

(No Model.)

A. A. DENTON.

APPARATUS FOR EVAPORATING LIQUIDS BY AIR.

No. 353.292.

Patented Nov. 30, 1886.

FIG. 1.

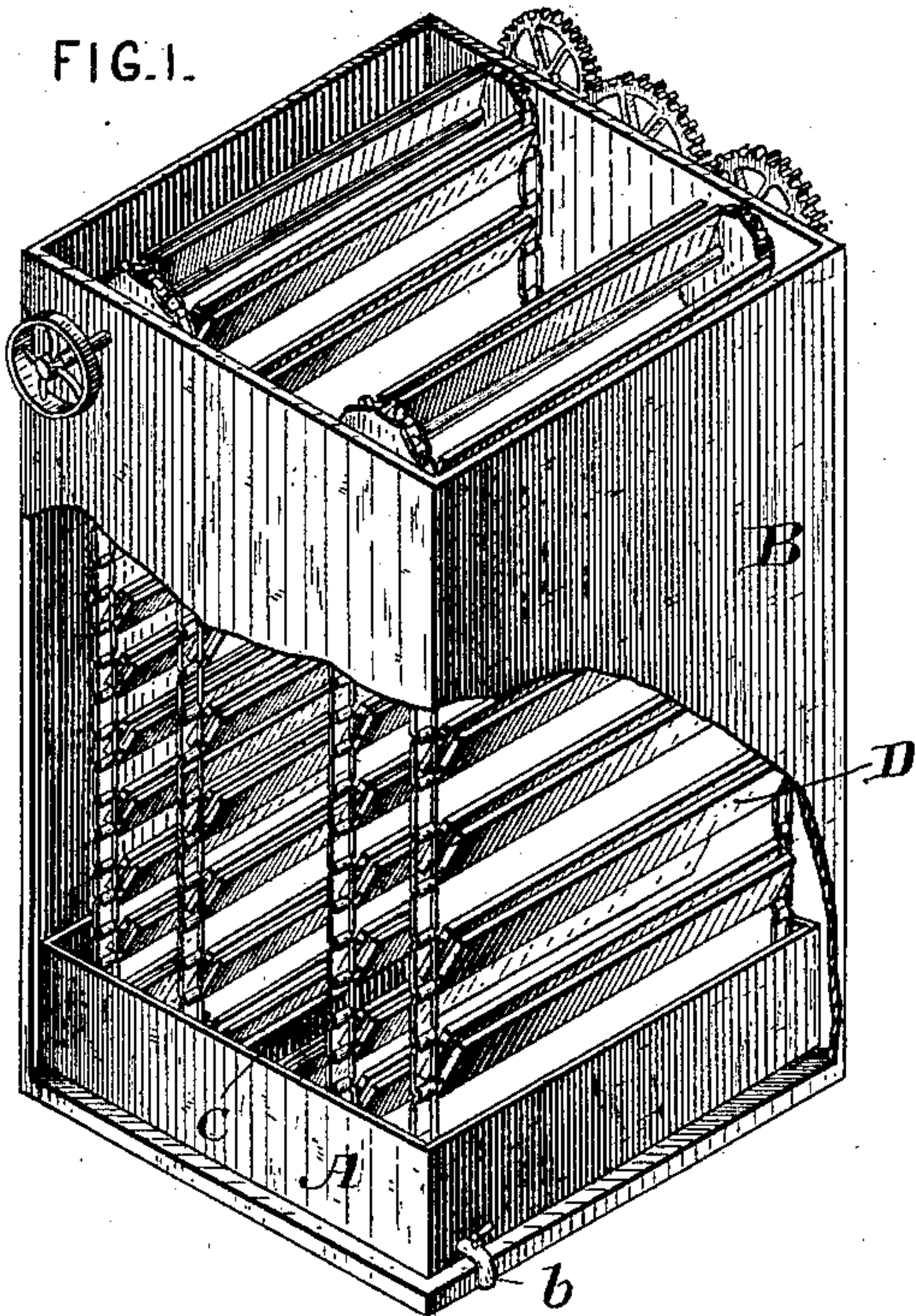


FIG. 2.

