J. F. HANRAHAN & H. A. WENDE.

EVAPORATOR.

APPLICATION FILED APR. 20, 1909.

948,322. **Patented Feb. 8, 1910.**

2 SHEETS—SHEET 1.

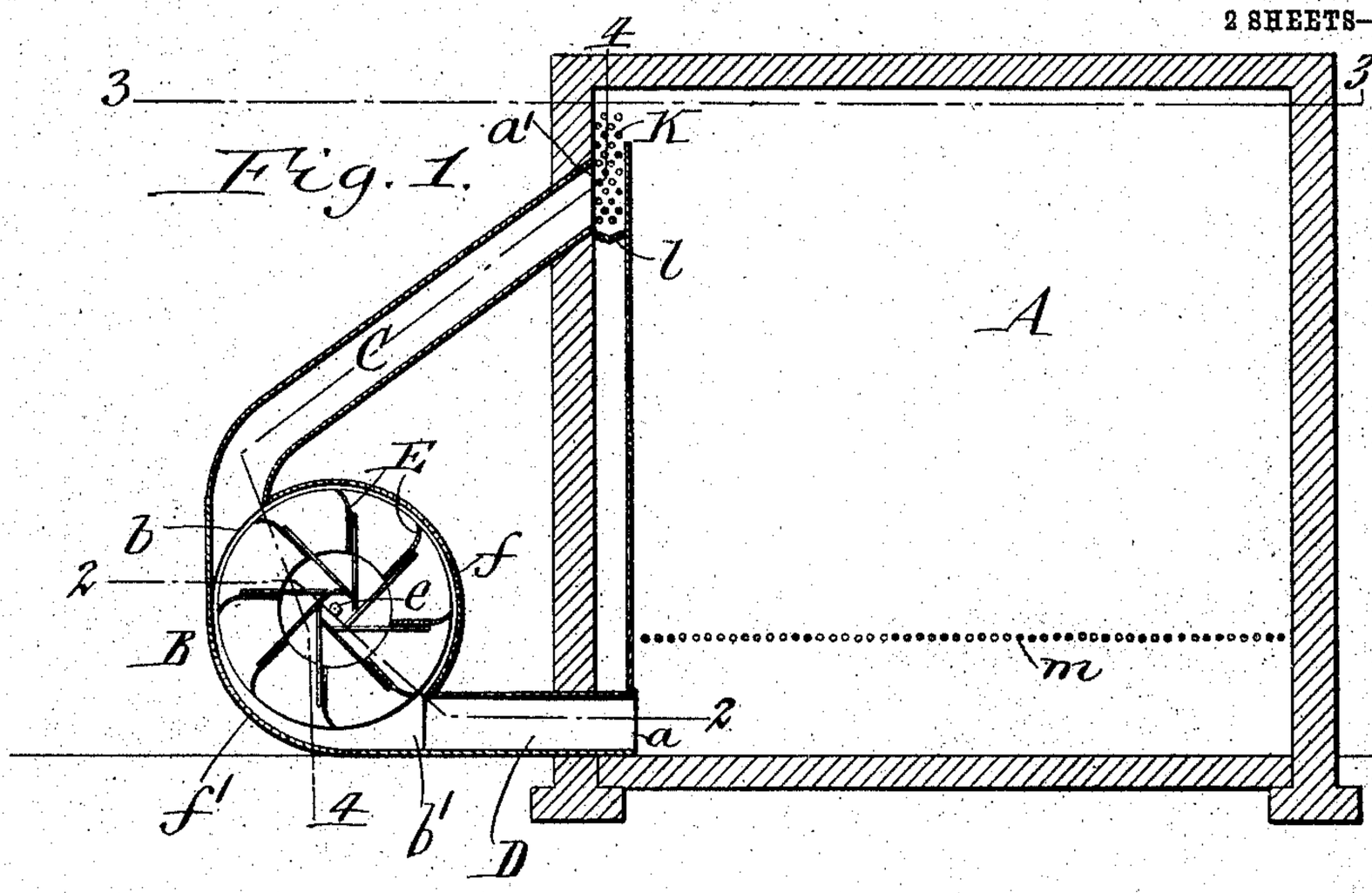

Fig. 1.

