(No Model)

4 Sheets—Sheet 1.

J. J. ADAMS & L. W. TRACY.

APPARATUS FOR THE TREATMENT OF CANE JUICE.

No. 435,784. Patented Sept. 2, 1890

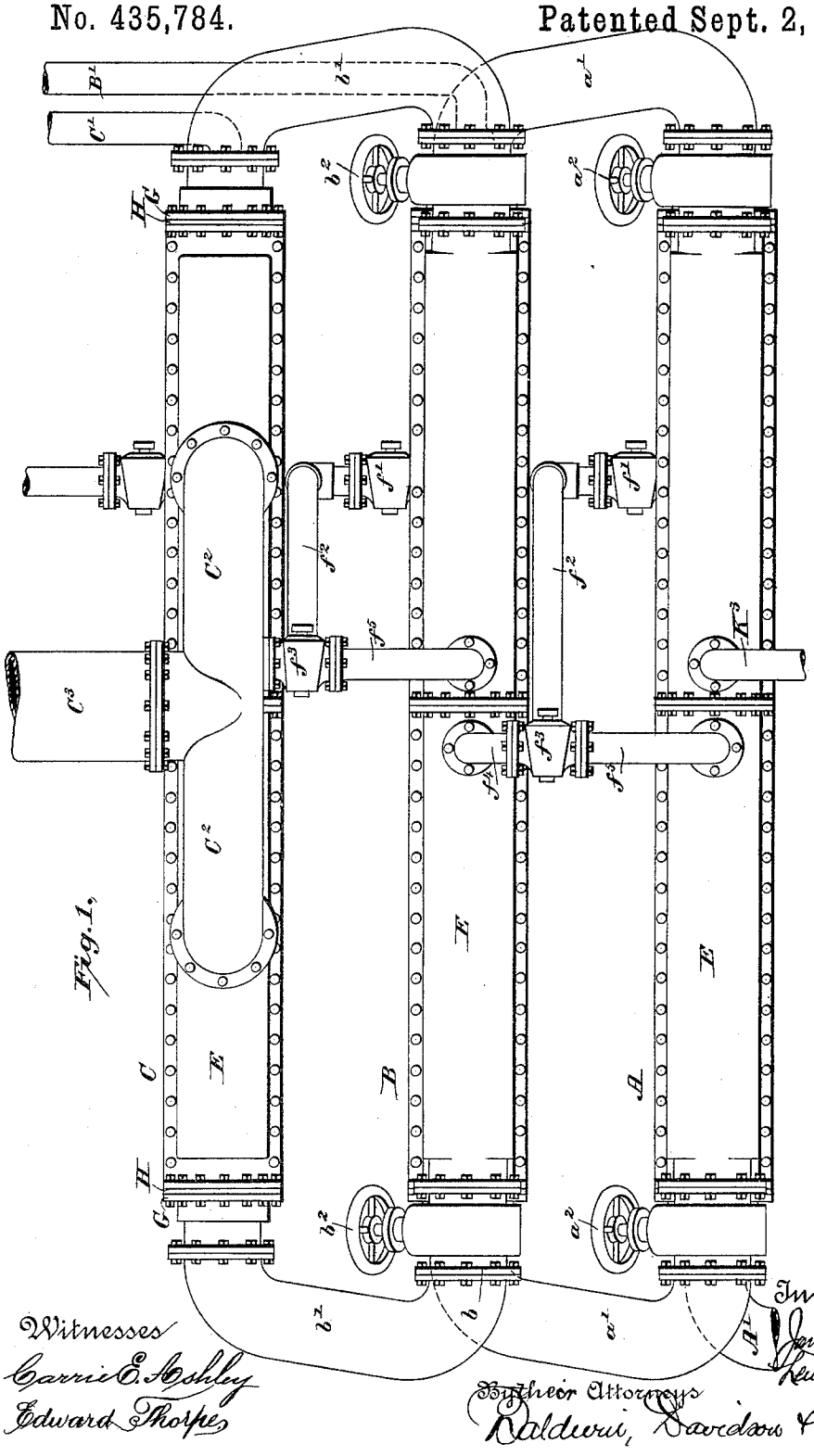


Fig. 1.

