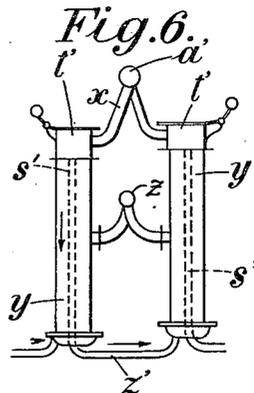
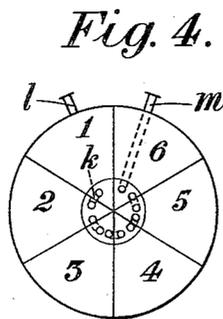
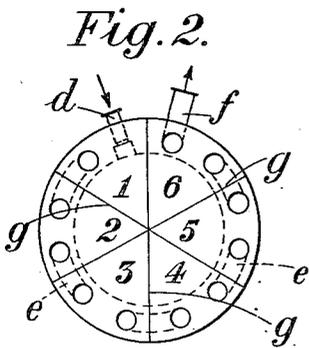
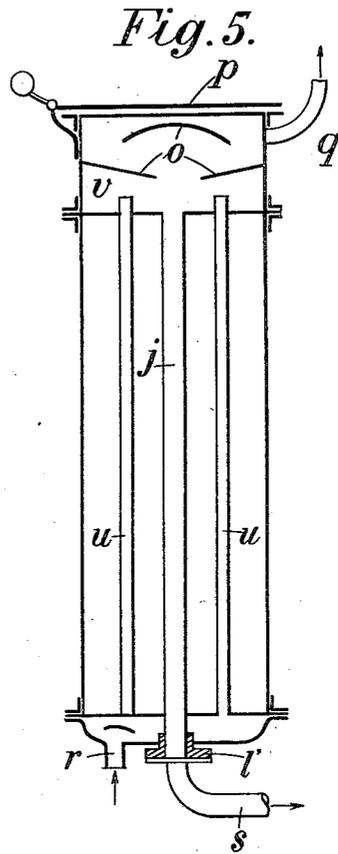
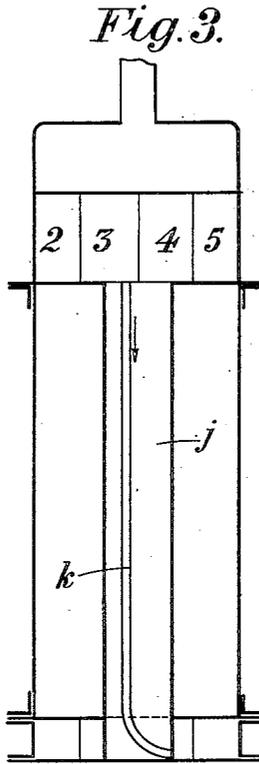
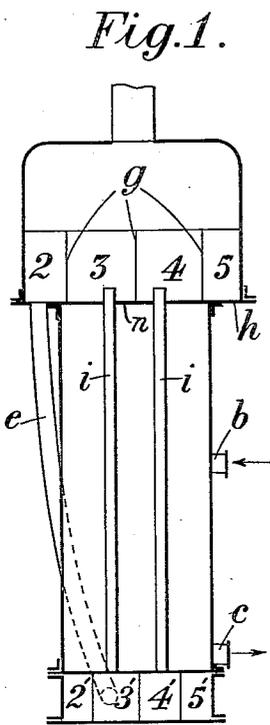


1,371,784.

Patented Mar. 15, 1921.
 2 SHEETS—SHEET 1.



Inventor.
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UNITED STATES PATENT OFFICE.

JEAN CHARLES GRIÈRE, OF VARESE, ITALY.

EVAPORATOR.

1,371,784.

Specification of Letters Patent. Patented Mar. 15, 1921.

Application filed August 24, 1920. Serial No. 405,748.

To all whom it may concern:

Be it known that I, JEAN CHARLES GRIÈRE, a citizen of the French Republic, residing in Varese, Province of Como, Italy, have invented certain new and useful Improvements in Evaporators, of which the following is a specification.

This invention relates to evaporators of the type comprising a circulatory system for the liquid which consists of a series of upper chambers and a series of lower chambers connected by rising tubes located in the heating space and by down-pipes, and so arranged that the liquid circulates from chamber to chamber, traversing an upper and a lower chamber alternately, owing to the action of the heat on the rising tubes.

In evaporators of this type as constructed heretofore there is the practical drawback that it is very difficult to eliminate the juice completely from the upper tube plate, on account of constructive necessities (angle irons and flanges of calenders, etc.) which necessitate the provision of a space between the upper edge of the plate and the lower edge of the discharge pipe which leads off the evaporated liquid.

On the other hand, the construction of evaporators with tube plates in the form of a truncated cone, that is to say, where the juice flows toward the center along an inclined surface, is complicated and expensive, and the working is faulty.

