No. 780,612. PATENTED JAN. 24, 1905.

F. MEYER.

EVAPORATING APPARATUS.

APPLICATION FILED NOV. 30, 1903.

2 SHEETS—SHEET 1.

Fig. 1.

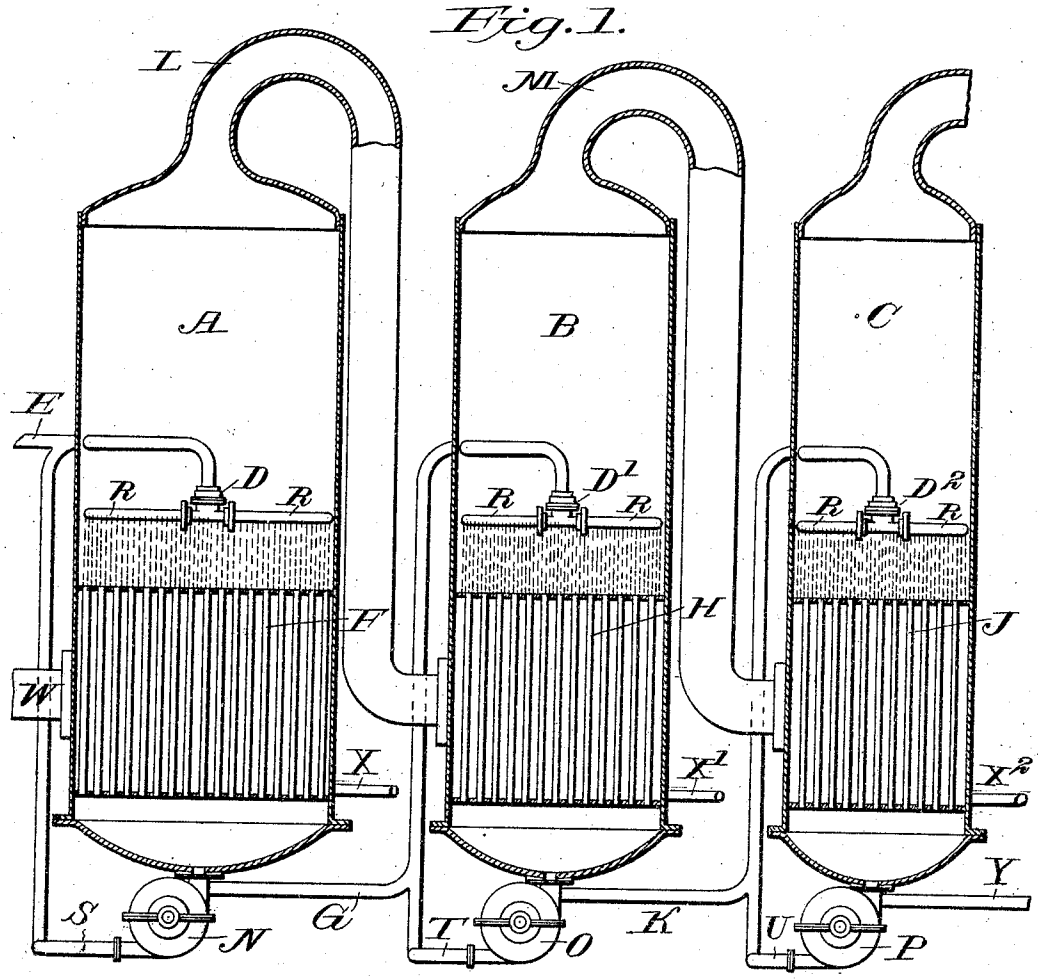
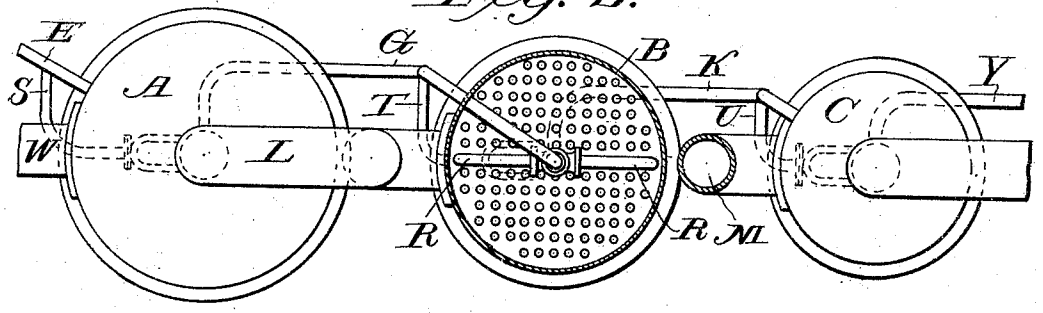



Fig. 2.