Witnesses
Carrie E. Ashley
Edward Thorpe

Inventors
James J. Adams
Lewis W. Tracy
By their Attorneys
Baldwin, Davidson & Wright

(No Model.) 4 Sheets—Sheet 2.

J. J. ADAMS & L. W. TRACY.

APPARATUS FOR THE TREATMENT OF CANE JUICE.

No. 435,784. Patented Sept. 2, 1890.

Fig. 3.

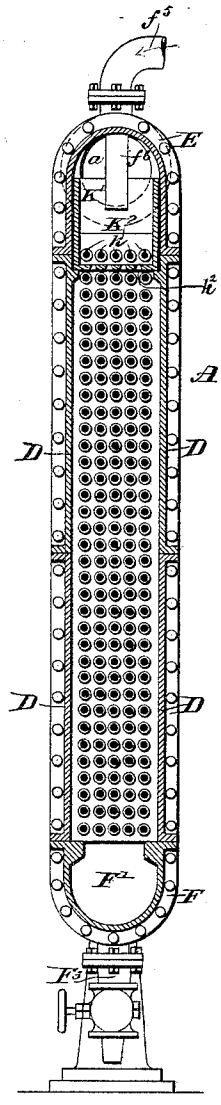
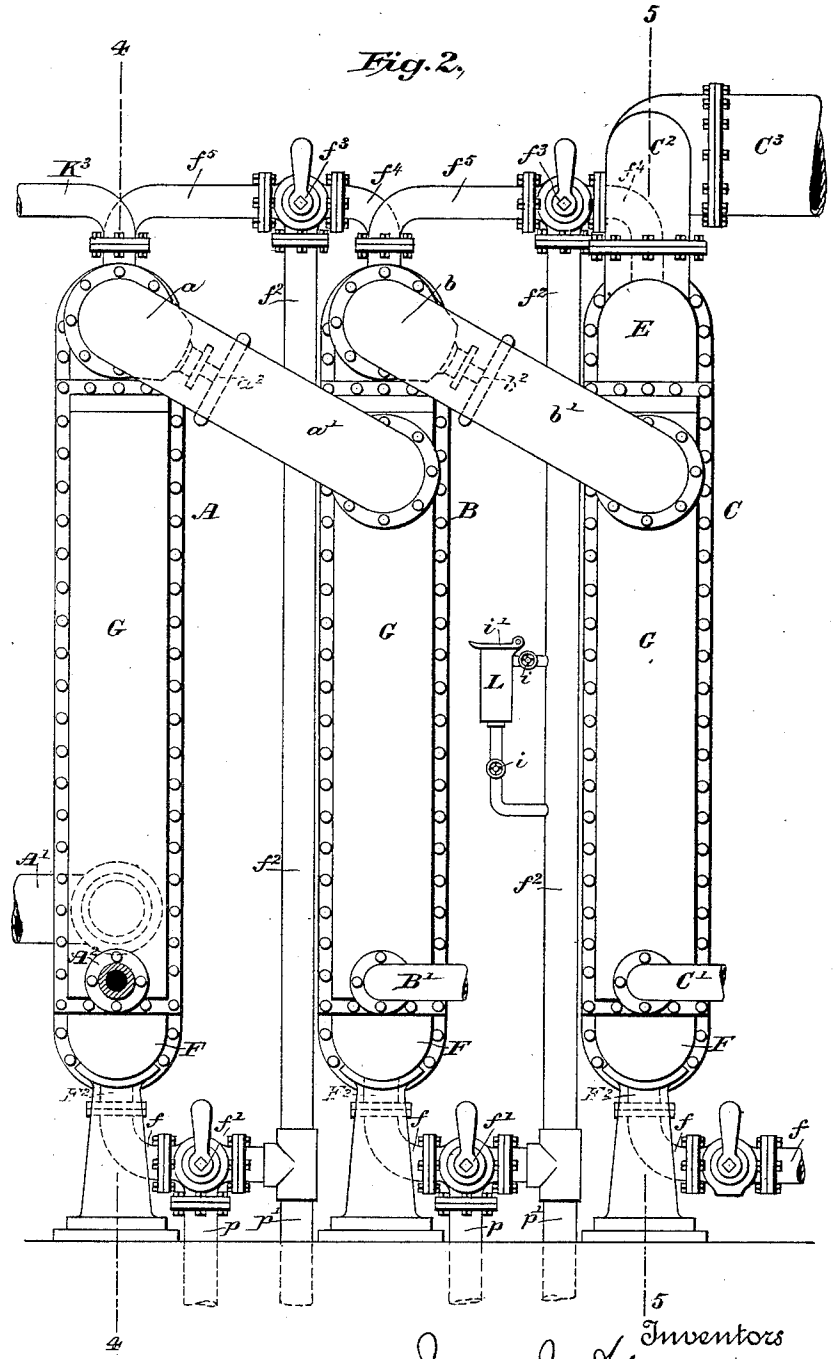


Fig. 2.