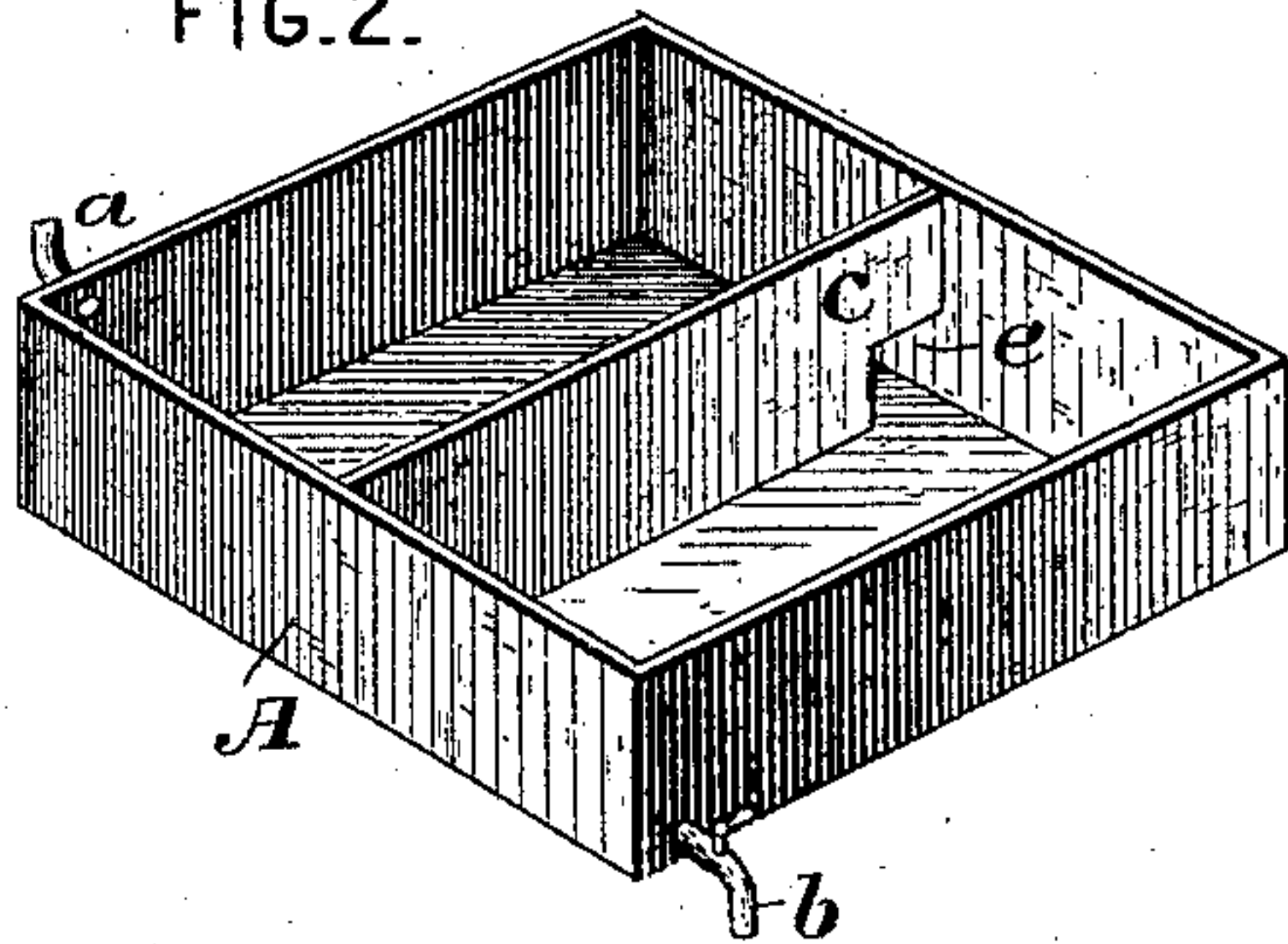


FIG. 3.

