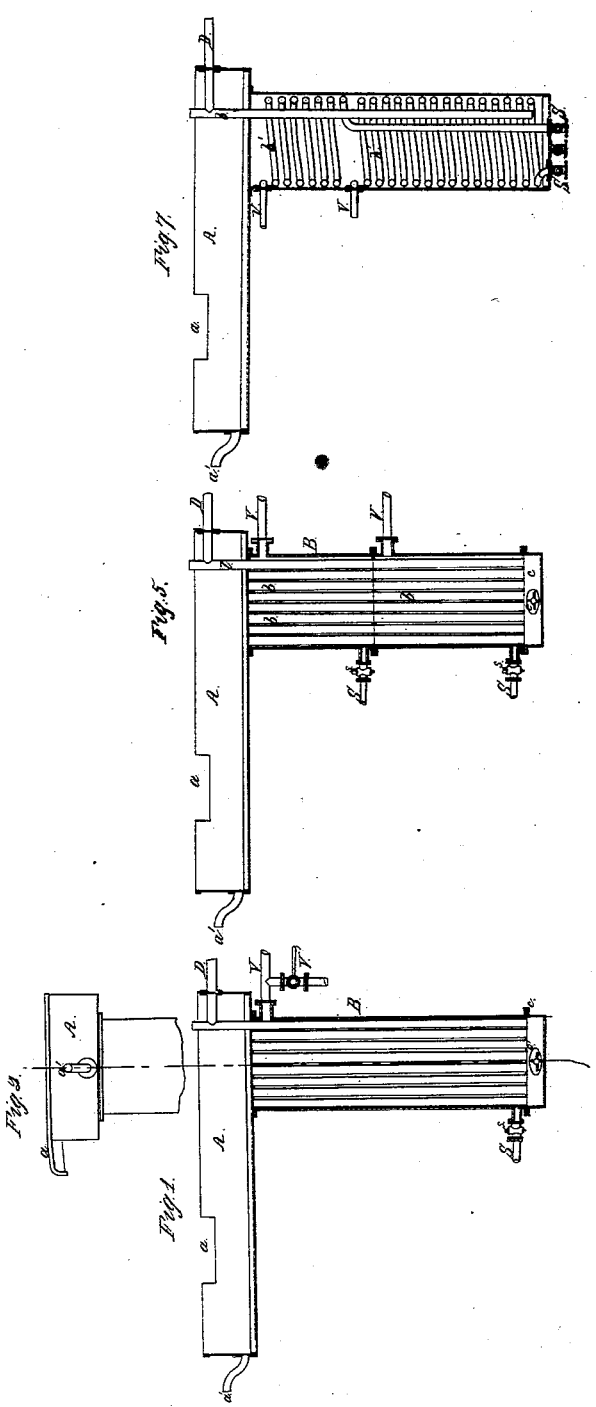
Sheet 1- 4 Sheets.

N. Rillieux.

Evaporating Pan.

No. 4,879. Patented Dec. 10, 1846.



Sheet 2. 4 Sheets.

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Fig 1.