Witnesses
Carne E. Ashley
Edward Thorpe

Inventors
James J. Adams
Lewis W. Tracy,
By their Attorneys
Baldwin, Davidson & Wright

(No Model.) 4 Sheets—Sheet 3.

J. J. ADAMS & L. W. TRACY.

APPARATUS FOR THE TREATMENT OF CANE JUICE.

No. 435,784. Patented Sept. 2, 1890.

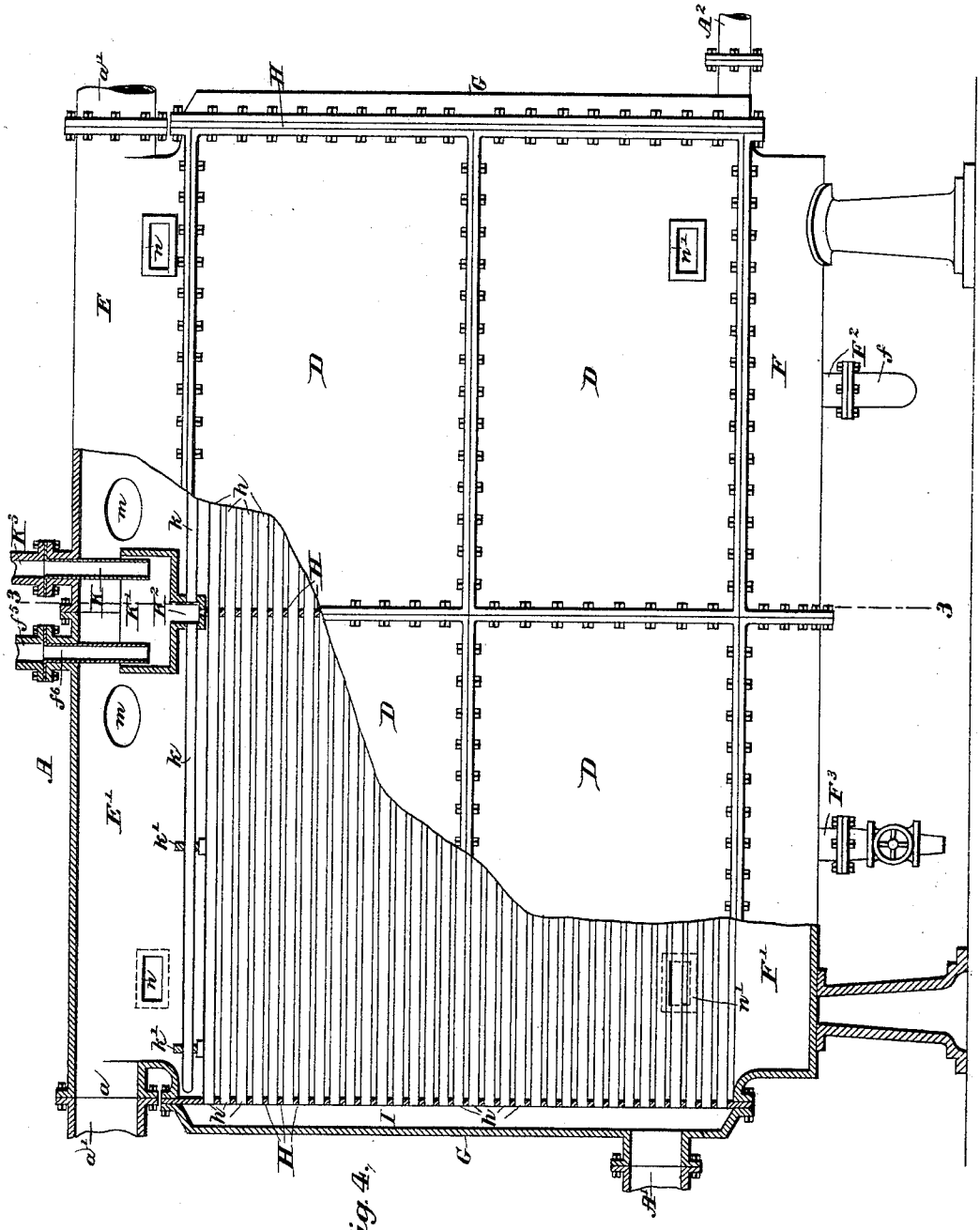


Fig. 4.

