(No Model.) 4 Sheets—Sheet 1.

P. LAUTH.

MALT DRIER.

No. 341,256. Patented May 4, 1886.

Fig. 1.

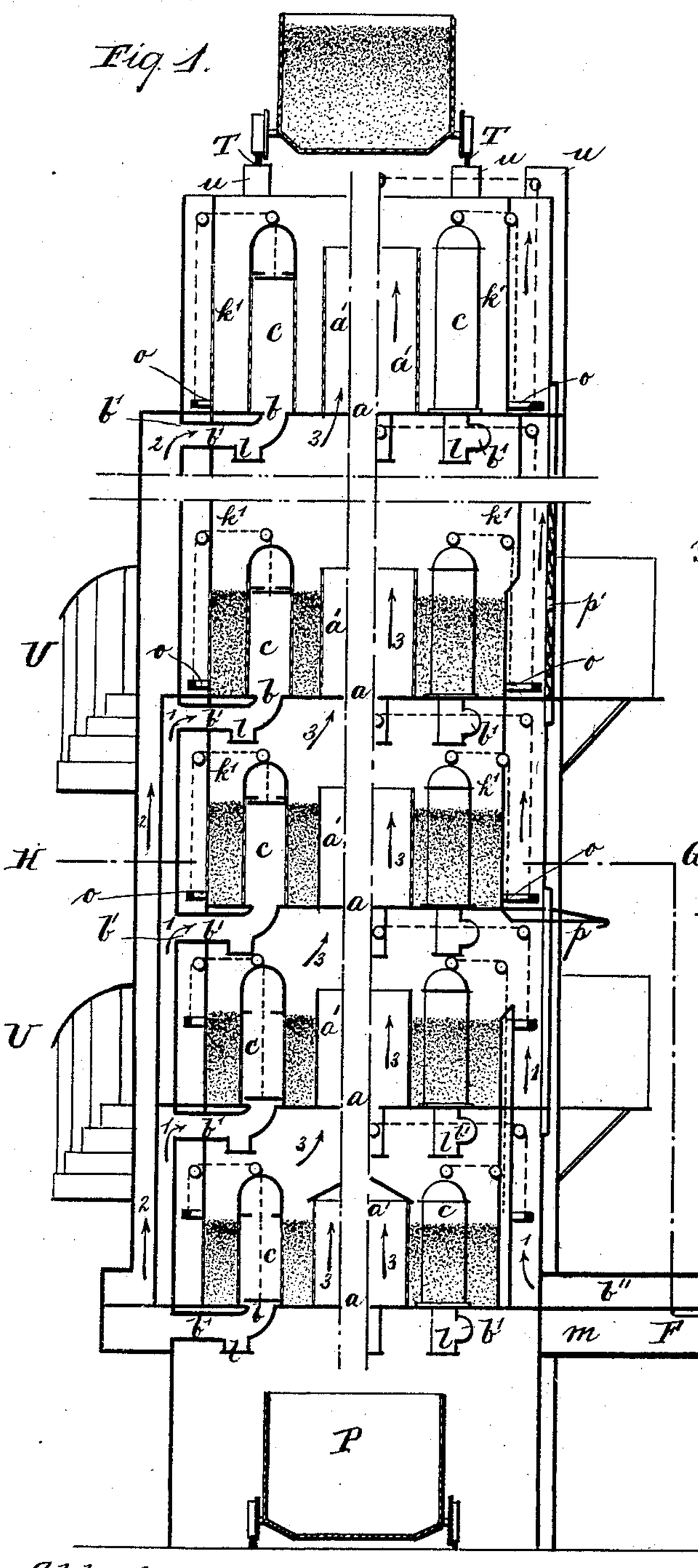
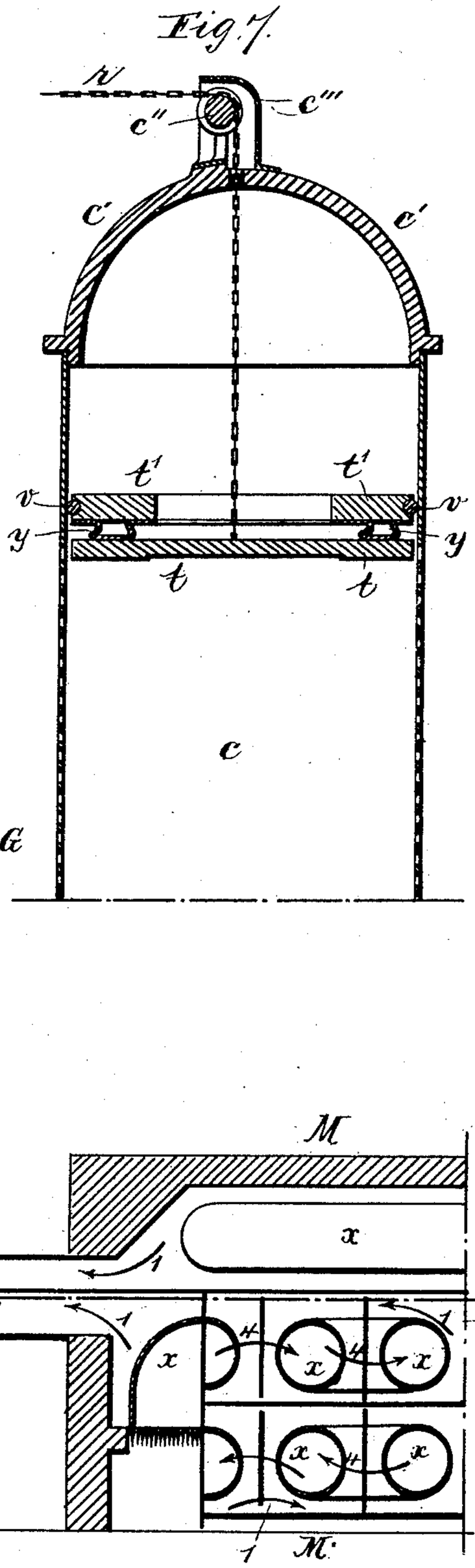


Fig. 7.