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2 SHEETS—SHEET 2.

Fig. 3.

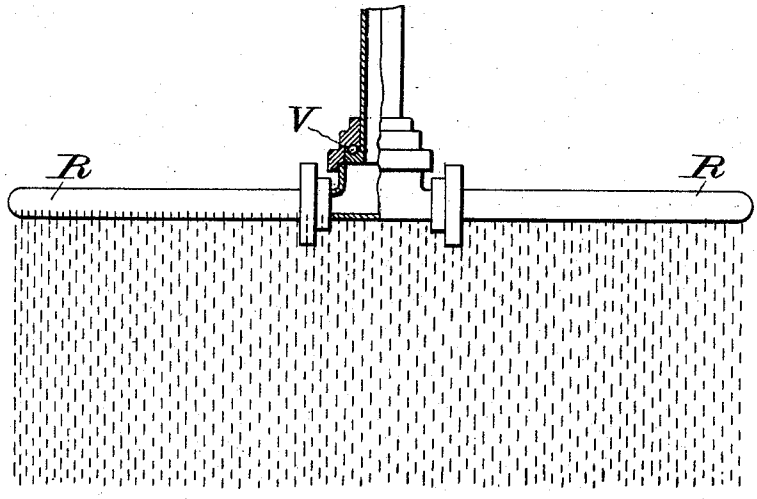
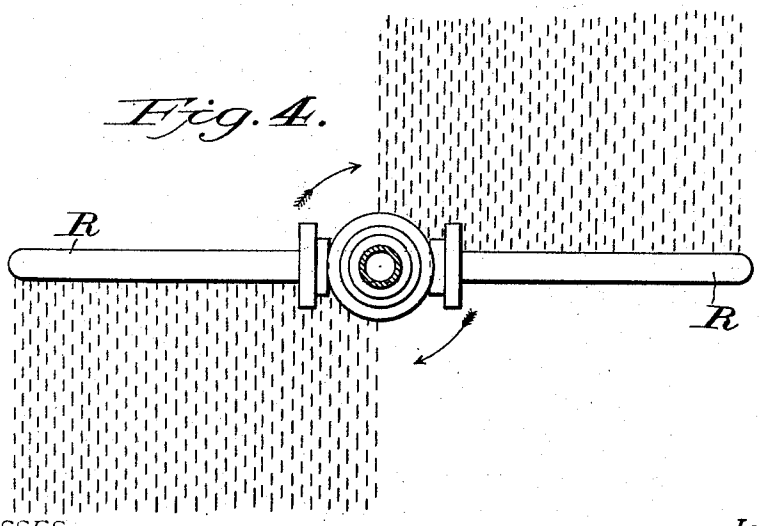



Fig. 4.




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No. 780,612. Patented January 24, 1905.

# UNITED STATES PATENT OFFICE.

FREDERICK MEYER, OF LONDON, ENGLAND.

## EVAPORATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 780,612, dated January 24, 1905.

Application filed November 30, 1903. Serial No. 183,217.

*To all whom it may concern:*

Be it known that I, FREDERICK MEYER, a subject of the King of Great Britain and Ireland, and a resident of London, England, have invented a new and useful Improvement in Evaporating Apparatus, of which the following is a specification.

This invention relates to apparatus used for the condensation or concentration by evaporation of saccharine syrups, brine, or other liquids; and its leading object is to greatly expedite the process of evaporation. More particularly, its objects are to insure the most effective distribution of the liquid with reference to the heated evaporating-surfaces, to prevent any considerable accumulation of the liquid in contact with such surfaces, to provide for effectively controlling the operation, and to employ a minimum of machinery for producing the desired results.

The invention consists in certain novel combinations of parts hereinafter set forth and claimed, including the combination with suitable accessories of a "sparger" or revolving sprinkler inside each evaporating vessel, and also a pump attached at the lowest point of each vessel or in any other suitable position, the same serving, respectively, to evenly distribute the syrup or other liquid over the evaporating-surfaces and when necessary to pump back the syrup or other liquid through the sparger or sprinkler and to redistribute the same in the same vessel for further concentration or condensation or alternatively to pump the same through the sparger or sprinkler of the succeeding vessel.