Witnesses
Carrie E. Ashley
Edward Thorpe

Inventors
James J. Adams
Lewis W. Tracy
By their Attorneys
Baldwin, Davidson & Wright

(No Model.) 4 Sheets—Sheet 4.

J. J. ADAMS & L. W. TRACY.

APPARATUS FOR THE TREATMENT OF CANE JUICE.

No. 435,784. Patented Sept. 2, 1890.

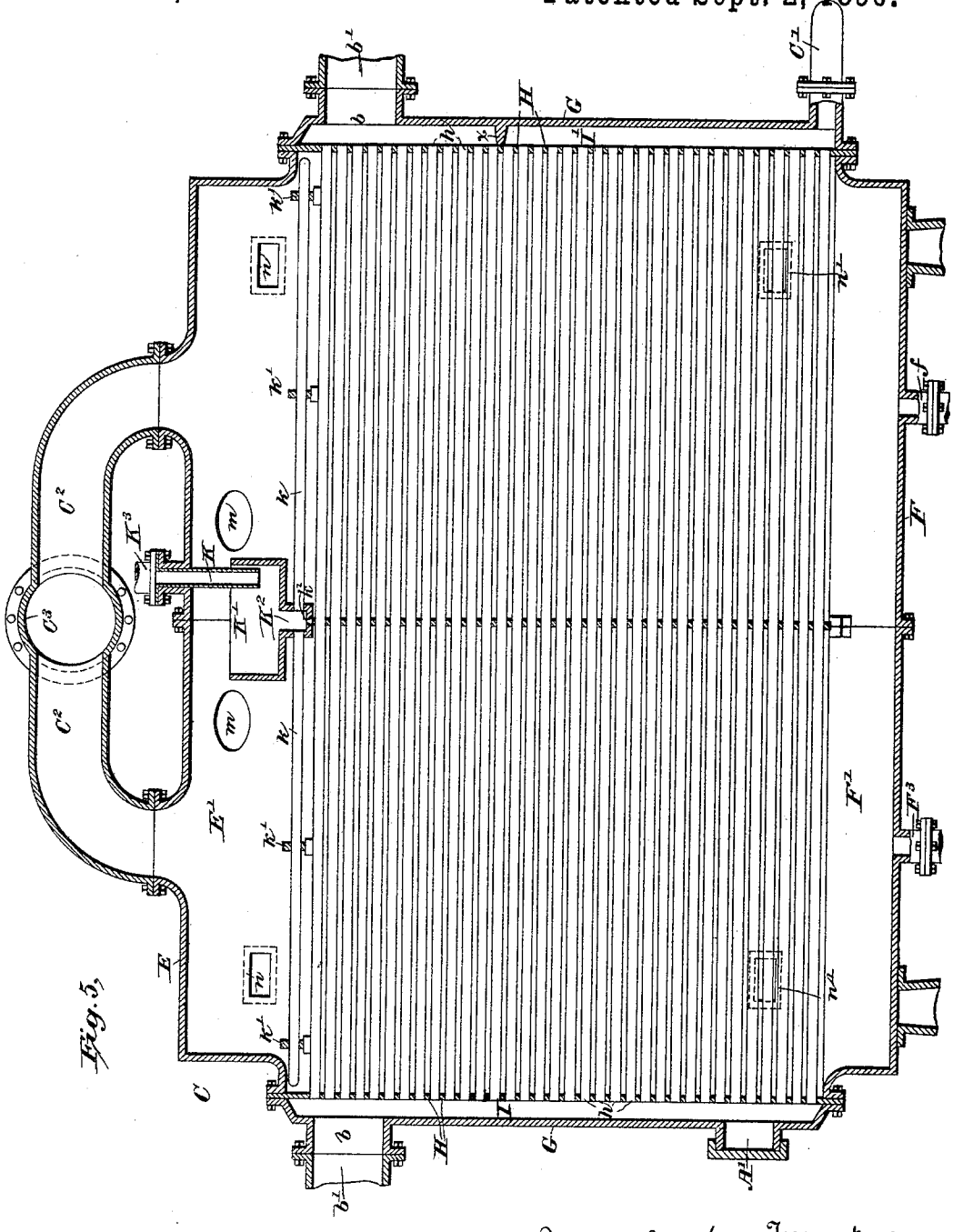


Fig. 5.

Witnesses
Carrie E. Ashley
Edward Thorpe

Inventors
James J. Adams
Lewis W. Tracy
By their Attorneys
Baldwin, Davidson & Wright.

UNITED STATES PATENT OFFICE.

JAMES J. ADAMS, OF CIENFUEGOS, CUBA, AND LEWIS W. TRACY, OF NEW YORK, N. Y., ASSIGNORS TO SAID TRACY AND JAMES E. GRANNISS, OF NEW YORK, N. Y.

APPARATUS FOR THE TREATMENT OF CANE-JUICE.

SPECIFICATION forming part of Letters Patent No. 435,784, dated September 2, 1890.

Application filed August 31, 1888. Serial No. 284,252. (No model.)

To all whom it may concern:

Be it known that we, JAMES J. ADAMS, a citizen of the United States, residing at Cienfuegos, Cuba, and LEWIS W. TRACY, a citizen of the United States, residing in New York city, New York, have jointly invented certain new and useful Improvements in Evaporating Apparatus, of which the following is a specification.

Our invention relates to that class of apparatus in which the cane-juice is successively passed through a series of evaporators, and in transit is evaporated under a vacuum to the desired density. The first evaporator may be heated by exhaust-steam from the mill-engine, and each succeeding one by the vapor of evaporation developed in the preceding evaporator, the vacuum in each succeeding evaporator being greater than that in the preceding one, and the juice may, if desired, be turned back to the evaporator from which it has been drawn, to be again treated therein and further condensed.

This general operation is well known, and several forms of apparatus have been devised for practicing it.

The purpose of our invention is to provide an improved apparatus, to render it lighter, and consequently cheaper to manufacture, handle, and erect than that heretofore used, and to economically improve the results obtained.