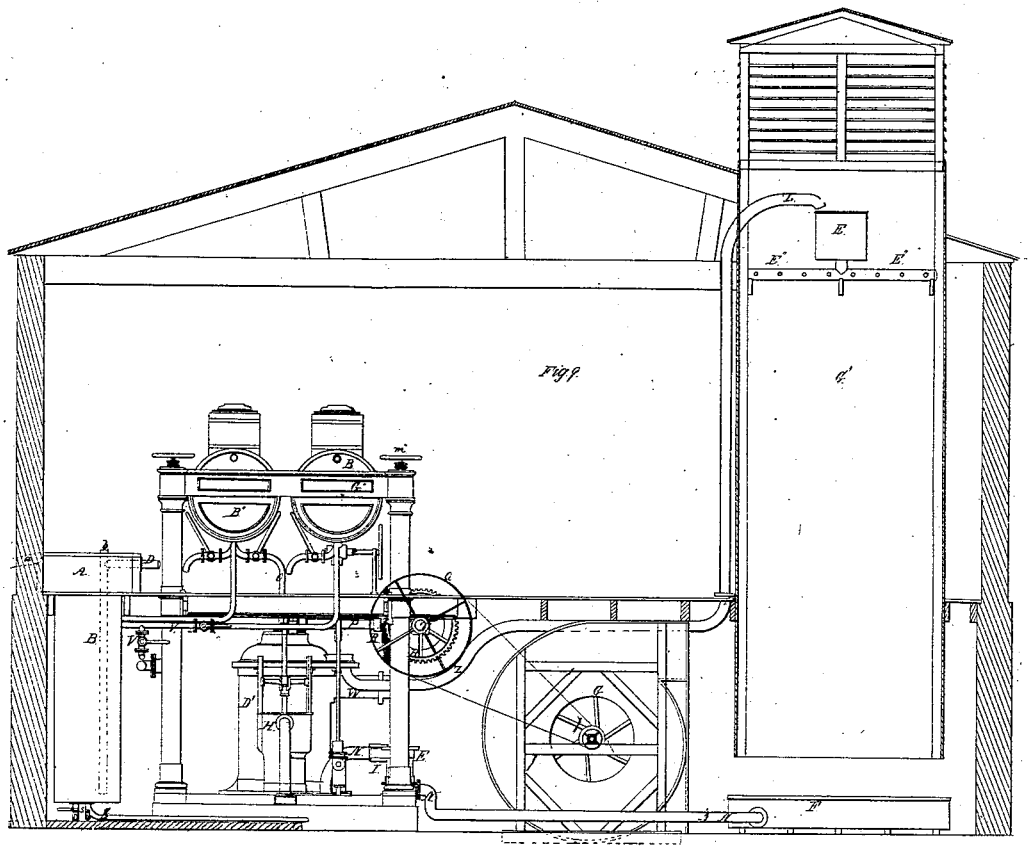
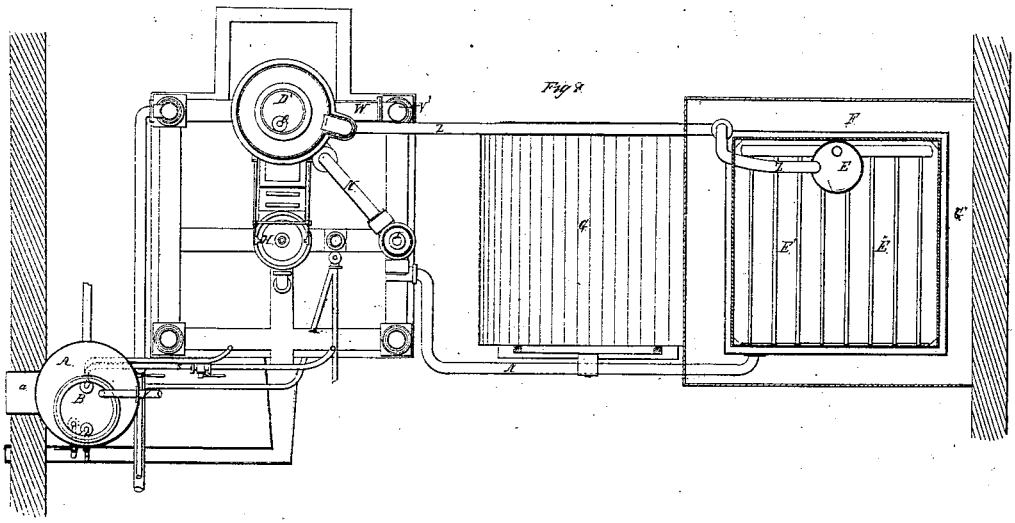


Fig 2.