I preferably employ an automatic sparger or sprinkler such as is generally used in the process of brewing and which is thus of demonstrated practicability. This form of sparger or sprinkler revolves automatically by the pressure of the syrup or other liquid as it leaves the perforated arms. Alternatively the "sprinkler," as it is hereinafter termed, may be made to revolve by gearing or other suitable means.

I preferably employ a series of evaporating vessels diminishing in size from the first to the last of the series and having the necessary extent of evaporating-surface within each vessel formed by vertical tubes heated by steam in the first vessel and in the succeeding vessel or vessels by the hot vapor from the preceding vessel. As the sprinklers revolve the liquid escaping from the perforations therein is evenly distributed within the subjacent vertical tubes forming the evaporating-surfaces. When it is found that the liquid is not in a proper condition to enter the second vessel, the liquid is pumped back into the sprinkler of this first vessel, which again distributes it within the evaporating-tubes for further condensation or concentration. The liquid then passes from the bottom of this first vessel through a pipe to the sprinkler in the second vessel and trickles down the bare hot tubes in the drum of this vessel, and if found necessary the liquid is pumped back into the sprinkler of this second vessel, which again distributes it within the bare hot tubes within the drum of the vessel for further condensation or concentration. Passing again from the bottom of this second vessel through a pipe connected to the sprinkler in the third vessel the liquid is distributed within the bare hot tubes of the drum in this vessel, and should the liquid require still further condensation or concentration it is pumped back into the sprinkler of this third vessel and again distributed within the bare hot tubes of this vessel from the bottom of which, supposing this vessel to be the last of the series, the liquid is finally drawn off by any suitable means. I do not limit myself to any particular number of evaporating vessels, but prefer to employ a series, as above indicated. The vapor arising from the liquid in the first vessel passes up through the top of this vessel into a pipe which is connected to the drum of the second vessel and is utilized for heating the tubes in said second vessel, and in like manner the vapor arising from the liquid in the second vessel is used for heating the tubes in the drum of the third vessel of the apparatus.

The great advantage obtained in the use of a sprinkler and pump in the manner above described is that very little syrup or other liquid is kept in the body of each vessel, and by the use of a revolving sprinkler none of

the liquid can drop down an individual tube without coming in contact with the inner surface of the tube in an ideal form for film evaporation. Moreover, the ascending vapor cannot carry over with it small particles of the syrup or other liquid, nor can it be recondensed by the liquid, as the latter is confined to a line represented by the arms of the sprinkler, whereas in existing systems the liquid covers the tubes and many of the steam bubbles formed at the bottom are recondensed before they can rise to the surface and escape, thus detracting from the evaporating power as compared with my apparatus.

The improved apparatus can be applied to open-air evaporation as well as evaporation in vacuum.

Two sheets of drawings accompany this specification as part hereof.

Figure 1 is a sectional elevation of the improved evaporating apparatus with three vessels in series, as above described. Fig. 2 is a plan view projected from Fig. 1; and Figs. 3 and 4 are respectively side and plan views of one of the revolving sprinklers, on a larger scale, illustrating its operation.

Like reference-letters indicate corresponding parts in all the figures.