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L. Mc. Gallagher

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per Henry Orth
(of Co.)
his atty.

(No Model.) 4 Sheets—Sheet 2.

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MALT DRIER.

No. 341,256. Patented May 4, 1886.

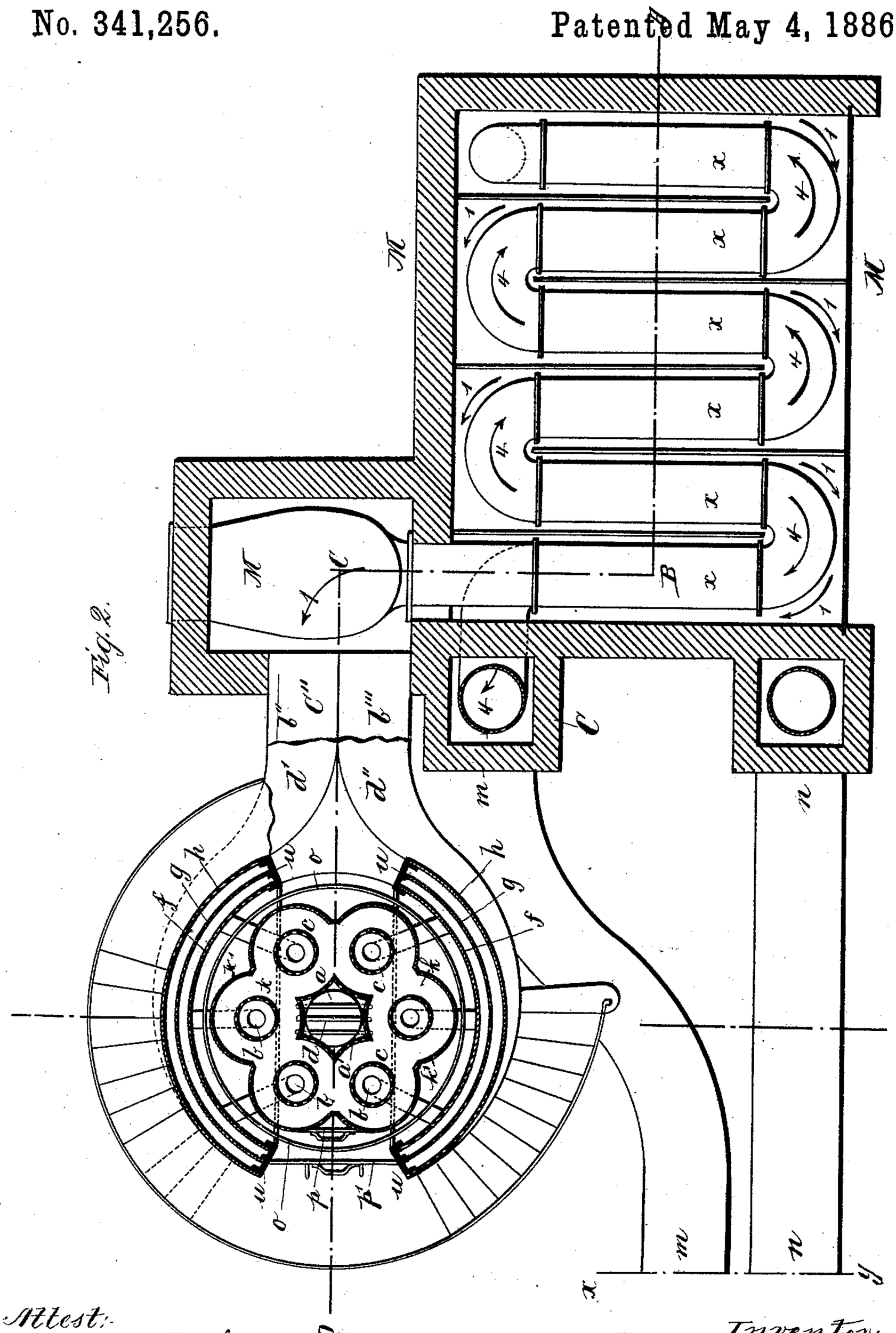

Fig. 2.

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(No Model.)

4 Sheets—Sheet 3.

P. LAUTH.

MALT DRIER.

No. 341,256.

Fig. 3. Patented May 4, 1886.

