2 Sheets—Sheet 1.

D. WATSON.

EVAPORATING APPARATUS.

No. 186,645. Patented Jan. 23, 1877.

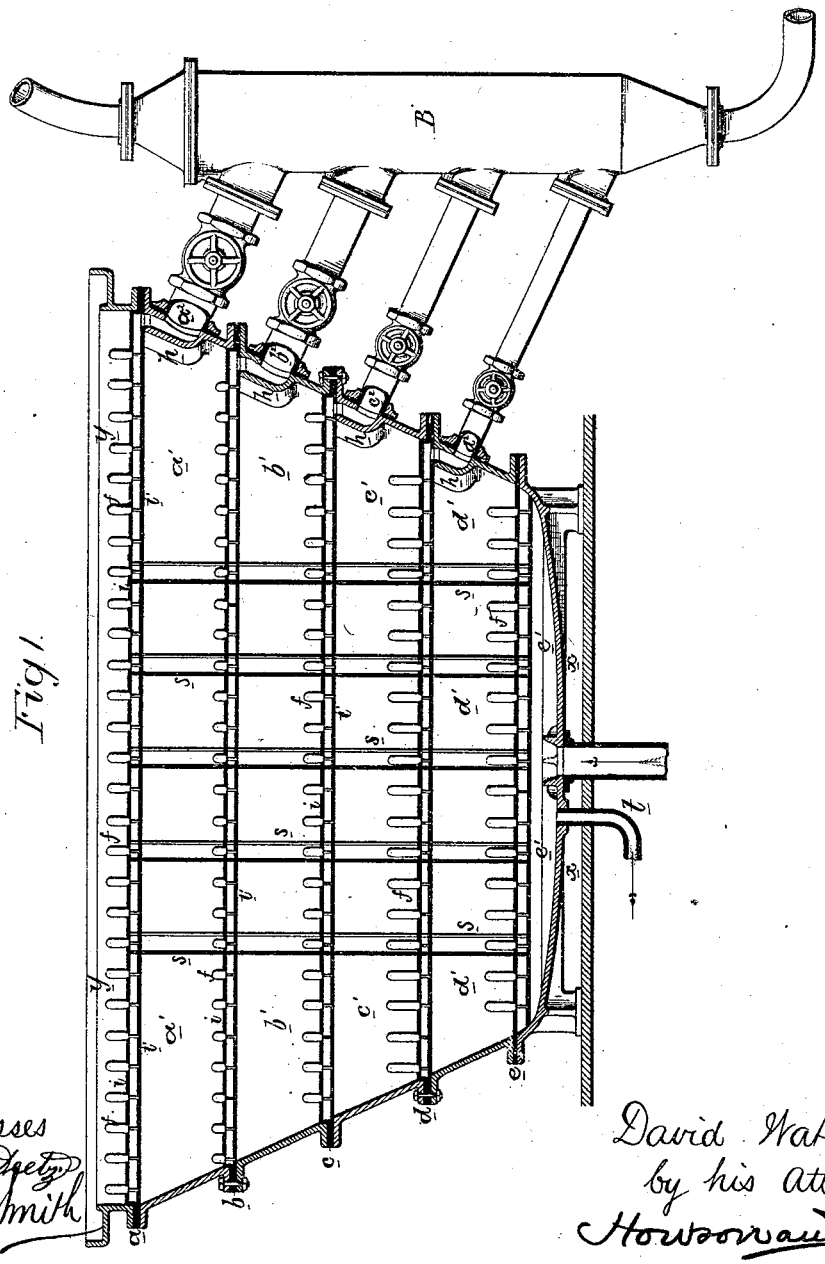

Fig. 1.

Witnesses
Ellwood S. Speetzy
Harry Smith

David Watson
by his Attorneys
Howson and Sons

2 Sheets—Sheet 2.

D. WATSON.

EVAPORATING APPARATUS.

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Fig. 2.