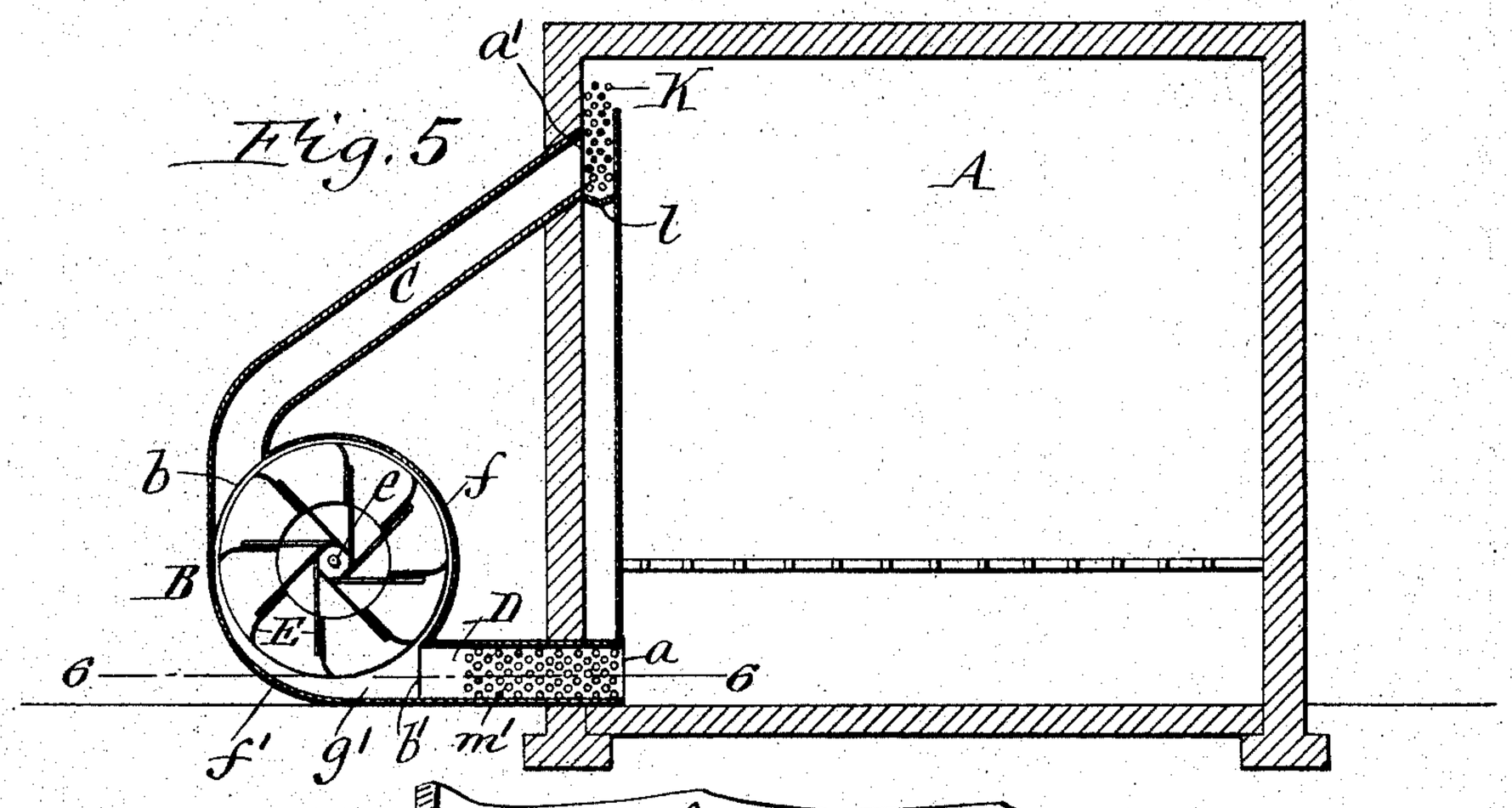

Fig. 5

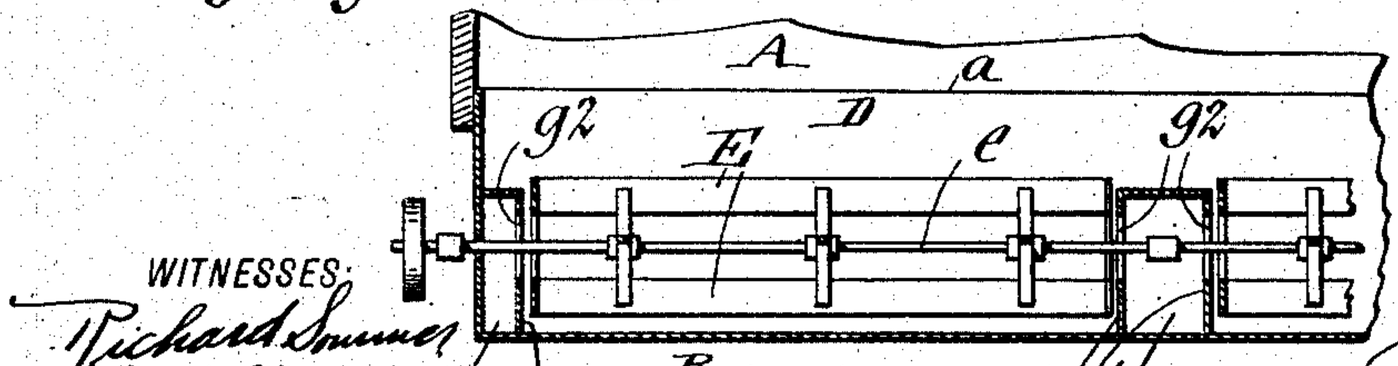

Fig. 2.