Sheet 3 - 4 Sheets

N. Rillieux,

Evaporating Pan,

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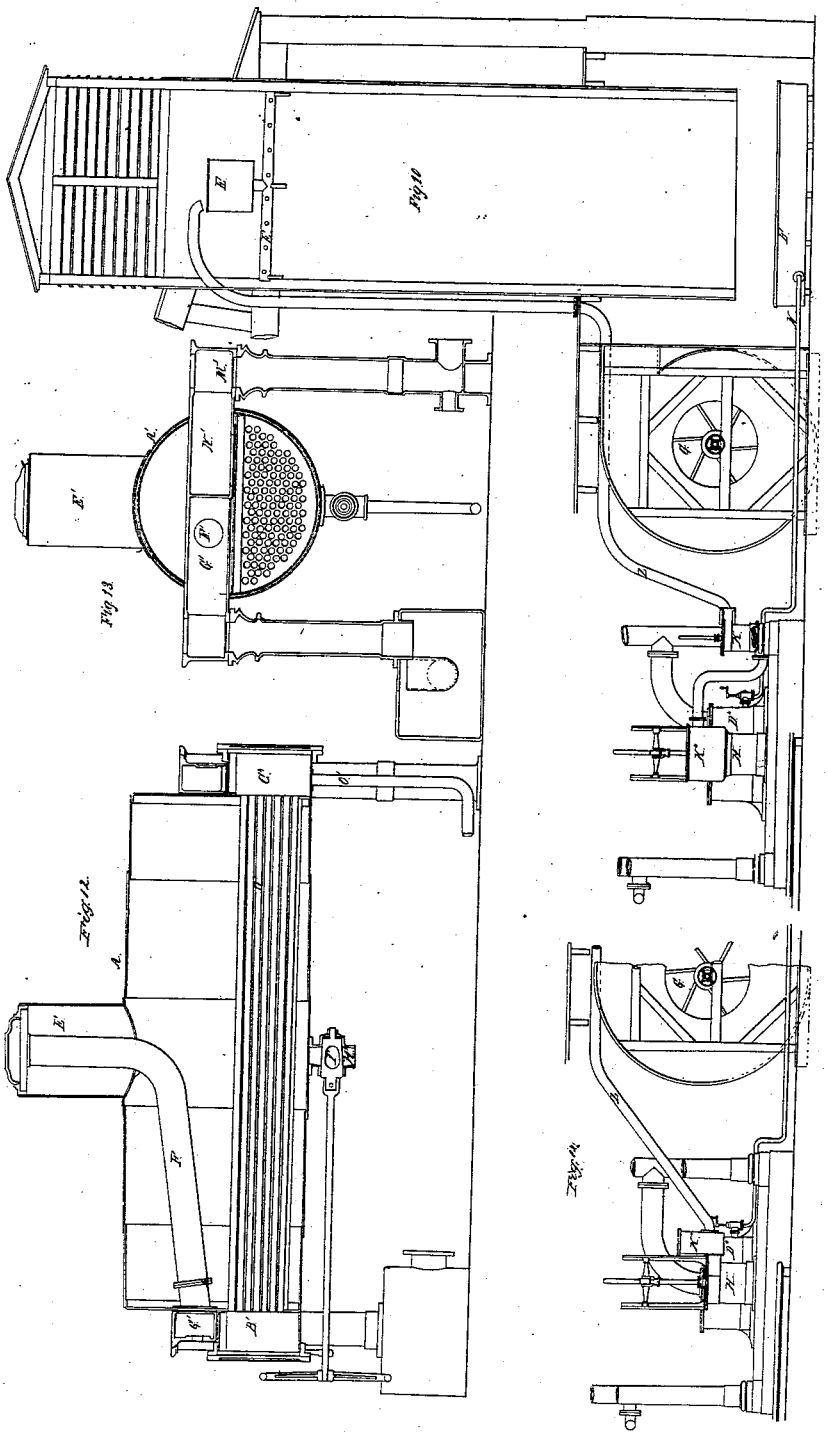

N. Rillieux,

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Fig. 15.

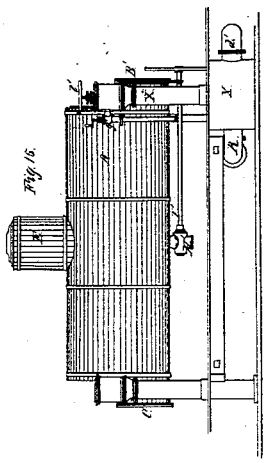


Fig. 17.

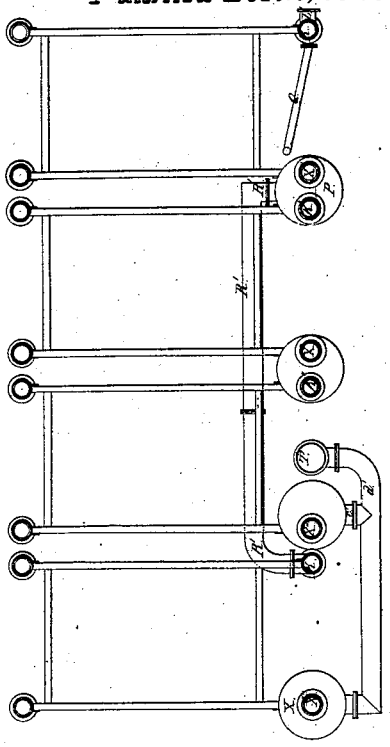


Fig. 14.