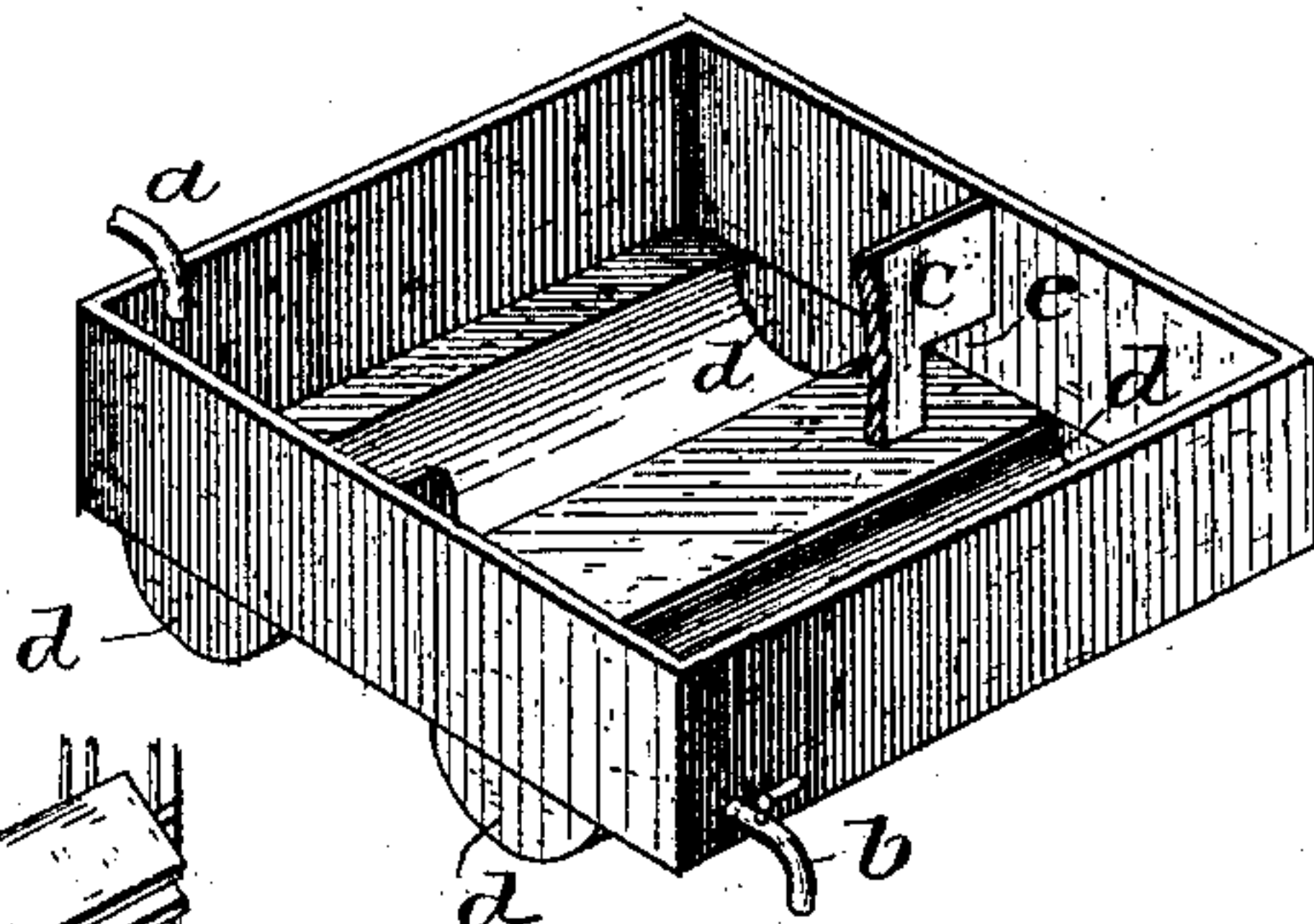


FIG. 4.

