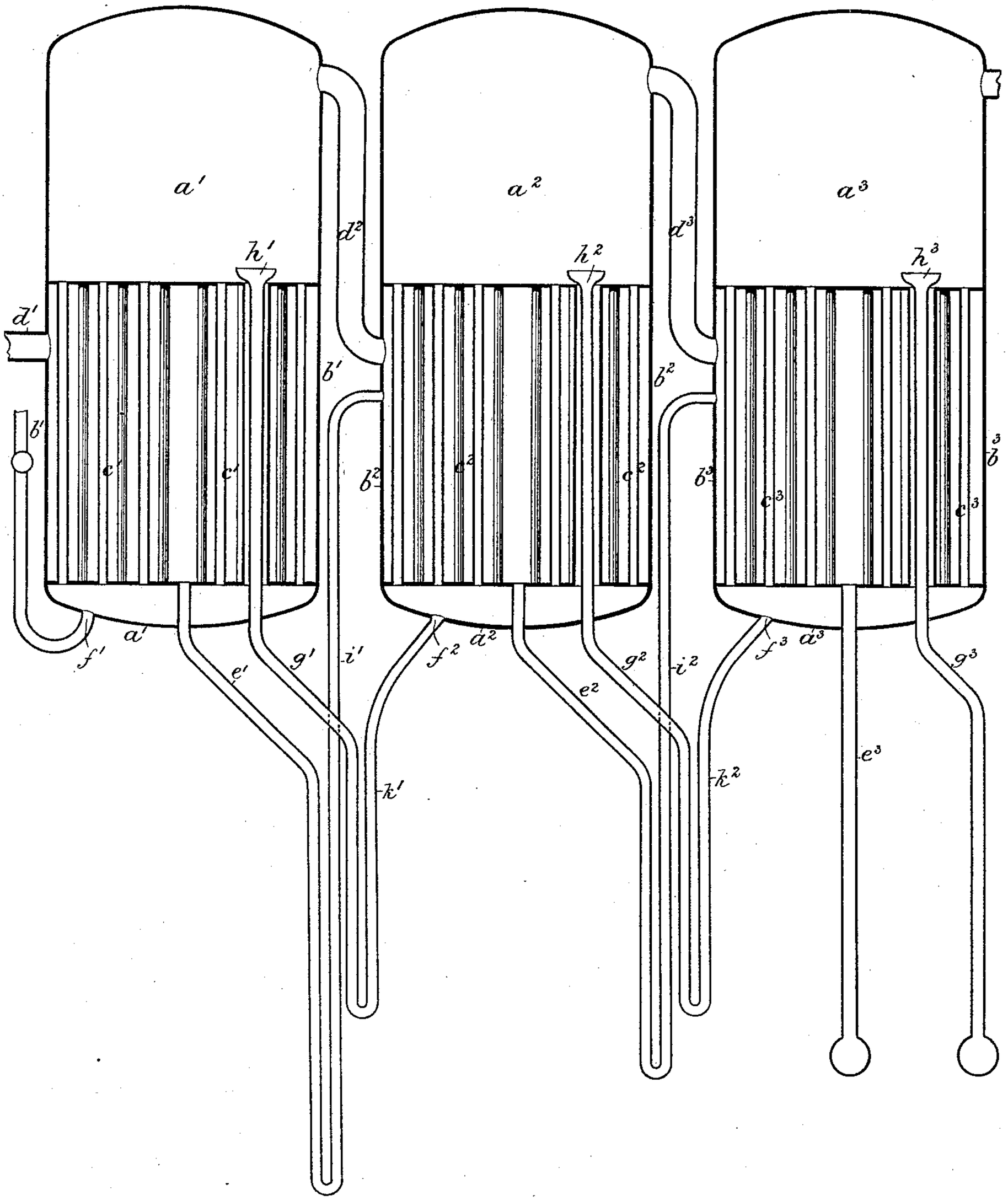
(No Model.)