A, B, and C are respectively the first, second, and third evaporating vessels of an apparatus constructed according to the present invention. The revolving sprinklers in the respective vessels are shown at D, D′, and $D^2$. Open-ended vertical tubes in the steam-drums of the respective vessels are shown at F, H, and J, and pumps attached to or connected with the respective vessels are shown at N, O, and P. The syrup or other liquid to be treated enters the sprinkler D of the first vessel by an inlet-pipe E and is discharged through a pair of arms R, which are provided with any number of perforations arranged so that while the liquid is escaping through these perforations the arms will revolve automatically, being supported on ball-bearings V. The liquid is thus evenly and effectively distributed among the bare hot tubes F in the drum of this vessel A, these tubes being heated by steam supplied through a neck W in the usual manner. The steam or vapor escaping from the liquid under treatment rises freely at the sides of the revolving arms R, and the sprinklers thus offer no material obstruction to the escape of such vapor at any time or from any point in the apparatus. It is sometimes found that the liquid on reaching the bottom of the vessel A through the tubes is not in a proper condition to enter the second vessel B. It is then forced back through a pipe S by said pump N into said sprinkler D to be again discharged down the bare hot tubes F in said first vessel. The liquid then passes from said first vessel A through a pipe G into said sprinkler D′ in the second vessel B, escaping from the perforated arms R of this sprinkler down the bare hot tubes H in the drum of said vessel B, and if found necessary the liquid is forced back through a pipe T by said pump O into said sprinkler D′ to be again discharged down the bare hot tubes H in this second vessel B. The liquid then passes from the second vessel B through a pipe K into the sprinkler $D^2$ in the third vessel C, escaping from the perforated arms R of the sprinkler down the bare hot tubes J in the drum of this vessel C, and if found necessary the liquid is again forced back through a pipe U by said pump P into said sprinkler $D^2$ and again discharged down the bare hot tubes J. The condensed or concentrated liquid as it finally collects in the bottom of the last vessel C is drawn off by a pump or other means through an outlet-pipe Y.

The tubes F in the first vessel A are heated by means of steam entering the drum of this vessel through an inlet-pipe W, as aforesaid, and circulating outside the tubes. In like manner the tubes H and J in the vessels B and C are heated by the hot vapor from the boiling hot liquid in the vessels A and B, the vapor being conveyed to the drums of these vessels by means of pipes L and M. The vapor or steam leaves the drums of the respective vessels in the form of condensed steam or water by means of outlet-pipes X, X′, and $X^2$.

Having thus described said improvement, I claim as my invention and desire to patent under this specification—

1. Apparatus for the condensation or concentration of liquids, such apparatus having, in combination, an evaporating vessel, an inlet-pipe for the liquid to be treated, a sprinkler within said vessel in communication with said inlet-pipe, subjacent open-ended vertical tubes through which the sprinkled liquid descends, and a heating-drum through which said tubes extend, said tubes being at all times substantially empty so as to expose substantially bare hot evaporating-surfaces down which the liquid under treatment trickles, substantially as hereinbefore specified.

2. An evaporating apparatus having, in combination, an evaporating vessel provided with a vapor-outlet, an inlet-pipe for the liquid to be treated, a sprinkler in the form of revolving arms within said vessel in communication with said inlet-pipe, subjacent open-ended vertical tubes through which the sprinkled liquid descends, a heating-drum through which said tubes extend, and means for keeping said tubes substantially empty so as to expose substantially bare hot evaporating-surfaces down which the liquid under treatment trickles, the vapor therefrom rising freely through said tubes and at the sides of said revolving arms and through said outlet, substantially as hereinbefore specified.

3. An evaporating apparatus having, in combination, an inlet-pipe for the liquid to be

treated, a sprinkler in communication with said inlet for distributing such liquid, subjacent open-ended vertical tubes within which the sprinkled liquid trickles downward, a heating-drum through which said tubes extend, an inclosing vessel within the bottom of which the condensed or concentrated liquid collects, and a pump in communication with the interior of said vessel and said sprinkler for keeping said tubes substantially empty and for forcing back the liquid through the sprinkler for further treatment, substantially as hereinbefore specified.

4. An evaporating apparatus having, in combination, an inlet-pipe for the liquid to be treated, an automatically-revolving sprinkler in communication with said inlet-pipe, subjacent evaporating-surfaces upon which the liquid is distributed by said sprinkler, means for heating said evaporating-surfaces, a vessel inclosing said sprinkler and evaporating-surfaces within which the condensed or concentrated liquid collects below said surfaces, and a pump in communication with the interior of said vessel and said sprinkler for returning the liquid for further treatment, substantially as hereinbefore specified.

5. The combination of a series of evaporating vessels each of them inclosing an automatically-revolving sprinkler, in the form of perforated arms for distributing the liquid, subjacent open-ended vertical tubes through which the liquid descends, a steam-drum by which said tubes are heated, a steam-pipe for supplying the drum of the first vessel, a pipe connecting the drum of each succeeding vessel with the top of the preceding vessel, and pumps connecting the interior of each vessel at bottom with the superjacent sprinkler and also with the sprinkler of the succeeding vessel, substantially as hereinbefore specified.

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

FREDERICK MEYER.

Witnesses:
EDWARD BARNETT,
ARTHUR JAMES BILLINGTON.