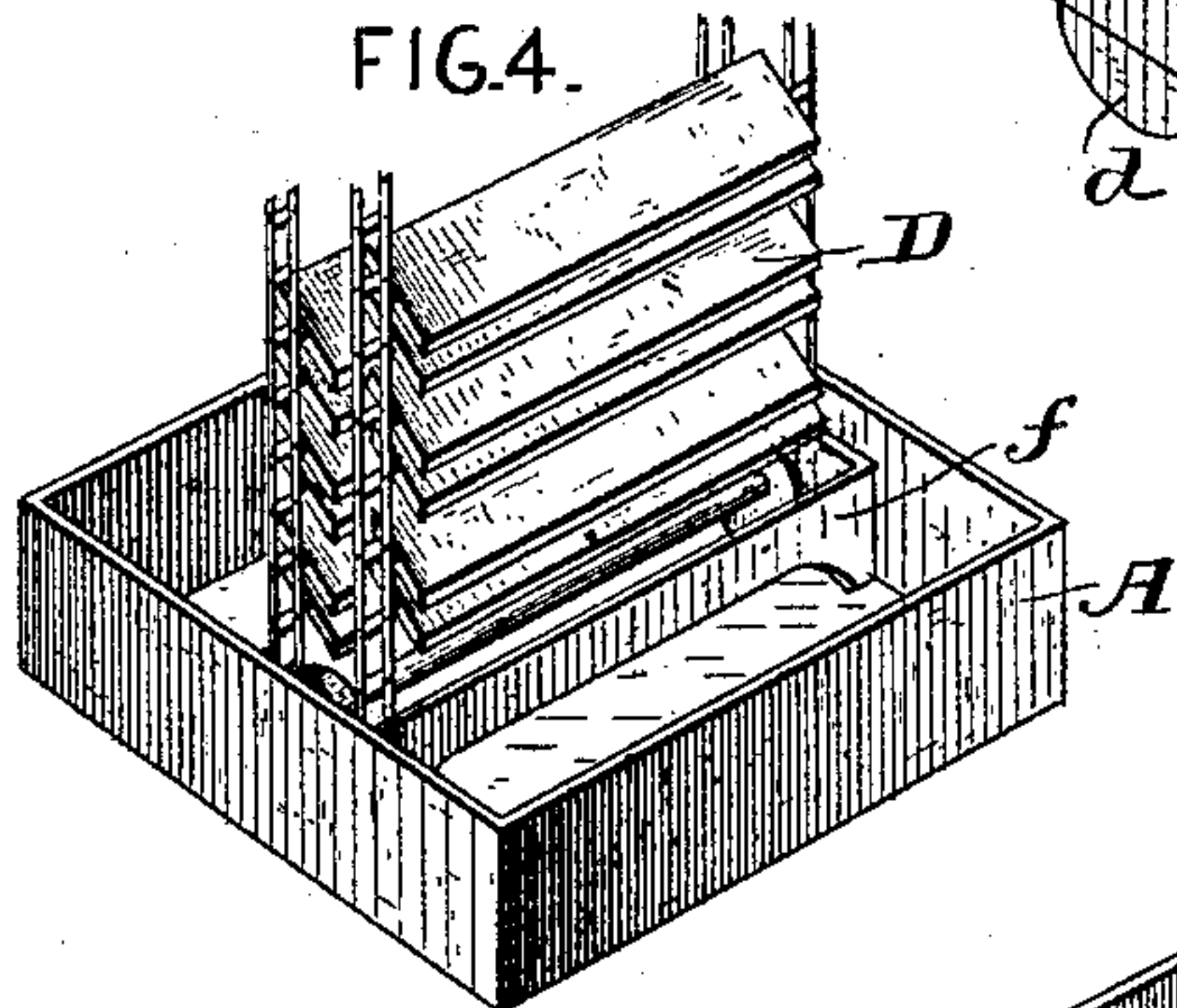


FIG. 5.