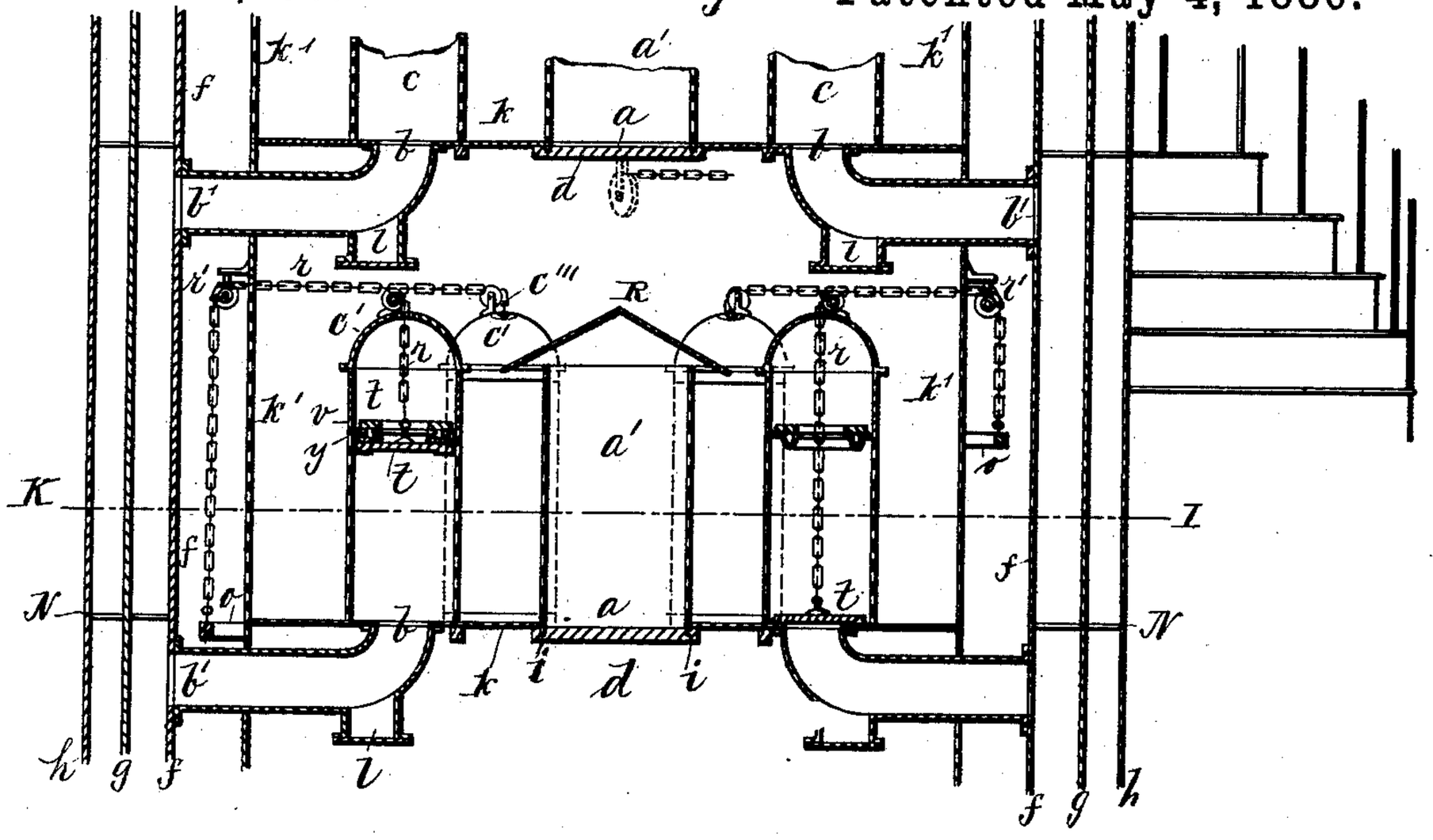
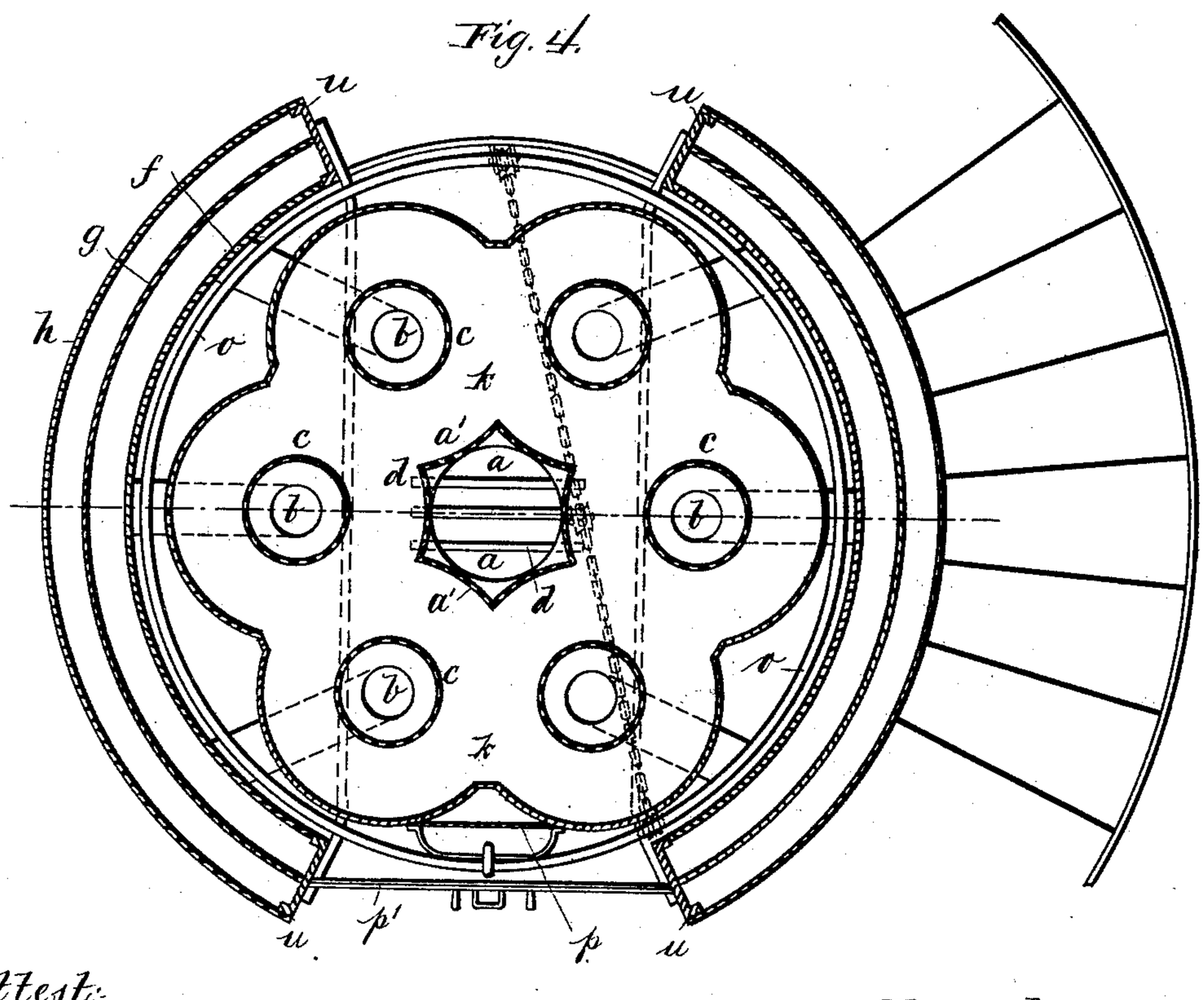


