

(No Model.)

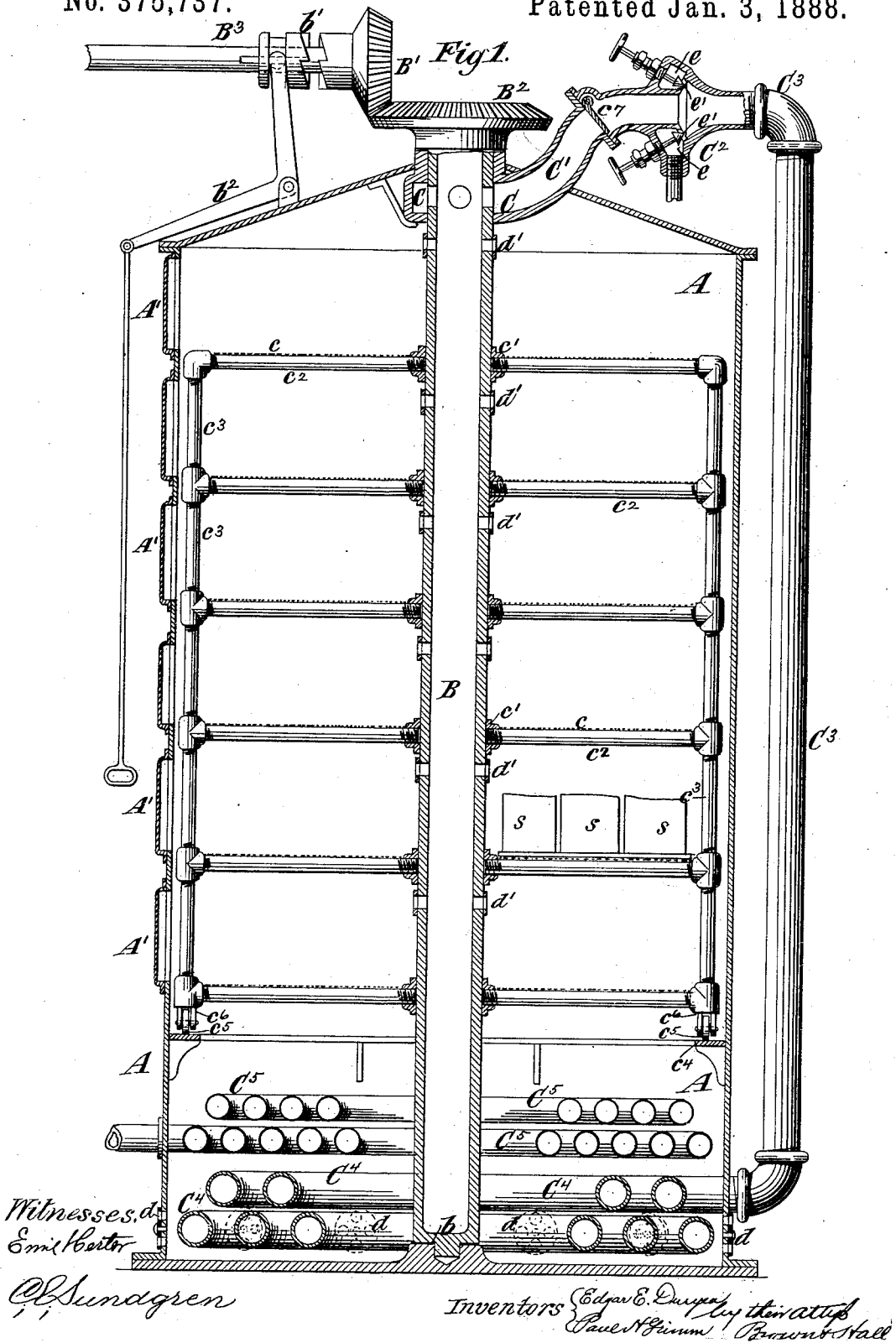
2 Sheets—Sheet 1.

E. E. DURYEY & P. H. GRIMM.

APPARATUS FOR DRYING STARCH OR OTHER SOLID MATTER.

No. 375,737.

Patented Jan. 3, 1888.



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2 Sheets—Sheet 2.