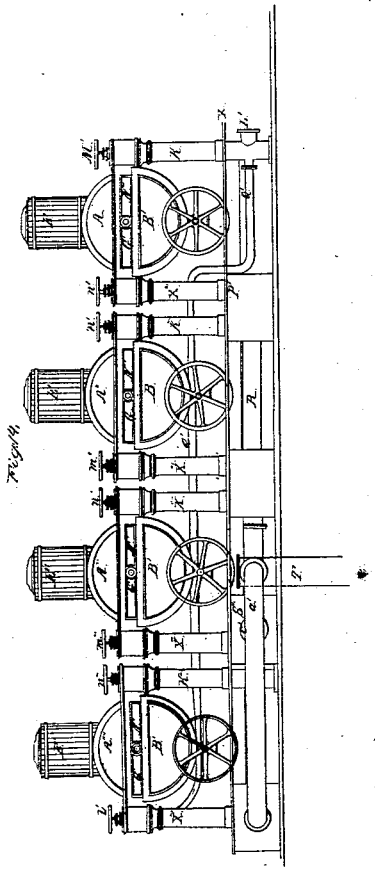
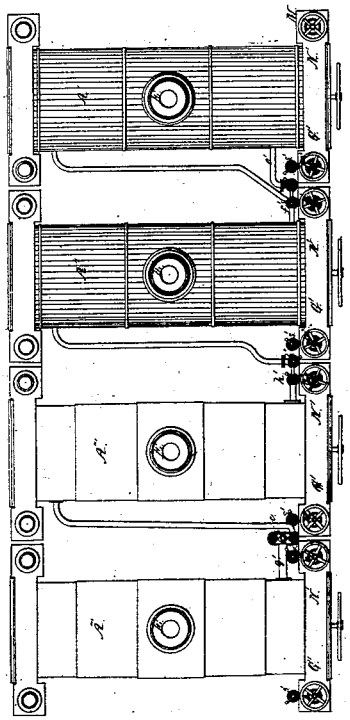


Fig. 16.



UNITED STATES PATENT OFFICE.

NORBERT RILLIEUX, OF NEW ORLEANS, LOUISIANA.

IMPROVEMENT IN SUGAR-MAKING.

Specification forming part of Letters Patent No. **4,879**, dated December 10, 1846.

To all whom it may concern:

Be it known that I, NORBERT RILLIEUX, of New Orleans, in the parish of Orleans and State of Louisiana, have invented new and useful Improvements in the Method of Heating, Evaporating, and Cooling Liquids, especially intended for the manufacture of sugar; and I do hereby declare that the following is a full, clear, and exact description of the principle or character which distinguishes them from all other things before known, and of the manner of making, constructing, and using the same, reference being had to the accompanying drawings, making part of this specification, in which—

Figure 1, Plate 1, is a longitudinal vertical section of the heater; Fig. 2, (same plate,) an end elevation of the upper part, A, thereof; Fig. 3, (same plate,) a plan; Figs. 4 and 5, (same plate,) a plan and vertical section of a modification of the mode of constructing the heater, and Figs. 6 and 7 (same plate) a plan and vertical section of another modification in the mode of construction. Fig. 8, Plate 2, is a plan of the cooler in connection with the entire apparatus, and Fig. 9 (same plate) an elevation of the same; Fig. 10, Plate 3, an elevation of a modification of the entire apparatus represented in Plate 2; and Fig. 11, Plate 3, a vertical section of the apparatus thus modified; Figs. 12 and 13, (same plate,) longitudinal and transverse vertical sections of one of the boilers or pans; Fig. 14, Plate 4, an elevation of a series of evaporating-pans; Fig. 15, (same plate,) a side elevation; Fig. 16, (same plate,) a plan thereof, and Fig. 17 (same plate) a horizontal section taken at the line X X of Fig. 14.

The same letters indicate like parts in all the figures.

My invention consists, first, of a heater for clarifying saccharine juices preparatory to the evaporating process, but which may be employed simply for heating the juice preparatory to clarifying; second, of a cooler employed in connection with the vacuum-pans or evaporators or boiling apparatus, by means of which the saccharine juices are cooled by a current of air that they may be employed as a means of condensation for the vacuum-pans, at the same time preparing them by partial evaporation for the evaporating-pans; and, third, of an arrangement of vacuum-pans or evaporators.