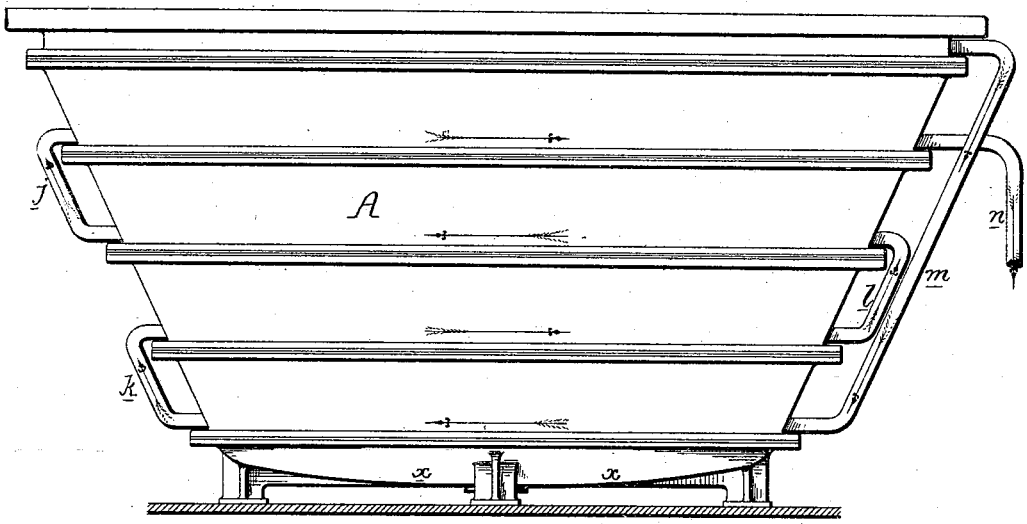


Fig. 3

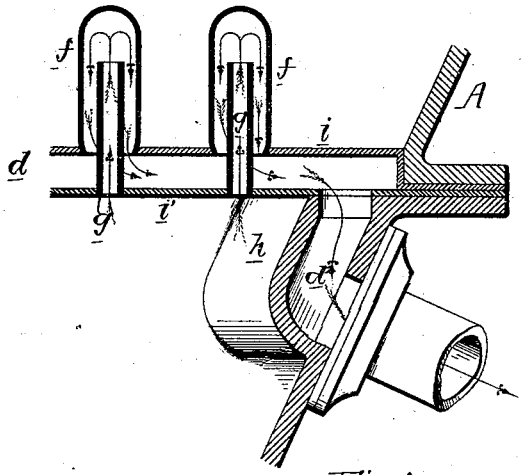
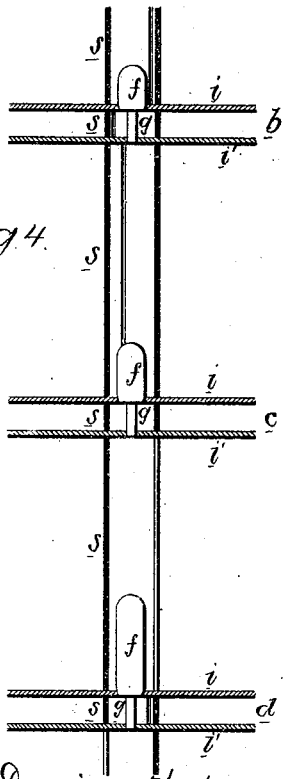


Fig. 5

Fig 4.



Witnesses
Ellwood F. Deetz
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by his Attorneys
Howson and Son

UNITED STATES PATENT OFFICE.

DAVID WATSON, OF HAVANA, CUBA.

IMPROVEMENT IN EVAPORATING APPARATUS.

Specification forming part of Letters Patent No. **186,645**, dated January 23, 1877; application filed July 10, 1876.

To all whom it may concern:

Be it known that I, DAVID WATSON, of Havana, Cuba, have invented certain Improvements in Apparatus for Evaporating Liquids, of which the following is a specification:

The object of my invention is to so construct an apparatus for evaporating liquids that the process may be accomplished in several compartments within a single casing, and at a lower temperature than at present; and this object I attain in the manner which I will now proceed to describe, reference being had to the accompanying drawing, in which—

Figure 1 is a vertical sectional view of my improved apparatus; Fig. 2, an outside view of the same, drawn to a smaller scale; and Figs. 3, 4, and 5, enlarged views of parts of the apparatus.

A is a casing, made in the shape of an inverted frustum of a cone, the bottom of which is closed by a concavo-convex plate, *x*, while the space within the casing is separated by five partitions, *a*, *b*, *c*, *d*, and *e*, into five chambers, a^1, b^1, c^1, d^1, and e', the space above the top partition forming an open shallow pan, *y*, for a purpose described hereafter. In the present instance, the casing A is made in sections, and the edges of the partitions are bolted between flanges on the various sections; but other modes of securing the partitions may be adopted. The partitions are made of two plates, *i* and *i'*, with an intervening space between them. To the upper plate *i* of each partition are secured the lower ends of a number of dome-like shells, *f*, made of thin sheet metal, the space within each shell communicating with the space between the plates *i* and *i'*, and also communicating with the chamber below that in which the said shell is situated, through a tube, *g*, secured at its lower end to the plate *i'*. (See Fig. 3.) The object of this is to afford an extended surface for heating the liquid in contact with the shells. The spaces inclosed by the partitions *a*, *b*, *c*, and *d* communicate with the interior of pockets *h*, formed on one side of the casing, and these pockets communicate, through pipes a^2, b^2, c^2, and d^2, with a condenser, B, of any suitable construction. The pipes a^2, b^2, c^2, and d^2 vary in diameter, the former being the largest and the latter the smallest, for a purpose hereafter explained.