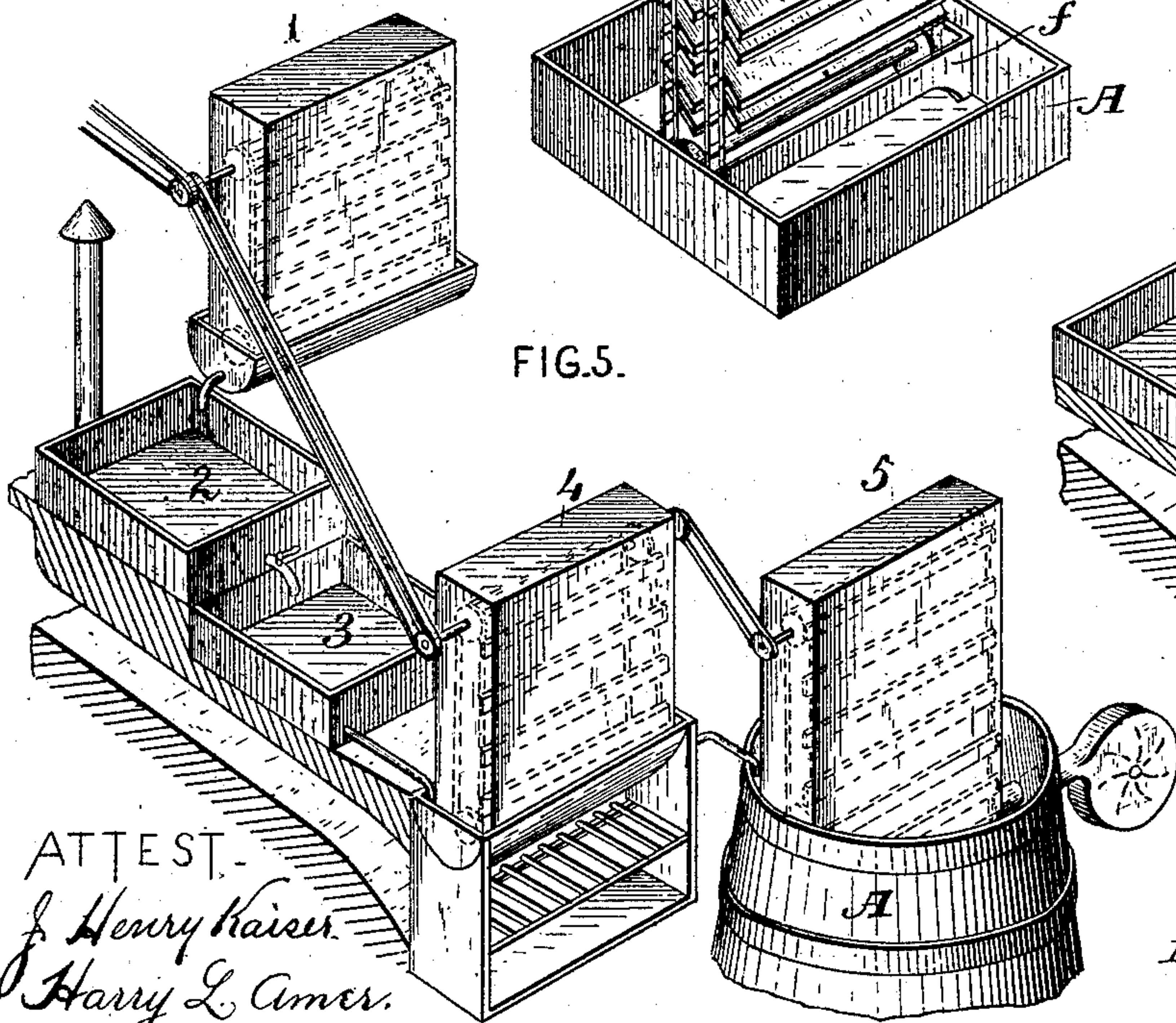
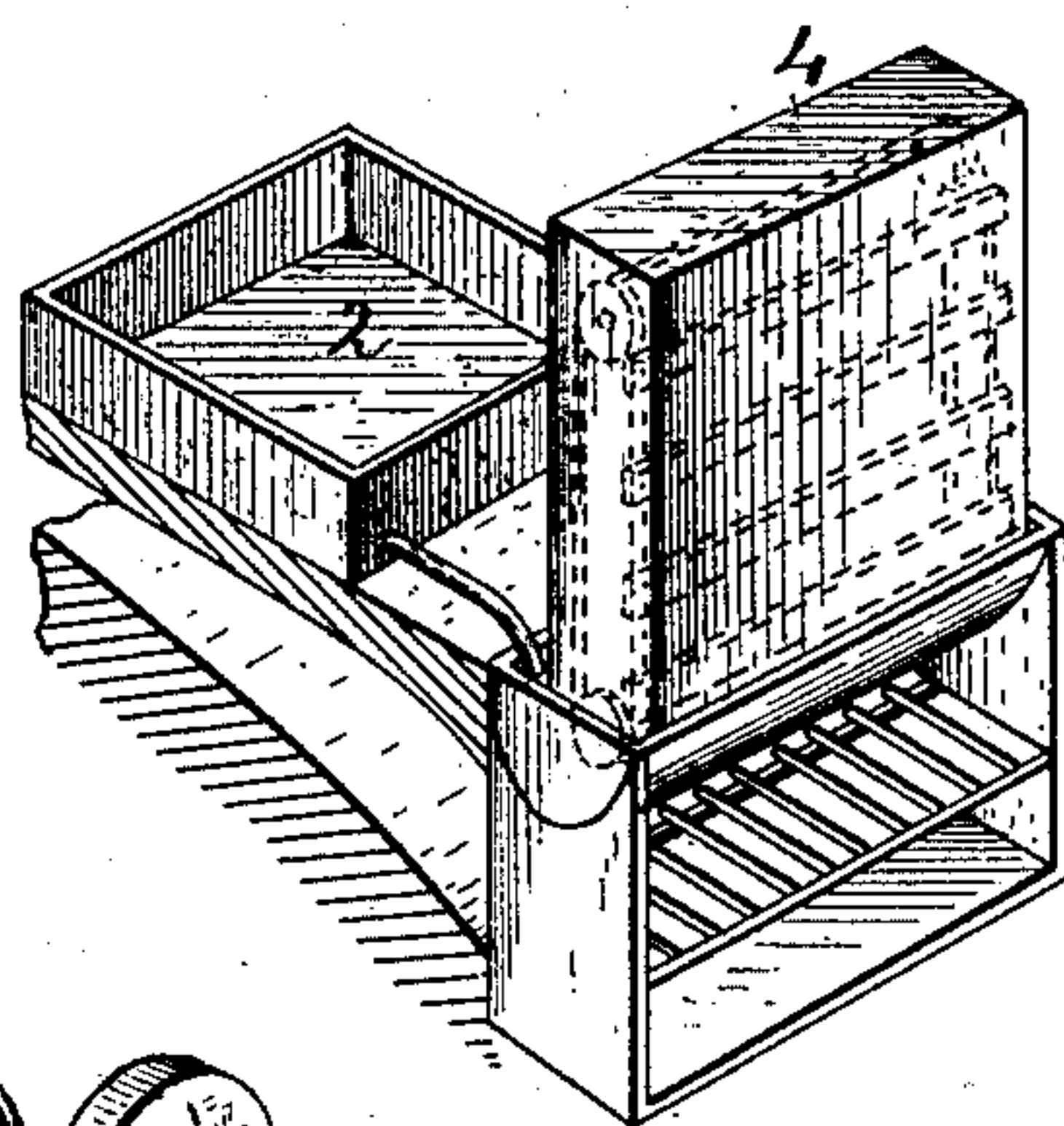