Fig. 4.



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4 Sheets—Sheet 4.

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MALT DRIER.

No. 341,256. Patented May 4, 1886.

Fig. 5.

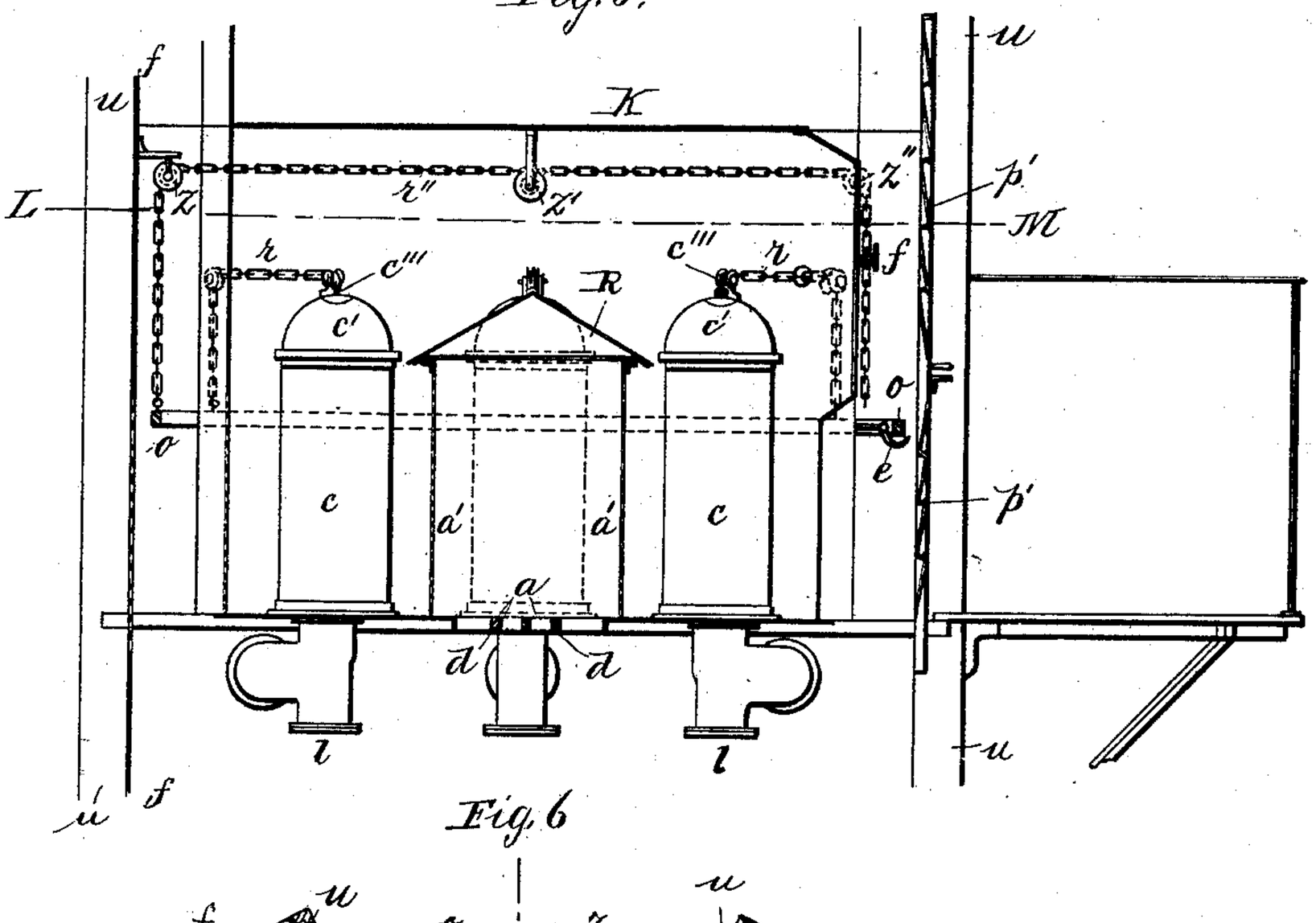
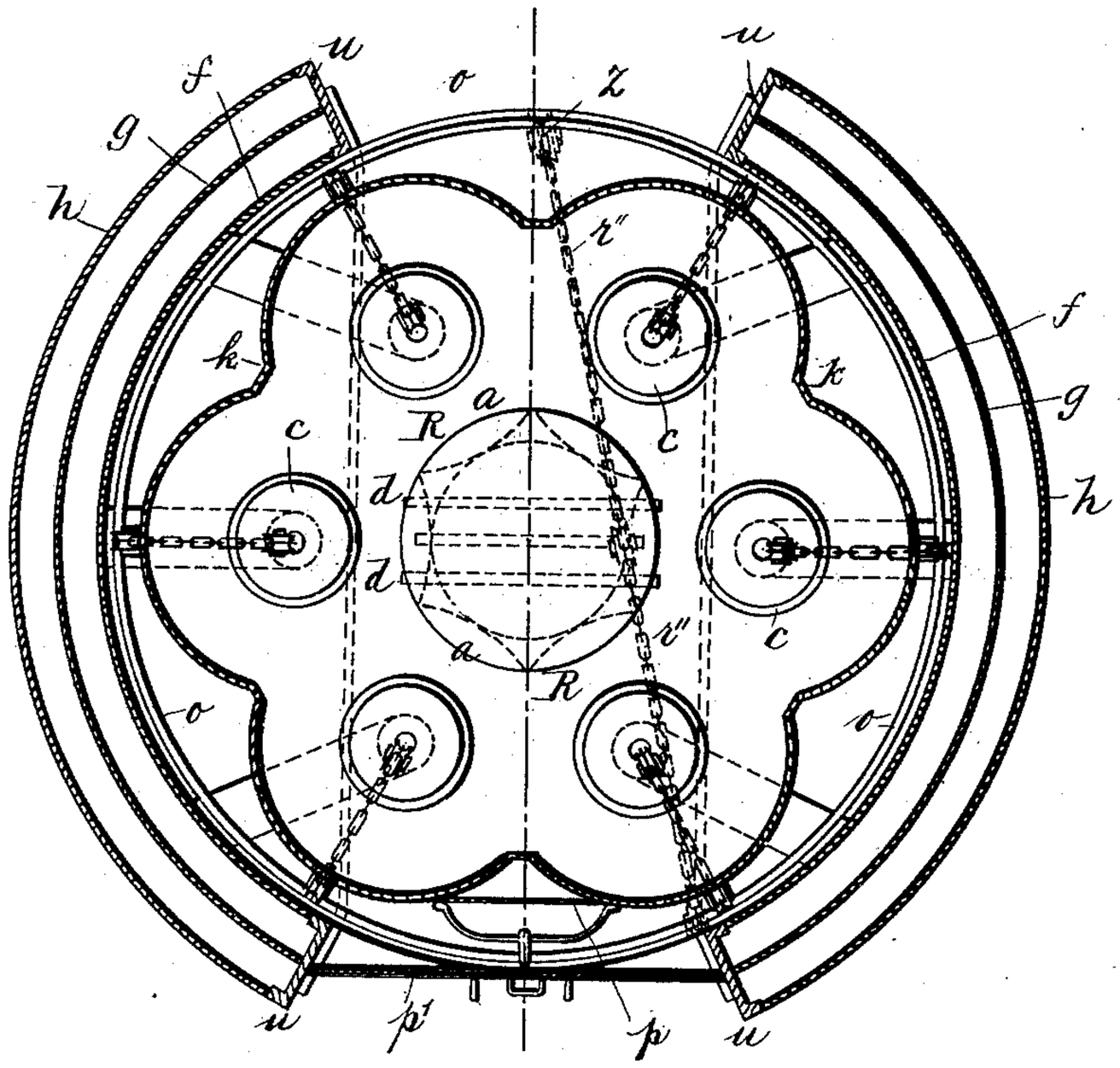


