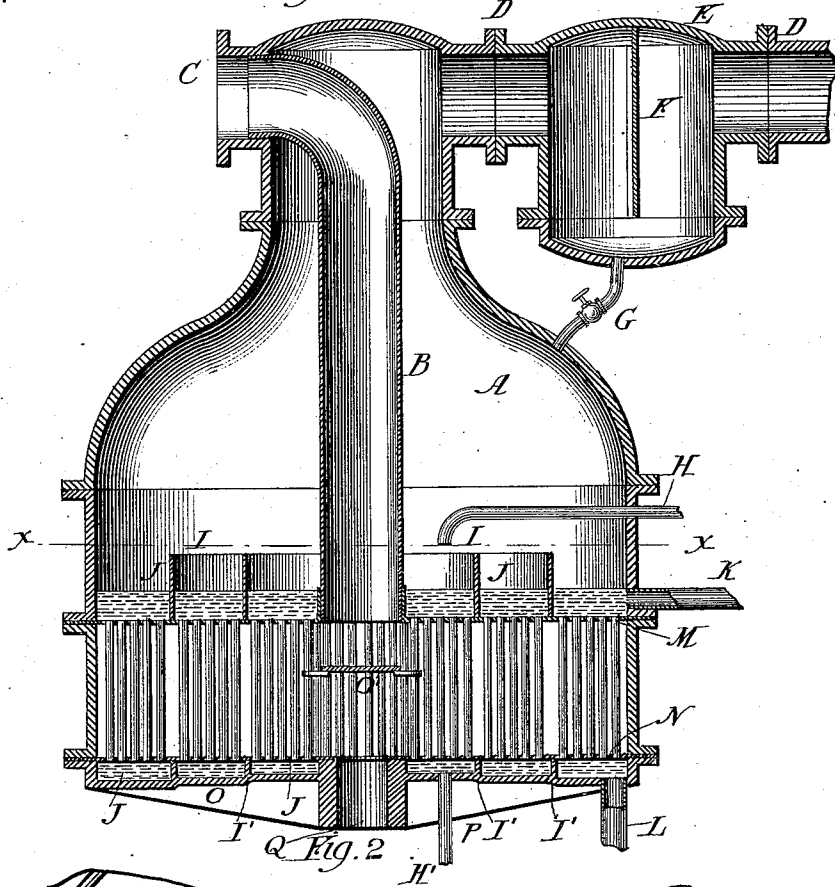
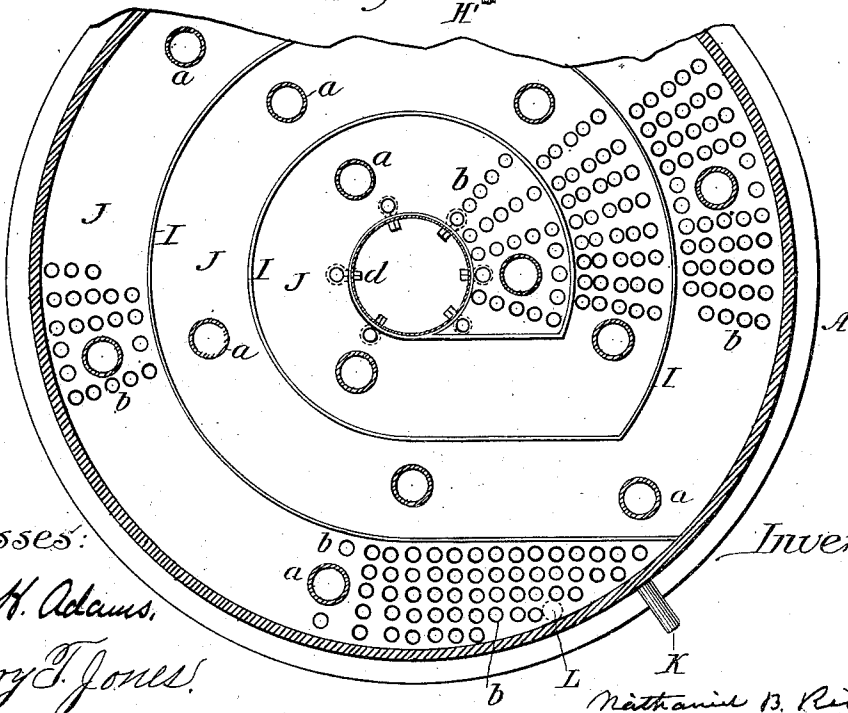


(No Model.)