FIG. 6.



ATTEST.  
f Henry Kaiser.  
Harry L. Amer.

INVENTOR.  
Albert A. Denton  
By L. Deane  
his Attorney



# UNITED STATES PATENT OFFICE.

ALBERT A. DENTON, OF BAVARIA, KANSAS.

## APPARATUS FOR EVAPORATING LIQUIDS BY AIR.

SPECIFICATION forming part of Letters Patent No. 353,292, dated November 30, 1886.

Application filed March 16, 1886. Serial No. 195,462. (No model.)

*To all whom it may concern:*

Be it known that I, ALBERT A. DENTON, a citizen of the United States, residing at Bavaria, in the county of Saline and State of Kansas, have invented certain new and useful Improvements in Apparatus for Evaporating Liquids by Air, of which the following is a specification, reference being had therein to the accompanying drawings.

The object of this invention is to improve the apparatus for evaporating liquids by air for which Letters Patent were granted me December 23, 1884, No. 309,775, and April 6, 1886, Nos. 339,388, 339,389, and 339,390.

It consists in an improved construction of the basin or pan containing the liquid to be evaporated in the apparatus previously described.

It also consists in using a scum-guard for the liquid-conveyer.

It also consists in using the aforesaid apparatus as a bleacher, exposing cane-juice or fruit-juices in thin films to the action of sulphurous-acid gas or other suitable substance, in connection with defecating and clarifying pans, to which lime or other chemicals may be added for the purpose of clarifying the liquid, and to which sugar or other soluble substance may be added for the purpose of increasing the density and raising the boiling-point of the liquid, as described in my patent dated December 23, 1884, No. 309,776, or an evaporating-pan for the purpose of evaporating the water from the liquid, and thus increasing the density and increasing the temperature of the liquid in order to coagulate the impurities, in connection with a finishing pan or basin containing the air-evaporating apparatus described in this and in my previous specifications, and also in connection with an air-evaporating apparatus, constructed as described, to which cold air is admitted for the purpose of exposing the warm liquid to cold air, for the purpose of quickly cooling the liquid in thin films, and at the same time evaporating it.

It also consists in constructing this combined apparatus, consisting of bleaching apparatus, defecator, clarifier or evaporator, and air evaporator and cooler, so that one furnace, one fire, and one fireman may, when desired, furnish the heat necessary for these combined purposes.

Figure 1 is a perspective view of this device with part of the casing broken away and top removed; Fig. 2, a detail in perspective of the pan; Fig. 3, a detail in view of the pan modified; Fig. 4, a detail showing the scum-guard as applied in use; Fig. 5, a perspective view showing the apparatus used in clarifying as well as evaporating; Fig. 6, a detail showing modification of the same.

A single-slat liquid-conveyer, or a series, or a compound-slat liquid-conveyer, or a series, may be placed in a basin or pan having a flat bottom, as shown in Fig. 1, containing the liquid to be evaporated or operated on. In this case it is necessary to have a sufficient depth of liquid over the bottom of the pan to immerse the lower slats of the liquid-conveyer.