Fig. 6



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his attiy.

UNITED STATES PATENT OFFICE.

PHILIPPE LAUTH, OF CARCASSONNE, FRANCE.

MALT-DRIER.

SPECIFICATION forming part of Letters Patent No. 341,256, dated May 4, 1886.

Application filed September 18, 1885. Serial No. 177,458. (No model.) Patented in France May 21, 1884, No. 162,172.

To all whom it may concern:

Be it known that I, PHILIPPE LAUTH, a citizen of the French Republic, residing at Carcassonne, in the said French Republic, have invented certain new and useful Improvements in Drying Apparatus, (and for which I have received French Letters Patent No. 162,172, dated May 21, 1884;) 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, reference being had to the accompanying drawings, and to the letters or figures of reference marked thereon, which form a part of this specification.

This invention relates to improvements in apparatus for drying grain and other substances, but more especially designed for drying malt; and it consists in constructive features and combinations of elements or parts, substantially as hereinafter fully described, and specifically pointed out in the claims.

In the accompanying drawings, Figure 1 is a schematic vertical sectional elevation, taken on line A B C D of Fig. 2, illustrating the general construction of the apparatus and the relative arrangement of the parts thereof, as well as a portion of the air-heater and its connections. Fig. 2 is a horizontal transverse section of the apparatus and the air-heater, taken on the line E F G H of Fig. 1. Fig. 3 is a vertical section of a portion of the apparatus, illustrating one of the drying-chambers on a larger scale. Fig. 4 is a horizontal transverse section taken on the line K I of Fig. 3. Fig. 5 is a vertical transverse section on a larger scale, taken on line C D of Fig. 2. Fig. 6 is a horizontal transverse section taken on line L M of Fig. 5; and Fig. 7 is a sectional detail view, also on an enlarged scale, of one of the air-distributers.