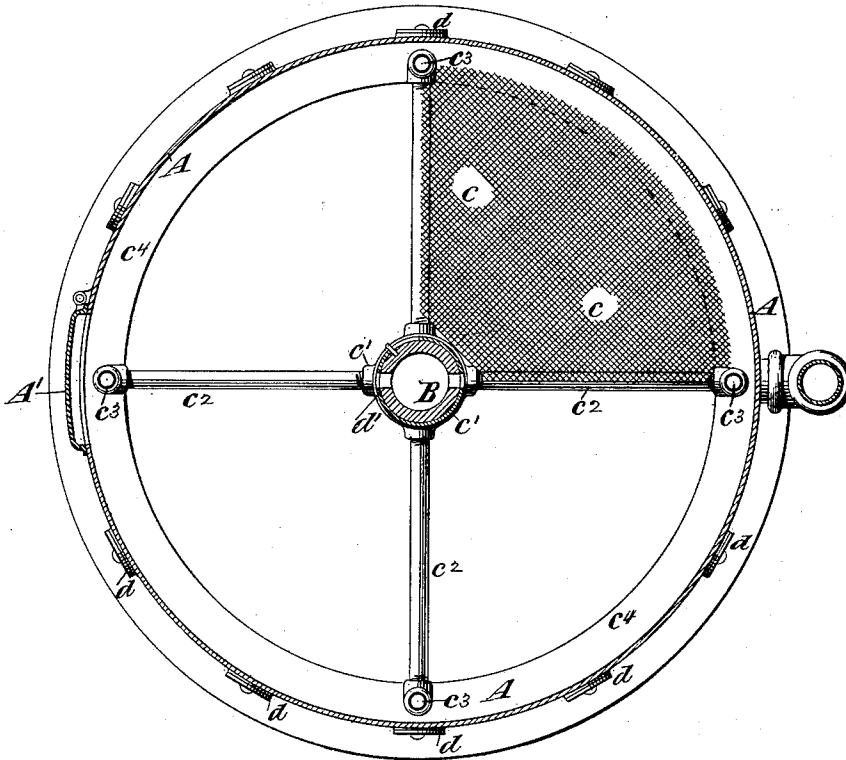
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*Fig. 2.*



*Witnesses.*

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# UNITED STATES PATENT OFFICE.

EDGAR E. DURYEA AND PAUL H. GRIMM, OF GLEN COVE, NEW YORK.

## APPARATUS FOR DRYING STARCH OR OTHER SOLID MATTER.

SPECIFICATION forming part of Letters Patent No. 375,737, dated January 3, 1888.

Application filed July 19, 1886. Serial No. 208,373. (No model.)

*To all whom it may concern:*

Be it known that we, EDGAR E. DURYEA and PAUL H. GRIMM, both of Glen Cove, in the county of Queens and State of New York, have invented a new and useful Improvement in Apparatus for Drying Starch or other Solid Matter, of which the following is a specification.

Starch is commonly dried in the form of blocks, which are placed within a kiln or drying-chamber provided with air-inlets in its lower portion and with outlet-openings or ventilators for the escape of air laden with moisture from its upper portion, the entering air being heated by steam or otherwise.

In our pending application for patent, Serial No. 208,374, filed of even date herewith, we have described and claimed a method of drying starch or other solid matter, which consists in withdrawing hot air and vapors from the kiln or chamber by the inductive action of currents of steam and in employing such hot air and vapor, together with the steam necessary to induce them for heating the fresh air entering the lower portion of the kiln or chamber. Such a method enables the drying of starch or other solid matter to be performed at less cost than heretofore, because it utilizes the heat which is contained in the moisture-laden air escaping from the kiln or drying-chamber for heating the fresh air entering the kiln or drying-chamber.

The object of our invention is to provide an apparatus for carrying out our improved method; and the invention consists, essentially, in the combination, with a kiln or drying-chamber provided with air-inlets in its lower portion, of a radiator arranged near the air-inlet openings and within the lower portion of the kiln or chamber, and having no communication with the interior thereof, and a steam-jet exhauster for withdrawing hot air and vapors from the upper portion or other part of the kiln or chamber and supplying them, together with the steam required to work the exhauster, to the radiator for heating the air entering the kiln or chamber. We also employ a second radiator in the kiln or chamber above the first radiator, which receives the hot air and vapors for receiving steam and imparting additional heat to the entering air, after it is first

heated by contact with the radiator receiving the hot air and vapors.

The invention also consists in the combination, with the aforesaid parts, of a rotary support for matter to be dried, arranged in the kiln or chamber above the radiator or radiators, whereby provision is afforded for placing the starch or other solid matter within the kiln or chamber through doors provided in the side thereof and for removing such matter after being dried, and also for subjecting all parts of the contents of the kiln or chamber uniformly to the currents of hot air in the kiln or chamber. The rotary support may comprise a hollow shaft having inlet openings for air and vapor at different points in its height and provided with suitable valves or dampers, and in such case the steam-jet exhauster would communicate with the hollow shaft for withdrawing hot air and vapors therefrom.

The above-referred-to features of construction and combination are also included in our invention.

In the accompanying drawings, Figure 1 is a sectional elevation of an apparatus embodying our invention, and Fig. 2 is a horizontal section thereof.