The features of our invention will be understood from the accompanying drawings, in which they have been embodied in one practical and efficient form, and in which—

Figure 1 shows in plan three of our improved evaporators connected for operation. Fig. 2 is an end view of the same; Fig. 3, a transverse section of an evaporator A on the line 3 3 of Fig. 4. Fig. 4 is a view of the same, partly in elevation and partly in section, on the line 4 4 of Fig. 2; and Fig. 5 is a vertical longitudinal section of the last evaporator C, on the line 5 5 of Fig. 2.

In our apparatus the heating medium, either exhaust steam from the engine in the first evaporator, or the vapors of evaporation in the succeeding ones, is circulated through pipes or passages, over the outside of which the cane-juice is caused to fall or drip in thin films or spray.

Three evaporators A B C are shown. They are sufficient to illustrate the invention and are all that are required for use in most cases. They are preferably relatively narrow, long, and high, as illustrated, and are in general construction alike—that is, the sides are each formed of four rectangular sections D, of wrought or cast metal, flanged at all four edges, and their contiguous vertical and horizontal edges are bolted together. Correspondingly-flanged cap and bottom sections E F and end sections G are bolted to the sides, as appears plainly in the drawings. The top and bottom sections may be formed, as illustrated, of two parts flanged and bolted together. Between the end sections and the sides, cap, and bottom, and held by the same bolts, are perforated plates H, preferably of wrought-iron, and a like transverse plate H, which may be of cast-brass, is similarly bolted between the vertical edges of the sections of the sides. Open-ended tubes h, of copper or other suitable material, are mounted in the perforated plates and expanded in the end plates to form close joints. This construction provides end chambers I I′, connected by the tubes for the circulation of the heating steam or vapors, as presently described.