My improved drying apparatus is composed of a series of superposed drying-chambers, preferably seven in number, for drying malt, though it may be composed of a greater or less number of such chambers, according to the nature of the material to be dried.

In the construction of driers the drying-chambers are usually of rectangular or cylindrical form, on the bottom of which the material to be dried is spread generally in thin layers, so that the heat may readily permeate such material. With such constructions large floor areas are necessary if any quantity of material is to be dried.

One of the objects of this invention is to so construct and arrange the drying-chambers and the means for supplying the heat thereto as to adapt them to receive layers of increased thickness of the material to be dried by giving the floor and inclosing walls thereof an irregular form. To attain the desired object the irregular form of the floors and walls should be such as to more or less subdivide the material to be dried by penetrating into such material—that is to say, by forming the walls in such a manner as to form re-entering angles on a given outline or peripheral line. To this end I construct the drying-chambers as follows:

The bottom or floor *k* of these chambers consists of a sheet-metal plate or disk the periphery of which is formed by six arcs of circles of equal radii, the centers of said circles being equidistant from each other, and the vertical walls of said chambers conform to the peripheral configuration of the floors thereof, as shown in Figs. 2, 4, and 6, and said vertical walls are perforated, as shown.

It is obvious that with the construction of drying-chambers shown and described the material contained therein is penetrated by the inclosing-walls at each inwardly-trending portion of the arcs thereof, thereby subdividing the material therein and providing a very large evaporating-surface through the perforations of these walls. When such chambers are combined with my improved arrangement of devices for supplying heat thereto, a much larger quantity of material can be dried than would be practicable in a chamber of equal floor-space when of usual construction.

The superposed chambers are supported from four **U**-shaped metal uprights, *u*, Figs. 2, 4, and 6, and the structure is provided with a spiral stairway, U, whereby the series of chambers may be reached. The floor *k* of each chamber has a central opening, *a*, and six openings, *b*, arranged concentrically around said central opening, *a*, and concentrically to

the six peripheral arcs of circles of said floors. The central openings, *a*, serve to transmit the grain or malt from one chamber to the other and to discharge the same from the lower chamber of the series. Upon each of these openings are arranged three cross-bars, *d*, Figs. 2 to 6, bolted to the under side of the floor-plate *k*, and enable the workman to shift the material from one chamber to the other beneath it in the process of gradual desiccation.

The bars *d* are grooved at *i*, Fig. 3, and form seats for the short tubes *a'*. These short tubes *a'* are formed of perforated sheet metal and are of hexagonal shape in cross-section, the hexagon being formed by arcs of circles drawn from the centers of the peripheral arcs of circles of the floor-plates *k*. At their lower ends the tubes *a'* are provided with a cylindrical sleeve that projects through the openings *a* in the floor-plates *k*, and is seated in the grooves *i* of the cross-bars *d*, as shown in Fig. 3, so that the tubes are supported from said floor-plates and the cross-bars, respectively. The tube *a'* of the lower drying-chamber is provided with a suitable door that closes the discharge-opening *a* in the floor-plate of said lower chamber, to prevent the admission thereto of cold air from the outside. These central hexagonal tubes, *a'*, form practically a continuous flue or chimney along the axis of the drying-chambers, through which the vapors disengaged from the material escape to the atmosphere.

The tubes *a'* are of varying length, that of the upper drying-chamber being the longest, that of the next drying-chamber a little shorter, and so on, down to the lower drying-chamber, the central flue of which is the shortest of the series. The vertical extent of the perforated portion of the outer walls, *k*, of the drying-chambers also varies in the same manner as the length of the central flues, *a'*. As the volume of the material is gradually reduced during the process of drying, a given charge of the green material is fed into the upper chamber, and, after a partial desiccation therein, will occupy less space when discharged into the next chamber, and so on throughout the whole series.

The central tubes, *a'*, are not rigidly connected to their seats, so that they may be readily removed for the discharge of the material from one chamber into the other.

The distribution of the heated air to the drying-chambers is effected through the distributing-cylinders *c*, secured over the hot-air-admission openings or ports *b*, (hereinbefore referred to,) formed in the floor-plates *k* of the drying-chambers. The cylinders are closed at their upper ends by a cap, *c'*, that has an opening through which passes a cord or chain, *r*. The chain *r* runs over a pulley, *c''*, which rotates in bearings formed in suitable standards bolted to the cylinder-cap *c'*, and to prevent the access of grain into the cylinder through the chain-opening when the grain is introduced into the apparatus or transferred from one chamber to the other, I provide a hood or shield, *c'''*, that covers said opening and chain-pulley, as more fully shown in Fig. 7.

One end of the chain *r* is attached to a damper or disk-valve, *t*, fitted in the cylinder *c* and adapted to close the air-admission port *b* thereof, and be adjusted vertically within said cylinder to regulate the area of air-distribution. Within the cylinder *c*, and above the valve *t*, is fitted a stop, *t'*, composed of a metal ring, which is held in the position to which it is adjusted by means of a spring-coil, *v*, fitted into a peripheral groove of the ring. The ends of the spring-coil are beveled off, so as to overlap each other and form a continuous coil around the ring and hold the same in position by frictional contact with the cylinder-walls.

By means of the described valve *t* and stop *t'*, the area of distribution of the heated air may be regulated according to the depth of the strata of material within the drying-chambers, or regulated so as to deliver the air at any point to the material or cut off the supply entirely when a charge of material is to be introduced in the upper chamber, or such charge is to be transferred from one chamber to another. Any suitable means may be employed for operating the disk-valves within the cylinders. I have shown in the drawings a very simple means, by means of which the valves of all the cylinders in a drying-chamber may be simultaneously operated or adjusted.