Similar letters of reference designate corresponding parts in both figures.

A designates an upright kiln or chamber, which may be of circular form, of brick, wood, metal, or other material. Arranged within the chamber A is an upright hollow shaft, B, which is supported by a step-bearing, *b*, at the bottom of the chamber, and which may be turned by any suitable mechanism—such, for example, as a pinion and wheel, *B' B'*, whereby it is connected with the horizontal shaft *B'*. The pinion *B'* may be connected with its shaft by a clutch, *b'*, and this clutch may be shifted by a lever, *b''*, in order to permit the shaft B to remain stationary whenever desired. The shaft B forms a central support for a carrier or supporting frame, comprising shelves *c*, on which may be arranged boards bearing the starch in blocks *s*. As here shown, the shaft B is provided with collars *c'*, from which project rotary arms *c''*, and the arms, which are in the same vertical planes, are connected by uprights or struts *c'''*. These several parts may be made of gas-pipe and connected by screw-

threaded fittings in a well-known manner, and the shelves or racks *c* may be of wire cloth or other material, preferably of an open character to permit a free circulation of air.

5 Around the lower portion of the kiln or chamber A is a projecting flange or track, *c*<sup>4</sup>, on which are supporting-wheels *c*<sup>5</sup>, attached to the circular carrier or support, and such wheels may be journaled in bearings formed upon  
10 plugs *c*<sup>6</sup>, secured in the fittings which are comprised in the circular support or carrier. By the track *c*<sup>4</sup> and the wheels *c*<sup>5</sup> the carrier or support is properly sustained in vertical position when loaded with matter to be dried, and  
15 is prevented from getting out of the perpendicular. The motion of the rotary support not only facilitates the charging of the kiln or chamber with matter to be dried and the removal of dried matter from the chamber, but  
20 it also provides for exposing the contents of the chamber equally and uniformly to the drying action of the hot air, which will naturally flow most readily to the point of least resistance, which in this case is toward the outlets  
25 leading to the exhauster. The matter to be dried may be introduced through doors A', arranged one above another, in the side of the kiln or chamber, and the turning of the carrier, whenever it is desired to load it with  
30 starch to be dried or to unload the dried starch, gives access to all parts of the circumference of the carrier through the doors A'.

Air may enter near the bottom of the kiln or chamber through inlet registers or dampers  
35 *d*, and the central hollow shaft, B, is provided with valves or dampers *d'* at different points in its height, and also above the circular carrier. These valves or dampers *d'* may consist simply of collars or bands encircling the shaft  
40 and capable of being turned thereon to bring holes or perforations in them into and out of coincidence with similar holes or perforations in the shaft. By means of these or other suitable valves or dampers the escape of hot air  
45 laden with moisture from different points in the height of the kiln or chamber may be properly regulated.

In this example of our invention the upper portion of the shaft B turns within a station-  
50 ary annular chamber, C, which is in communication with its interior, and from which leads a throat or passage, C', having connected with it a steam-jet exhauster, C<sup>2</sup>. Steam-jet nozzles for operating the exhauster are arranged  
55 at different points in a circle and control the passage of steam from an annular belt or jacket, *e*, into the throat or passage C'. These steam-jet orifices are separately controlled by valves *e'*, and by the inductive action of the  
60 steam-jets air and vapors are exhausted from the interior of the kiln by the central shaft, and are delivered, together with the steam employed in operating the exhauster, through the pipe C<sup>3</sup>. A steam-jet exhauster of any  
65 suitable character may be employed; but we deem it very desirable to use such a one as

forms the subject of Patent No. 282,074, granted July 31, 1883, to Paul H. Grimm.

In the lower portion of the kiln or drying-chamber, and in such position therein that  
70 the air entering through the inlet-openings *d* will come in contact with its surface, is arranged a coil of pipe, C<sup>4</sup>, or other suitable radiator. This radiator should be made of thin  
75 metal, so that the heat from the hot air and vapors passing through it will be readily transmitted to the fresh air entering the kiln or chamber and coming in contact with the exterior surface of the radiator.

It is not proposed by the action of the ex-  
80 hauster C<sup>2</sup> to create a vacuum in the drying-tube or kiln A, but simply to produce an active circulation therein and supply the hot air and vapors withdrawn from the chamber or kiln to the radiator C<sup>4</sup> for heating the en-  
85 tering air. It will be understood that the heating-coil C<sup>4</sup> has the pipe C<sup>3</sup> communicating with one end and an exhaust-pipe may extend from its opposite end. In Fig. 1 we have shown the vertical section of the machine as  
90 taken through the plane of the air-registers *d*, and hence the delivery or outlet end of the coil C<sup>4</sup> could not be there shown. It will be understood, however, that the delivery-pipe may lead from the coil C<sup>4</sup> in the same plane  
95 with its lower convolutions and outward through the wall of the kiln or chamber at any point between two of the air-registers *d*. By such a method of operation, and by an apparatus such as above described, a material econ-  
100 omy in the drying of starch and other solid matter is secured, and the operation of drying matter carried on continuously.