The basin or pan A may have the shape of a trough or semicircle, fitting the arc of the circle described by the slats of the liquid-conveyer when passing under the lower wheels, as shown in my other applications. This form diminishes the quantity of liquid necessary to properly immerse the lower slats of the liquid-conveyer to the least possible quantity. In cases where heat is applied to the liquid under the basin or pan this construction also largely increases the heating-surface of the basin or pan, which is also desirable.

It is sometimes desirable to admit the liquid to be evaporated continuously to the basin or pan A, and to draw off the evaporated liquid continuously from the basin or pan, instead of at intervals, and to perform the evaporation while the liquid is passing or moving through the basin or pan. I accomplish this by constructing the basin or pan A, Fig. 1, having a flat bottom divided by partitions *c*, so that the liquid passes through the channels between the partitions, and through openings or spaces *e* at each alternate end of the partitions, so that the liquid enters continuously at one end of the first channel in the basin at *a*, passes along that channel and around the partition, returning in the second channel, and so on, passing backward and forward across the pan until it reaches the point of exit at *b*, where it passes out of the pan. The single-slat conveyers or the compound-slat conveyers *D D* evaporate the liquid in each channel as the liquid passes through the channel or channels of the basin or pan.



I prefer to have the openings or spaces *e*, in the alternate ends of the partitions, near the bottom of the pan, so that the denser liquid may pass into the next channel, while the lighter liquid on the surface is retained. The bottom of the pan may also consist of a series of troughs or corrugations, the bottom of the liquid-conveyers passing through these troughs or corrugations, as shown in Fig. 3 at *d d*, the liquid being admitted to the first trough at *a*, passing along that trough and through outlet *e* into the next trough, and passing along that trough to the outlet *b* into the next trough, or out of the pan, and being evaporated by the liquid-conveyers while passing through the troughs. In this form, also, I prefer to have the openings or connections *e* in the alternate ends of the troughs near the bottom of the pan, so that the lighter liquid on the surface may be retained, while the denser liquid at the bottom passes into the next trough or channel.

By this construction the quantity of liquid necessary to immerse the lower slats of the liquid-conveyers is reduced to a minimum, the heating-surface of the bottom of the basin or pan A, containing the liquid to be evaporated, is considerably increased, and the liquid is admitted continuously to the basin or pan A and may be drawn off continuously, and the liquid is evaporated by the liquid-conveyers D while it is passing through the troughs or channels of the pan.

This method has many advantages, for none of the liquid is retained long in the basin or pan exposed to heat, and the less the quantity of liquid operated on at a time the sooner the evaporation is performed.

I am aware that evaporating-pans have been constructed with partitions and the liquid evaporated while moving through channels in the pan, the liquid being admitted continuously; but I am not aware that the basin or pan of an air-evaporating apparatus has been thus constructed, or that the evaporation in such basin or pan has ever been performed by traveling liquid-conveyers working in such channels or troughs.

In some cases I place a guard around the lower part of the liquid-conveyer in the liquid in the basin A, as shown at *f*, Fig. 4. The object of this guard is to prevent the scum on the surface of the liquid from adhering to the slats of the liquid-conveyer. The impurities are coagulated and the scum is formed in the hotter parts of the liquid which are more remote from the liquid-conveyer, much more than near the liquid-conveyer, because the evaporating-surfaces of the liquid-conveyer are also cooling-surfaces, and the greater degree of heat in the parts of the pan more remote from the liquid-conveyer determines the coagulation of the impurities and the formation of scum in these parts rather than at the liquid-conveyer. The object of the guard *f*, Fig. 4, is to prevent the scum being thrown by the boiling of the liquid, or while it is skimmed off, upon the surfaces of the slats of the liquid-conveyer and

adhering to them. The guard *f* extends nearly to the bottom of the liquid in the basin, but allowing free access of the liquid in the basin to the liquid-conveyer, and extends above the surface of the liquid around the liquid-conveyer, thus preventing the scum on the surface of the liquid from coming in contact with the liquid-conveyer.

In manufacturing sugar and sirup from cane-juice or other saccharine liquids, and in evaporating fruit-juices and other impure liquids, it is necessary to clarify as well as to evaporate them. In such cases I use, first, Fig. 5, a bleacher, 1, consisting of an apparatus for exposing large surfaces of liquid to air or vapor or gas, similar to that for which a patent was allowed me December 23, 1884, No. 309,775, and similar to the apparatus described in my subsequent specifications now pending.