The chambers a^1, b^1, c^1, and d^1, as shown in Fig. 2, communicate with each other through pipes *j*, *k*, and *l*, the pipes *j* and *k* being arranged on one side of the casing, and the pipe *l* on the opposite side. The chamber d^1 also communicates through a pipe, *m*, with the open pan *y* at the top of the apparatus, and the chamber a^1 has a discharge-pipe, *n*. The course taken by the liquid in passing through the apparatus is shown by the arrows in Fig. 2, the liquid being first introduced into the open pan *y* at the top, and descending through the pipe *m* into the chamber d^1. Steam enters the chamber e', and rises into the shells *f* of the partition *e*. The latter soon become highly heated, and cause the liquid to boil as it flows over the partition, the vapor of the boiling liquid ascending into the shells *f* of the partition *d*, and, after heating the same, passing into the space between the plates of the partition, and thence, through the pocket *h* and pipe d^2, to the condenser, the condensation of this vapor thus creating a partial vacuum in the chamber d^1, and facilitating the boiling of the liquid therein. The liquid then ascends through the pipe *k*, and enters the chamber c^1, across the bottom of which it flows in contact with the heated shells *f* of the partition *d*, which again raise its temperature to the boiling-point, the vapor rising into the shells *f* of the partition *c*, passing to the condenser, and producing a partial vacuum in the chamber c^1, in the same manner as before described. The liquid next passes up through the pipe *l* into the chamber b^1, where it is again heated, giving off vapor, which heats the shells of the chamber above, and is condensed as before, the liquid passing up through the pipe *j* into the chamber a^1, crossing the bottom of the same, and being discharged in the desired thickened condition through the pipe *n*. The vapor from the chamber a^1, before condensation, heats the shells *f* of the topmost partition *a*, thus serving to partially heat the liquid in the shallow pan *y*, which feeds the apparatus, while at the same time

this vapor is deprived of a great portion of its heat, which would otherwise pass to the condenser.

It will be evident that as each set of shells is heated merely by the vapor from the chamber beneath, the heat of the shells at the top of the apparatus is less than that of those at the bottom—in other words, the heat of the shells gradually decreases from the bottom upward; but to compensate for this, the heating-surfaces at the top of the apparatus are, owing to the form of the casing, of much larger area than those at the bottom, while owing to the difference in the area of the pipes, which form communications between the chambers a^1, b^1, c^1, and d^1 and the condenser, the vacuum is greatest in the top and least in the bottom chamber, or, in other words, decreases from top downward. Owing to the extended area of the partitions, and to the difference in the degree of vacuum within the chambers of apparatus, considerable pressure is exerted against the partitions, and in order to prevent the collapse of the same I employ the system of stays shown in Figs. 4 and 5.

At regular distances apart within the chambers of the apparatus are arranged a series of split tubes, *s*, which extend from top to bottom of the chambers, while between the plates *i* and *i'* of each partition are arranged similar, but shorter, tubes, the position of the tubes within each of the chambers, and within each of the spaces between the plates of the partitions, being exactly alike, so that a number of stays extending from the bottom plate of the lowermost partition *e* to the top plate of the topmost partition *a* are produced—these stays, owing to their columnar form, being best calculated to resist the crushing pressure to which the collapse of the partitions would subject them. Owing to the close proximity of the heating-shells *f* within the chambers, it becomes necessary to allow the tubes *s* to surround a number of them; and in order to allow the free access of the liquid to these shells and the free exit of the vapor therefrom into the spaces in the partitions, the splitting of the tubes is resorted to. The water of condensation from the steam which heats the shells *f* of the partition *e* passes round the loosely-fitting edges of the bottom plate *i'* of the same into the chamber *e*, from which it is carried off through a pipe, *t*. Filtering-vessels may, if desired, be combined with the connecting-pipes *j*, *k*, and *l*, so that the liquid will be filtered as it passes from one chamber to another.

It will be evident, without further description, that with the above-described apparatus the continuous evaporation of the juice can be effected within a single casing much more readily and cheaply than with a series of vacuum-pans, while the cost of the apparatus in the outset is comparatively slight.

I claim as my invention—

1. In an apparatus for effecting the evaporation of liquids, the combination, within a casing, of a series of vacuum-chambers, connected as described, whereby the juice enters the bottom chamber of the series, and is caused by the vacuum to pass up into and across the heated bottom plates of all the chambers before being discharged from the uppermost, as set forth.

2. The combination of the casing A with the partitions *a b c*, &c., the heating-surfaces of which increase in area from the bottom of the casing upward, as set forth.

3. The combination of the casing A, its chambers a^1 b^1 c^1, &c., and the condenser B, with the pipes a^2 b^2 c^2, &c., differing in area, as described, and serving to establish communication between said chambers and the condenser, as set forth.

4. The combination of the condenser B and its connecting-pipes with the casing A, its double partitions *a b c*, &c., and the pockets *h*.

5. The combination of the casing A and its partitions with split tubes *s*, forming stays, as set forth.

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

DAVID WATSON.

Witnesses:
JOS. A. RAPHEL,
L. V. SCHMIDT.