In each evaporator the cane-juice to be treated is introduced through the cap to the chamber E′ and distributed over the bank of heated pipes h in the following manner: A nozzle K delivers the juice to a tank K′, supported in the chamber E′ by lugs or cleats on the side sections D, and the tank has a transverse well K^2 in its bottom, from each side of which a series—preferably four or more—of channel-pipes k, slit or open along their tops, Fig. 3, extend, being supported in perforated plates k', also carried by lugs on the side sections D. We also form in the bottom of the well K^2 a line of apertures k^2, Figs. 3 and 5, through which the juice also is delivered. These apertures are made larger at the bottom than at the top to render them less liable to become choked by deposits from the juice.

The juice after passing over the heated pipes falls into a chamber F′, formed by the bottom section of the evaporator and having two outlets, one F^2, through which the juice passes out, and another F^3, which serves as a tap or blow-off to be used in cleansing the apparatus.

The first evaporator A (shown in detail in Fig. 4) has near the bottom of one end section an inlet A′, through which the exhaust-steam passes to the chambers I I′ and tubes *h*, and at the bottom of the opposite end section an outlet A^2 for the escape of the steam and water of condensation to any suitable trap, if desired. The cane-juice, which has been introduced, as described, through a pipe K^3 from any suitable source, descends over and through the bank of heated pipes *h*, and is thereby evaporated or increased in density. From the chamber F′ the juice may pass by pipe *f*, three-way cock *f′*, pipe f^2, three-way cock f^3, and pipe f^4 into the top of the next evaporator B, through which it pursues a similar course. The heated vapors driven off from the juice in evaporator A rise to the chamber E′, and pass out at each end through openings *a* and large pipes *a′* to the ends of the next evaporator B, which are each formed with taps or openings with which the pipes *a′* connect. These vapors circulate in the chambers I I′ and pipes *h* of evaporator B, and pass out by a pipe B′ to the condenser. The effect of this is to maintain a vacuum—say of three or four inches—in the chamber E′ of the first evaporator A. The vacuum is small, because the juice contains an excess of water and the amount of steam or vapor liberated is large.

The juice from the chamber F′ of evaporator B may pass to evaporator C by pipe *f*, three-way cock *f′*, pipe f^2, three-way cock f^3, and pipe f^4, and the vapors in chamber E′ of pan B pass by outlets *b* and pipes *b′* to the chambers I I′ and pipes *h* of evaporator C, from which they are drawn through pipe C′ to the condenser. The juice in evaporator B being, however, denser than that in A, less vapor will be liberated, and consequently a higher vacuum is maintained—say from fifteen to eighteen inches—in the chamber E′ of evaporator B. From the last evaporator C the juice passes by pipe *f* to a pump, from whence it may be delivered as desired. The vapors developed in pan C are drawn from the chamber E′ through pipes C^2 C^3 to the condenser, and the juice having been further increased in density gives off less vapor and consequently a greater vacuum — say of twenty-six or twenty-seven inches—is maintained in the chamber E′ of C. When working with sufficient difference in vacuum in the several evaporators, the juice will pass automatically in the manner described from one to another; but otherwise the lower three-way cocks *f′* are turned so as to pass juice from the chambers F′ of A and B to pumps through pipes *p*, and from the opposite sides of the pumps the juice is delivered through pipes *p′* to pipes f^2 and to the next evaporator through the upper three-way cock f^3. If upon testing, as presently described, the juice entering the last evaporator is found not to be of proper density, either upper three-way cock f^3 may be turned so that the juice from the pump will be returned through pipe f^5 and nozzle f^6 to the evaporator from which it has just been taken.

On the last pipe f^2, leading to the evaporator C, a test-cup L is placed. It may be connected with the pipe at two points through valves *i*, and has a removable or hinged cap *i′*. Juice may thus be drawn from the pipe and tested, as usual.

The cap or top section of each evaporator is provided with hand-holes *m*, two being shown on each side, and also with glass-covered peep-holes *n*, arranged opposite each other, two on each side, through which the condition of the apparatus and juice may be examined. Similar pairs of peep-holes may be placed in the bottom section F, or in the side sections, as shown at *n′* near the lower edges of the side sections. The heating-vapors in the second and third evaporators being introduced at both ends to insure their proper circulation, we form a transverse bridge or flange *x* on the inner faces of the end pieces of B and C, in which the outlets B′ C′ are formed, preferably about one-third the way from the top. This compels the vapors introduced at that end of the evaporator to pass through the tubes and prevents their being drawn directly down through the end chamber.