In this apparatus the liquid is exposed in thin films to the action of sulphurous acid gas; or a solution of sulphurous gas and of water may be formed, or bisulphite of lime may be formed in this apparatus, and the solution or the bisulphite may then be added to the liquid which is to be clarified; but I prefer to expose the cane-juice or fruit-juice to the fumes of sulphur in this apparatus, or to other suitable gas. The liquid then passes into a defecating-pan, 2, where lime or other suitable chemicals may be added to clarify the liquid. The liquid is then heated nearly to its boiling-point to coagulate the impurities, and the clear liquid is then drawn off into the clarifying-pan 3, leaving the scum and the sediment in the defecating-pan. In the clarifying-pan heat is applied, and the liquid is boiled until its density is increased sufficiently to raise its boiling-point and to increase its temperature to a degree sufficient to complete the coagulation of the impurities.

Instead of thus boiling the liquid to increase its density, sugar or any suitable soluble substance may be added to the liquid in sufficient quantity to increase the density of the liquid at once, instead of by long-continued boiling, as described in my process for making sugar for which Letters Patent were granted me December 23, 1884, No. 309,776. In this case, after the sugar or other soluble substance is added and the liquid has the proper density, heat is applied until the liquid is near its now high boiling-point. Then the heat is removed and the liquid is skimmed, and the now clarified semi-sirup is drawn off into the air-evaporating apparatus 4, described in this and in my previous specifications, and the evaporation is completed at the proper temperature. When the liquid has attained the proper density, it is drawn from this air-evaporating apparatus into a similar apparatus, 5, for exposing large surfaces of liquid to air, and the liquid is exposed in thin films to cold air, and it is quickly cooled, and this cooling process also still further evaporates the liquid, all of which is shown in Fig. 5.



In some cases the bleacher may be dispensed with, and with some liquids the first or the defecating pan may be also dispensed with, and in some cases the cooling apparatus may be dispensed with, as in Fig. 6. In other cases, however, the combination of the bleaching apparatus, the defecating-pan, the clarifying or evaporating pan, the air-evaporating finishing apparatus, and the cooling apparatus is greatly preferable.

What I claim, and desire to secure by Letters Patent, is—

1. In an air-evaporator, a basin or trough for the liquid, made in semicircular form, and combined with the liquid-conveyers, substantially in the manner and for the purposes described.

2. In an air-evaporator, a basin or pan having a flat bottom and divided by parallel partitions into channels, the partitions having openings at alternate ends, so that the liquid passes or flows backward and forward across the pan through the channels, the liquid being admitted continuously, and being evaporated by the single-slat or compound-slat liquid-conveyers in each channel while flowing through the pan, and also passing out of the pan continuously, as set forth.

3. In an air-evaporator, a basin or pan having a bottom composed of a series of troughs or corrugations corresponding to the single-slat or compound-slat liquid-conveyers used, the troughs being connected by pipes at their alternate ends, so that the liquid flows forward and returns across the pan through the troughs or corrugations, and from one trough to another through the connections, the liquid being admitted continuously, and being evapo-

rated by the liquid-conveyers while flowing through the troughs and passing out of the pan continuously, the troughs or corrugations having a semicircular form fitted to the arc of the circle described by the single or compound slats of the liquid-conveyers while passing under the lower wheels, as set forth.

4. In an air-evaporator having a basin divided by parallel partitions into channels or troughs, the alternate openings or connections of one channel or trough to the next, near the bottom of the channels or troughs, to retain the less dense liquid on the surface, as set forth.

5. In an air-evaporator, as described, in combination with the slats or liquid-conveyers, and a trough or basin, as described, a scum-guard, *f*, in the trough or basin and at the lower end of the slat or conveyer, substantially as described.

6. In evaporating sirup, fruit juices, and like liquids, the process of exposing large surfaces of the liquid to air, vapor, or gas, for bleaching or clarifying by the fumes of sulphur or other gas, or by use of bisulphite of lime, then, after the first clarification has been performed by heat, adding clarifying chemicals when the liquid is boiling, adding at the same time sugar or other clarifying substance to increase the density, and evaporating the liquid thus treated by an air-evaporator apparatus, as described, all substantially in the manner set forth.

In testimony whereof I affix my signature in presence of two witnesses.

ALBERT A. DENTON.

Witnesses:

ORLO HUBBARD,  
H. DICKEY.