The heat imparted from the radiator C<sup>4</sup> may not be sufficient to heat the entering air to the  
105 desired degree, and in such case we employ a steam-coil or radiator, C<sup>5</sup>, through which steam is circulated to supplement the heat which the entering air derives from contact with the coil C<sup>4</sup>.  
110

We have shown a check-valve, *e'*, in the pipe C', which will prevent the steam employed in working the exhauster from escap-  
ing backward into the kiln or chamber in case the free delivery of steam and vapors through  
115 the pipe C<sup>3</sup> be impeded in any way.

Our invention may be employed in connection with the ordinary starch-drying kiln by arranging an exhauster to withdraw the hot  
120 moisture-laden air from the upper portion of the kiln, instead of allowing it to escape through a ventilator, and supplying such hot and moist air to a radiator in the lower portion of the kiln for heating the entering air.

We are aware that a lumber-drier has been  
125 heretofore made in which a steam-jet exhauster is employed for withdrawing the vapors from a closed chamber and supplying them, together with the steam required to work the exhauster, to a jacket surrounding  
130 the chamber, and we do not include such a combination of parts as of our invention. In

that apparatus the lumber-chamber is closed and the heat from the vapors and steam delivered from the exhauster simply serve to heat the interior of the chamber through the walls thereof, and this jacket does not constitute a radiator which is arranged within the chamber and with which air entering the inlet-openings to the chamber comes in contact.

We are also aware that it is not new, broadly, to pass matter to be dried over a rotary support arranged within the drying-chamber; but such rotary support has never been arranged within a chamber above a radiator in the lower part thereof, and which has air-inlet openings adjacent to the radiator and a steam-jet exhauster for withdrawing air and vapor from the upper part of the chamber and supplying them to the radiator. The rotary support forms a new combination with the aforesaid parts, because by it the solid matter being dried is more uniformly subjected to currents of heated air rising through the kiln or chamber, and the contents of the kiln or chamber are more uniformly dried in a given time. It will be impossible to operate the construction shown without having the heated air take well-defined currents through different portions of the kiln or chamber, and if the solid matter were upon a fixed support the portions of it which lie in the path of such currents would be subjected to a more active drying action than those portions which lie outside the paths of the currents. By employing a rotary support all portions of the contents are brought equally within the influence of the currents of heated air and a product of uniform quality is secured.

What we claim as our invention, and desire to secure by Letters Patent, is—

1. The combination, with a kiln or drying-chamber provided with air-inlets in the lower portion, of a radiator arranged near the air-inlets within the lower portion of the kiln or chamber, but having no communication with the interior thereof, and a steam-jet exhauster for withdrawing hot air and vapors from the kiln or chamber and supplying them, mingled with the steam required to work the exhauster, to the radiator for heating the air entering the kiln or chamber, substantially as herein described.

2. The combination, with a kiln or drying-chamber provided with air-inlets in its lower portion, of a rotary support for matter to be dried arranged therein, a radiator arranged in the lower part of the kiln or chamber below the rotary support and near the air-inlets, but having no communication with the interior of the kiln or chamber, and a steam-jet exhauster for withdrawing hot air and vapors from the kiln or chamber and supplying them, together with the steam employed in working the exhauster, to said radiator, whereby the air entering the lower part of the kiln or chamber will first come in contact with and be heated by the radiator, and will then rise into contact with the matter to be dried, which is on the said support, substantially as herein described.

3. The combination, with a kiln or drying-chamber provided with air-inlets in its lower portion, of a rotary support for starch or other solid matter arranged therein, and comprising a hollow shaft having inlet-openings for air and vapor at different points in its height, a radiator arranged in the lower portion of the kiln or chamber, and a steam-jet exhauster for withdrawing hot air and vapors from said shaft and supplying them, together with the steam employed in working the exhauster, to the radiator, substantially as herein described.

4. The combination, with the kiln or drying-chamber A, provided with air-inlets in its lower portion, and having the circular track  $c^1$ , of a rotary support comprising a central shaft and wheels,  $c^2$ , running on said track, a radiator,  $C^1$ , in the lower portion of the kiln or chamber A, and a steam-jet exhauster,  $C^2$ , for withdrawing hot air and vapors from the kiln or chamber and supplying them, together with the steam required to work the exhauster, to the radiator, substantially as herein described.

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