First, of the heater: This part of my invention is distinguished from all other things before known by so arranging it that the saccharine juice is conducted through a tube or pipe and delivered at the bottom of a vessel provided with tubes, through which the juice rises gradually to the top, receiving heat from the tubes which are heated by the circulation of hot water or steam around them, the upper part of the vessel being provided with a rim which has a pipe for the clarified juice to pass off, and a spout for the discharge of the scums which is placed a little above the connection of the pipe that carries off the clarified juice.

Of the cooler: The nature of this part of my invention consists of the employment of a current of air from a fan-blower, which passes up a vertical flume and meets the saccharine juice or other fluid falling in spray from a perforated pan or pipes above, and then in using the saccharine juice thus cooled and partly evaporated for the condensing process by passing it through the pipes of what is known as the "Hall Condenser" to make the vacuum in the pans. After this the juice is separated, a portion, in a partly-heated state, is fed into the first of the series of evaporating-pans, and the rest returned to the cooler preparatory to another operation. By means of this arrangement I attain an economical result, for the cooling operation partly evaporates the saccharine juice, and at the same time avoids the necessity of using water for carrying on the process, which saving is very important on account of the great scarcity of water in many parts of the sugar-growing country.

Of the evaporating-pans: A series of vacuum or partial vacuum pans have been so combined together as to make use of the vapor from the evaporation of the juice in the first to heat the juice in the second, and the vapor from this to heat the juice in the third, which latter is in connection with a condenser, the degree of pressure in each successive one being less; but the defect in this plan is that when the last, called the "striking-pan," (so called from the fact that the sugar is there reduced to the condition in which it is to be transferred to the coolers or granulating-vats,) is stopped all the others in the series must be stopped

also, and as this occurs every time the striking-pan is discharged and when it is used for reboiling the molasses it becomes a serious inconvenience. The object of my improvement is to avoid this inconvenience by connecting the striking-pan by a pipe governed with a cock with the first sirup-pan, so as to heat it with the vapor from the said first sirup-pan, so that the connection can be closed at pleasure without interrupting the operation of the series of sirup-pans, the last of which is in connection with the condenser, instead of being in connection with the striking-pan. The number of sirup-pans may be increased or decreased at pleasure so long as the last of this series is in connection with the condenser, and it will be obvious that the striking-pan, instead of being heated with steam from the first sirup-pan, may be heated by vapor from either of the series except the last, although I prefer to take the vapor from the first; but this connection must be independent of the connection between the several sirup-pans with each other and that of the last of the series with the condenser.

In the accompanying drawings, Plate 1, A is the trough of the heater at the top of a vertical cylindrical vessel, B, containing a series of vertical tubes, *b*, the upper ends of which are attached to and open into the trough A, and their lower ends attached to a perforated plate near the bottom of and opening into a chamber, *c*, at the bottom of the vessel B, provided with a man-hole, *c'*, for the purpose of cleaning out. One of the vertical tubes *b* extends up higher than the rest, and communicates with a pipe, D, through which the saccharine juice is introduced from the coarse strainers (in the usual manner) that separate the coarse impurities. The juice passes down this tube to the chamber *c*, and gradually rises in the tubes *b* into the trough A, and is, after being heated, discharged through the bent-up pipe *a'*, the scum being discharged through a spout, *a*, lower than the upper part of the discharge-pipe *a'*, but above its connection with the trough, so that none but the clarified juice shall enter the discharge-pipe, and the scum shall rise sufficiently high to be discharged before the juice can escape through the discharge-pipe, to avoid the escape of any impurities with the juice. As the juice circulates through the tubes *b* it is heated by the waste hot water from the pans, which enters near the top of the vessel B, through a pipe, V, circulates around the tubes, and passes out through a pipe, S, provided with a regulating-cock, *s*. For the purpose of starting the apparatus, and before the sugar-pans are heated, this part of the apparatus is heated by steam from a boiler, which is introduced through a branch pipe, V', which connects with the hot-water pipe V. The first modification of this part of the apparatus is represented in same plate, Figs. 4 and 5, and the second modification by Figs. 6 and 7, same plate. The first modification differs only from the above in having the vessel B divided into an upper and lower compartment by a horizontal diaphragm, and having two pipes, V V, for introducing the hot water to both of them, and two pipes, S S, for discharging it, the hot water for the lower compartment being supplied from the pan working under the lowest pressure to commence heating the juice, and that for the upper compartment from the pan working under higher pressure to increase the heat of the juice as it approaches the top. And the second modification differs from the others in carrying the hot water for heating the juice through two coils of pipes or worms, *b'*, the juice being introduced into the vessel by the same means as above. This apparatus, under either of its forms, can be employed either as a simple heater to heat the saccharine juice to about 175° by the hot water from the pans or boilers, and then to be clarified in the usual way, or, as I prefer it, to clarify the juice by heating it to the boiling-point, but without ebullition, as the agitation would prevent the separation of the impurities, which, under the action of heat without ebullition, rise to the top in the form of scum and are discharged at the spout.