Each vapor-pipe *a′ b′* is provided with an adjustable valve a^2 b^2, by which A or A and B may be disconnected from C in the event of its being desired to use only B and C or C alone. Inlets in B and C, corresponding with the steam-inlet A′ of A, are therefore provided, but are closed, as shown, when the three evaporators are being operated, as described.

As is usual in apparatus of this class, the temperature is reduced as the vacuum is increased, the vapor from pan A, which heats pan B, being of a lower temperature than the steam in A, and the vapor from B, which heats pan C, being of still lower temperature.

In our apparatus the arrangement of channel-pipes for discharging the juice in spray or finely-divided condition upon the heated pipes or passages is important, not only because of the manner in which the juice is delivered upon the pipes, but because any lime or other foreign matter likely to deposit will settle in the bottoms of the channel-pipes, and not in any way interfere with the free even and continuous discharge of the juice. The juice falling upon the bank of pipes *h* flows over and around them, is thoroughly broken up, and is during its passage to the bottom fully exposed in the most advangeous manner to the heat, and has the great-

est amount of moisture driven off for a given amount of heat. Further, since the juice in being evaporated can pass in any direction along between and around the pipes *h*, its free passage cannot be choked or interfered with in any manner, as is frequently the case where the juice is conveyed through pipes and the heat applied outside.

Heretofore apparatus of this kind has been heavy, bulky, difficult to handle, and expensive. Our evaporators are constructed of detachable sections or parts, each relatively light and easily handled. They may therefore be easily shipped to the point of use and there readily assembled for operation without the use of special skilled labor. The space occupied is relatively small, since the apparatus is compactly built, and is of such design as to occupy a minimum amount of space for the results accomplished.

We claim as our invention—

1. The combination, substantially as set forth, in an evaporator, of the horizontally-arranged heating-pipes, a juice-tank arranged above the heating-pipes and between the ends thereof, and horizontal juice-discharge pipes extending in opposite directions from the juice-tank above the heating-pipes and having slits along their upper surfaces, for the purpose specified.

2. The combination of the bank of heating-pipes, with the juice-tank arranged above them, the tank having in its bottom a narrow transverse well or depression, and the open-top channel-pipes for discharging the juice in a divided or spray-like condition upon the heating-pipes, substantially as set forth.

3. The combination, substantially as set forth, in an evaporator, of the shell or casing, end chambers I, having openings or ports for the admission and discharge of the heating-fluid therein, a series of horizontal tubes or passages connecting the chambers at the opposite ends of the evaporator and extending through the perforated inner walls thereof, a perforated partition arranged midway between the end chambers and supporting the tubes, a juice-collecting chamber below the tubes, a vapor-collecting chamber above them, a juice-supply tank arranged in the vapor-chamber, a pipe conveying juice from the juice-collecting chamber, and pipes conveying vapor from opposite ends of the vapor-chamber.

4. In an evaporator, the combination of the flanged sections forming the sides, the flanged cap E and flanged bottom F, the flanged end sections, the perforated tube-plates bolted between the end sections and the sides, top and bottom sections, the bank of heating-tubes *h*, mounted in said plates, juice-delivery devices for discharging the juice upon the top of the bank of tubes, an outlet for the withdrawal of the juice after its descent over and around the tubes, and steam or vapor inlet and outlet openings in the end sections.

5. In an evaporator, the combination of the flanged rectangular sections forming the sides, flanged top and bottom sections, flanged end sections, a perforated tube-supporting plate bolted between the contiguous vertical edges of the sections forming the sides, similar tube-plates bolted between the end sections and the sides and top and bottom sections, and heating-tubes mounted in said tube-plates and communicating with steam or vapor chambers I I′ at the ends of the evaporator, substantially as set forth.

6. The combination of the bank of heating-pipes, with the tank having a transverse well in its bottom and apertures k^2 in the bottom of said well, and the open-top channel-pipes connected with the sides of the well, substantially as and for the purpose set forth.

In testimony whereof we have hereunto subscribed our names.

JAMES J. ADAMS,
LEWIS W. TRACY.

Witnesses:
ALFRED SHEDLOCK,
EDWARD C. DAVIDSON.