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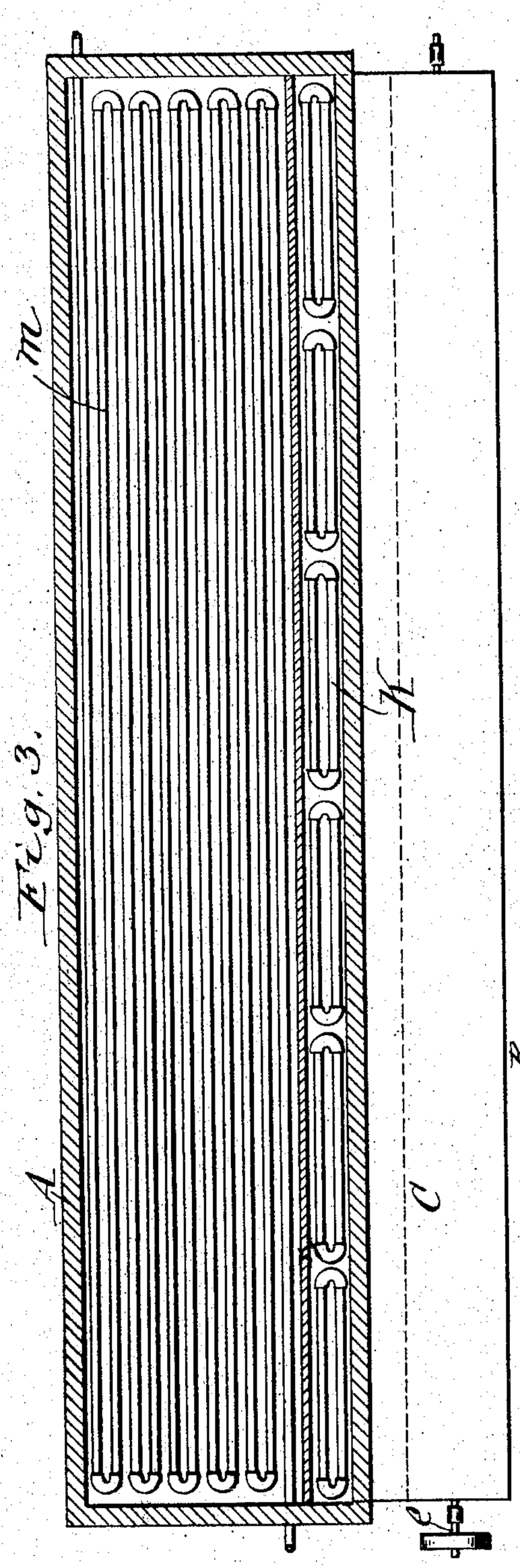

