammed down, the covers placed on and sealed also by the sand-joints *o*. When all the crucibles have been placed in the chamber, the doors thereof are closed, these doors being faced with felt to insure a close joint being obtained, after which the air-exhauster, ventilator, or air-shaft is connected up and set in operation, and at the same time the heating apparatus is also started to work. The heated air in the heating-chamber plays upon the bottoms of the crucibles and circulates through the holes in the porous supporting-rings, and thereby removes the moisture which is taken up in the said rings by capillary suction. The said heated air also rises up the outer walls and over the extreme edges thereof and is then drawn over the interior walls toward the entrances at the lower ends of the pipes and is finally withdrawn from the interiors of the vessels up the pipes by the exhauster, ventilator, or air-shaft. When a blower apparatus is employed, the air still makes the same movements on the outside and inside of the crucibles. The direction of movement of the drying fluid through the apparatus will depend upon the connections of the source of the fluid. When connected in one way, the air will flow in one direction, and when connected the other way the air will flow in the opposite direction. So far as this invention is concerned it will be obvious that it is immaterial whether the drying fluid is introduced at one end of the apparatus and exhausted at the other or whether the fluid flows reversely. Suitable instruments may be applied in a well-known manner for indicating the quality of the drying fluid, such as its temperature, pressure, speed, and hygrometrical state. In this way the drying operation may be readily and at will accelerated and retarded to any degree, and the crucibles may be completely dried

without being subjected to the expensive removals which are necessary in ordinary drying systems as now practiced, which requires the passage of the said crucibles through two chambers of different temperatures.

The advantages attendant upon the use of drying apparatus in accordance with this invention are, first, reduction of the capital required to establish works for the production of the various vessels and hollow articles above referred to in consequence of the less warehouse-room required to hold the raw material and the intermediate and finished products; second, considerable reduction of space and structures necessary for producing and storing under cover of the various vessels and hollow articles; third, the form or quality of the articles may be readily and rapidly changed or altered when required; fourth, the drying is more regularly performed, and the development of cracks, fissures, or other deformations is obviated; fifth, the resisting powers and homogeneity of the articles produced is considerably augmented; sixth, the goods can be more economically and easily handled; seventh, the drying operations can be easily controlled and regulated at will.

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

1. A closed chamber for drying hollow bodies, which are pasty, porous and moist and which are provided with bottoms, the chamber being provided with fixed conduits which traverse its walls, and with movable conduits which extend practically to the bottom of the bodies to be dried, in combination with sand-joints uniting the fixed and movable conduits.

2. A closed chamber for drying hollow bodies which are pasty, porous and moist and which are provided with bottoms, said chamber being provided with an open-work floor for supporting the bodies and provided with conduits traversing its walls and extending practically to the bottom of the hollow bodies.

3. A closed chamber for drying hollow bodies, which are pasty, porous and moist and which are provided with bottoms, said chamber being provided with an open-work floor for supporting the bodies, porous rings interposed between the floor and the bottoms

of the hollow bodies, and conduits traversing the walls of the chamber and extending practically to the bottoms of the bodies to be dried.

4. In a drying apparatus, the combination with a chamber, of a source of drying fluid communicating with said chamber, said chamber having an outlet for said fluid, and a ring within said chamber adapted to support the article to be dried, said ring having perforations extending from its interior to its exterior, substantially as described.

5. In a drying apparatus, the combination with a chamber, of a source of drying fluid communicating with said chamber, said chamber having an outlet for said fluid, and a ring within said chamber adapted to support the article to be dried, said ring being formed of two circular sections having notches adapted to register whereby the completed ring is formed with perforations extending from its interior to its exterior, substantially as described.

6. In a drying apparatus, the combination with a chamber having an opening at its bottom, of a pipe extending in proximity to the bottom of said chamber, a conduit connected with the upper end of said pipe, said conduit having a hole in its top through which said pipe may be removed, a covering for the hole in said conduit, sand-joints between the upper end of said pipe and the top of said chamber, and the conduit-hole covering and said conduit, and means for causing a circulation of drying fluid through said opening, chamber, pipe and conduit, substantially as described.

7. In a drying apparatus, the combination with a chamber having an opening in its bottom, a pipe extending into proximity to the bottom of said chamber, a ring beneath the end of said pipe and adapted to support articles to be dried, said ring having perforations extending from its interior to its exterior, and a source of drying fluid connected to said chamber, substantially as described.

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

LOUIS GEORGES FROMONT.

Witnesses:

ALBERT LECOCQ,

YOUSSEF DELANAYE.