The object of the present invention is to eliminate these various disadvantages and to provide an evaporator of the type referred to more convenient in design, easier to erect and to work, and at the same time more efficient in insuring regular circulation of the liquid with resulting more equal, and therefore greater, transmission of heat, than in previous evaporators.

The essential feature of the invention consists in the down pipes which pass the liquid to be evaporated from the upper chambers to the next lower chambers having their ends flush with the upper tube plate which is always quite horizontal, the concentrated liquid being discharged through the last down pipe.

When the down pipes are outside the evaporator, the upper tube plate is of greater area than the lower tube plate whereby it can receive at its periphery, and outside the

nest of rising tubes, the vertical down pipe or pipes without bends.

The down-pipes, instead of being outside the nest of rising tubes, may be arranged in the center of the said nest in the interior of a central tube, the upper ends of the down-pipes being flush with the surface of the upper plate, and their lower ends opening into the next lower chamber of the series.

In the case of an evaporator with only one upper and one lower chamber, the single down-pipe which may be central or eccentric, with reference to the tube plates, is provided with a stuffing box where it leaves the evaporator.

The upper and lower chambers of a multi-chamber evaporator may consist of two series of compartments separated by partitions, one series located above the upper tube plate and the other series below the lower tube plate, and the whole inclosed in a suitable shell or casing.

According to this invention the evaporator may be built up of a number of elements each comprising a single upper and a single lower chamber connected by rising tubes and a single down-pipe as indicated above, the said elements being arranged in series, so that the down-pipe of the first element delivers liquid to the lower chamber of the second element, and so on, or in parallel so that liquid enters all the lower chambers and is discharged from all the down-pipes simultaneously.

This arrangement results in great simplification of construction, in a better utilization of the erecting space and generally in more convenient handling of the apparatus.

In order to make possible quick inspection or cleaning of the tubes of the evaporating surface, and to avoid unnecessary height of the dome above the upper chambers, the said dome may be fitted internally with removable metal plates adapted to prevent froth and drops of juice from passing away with the steam and with tipping cover with a tight joint.

Another drawback common to continuous evaporation apparatus in which the juice circulates only once in each evaporating tube, is that the dome into which the vapor rises, and the vapor-evacuating conduits leading therefrom, are liable to become filled with liquid. Moreover in the event of an

unforeseen stoppage of evaporation, or of an obstruction in the circulation, there is a possibility of steam escaping through the down-pipe and when this pipe, in multiple action apparatus, connects the last element or chamber of an evaporator to another apparatus heated say by the juice steam generated by the first evaporator, or simply to a condenser, the difference of pressure existing between the front and the rear end of the pipe will cause auto-evaporation of the liquid in the pipe, and direct passage of the steam into the evaporating chamber of the next evaporator or into the condenser. To maintain the pressure in the said pipe before it opens into the next apparatus by throttling the flow of juice therein by means of a valve is an expedient which is not very reliable and has many disadvantages, not the least of which is the irregularity of the circulation of the liquid in the interior of the evaporating tubes of the next apparatus and consequently an impaired utilization of their heating surface.

These disadvantages are overcome by means of float chamber devices and a casing with spiral passages as hereinafter described and claimed.

In order that the invention may be fully understood there will now be described with reference to the accompanying drawings, and by way of example only, several evaporators embodying the invention.

In these drawings, which are of diagrammatic nature,

Figures 1 and 2 are sectional elevation and plan respectively of one form of evaporator,

Figs. 3 and 4 are similar views of a second construction,

Fig. 5 is a sectional elevation of a one chamber evaporator,

Fig. 6 is an elevation showing how the evaporator of Fig. 5 is duplicated to form a multi-chamber evaporator, and

Fig. 7 is a plan view of such an evaporator,

Fig. 8 is an elevation of two evaporators equipped with certain safety devices described hereinafter, and

Figs. 9 and 10 are details relating to Fig. 8.

In the evaporator shown in Figs. 1 and 2, *b* is the heating steam inlet, *c* the outlet for the water of condensation, *i* the rising tubes arranged in bundles and in which the liquid is evaporated. Each bundle connects an upper chamber 1, 2, 3, 4, 5, 6, with the corresponding lower chamber 1', 2', 3', 4', 5', 6' located above and below the upper and lower tube plates, respectively, the chambers being separated by radial partitions *g*, but the space between the tube plates forms a single heating chamber, the steam having access to all the rising tubes. *d* is the juice inlet, *f* its outlet from the evaporator.

The upper tube plate is of greater area than the lower so that it has an annular part *h* which overhangs the lower part of the evaporator. The upper tube plate *n* is surmounted by a dome the lower part of which is occupied by the upper chambers 1-6 and the upper part forms a steam space from which the steam passes away through a pipe. To the annular part of the upper tube plate are fitted the down pipes *e* having their upper openings flush with the upper surface of the tube plate so that no liquid can accumulate thereon. The lower end of the down-pipes, which are without sharp bends, are connected to the lower chambers, the pipe from chamber 1 being connected to chamber 2', that from chamber 2 to chamber 3', and so on.

