

No. 709,172.

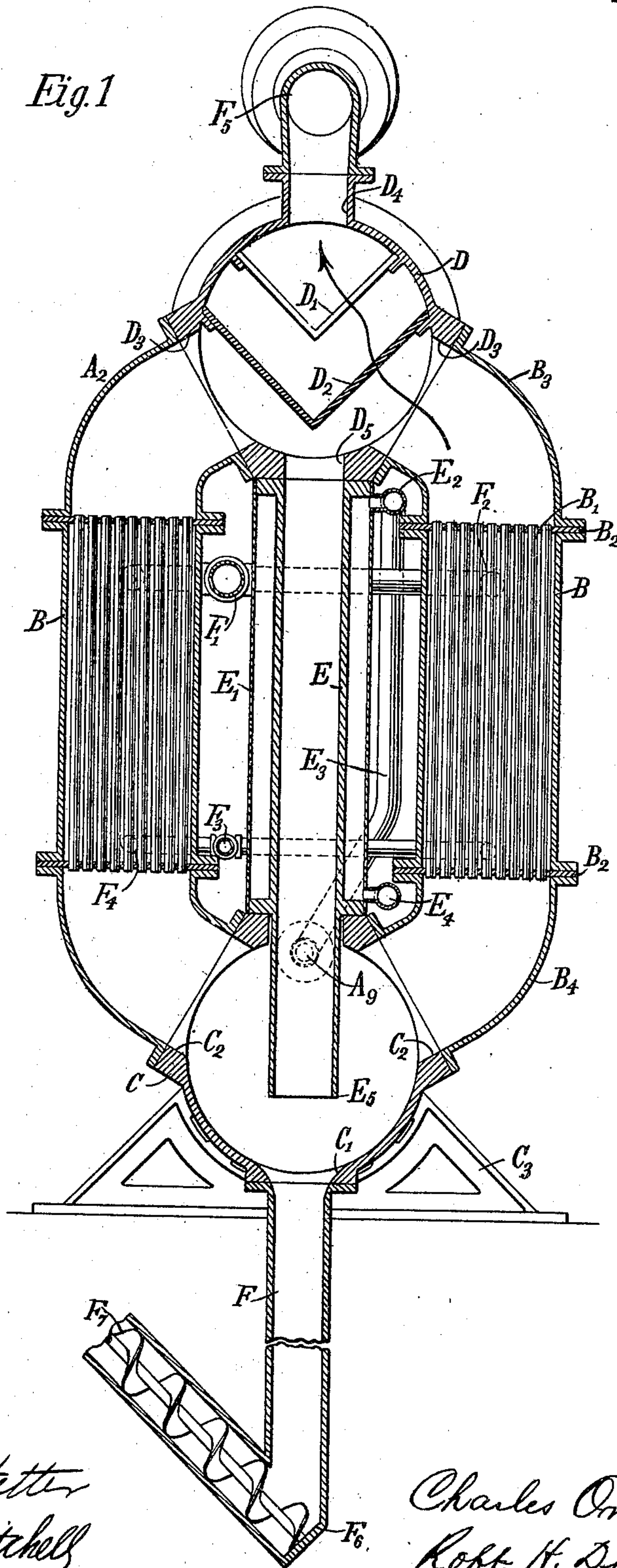
Patented Sept. 16, 1902.

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VACUUM EVAPORATING APPARATUS.

(Application filed Dec. 4, 1901.)

(No Model.)

2 Sheets—Sheet 1.



Witnesses:

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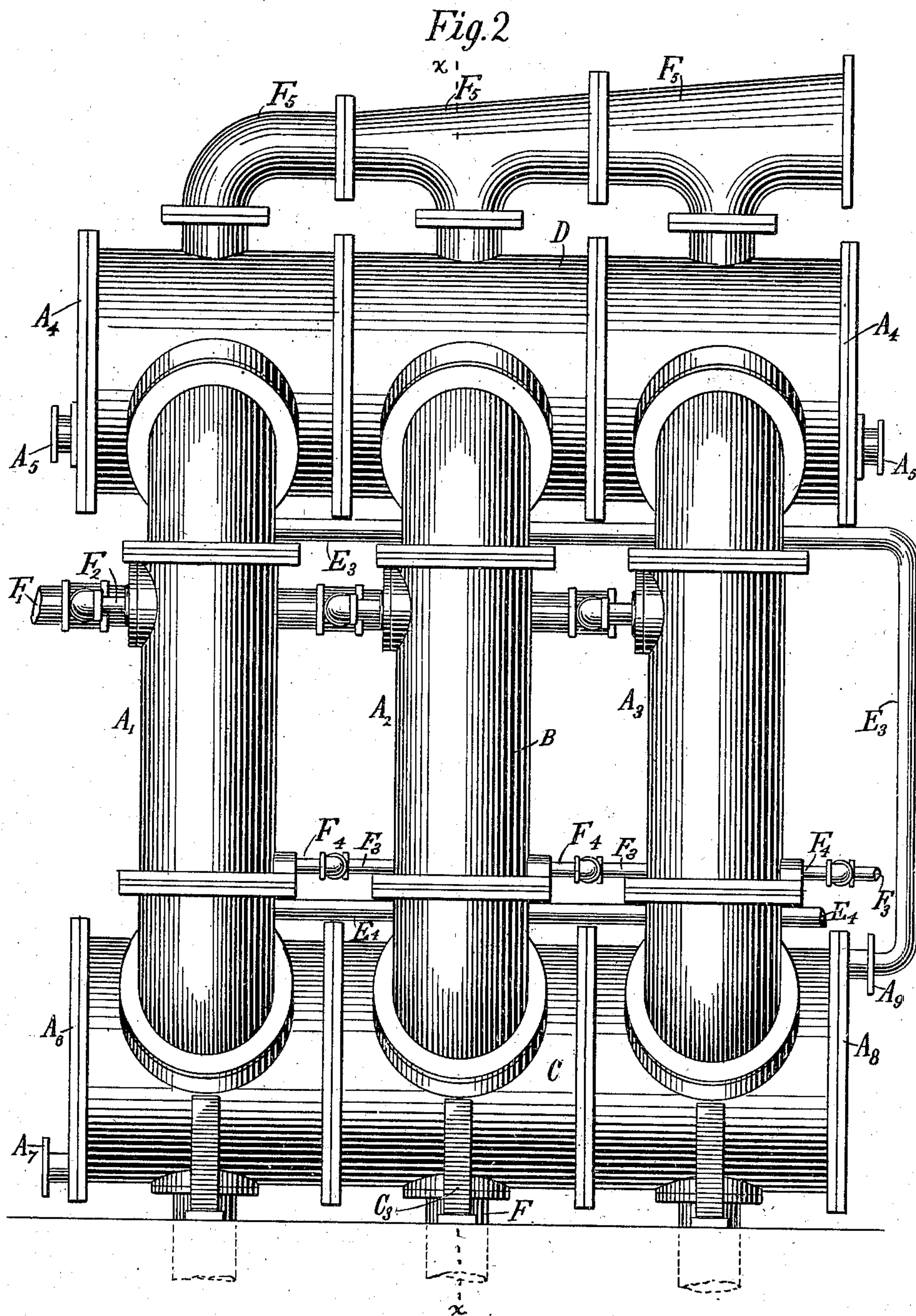
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# UNITED STATES PATENT OFFICE.

CHARLES ORDWAY, OF BROOKLYN, NEW YORK.

## VACUUM EVAPORATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 709,172, dated September 16, 1902.

Application filed December 4, 1901. Serial No. 84,611. (No model.)

*To all whom it may concern:*

Be it known that I, CHARLES ORDWAY, a citizen of the United States, and a resident of the city of New York, borough of Brooklyn, in the county of Kings and State of New York, (post-office address Times Building, New York city, New York,) have invented certain new and useful Improvements in Vacuum Evaporating Apparatus, of which the following is a specification, reference being had to the accompanying drawings, forming a part of the same.