N. B. RICE.
VACUUM EVAPORATING APPARATUS.

No. 351,795.

Fig. 1. Patented Nov. 2, 1886.



Witnesses:

Albert H. Adams.

Harry T. Jones.

Inventor:

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UNITED STATES PATENT OFFICE.

NATHANIEL B. RICE, OF CHICAGO, ILLINOIS.

VACUUM EVAPORATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 351,795, dated November 2, 1886.

Application filed January 30, 1886. Serial No. 190,321. (No model.)

To all whom it may concern:

Be it known that I, NATHANIEL B. RICE, residing at Chicago, in the county of Cook and State of Illinois, and a citizen of the United States, have invented certain new and useful Improvements in Vacuum Evaporating Apparatus, of which the following is a full description, reference being had to the accompanying drawings, in which—

10 Figure 1 is a vertical section, and Fig. 2 a cross-section through the tubular portion.

The object of this invention is to provide an evaporator to be used in the vacuum process of evaporation, either by itself or in connection with one or two additional evaporators of a similar construction, it being designed to take the place of evaporators now used in a similar manner in evaporating the water from saccharine liquors, milk, gelatinous liquors, or other fluid to be evaporated or reduced; and its nature consists in the several improvements and combinations of parts, hereinafter described and claimed as new.

In the drawings, A indicates the exterior shell or case; B, the steam-inlet pipe; C, flanged tube for connecting the steam apparatus; D, tubes or extensions for connecting with a second evaporator, or with the condenser when only one evaporator is used; E, a receptacle for retaining any valuable material carried over; F, plates for checking and diverting the current; G, tube for passing condensed matter into the evaporator; H, upper feed-tube; H', lower feed-tube; I I', partition-plates; J, channels; K, opening or tube for drawing off at the top of the liquid; L, discharge-tube for drawing off; M N, division-plates or diaphragms, to which the small tubes are attached; O, bottom plate and bottom of channel; P, ribs for strengthening bottom plate; Q, orifice for discharging the water of condensation; a, large tubes for the passage of the liquid; b, smaller tubes for the same purpose and for heating; O', plate for distributing steam; d, supports for the plate c.

45 I usually make the shell A of cast-iron, in the form shown, about eight feet in diameter and about ten feet in height; but the form and these proportions may be varied according to the desired quantity of material to be treated, or according to the location in which they are to be placed; or, if changed to a rectangular or other form, the channel-forming plate or plates will be correspondingly changed. Within this

shell I place a tubular section, the tubes of which are about two feet long, and are firmly attached to the plates M N, which are preferably held in place by projecting out into or between the flanges of the outer case; and the plate N is supported within the shell upon and by the partition-plates I', and secured by bolts, and the plate M is supported by the tubes a b, and stay-bolts may also be applied. The partitions I extend up and are immediately over the partitions I'. This partition I is curved so as to form a continuous channel traversing the evaporator from the center outward. This partition may be made in the scroll form; but I prefer to make it partly concentric and partly tangential, as shown, as in this form it is more easily made and the small tubes somewhat more easily arranged, it being understood that when an oval or angular form is used the partition will be correspondingly changed.

The tubes a b form parts of the channel J and connect the upper part of the channel with the lower part formed in the bottom plate, O, so that the liquid which stands in the evaporator will fill these tubes, and I prefer to keep the evaporator filled up to the line shown in Fig. 1.

The liquid passing in at either feed-tube is delivered near the center of the device, from whence it is caused to traverse the channel J around through the device until it is permitted to pass out at the outlet or discharge pipe L or K.

The partitions I are continued below the plate N by the ledges I', and fit closely against it, and the channel between the plates N and O increases in depth as it approaches the exterior, as shown in Fig. 1, so as to aid in producing a current around through the channel which extends from the partition-plate I down to the plate O, the tubes a b being arranged to form parts of this channel, as shown.

The tubes a b are made of iron, copper, or other suitable material, and the tubes a are about eight inches in diameter, while the tubes b are usually two inches in diameter. The heat being applied direct to the tubes a b and the under side of plate M and the upper side of plate N, the tendency of the liquid is to rise, owing to the application of heat and the formation of vapor, and in order to prevent the rising of the liquid in the tubes b from forming partial vacuums therein I have applied

the larger tubes *a*, which constantly supply a down current of the liquid, so that, however much the liquid may rise in the tubes *b*, the tubes *a* will keep the channels beneath the plate *N* full, thus keeping up a constant circulation between the upper and lower parts of the channel *J*.