Fig. 3.

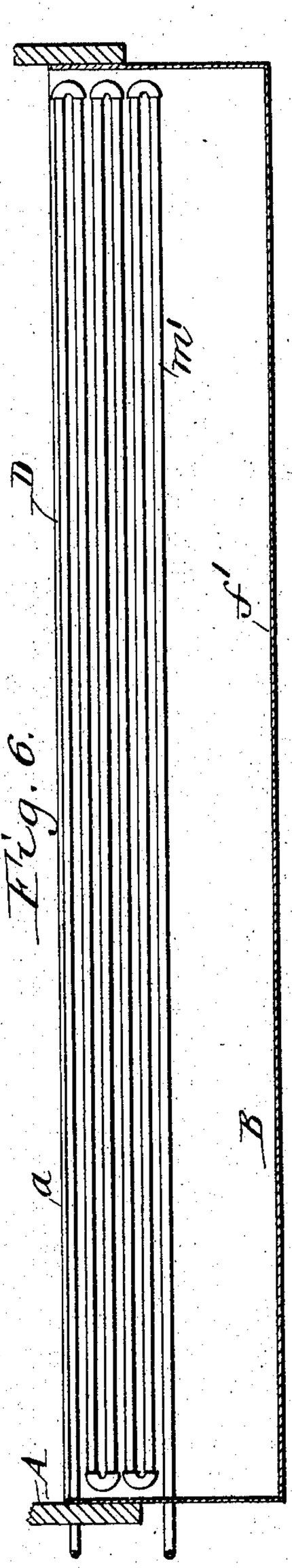

Fig. 6.

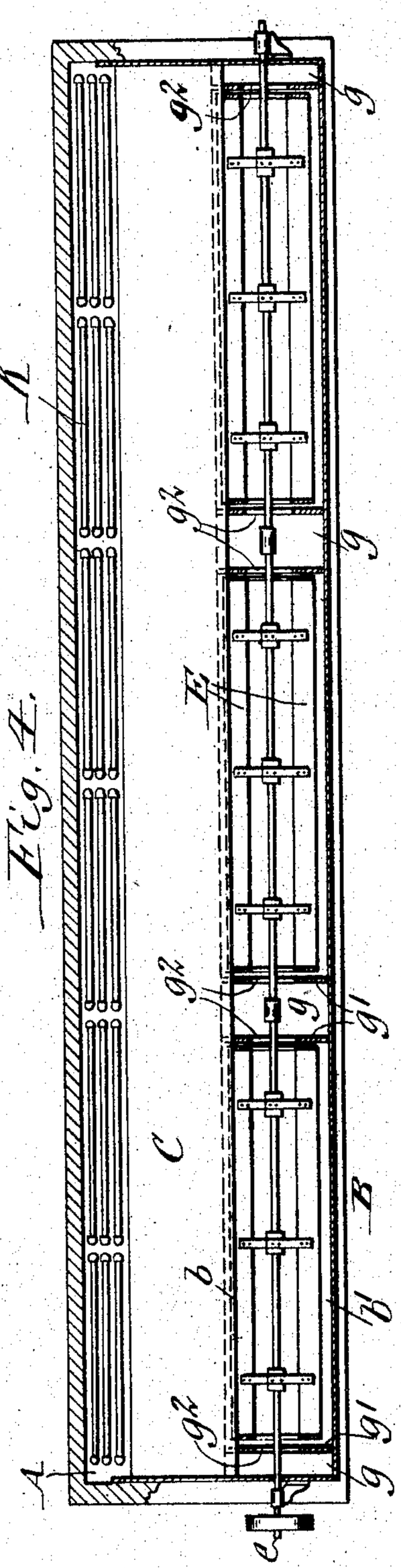

Fig. 7.