As stated above and shown in Figs. 1, 3, and 7, the valves *t* are attached to one end of a chain, *r*, that passes over a guide-pulley, *c''*, mounted on the cylinder-cap *c'*. From the pulley *c''* the chain passes through an opening in the wall of the chamber over a guide-pulley, *r'*, and is connected at its opposite end an operating-ring, *o*, that encircles the drying-chamber, and which is manipulated as follows: A chain, *r'*, is attached to ring *o* and passes over guide-pulleys *z z' z''* into and through the drying-chamber to a point diametrically opposite to its point of attachment to the ring, or nearly so, its free end being secured to a hook, *f*, on the chamber-wall when the ring is adjusted, while the latter is placed into a rest, *e*, whereby its horizontality is maintained. The walls of the cylinders are perforated to a certain height, the extent of the perforated portion being determined by the depth of the material within the chamber, and varies from the upper to the lower chamber with the reduction in the volume of a charge of material as it passes from one chamber to another during the process of drying.

The inclosing-walls of the chambers are, like the cylinders *c*, perforated to a given height, the extent of the perforated portion being likewise determined by the depth of the charge in the respective chambers. Thus the extent of the perforated portion of the inclosing-walls of the upper chamber is greater than that of the chamber below it, and the extent of the

perforated area of the latter chamber is again greater than that of the chamber below it, and so on to the lowest chamber.

By the combined means of supplying heat to the drying-chambers and drawing off the gases and vapors resulting from the process of desiccation with my improved form of drying-chambers it will readily be seen that layers of material of much greater depth can be dried than is practicable in driers having their chambers or floors of usual construction.

The imperforate portion of each chamber has an opening, to which is secured a door, *p*, by means of which access may be had to the interior of said chamber, said door being preferably arranged to open downwardly. The drying-chambers are surrounded by an imperforate inclosing-wall, *s*, of sheet metal, secured to the standards *u*, which wall serves to conduct the vapors that escape from the perforated portions of the chambers to the top and out of the apparatus. The inclosing-wall *s* is also provided with doors *p'*, corresponding with the doors *p* of the drying-chambers through which access may be had to the said doors *p* from the exterior of the apparatus and to the adjusting-rings *o*, above described, these doors being arranged at the landings of the winding-stairs U. The doors of the upper drying-chamber may be dispensed with, as said chamber, as well as the space between it and the inclosing-wall *s*, may be left open at top, and access thereto and to the adjusting-ring may be had from that point. To the standards *u* are secured sheet-metal plates *g* and *h*, forming between them and the wall *s* two annular air-ducts, one for the hot air and the other for air of lower temperature. The hot-air duct extends only up to the fourth drying-chamber, while the duct for the more temperate air extends to the top chamber.

The air is heated and delivered to the drying-chambers as follows: An air-forcing apparatus—such as a fan—forces air through a conduit, *m*, Fig. 2, into a heating-furnace, where it is heated by the heater M, and escapes therefrom at top through two ducts, *b'' b'''*, connected with the annular air-duct formed by the inclosing-walls *g* and *s*, and from thence said air passes through pipes *b'* and ports *b* into the distributing-cylinders *c*, Figs. 1, 2, 3, and 4. A second fan forces air into a duct, *n*, from which it passes to the upper portion of the heater M, and thence, also, through two ducts, *d' d''*, into the annular air-duct formed by the walls *g* and *h* of the apparatus. The ducts *b'' b'''* and *d' d''* serve to divide the temperate and hot-air currents and conduct the same in opposite directions around the drying-chambers. The more moderately-heated air passes around the hot-air duct to the fourth drying-chamber, and thence passes around the remaining chambers and through the connecting-pipes *b'* and ports *b* into the distributing-cylinders *c* of said chambers. To prevent the hot and more temperate air to at once ascend to the upper drying-chambers, the air ducts are divided into chambers by cross-partitions N, leaving an opening in said partitions for the air to escape from one chamber to the next above it. It will thus be seen that the four (more or less) lower drying-chambers are surrounded by two heating-chambers, the inner one being for the hot air and the outer one for the cooler air, so that any heat radiated from the inner air-chamber will serve to heat the air in the outer air-chamber, thereby effecting a great saving in the fuel in heating the air.

The air-ports through which the air passes into and out of the air-chambers are preferably so arranged that the inlet-port of one chamber is opposite to the like port of the chamber immediately above, to divert the flow of hot air and cause the same to envelop the drying-chambers.

The course of the hot air through the heater and the apparatus is indicated by arrows 1, that of the less heated air by arrows 2, that of the vapors by arrows 3, and the course of the products of combustion of the heater through the pipes *x* to the chimney C by arrows 4.

In the drying of malt the operation of desiccation is carried on as follows: On top of the apparatus is arranged a track, T, supported from the standards *u*, on which runs a car, the charge of which is dumped into the upper drying-chamber, the short tube *a'* being then covered by a hood, R, (shown in Figs. 3, 5, and 6,) to prevent the material from falling into the said tube, which hood is removed after the chamber has been charged. The material is allowed to remain in this chamber exposed to the action of the more moderately heated air for about three hours, and is then transferred to the chamber below it, a fresh charge being introduced into the upper chamber. During the transfer of the charge from the upper chamber to that below it the axial tube *a* of the latter is closed, also, by a hood, R, for the purposes stated. The malt being again exposed to the action of the more moderately heated air for about three hours is transferred from the second chamber to the third and that of the first to the second, a fresh charge being introduced into the first or upper chamber. This process is repeated until all the chambers are charged with malt, when the process of drying will be a continuous one, the charge being removed from the lower chamber into a car, P, the transfer of the malt effected from one chamber to the other, and a fresh charge introduced into the upper chamber every three hours. The transfer of the malt from one chamber to the other is effected through the axial openings *a* of the chamber-floors *k* by the removal of the short tube *a'*, the tube of the chamber receiving a charge being covered by a hood, R, as and for the purposes above stated, and while this transfer takes place the disk-valves are lowered to close the ports *b* of the air-distributing cylinders *c*, to prevent the hot air from entering the chambers during such transfer.