Steam (usually exhaust steam) is admitted through the tube *B* into the space between the plates *M* and *N*, which space it fills, so as to completely envelop and heat all of the tubes. To insure the distribution of the steam, a plate, *O'*, may be interposed, as shown at Fig. 1, which may be supported by clamps *d*, attached to convenient tubes, as shown in Fig. 2. The central portion, or that immediately beneath the pipe *B*, is not ordinarily supplied or filled with small tubes, it being left open, as shown in Fig. 2.

The height of the liquid within the evaporator may be determined by the pipe *K*, which is to be provided with a stop-cock; or surface portions of the liquid may be drawn off through this pipe and the lower portions through the pipe *L*, when the feed is through the tube *H*; but when the feed is through the tube *H'* the condensed liquid will flow off through the pipe *K*. When the feed-pipe *H* is used, the condensed liquid is drawn off or passed to a second evaporator by means of the pipe *L* or *K*, while the water of condensation is drawn off through the orifice *Q*, which is to be provided with a valve or other device to hold the steam in place.

The produced vapors pass out or are pumped out through the pipe *D*, which pipe has the receptacle *E* interposed between its ends for receiving and holding any spray or valuable material which may be carried over, which material is condensed against the plate *F* and falls to the bottom, and is returned through the pipe *G*. The vapors produced by the evaporation of the inclosed material contain and carry a large amount of heat, which is ordinarily passed to a second evaporator of the same construction, and enters a pipe, *B*, the same as the steam enters the one shown. A third evaporator is frequently attached, so as to utilize all of the heat in the work; but as the method of connecting two or three of these and utilizing heat in this manner is not of my invention, the additional evaporators are not shown.

The operation of this evaporator will readily be understood from the description, and it will be seen that the liquid to be condensed or dried passes in near the center and circulates around through the channel *J* until it reaches the outlet at *K* or *L*, from which it is passed by the pipe *L* or *K* to a suitable receiver or to an adjoining evaporator.

In the evaporators heretofore used in this method of evaporation there has been no certainty that the contained liquid would be passed to the next evaporator; and, in fact, the heavier portions usually remain without being changed from one to the other, so that the

liquid in each of the several evaporators is not of uniform density or quality, and as some portions are liable to remain a long time in the evaporator subjected to heat, they would thereby become damaged; but by my system of circulation the passage of all of the liquid is direct and continuous through the evaporator, and from one evaporator to and through another continuously is insured, which is not only a great advantage in producing uniformity of evaporation and in results, but the circulation through the channels and through the tubes *a b* produces a uniformity of liquid by starting and mixing it in its passage, by which arrangement I obtain improved results in the rapidity of evaporation, and in the uniformity of the liquid concentrated, and in the quality of the product. The circulation through the tubes *a b* does not interfere with the increasing density of the liquid or fluid caused by its evaporation while traversing the channel *J*.

It will be understood that when the feed-tubes *H H'* are applied they are not both used at the same time, and that when the tube *H* is used the discharge will be through the pipe *L*, and when the tube *H'* is used the pipe *K* will be the discharge-tube; also, that suitable well-known vacuum-pumps and apparatus for receiving the condensed material are to be applied, and that in evaporating a thin liquid the heating-tubes might be of a uniform size and still operate to produce an imperfect vertical circulation.

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

1. In an evaporator, the combination, with the partition-plates *I I'*, of the vertical tubes *a b*, arranged within the said partition-plates, substantially as described.

2. In an evaporator, the combination, with the plates *M* and *N*, having a liquid-space above and below the same, respectively, of vertical tubes *a b*, whereby a vertical circulation of the contained fluid is produced, substantially as described.

3. The plate *O*, having partitions *I'*, forming the lower part of the channel, of an increasing depth toward the exit or discharge, substantially as specified.

4. The combination of a feed-tube with the circulating-channel *J* and an outlet-tube, whereby the liquid fed in is caused to traverse the evaporator to the point of discharge, substantially as specified.

5. The combination and arrangement of the shell *A*, feed-tube *H*, partitions *I I'*, channeled base-plate *O* with the steam-tube *B* and liquid-tubes *b*, substantially as and for the purpose specified.

6. In an evaporator, the channel *J*, composed partly of tubes passing through a heating-space, substantially as specified.

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Witnesses:

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