In Figs. 3 and 4 the down-pipes, instead of being external as in Figs. 1 and 2, are arranged inside a central tube *j* which runs from the upper tube plate to the base of the evaporator. The upper and lower tube plates are of similar diameter, but in general the construction is similar to that of Figs. 1 and 2. *l* is the inlet for the liquid, *m* the outlet.

The evaporator shown in Fig. 5 has a single upper chamber and a single lower chamber of equal diameters connected by a bundle of rising tubes *u*. The single down-pipe *j* has its upper end flush with the surface of the tube plate in accordance with the invention, and a stuffing box *v* is provided in the base of the evaporator where the pipe *j* issues. The steam dome is of reduced height and is fitted with removable plates *o* such as shown, which prevent the froth and drops of juice from being carried off with the steam through the pipe *q*. The dome has a hinged cover *p* which closes the dome with a tight joint. *r* is the inlet for the liquid, and *s* the discharge bend of the down-pipe.

Figs. 6 and 7 show how six evaporators as described with reference to Fig. 5 are used as elements of a multiple evaporator. *y y* are the evaporator elements, *t'* the steam domes whose discharge pipes *x* deliver into a common pipe *a'*, *s'* are the down pipes and *z'* the horizontal portion thereof by which the liquid is taken to the lower chamber of the next element. The six elements are arranged in two rows with a common collector *z* for the heating steam. The liquid can pass successively into each of the six elements or simultaneously into all the elements and the circulation of the heating steam could be arranged in accordance with the same alternative.

In Figs. 8-10, A is the last element of an evaporator, and B the first of the next evaporator (Fig. 8). The element A has a box *d'* with a float *b'*, connected by conduits *e'* to the dome or steam and juice chamber *c'*. The float is connected by a cord or rod *w'*

to a regulating valve g' inserted in the juice inlet pipe q' , the automatic action of which valve is effected by the level of the juice in the chamber c' . The latter normally does not contain any juice at all, the juice merely runs over the tube plate toward the discharge pipe $b b''$; but if for any reason the juice fails to circulate and rises in the chamber c' , the float b' reduces or stops completely the admission of juice into the apparatus.

Between A and B, in the pipe which is used for passing the juice from one element to another, is inserted a second device for the purpose of preventing the passage of steam and allowing automatic evaporation of the juice before its admission into the next element, so as not to disturb the evaporation process of the latter, this device comprising a casing h' communicating at the top with the dome c' through a pipe k' , the juice from the element A entering the casing through the pipe b'' . The casing contains a float j' controlling a valve i' which allows the latter to open only when the chamber h' contains sufficient liquid to prevent steam from passing on to the next element.

After having passed through the valve i' , the juice enters another casing l'' which is in communication through a pipe o' with a vessel at a relatively low pressure such as the dome of the element B. The said casing l'' forms an auto-evaporating casing for the juice. To insure in a regular and rapid manner, without any liquid being carried away, the evaporation of the juice due to its superheated state, the lower part of the casing l'' is divided into compartments m' constituted by a vertical spiral partition w' as shown in Fig. 9. In the spiral shaped passage are placed vertically, at desired intervals, wire nettings p' (Figs. 9 and 10) or any other devices such as wires, points, or the like adapted to produce mechanically, at the passage of the juice, a formation of steam bubbles and thus to remove more quickly the excess heat of the liquid. The fluid is carried over to the lower chamber of the element B from the compartments m' by the outlet pipe n .

What I claim as my invention and desire to secure by Letters Patent is:—

1. In an evaporator apparatus having two evaporating elements, a liquid conduit connecting the upper chamber of the first element with the lower chamber of the second element, a first separating means in said conduit having a return duct for vapors to said upper chamber of the first element, a second separating means provided in said conduit with a duct to the upper chamber of the second element for discharging vapors thereto separated from the liquid in said second separating means, the liquid residue being discharged through said conduit into the lower chamber of said second element, each of said elements comprising, an upper chamber subdivided into a plurality of compartments, a lower chamber similarly subdivided, rising tubes connecting similarly located compartments in both chambers, a heating chamber for said tubes provided with an inlet and an outlet for a heat supplying medium, a down pipe connecting one compartment in the upper chamber with a differently located compartment in the lower chamber and inlet and outlet pipes for the liquid in said lower chamber.

2. In apparatus of the class described, in combination, two evaporating elements, a fluid conduit connecting said elements, a preliminary chamber in said conduit communicating with the first element to return steam thereto, a second chamber in said conduit the bottom of which is in communication with the bottom of the second element, and the top of which is in communication with the top of the second element, and a continuous spiral shaped passage in said second chamber having perforated transverse partitions, and a valve between said two chambers controlled by the height of the fluid in the first chamber.

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

JEAN CHARLES GRIÈRE.

Witnesses:

NICOLA PETRUCCI,
NAZZARENO CALDARELLI.