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UNITED STATES PATENT OFFICE.

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EVAPORATOR.

948,322. Specification of Letters Patent. Patented Feb. 8, 1910.

Application filed April 20, 1909. Serial No. 491,138.

To all whom it may concern:

Be it known that we, JOSEPH F. HANRAHAN, a citizen of Canada, and HERMANN A. WENDE, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented a new and useful Improvement in Evaporators, of which the following is a specification.

This invention relates to an evaporator, drier or kiln which is more particularly intended for drying large quantities of products or articles at a time but which may also be used to advantage for drying articles in small quantities.

In the use of evaporators or driers as heretofore constructed, it has been impossible to dry all the articles or products in a bath uniformly, which necessitated a continuation of the drying of some parts of the batch or charge after the fully dried product had been removed which involved a loss in the capacity of the evaporator. Another objection to the old apparatus is that too much time is consumed in the drying of products which must be dried at low temperatures.

The object of this invention is to provide an evaporator in which the air is caused to circulate uniformly and to provide a fan whereby the air is forced or propelled at the same rate throughout the entire length of the drying chamber, thereby insuring uniformity in the drying of the product and also enabling articles to be dried more rapidly at low temperatures.

In the accompanying drawings consisting of 2 sheets: Figure 1 is a vertical cross section of an evaporator embodying one form of our invention. Fig. 2 is a fragmentary horizontal section thereof on a reduced scale, in line 2—2, Fig. 1. Fig. 3 is a horizontal section, on a reduced scale in line 3—3, Fig. 1. Fig. 4 is a vertical longitudinal section in line 4—4, Fig. 1. Fig. 5 is a vertical cross section showing a modification of our invention. Fig. 6 is a fragmentary horizontal section, on a reduced scale, in line 6—6, Fig. 5.

Similar letters of reference indicate corresponding parts throughout the several views.

A represents the drying chamber which receives the products or articles to be dried and which may be of any suitable form or construction. One of the longitudinal walls of this chamber is provided adjacent to the bottom of the chamber with an air inlet *a* and adjacent to the top thereof with an air outlet a^1 said inlet and outlet of the chamber extending horizontally the full length of the chamber or substantially so, as shown in Figs. 3, 4 and 6.

B represents the case of a fan which is preferably arranged outside of the wall of the chamber containing the air inlet and outlet and extending the full length of the chamber, or substantially so and parallel therewith. On the upper outer part of the periphery of the fan case the same is provided with a tangential air inlet *b* which is connected by an upper inclined air conduit or pipe C with the upper air outlet of the drying chamber. On the lower inner part of the periphery of the fan case the same is provided with a tangential air outlet b^1 which is connected by a lower horizontal air conduit or pipe D with the lower air inlet of the drying chamber. The fan case and its inlet and outlet pipes C, D form a return flue or conduit for the descending body of air. The upper and lower conduits C, D are co-extensive with the fan case and drying chamber.

Within the fan case are arranged a plurality of fan blades E which rotate vertically and are mounted on a horizontal shaft *e* arranged lengthwise in the fan case and driven in any suitable manner.

That side *f* of the periphery of the fan case between the inner angles of the tangential inlet and outlet is arranged concentrically with the axes of the fan blades and case and the opposite side f^1 of the periphery of the case between the outer angles of the tangential inlet and outlet of the fan case is of scroll form or arranged eccentrically to the axes of the fan case and blades being of gradually increasing radii from the tangential inlet to the tangential outlet of the fan case, as shown in Fig. 1. The direction of rotation of the fan blades is such that when passing the eccentric side of the periphery of the fan case they move from the shorter to the longer radii thereof. By this means the air carried around by the fan blades within the concentric part of the periphery of the case is confined against outward radial movement under the centrifugal ac-

tion of the fan blades but when the latter pass the eccentric part of the periphery of the case the air at this time is permitted to move radially outward a limited extent and produce a downward suction of the air from the upper part of the drying chamber through the upper air conduit and into the fan case from which latter it is again forcibly expelled through the lower air pipe into the lower part of the drying chamber wherein it again rises to the top, being forcibly and continuously circulated in this manner so long as the fan is in operation.