The present invention relates generally to vacuum evaporating apparatus, and particularly to the construction of an effect for use in such apparatus; and it consists in the various features of construction and the combination and arrangement of parts hereinafter described and claimed.

The accompanying drawings illustrate one form of an effect embodying the invention, in which the same reference characters refer to similar parts in both figures.

Figure 1 is a vertical section along the line  $\alpha\alpha$  of Fig. 2, and Fig. 2 is a side elevation of an effect comprising three sections.

Referring to the drawings,  $A'$ ,  $A^2$ , and  $A^3$  represent different sections of the effect, which are of substantially the same construction. Each section comprises the following principal parts, viz: shells B, each inclosing a battery of heating-tubes  $B'$ ; a liquor-chamber C; a vapor-chamber D; tubes  $B^3$ , connecting the upper ends of the shells with the vapor-chamber; tubes  $B^4$ , connecting the lower ends of the shells with the liquor-chamber; a jacketed downtake E, connecting the vapor and the liquor chambers; a vacuum-leg F, extending downward from the liquor-chamber. In addition to these principal parts each section is provided with a vapor-inlet  $F^2$  and a vapor-outlet  $D^1$  and its extension  $F^5$ , a liquor-inlet  $E^4$  at the lower end of jacket  $E'$  of downtake E, and liquor-outlet  $E^2$  at or near the upper end of the jacket. These several sections are provided with flanges formed on the liquor and vapor chambers and on the vapor-outlet tubes  $F^5$ , by means of which any desired number of such sections can be readily united to form a single effect or can be easily and quickly separated for convenience of transportation and repair.

The main parts of the individual sections are also provided with flanges for the same purposes. The sections are supported upon any suitable base, as  $C^3$ , below which the vacuum-leg F extends. The heating-tubes  $B'$  may be secured in place in the shells B in any suitable way. As shown in the drawings, Fig. 1, their ends are expanded into the tube-sheets  $B^2$ , which are clamped between the flanges of the shells and the adjacent tubes  $B^3$  and  $B^4$  to form heating-chambers, within which the tubes  $B'$  are located. The vapor-chamber D is preferably provided with dash-plates  $D^1$  and  $D^2$ , arranged to intercept particles of solid or liquid matter which may be carried with the vapor, the plates  $D^2$  being in front of the opening  $D^3$ , while the plates  $D^1$  are staggered relatively to plates  $D^2$  to cause the vapor to take a circuitous path in its passage through the vapor-chamber to the vapor-outlet. It is the function of the jacket  $E'$  to provide for the circulation of a body of cool liquid in contact with the wall of the downtake for the purpose of lowering the temperature of the heated liquor therein, and thereby increase its specific gravity to cause or facilitate the precipitation of salts or other solid matter contained in the heated liquor. For the purpose of obtaining a larger cooling-surface the outer surface of the downtake may be increased in any well-known way, as may the outer surface of the jacket, if desired. Any liquid or fluid may be circulated through the jacket to cool the liquor in the downtake; but for economy in working it is preferred to use fresh liquor which is to be concentrated in the apparatus and to pass it directly from the jacket in its heated condition to the liquor-chamber of the effect. For this purpose the fresh liquor is fed by gravity or by a suitable pump from a source of supply to pipe  $E^4$  in communication with the lower end of the jacket, and after circulating around the downtake it passes into pipe  $E^2$ , which communicates with the upper end of the jacket, and thence through a pipe  $E^3$  into the liquor-chamber C through inlet  $A^9$ .

In order to promote the free circulation of the liquor in the liquor-chamber and to prevent or break up the stratification of liquor of varying density therein, it is important to carry the lower end  $E^5$  of the downtake well



down toward the bottom of the chamber, so that the force of the discharge therefrom will produce the desired agitation and resulting circulation of the liquor at or near the bottom of the chamber, where the denser and more objectionable stratification is liable to take place. It is also desirable that the lower end of the downtake be in line with the flared hole C' at the top of the vacuum-leg F, so that the precipitates as they are discharged from the downtake will fall directly into the vacuum-leg rather than be deposited on the bottom of the liquor-chamber to interfere with the circulation. The bottom or boot F<sup>6</sup> of the vacuum-leg should be about thirty-two feet below the liquor-chamber, and the inclined branch in which the screw conveyer F<sup>7</sup> works should preferably rise above the level of the liquor in the effect.