A. CHAPMAN.

VACUUM EVAPORATING APPARATUS.

No. 411,012. Patented Sept. 17, 1889.



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UNITED STATES PATENT OFFICE.

ALFRED CHAPMAN, OF LIVERPOOL, ENGLAND.

VACUUM EVAPORATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 411,012, dated September 17, 1889.

Application filed October 6, 1888. Serial No. 287,442. (No model.) Patented in England February 20, 1888, No. 2,511, and in British Guiana April 9, 1888.

To all whom it may concern:

Be it known that I, ALFRED CHAPMAN, engineer, a subject of the Queen of Great Britain, residing at Liverpool, England, have invented certain new and useful Improvements in Vacuum Apparatus for Evaporating Saccharine or other Solutions or Liquids, (for which I have obtained Letters Patent in England, No. 2,511, dated February 20, 1888, and in British Guiana, dated April 9, 1888,) of which the following is a specification.

My invention has reference to vacuum apparatus for evaporating saccharine or other solutions or liquids by double, triple, or multiple effect, wherein are employed a plurality of evaporating vacuum-pans in which different degrees of pressure are maintained. In working apparatus of this description it is very desirable to have a free exit for the water produced by the condensation of steam or vapor in the drums of the various evaporating-pans without losing any heat that can be utilized or impairing the vacuum in the drums; and it is also desirable to maintain a free and uninterrupted circulation through the various pans of the solution or liquid which is being treated. Many contrivances have from time to time been designed in order to attain these objects; but these contrivances have either involved steam-traps, which have been found very troublesome, or special pumps for removing and circulating the condensation waters and the solutions; or, again, the waters of condensation have been carried directly to a condenser and their flow into it regulated by means of valves.

Now, according to my invention, without the employment of any valves, pumps, steam-traps, or other mechanism of any description, I make the exit of the condensation waters from each drum regular and self-adjusting, while all the heat contained in these waters that can be utilized for evaporation is availed of, and I also maintain a free and uninterrupted circulation from pan to pan of the solution or liquid which is under treatment.

For the purpose of providing for a free exit for the condensation water from each drum, I connect a pipe to the bottom of the steam-drum of the first pan at the part where the condensations would ordinarily come out, and I carry this pipe down about twenty-five feet, (more or less,) and then carry it up and connect it to the drum of the second pan at a convenient height above the bottom, so that the water being discharged into this drum may part with its extra heat. From the exit of the second drum I carry down a similar pipe, which I likewise carry up and then connect to the steam-drum of the third pan, and so on for any number of pans. These pipes form what may be called "inverted siphons."

For the purpose of maintaining a free and uninterrupted circulation through the pans of the solution or liquid under treatment, I carry a pipe down from the first pan about twenty feet, (more or less,) and then carry it up to and connect it with the second pan, into which it discharges. Similarly I connect the second pan with the third pan, and so on for any number of pans. These pipes likewise form inverted siphons.

By the means above described I obtain a complete and uninterrupted circulation of the condensation waters on the one hand and of the solution or liquid under treatment on the other without the use of any regulating-valves, steam-traps, or other mechanical contrivances, while the pressures in the pans and in the drums are preserved unimpaired.

It will be desirable to place the pans on a stage twenty-five feet or more above the ground-level.

The annexed drawing is a vertical section showing the application of my improvements to a set of three vacuum-pans constituting a triple-effect apparatus.

a' a^2 a^3 are the three pans, and b' b^2 b^3 their three steam-drums, fitted with the ordinary tubes c' c^2 c^3, through which the solution or liquid under treatment flows. d' is the pipe by which steam is supplied to the first pan. d^2 and d^3 are the pipes which convey the vapor from the top of the first and second pans, respectively, to the steam-drums of the second and third pans. To the bottom of the steam-drum b' of the first pan I connect a pipe e' and carry it down about twenty-five feet, (more or less,) as shown. I then carry it

up and connect it, as seen at i', to the drum b^2 of the second pan, so that the condensation waters from the first drum are discharged into the second drum and part with their extra heat. From the bottom of the second drum b^2, I carry down a similar pipe e^2, which I likewise carry up, as seen at i^2, and then connect to the steam-drum b^3 of the third pan. To the bottom of the steam-drum of the third or last pan I connect a pipe e^3, leading to a condenser or otherwise. It will thus be seen that the exit of the condensation waters from each drum is regular, while all the heat contained in them that can be utilized for evaporation is availed of.