In the absence of any provision to prevent it the rarefaction of the air at the axis of the rotary fans due to the centrifugal action of the latter would cause a conflict of air currents at this place which would interfere with the propelling effect of the fan blades on the air for withdrawing the same from the top of the drying chamber and returning the same to the bottom thereof. To avoid this means are provided whereby sufficient air is diverted from the air inlet of the fan case to the axis of the blades to compensate for the air which is withdrawn from this location by the centrifugal action of the fan blades. The preferred means for accomplishing this result consists in dividing the fan blades into a plurality of groups, or sections each group containing a circumferential row of blades and the several groups being arranged lengthwise side by side on the fan shaft, as shown in Fig. 4, and providing auxiliary air supply conduits *g* which are arranged adjacent to the ends of the groups of the fan blades and each of which extends from the air inlet of the fan case to the axis of the blades. These auxiliary air conduits are formed by vertical partitions or diaphragms g^1 arranged in the fan case between the groups of blades and extending from the inlet to the outlet thereof and having air inlet eyes g^2 in line with the axis of the blades. As the fan blades rotate that part of the air which is forced outwardly from the center of the same by the centrifugal action of the blades is replenished by the air supplied through the auxiliary air conduits *g*, thereby preventing any back pressure or clashing of the air currents and enabling a large volume of air to be propelled by the fan with the expenditure of comparatively little power.

By means of this fan a uniform draft of air into the upper air conduit and a uniform blast of air from the lower air conduit is produced throughout the entire length of these conduits which causes a current of air of equal uniformity to rise from the lower to the upper part of the drying chamber and thereby operate alike on the products in all parts of this chamber, thereby avoiding the necessity of redrying of part of the products in a charge as has been customary heretofore with consequent loss of efficiency in the apparatus and loss of uniformity in the product put out.

The vapors which are taken up by the air in passing the products to be dried are condensed by intercepting the air by means of a condenser on its way to the fan which condenser preferably consists of water conducting coils K which are arranged in front of the upper air outlet of the chamber and from which the water of condensation drips upon a gutter or pan *l* leading to a sewer or receptacle.

The air freed from vapors upon being returned to the lower part of the drying chamber is preferably heated so as to increase its vapor absorbing capacity. The means for this purpose may consist of heating coils or pipes *m* arranged in a horizontal row in the lower part of the drying chamber, as shown in Figs. 1 and 3, or similar pipes or coils m^1 may be arranged in the lower air conduit, as shown in Figs. 5 and 6. The coils *m*, m^1 may be heated by circulating a suitable heating agent through the same, such as steam or hot water. In both of these heating means the coils are co-extensive with the length of the drying chamber, air conduit, fan case and fan blades, so that the stream of air before it rises past the products under treatment in the drying chamber is heated uniformly and thoroughly throughout the entire length of the drying chamber. It is preferable to heat the air in the lower or outlet conduit D, as shown in Figs. 5 and 6, inasmuch as the air in this part of the conduit is comparatively cool and compact and the coils m^1 are able to operate rapidly and effectively on the air for heating the same before it reaches the lower part of the drying chamber and has expanded more or less.

It is of course understood that the propelling effect of the fan is aided by the natural tendency of the cool column of air in the upper and lower air conduits and fan case to descend by gravity and the hot or warm air in the drying chamber to rise. When, however, the article or product to be dried requires treatment under comparatively low temperatures, as is the case in drying of glue and similar material, the thermal action of the air, if solely depended on, would produce a comparatively slow circulation of the air which would prolong the period of drying in the same measure. By the use of the fan, however, the movement of the air is accelerated and the drying operation expedited, thereby materially increasing the out put of the evaporator and reducing the cost of operation.