The chambers surrounding the heating-tubes B' within the shells B are provided with drip-pipes F<sup>4</sup>, each of which communicates with the continuous pipe F<sup>3</sup>, by which the water of condensation is carried off. A<sup>5</sup> denotes eyeglasses in the heads of the vapor-chamber, through which its interior can be observed and any obstruction of proper circulation can be detected.

As stated, any desired number of sections may be united to form a single effect, as shown in Fig. 2 of the drawings, and such effect may be used as an evaporating apparatus by connecting the vapor-discharge pipe F<sup>5</sup> of the last or right-hand section with a condenser and vacuum-pump and admitting steam or other heating-vapor into the pipe F', which communicates through pipes F<sup>2</sup> with the interior of the shells B and operates to evaporate the liquor as it passes through the tubes B' from the liquor to the vapor chambers, the liquor to be concentrated being fed to pipe E<sup>4</sup>, which communicates with the lower end of the jacket surrounding the downtake of each section, and after circulating around the downtakes it passes into tube E<sup>2</sup> and through tube E<sup>3</sup> into the common liquor-chamber C.

It is observed that an effect may comprise only a single section, as A' of Fig. 2, which would be complete by providing the open ends of the liquor and vapor chambers with heads corresponding to heads A<sup>3</sup> and A<sup>4</sup> of section A<sup>3</sup> and leading the liquor-pipe E<sup>3</sup> into the liquor-chamber of section A'.

It is desirable in order to obtain the greatest efficiency in evaporation to unite several of the single effects herein described in multiple to produce a multiple evaporating apparatus, and this can be readily done in any of the well-known ways.

In operation it is preferred that the feed of the liquor to an effect should be so proportioned to its evaporation and discharge that the level of the liquid alone apart from the vapor caused by evaporation—that is to say, the liquor-level—assuming that no evaporation is taking place in the effect, will be somewhat above the lower ends of the

heating-tubes B', preferably at about one-fourth to one-third the height of these tubes. The circulation of the liquor after it enters the liquor-chamber is through the tubes B<sup>4</sup>, through the heating-tubes B' to the vapor-chamber, and thence through the downtake to the chamber again, and this circulation may be continued until the desired concentration is reached, when the liquor may be drawn off at the discharge A<sup>7</sup> or until the solid matters contained in the liquor have been sufficiently precipitated therefrom.

A multiple-effect evaporator comprising a number of effects of the construction herein described is especially advantageous and efficient in the concentration of liquors which contain a considerable proportion of solid matter which is precipitated by cooling the concentrated liquor—as, for example, salt solutions, caustic-soda solutions containing free salt, and certain saccharin solutions.

It is readily seen from the foregoing description and accompanying drawings that whenever it is desired to obtain greater heating-surface in an evaporating effect any number of additional sections may be easily and quickly united to such effect and that the several sections of an effect may be readily separated from each other; also, that the main parts of each section are easily removable for the purposes of cleaning and repair and that such parts, as well as the sections themselves, are interchangeable, which contributes to the ease and facility of erecting a large evaporating apparatus.

It is evident that many modifications may be made in the construction of the evaporating effect herein described, and shown in the drawings, and that parts of such construction may be used without employing all of the same. I do not, therefore, desire that my invention be limited to the particular form of apparatus shown in this case; but what I claim as new and wish to protect by Letters Patent is set forth in the appended claims.

What is claimed as new is—

1. In evaporating apparatus, an effect comprising a series of similar sections each of said sections being provided with flanges to readily assemble the same to form said effect, each of said sections comprising a vapor-chamber, a liquor-chamber, a vertical downtake connecting said vapor-chamber and said liquor-chamber and extending nearly to the bottom of said liquor-chamber, two batteries of vertical heating-tubes arranged adjacent said downtake on either side of the same, flanged connections connecting said heating-tubes with said vapor-chamber and said liquor-chamber to enable said heating-tubes to be readily removed from said chambers, a vacuum-leg connected with said liquor-chamber substantially in line with said downtake, a boot at the lower end of said vacuum-leg, a screw conveyer communicating with said boot, said liquor-chamber being formed adjacent said vacuum-leg with a flared hole to di-



rect material into said vacuum-leg, a jacket surrounding said downtake and connections to feed the liquor into said jacket to cool said downtake and to feed said liquor from said jacket into said liquor-chamber.