f' is the inlet for the solution or liquid to be treated to the first pan a'. The solution, after passing upwardly through the tubes c', flows through a pipe h' into pipe g', which I carry down about twenty feet, (more or less,) as shown, and then carry up, as seen at k', and connect with the second pan, into which it discharges at f^2. Similarly I connect the second pan with the third pan by pipes h^2 and g^2 and continuation k^2. From the pipe h^3 of the third or last pan I carry a pipe g^3 to a reservoir or otherwise. By the above arrangement a free and uninterrupted circulation of the solution from pan to pan is maintained.

If it be thought more convenient, the pipes e' e^2 and g' g^2, down which the waters of condensation and the solution respectively flow, may be placed within the pipes or continuations i' i^2 and k' k^2, respectively, so far as they extend together. The waters of condensation and the solution will then flow up the annular spaces between the inner and outer pipes. The pipes for conveying the condensation waters will of course be covered where exposed with non-conducting material in order to prevent loss of heat.

The length below the evaporating-pans to which the bent connecting-pipes or inverted siphons extend is determined by the relative pressures maintained in the several evaporating-pans. The depending connecting-pipes or inverted siphons should be carried down a sufficient distance to at all times maintain a column of saccharine solution or water of condensation to balance the difference in barometric pressure between the adjacent evaporating-pans or the adjacent drums. Thus, if there should be, for example, a working-pressure of thirty-five inches in the first evaporating-pan and a working-pressure of twenty-three inches in the second pan, the pipe g' should extend below the bottom of the pans at least a sufficient distance to maintain a column of saccharine solution which will balance twelve inches of mercury. In order, however, to provide against all contingencies, the pipes should extend a distance below the pans considerably exceeding the distance demanded by the normal working-pressures. By the employment of these depending connecting-pipes or inverted siphons a free and unobstructed circulation of the saccharine solution and of the water of condensation is insured without interfering with the maintenance of the proper pressures and temperature throughout the series of evaporating-pans.

I claim as my invention—

1. In a double, triple, or multiple effect vacuum evaporating apparatus, the steam-drums thereof, wherein different degrees of pressure are maintained, in combination with depending bent tubes or inverted siphons connecting adjacent drums, said tubes or siphons conveying the water of condensation from one steam-drum to the next in the series, and said tubes or siphons extending below said drums a sufficient distance to maintain a column of water of sufficient height to balance the difference in barometric pressure between adjacent drums, substantially as set forth.

2. In a double, triple, or multiple effect vacuum evaporating apparatus, the evaporating-pans thereof, wherein different degrees of pressure are maintained, in combination with depending bent tubes or inverted siphons connecting adjacent pans, said tubes or siphons conveying the saccharine liquid from one pan to the next in the series, and said tubes or siphons extending below said pans a sufficient distance to maintain a column of saccharine liquid of sufficient height to balance the difference in barometric pressure between adjacent pans, substantially as set forth.

3. In a double, triple, or multiple effect vacuum evaporating apparatus, the evaporating-pans thereof, wherein different degrees of pressure are maintained, and the steam-drums, in combination with depending bent tubes or inverted siphons connecting adjacent steam-drums, and depending bent tubes or inverted siphons connecting adjacent evaporating-pans, said tubes or siphons extending below said pans and drums a distance determined by the relative pressures in said pans and drums, substantially as set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

ALFRED CHAPMAN.

Witnesses:
THOMAS ROBERTS,
THOMAS E. DRISKELL.