Thermometers are arranged in the uprights *u* in the hot-air chamber of each drying-chamber to indicate the temperature therein, for obvious reasons.

The pipes *b'*, that connect the air-chambers with the distributing-cylinders, are provided with traps *l*, closed by means of screw-caps, for the collection and removal of germs that may pass through the perforations of the distributing-cylinders.

Instead of employing perforated floors for the admission of the heated air to the material in the drying-chambers, as has been the custom heretofore, I find it more advantageous to employ imperforate floors and introduce the heated air into the charge at different points and along its entire depth. This I accomplish by means of the perforated distributing-cylinders *c*, and it will be readily seen that the heated air in this manner is caused to permeate the material more thoroughly and more rapidly than would be the case if the heated air were admitted through a perforated floor.

Another advantage resulting from the described arrangement is that the vapors escaping from one chamber cannot come in contact with the material in the chamber above it, as said vapors are free to escape through the axial tubes *a'*, to and out of the upper chamber.

Having thus described the nature of my invention, and how the same is to be performed, I claim—

1. In a malt-drier, a drying-chamber the inclosing-walls of which are composed of symmetrical sections united to form re-entering angles that project radially from a common circle toward the axis of the chamber, substantially as described, for the purpose specified.

2. In a malt-drier, a drying-chamber the inclosing-walls of which are composed of symmetrical sections united to form re entering angles that project radially from a common circle toward the axis of the chamber, in combination with heat-ducts projecting from the floor of the chamber, said ducts being arranged in a circle concentric with the axis of the chamber and on radial lines that intersect the space between each two of said angles, substantially as and for the purpose specified.

3. In a malt-drier, a drying-chamber the inclosing-walls of which are composed of symmetrical sections united to form re-entering angles that project radially from a common circle toward the axis of the chamber, in combination with an axial flue, the inclosing-walls of which are composed of corresponding sections united to form salient angles that project from a common circle and on the same radial lines as the re-entering angles toward the latter, substantially as and for the purpose specified.

4. In a malt-drier, a drying-chamber the walls of which are composed of symmetrical sections united to form re-entering angles that project on radial lines from a common circle toward the axis of the chamber, and an axial flue, the inclosing-walls whereof are composed of corresponding sections united to form salient angles that project from a common circle and on the same radial lines as the re-entering angles toward the latter, in combination with heat-ducts projecting from the floor of the chamber, said heat-ducts being arranged on a circle concentric with the axis of the chamber and on radial lines that intersect the spaces between said salient and re-entering angles, substantially as and for the purpose specified.

5. In a malt-drier, a drying-chamber having an imperforate floor, perforated inclosing-walls, and an axial perforated duct, *a'*, in combination with a series of hot-air distributing ducts or cylinders extending into said chamber, substantially as and for the purpose specified.

6. In a malt drier, a drying-chamber having an imperforate floor and an axial duct, *a'*, the perforated walls of said chamber and duct being constructed to describe arcs of circles drawn from the same centers, in combination with perforated hot-air-distributing ducts or cylinders extending into said chambers, and regulating-valves adjustable within the cylinders to regulate the distribution or cut off the admission of hot-air to said chambers, substantially as and for the purpose specified.

7. In a malt-drier, a series of superposed drying-chambers having imperforate floors, partially perforated inclosing-walls, and perforated axial ducts, the perforated area of said inclosing-walls and the length of the axial ducts of said chambers decreasing from the upper chamber to the lower of the series, in combination with partially-perforated hot-air-distributing cylinders or ducts extending into said chambers from the floors thereof, the perforated area of which decreases also from the upper to the lower chamber, and valves for said distributing-cylinders for regulating the admission of the hot air to or cut off the same from the drying-chambers, substantially as and for the purpose specified.

8. In a malt-drier, a drying-chamber having perforated inclosing-walls, a perforated axial duct for the escape of vapors, and perforated heating-ducts projecting from the floor of the chamber into the same, in combination with a valve operating to vary the heat-distributing area of the ducts, substantially as and for the purpose specified.

9. In a malt-drier, a series of superposed drying-chambers provided with axial ducts *a'*, constructed as described, the inclosing-walls *s*, and air-chambers formed by inclosing-walls *g h*, in combination with the valved air-distributing cylinders *c* and their connections *b'* with the air-chambers formed by said walls *g h* and an air-heater, substantially as and for the purpose specified.

10. The combination, substantially as described, with the drying-chambers, the cylin-

ders *c* for conducting heated air thereto having a portion of their walls perforated, the valves *t*, operating in said cylinders to vary the heat-distributing surface thereof, and the stops *t'* for said valves, of means for adjusting the valves, which consist of the ring *o*, to which the valves are connected by chains or ropes *r'*, and the chain or rope *r*⁴, substantially as and for the purpose specified.

In testimony that I claim the foregoing I have hereunto set my hand this 10th day of August, 1885.

PHILIPPE LAUTH.

Witnesses:
FRÉDÉRIC HUNT,
CAMILLE CHARROPPIN.