2. In evaporating apparatus, a sectional effect comprising a series of similar sections bolted together by connecting-flanges formed on said sections, each one of said sections comprising a vapor-chamber, a liquor-chamber, a vertical downtake connecting said vapor-chamber and said liquor-chamber and two batteries of heating-tubes arranged on either side of said downtake and connected to said liquor-chamber and said vapor-chamber to form a sectional effect which may be readily varied in capacity by varying the number of sections in said effect.

3. In evaporating apparatus, an effect comprising a series of similar sections provided with flanges to readily assemble said sections, each of said sections comprising a vapor-chamber having baffle-plates, a liquor-chamber and a vertical downtake connecting said vapor-chamber with said liquor-chamber and extending nearly to the bottom of said liquor-chamber, batteries of tubes mounted adjacent said downtake and connected to said liquor-chamber and said vapor-chamber, said sections when assembled having the liquor-chambers and vapor-chambers in communication to form common liquor and vapor chambers.

4. In evaporating apparatus, an effect comprising a series of similar sections, said sections being provided with opposing flanges on the vapor and liquor chambers of said sections to be bolted together to readily connect said sections together, each of said sections comprising a vapor-chamber, a liquor-chamber, a vertical downtake connecting said chambers and two batteries of heating-tubes arranged on either side of said downtake and connected to said liquor-chamber and said vapor-chamber.

5. In evaporating apparatus, an effect comprising a series of similar sections, said sections being provided with opposing flanges on the vapor and liquor chambers of said sections to be bolted together to readily connect said sections and form an effect having a common vapor and liquor chamber extending the whole length of the same, each of said sections comprising a vapor-chamber having baffle-plates arranged therein, a liquor-chamber, a vertical downtake connecting said

chambers and two batteries of heating-tubes arranged on either side of said downtake and connected to said liquor-chamber and said vapor-chamber.

6. In evaporating apparatus, an effect comprising a vapor-chamber, a liquor-chamber provided with a vacuum-leg, a vertical downtake connecting said vapor-chamber and said liquor-chamber and extending nearly to the bottom of said liquor-chamber and substantially in line with said vacuum-leg, batteries of heating-tubes connected to said liquor-chamber and said vapor-chamber, a jacket surrounding said downtake and connections by which liquor fed to said effect enters said jacket to cool the liquor in said downtake and is fed from said jacket into said liquor-chamber.

7. In evaporating apparatus, an effect comprising a vapor-chamber, a liquor-chamber, a vertical downtake connecting said vapor-chamber and said liquor-chamber and extending nearly to the bottom of said liquor-chamber, batteries of vertical heating-tubes arranged adjacent said downtake and communicating with said vapor-chamber and said liquor-chamber, a vacuum-leg connected to said liquor-chamber and substantially in line with said downtake, means to remove material from said vacuum-leg, a jacket surrounding said downtake and means to secure a circulation of fluid in said jacket to cool said downtake.

8. In evaporating apparatus, an effect comprising a vapor-chamber, a liquor-chamber, batteries of heating-tubes communicating with said vapor-chamber and said liquor-chamber, a vertical downtake communicating with said vapor-chamber and said liquor-chamber, a jacket around said downtake, means to supply fluid to said jacket to cool the liquor in said downtake and means to remove precipitated material from said liquor-chamber.

9. In evaporating apparatus, an effect comprising a vapor-chamber, a liquor-chamber, heating-tubes connected to said vapor-chamber and said liquor-chamber, a downtake connected to said vapor-chamber and said liquor-chamber, a jacket surrounding said downtake and means to cause a circulation of fluid in said jacket to cool said downtake.

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