We claim as our invention:

1. An evaporator comprising a drying chamber adapted to receive the articles to be dried, a fan case having its inlet connected with the upper part of said chamber and its

outlet connected with the lower part of said chamber, fan blades rotatable in said case, and means for condensing the vapors in the air withdrawn from the upper part of the chamber, the length of said fan case, its inlet and outlet and its blades being substantially the same as the length of said drying chamber.

2. An evaporator comprising a drying chamber adapted to receive the articles to be dried, a fan case having its inlet connected with the upper part of said chamber and its outlet connected with the lower part of said chamber, fan blades rotatable in said case, means for heating the air delivered into the lower part of the chamber and means for condensing the vapors in the air withdrawn from the upper part of the chamber, the length of said fan case, its inlet and outlet and its blades being substantially the same as the length of said drying chamber.

3. An evaporator comprising a drying chamber adapted to receive the articles to be dried, a circular fan case having an inlet at one part of its periphery which is connected with the upper part of the drying chamber and an outlet at another part of its periphery which is connected with the lower part of said chamber, and fan blades rotatable in said case, said fan case being arranged horizontally and parallel with the length of the drying chamber and said case, inlet, outlet and blades being of substantially the same length as said chamber.

4. An evaporator comprising a drying chamber adapted to receive the articles to be dried, a circular fan case having an inlet at one part of its periphery which is connected with the upper part of the drying chamber and an outlet at another part of its periphery which is connected with the lower part of said chamber, fan blades rotatable in said case and an auxiliary air conduit leading from said inlet to the central part of said blades.

5. An evaporator comprising a drying chamber adapted to receive the articles to be dried, a circular fan case having a tangential inlet at one part of its periphery which is connected with the upper part of the drying chamber and a tangential outlet at another part of its periphery which is connected with the lower part of said chamber, one side of the periphery of said case between its inlet and outlet being concentric with the axis of the case and the other side of the periphery of the case between the inlet and outlet being eccentric and of gradually increasing radius toward said outlet, and fan blades rotatable within the case concentrically with the axis thereof and movable along said eccentric peripheral part from the shorter toward the longer radii thereof.

6. An evaporator comprising a drying chamber adapted to receive the articles to be dried, a circular fan case having a tangential inlet at one part of its periphery which is connected with the upper part of the drying chamber and a tangential outlet at another part of its periphery which is connected with the lower part of said chamber, one side of the periphery of said case between its inlet and outlet being concentric with the axis of the case and the other side of the periphery of the case between the inlet and outlet being eccentric and of gradually increasing radius toward said outlet, and fan blades rotatable within the case concentrically with the axis thereof and movable along said eccentric peripheral part from the shorter toward the longer radii thereof and an auxiliary air supply conduit leading from the periphery of the case adjacent to the inlet thereof to the blades at the axis thereof.

7. An evaporator comprising a drying chamber adapted to receive the articles to be dried, a return conduit for the descending air comprising a fan case having an inlet connected with the upper part of said chamber and an outlet connected with the lower part of said chamber, fan blades rotatable in said case, and means for heating the air in the outlet of the fan case, said drying chamber, return conduit, fan blades and heating means being of substantially the same length.

8. An evaporator comprising a drying chamber adapted to receive the articles to be dried, a return conduit for the descending air comprising a fan case having an inlet connected with the upper part of said chamber and an outlet connected with the lower part of said chamber, fan blades rotatable in said case, condensing means arranged in the upper part of the return conduit for condensing the vapors in the air withdrawn from the upper part of the drying chamber, and heating means arranged in the lower part of said return conduit for heating the air therein before it reaches the lower part of the drying chamber, said drying chamber, return conduit, condensing means, heating means and fan blades being of substantially the same length.

Witness our hands this 16th day of April, 1909.

JOSEPH F. HANRAHAN.
HERMANN A. WENDE.

Witnesses:
THEO. L. POPP,
E. M. GRAHAM.