From the heater the saccharine juice is conducted to the filters in the usual manner, which does not require to be described or represented, and from these it is discharged in the vat F of the cooler, (see Plate 2,) which is a large flat vessel, and from this it is forced through the pipe N by a force-pump, I, into and through the tubes of a Hall condenser, D'', through which it ascends, and a portion—about one-twentieth—is forced from the top of the condenser through a pipe, *o*, into the pan B'' of the boiling or evaporating apparatus, and the rest through the pipe *z* into a vessel, E, which delivers it to a series of horizontal perforated tubes, E'', which discharge it in spray at or near the top of a vertical chamber, G'', down which it falls into the receiving-vat F at the bottom. As the juice descends in the form of spray it is met by a current of air from a rotary fan-blower, G, which cools and partly evaporates it. When thus cooled, it is again forced, as before described, through the tubes of the condenser, and its passage through condenses the vapor from the vacuum-pan B, which escapes from the upper part of the bonnet through a pipe, F', (as represented in Fig. 12, Plate 3,) into the hollow support G', from thence through a valve in the back hollow pillar, V', and thence along a horizontal pipe, W, to the condenser and outside the pipes thereof, (in the well-known manner of the Hall condenser, which needs no representation,) and when condensed the water and air are drawn out by the air-pump H in the usual manner of exhausting a condenser. The vacuum-pan is heated by the vapor from the saccharine juice in the pan B'', and when condensed the hot waste water passes out through the pipe V to the heater, for the purpose before described. The air and feed pump is operated by eccentrics or cranks on the shaft P and the fan-

blower G by a belt from the belt-wheel Q on the shaft T, the shafts T and Q being geared together by cog-wheels R, receiving motion from some first mover. As the evaporating apparatus represented in this connection is similar to the one patented by me on the 26th of August, 1843, it is not deemed necessary to give a description of it in this connection, particularly as it must be obvious that my improved methods of heating and clarifying and cooling and condensing can be combined with any kind of evaporating apparatus, and I contemplate employing them in connection with the evaporating apparatus to be hereinafter specified. I have therefore simply described the manner of combining these improvements with an evaporating apparatus for making sugar.

From the foregoing it will be obvious that the effect of this arrangement is to condense the vapor from the vacuum-pans which communicate with the condenser, so that by the circuit the saccharine juice is partly evaporated and prepared for being introduced in the pans while it is used as a means of condensing the vapor from and keeping up a vacuum in the vacuum-pans, thus effecting a leading object of my invention—viz., carrying on the whole operation without the necessity of using water for condensation, as water is frequently very scarce in many of the best sugar-manufacturing regions of the country. The essential features of this part of my invention may, however, be used with water, but without waste, by arranging the apparatus as represented in Plate 3, Figs. 10 and 11. In this modification the quantity of water necessary for carrying on the condensing operation is placed in the vat F, and from this it passes through the pipe N to a common condenser, D″, to form the condensing-jet in the usual manner of working a condenser, and from the condenser it is drawn out and discharged into the hot well *k*″ by a common single-acting air-pump, H, and from the hot well the water of condensation is forced through the pipe Z by a force-pump, K, or by an air-vessel into the vessel E, which discharges it in spray through the perforated tubes, to be cooled in its descent to the vat F by the current of air from the fan-blower G, as above described. The water evaporated in the cooling-room during the descent of the spray is equal to the water produced in the condenser by the condensation of the vapor from the pans, so that the first charge of water with which the apparatus is started will continue to work it for any length of time.

Of the boiling or evaporating apparatus represented in Figs. 12 and 13 of Plate 3, and Figs. 14, 15, 16, and 17 of Plate 4: The pillars and frame-work that support the pans or boilers are made hollow to answer the purpose of the pipes for conducting liquids to be evaporated, the waste water, and the vapor by which the process is to be carried on.

The evaporating pans or boilers A′ A″ A‴ A⁗ are all constructed alike. They are cylindrical, and the lower half at each end extends beyond the heads to form a chamber, B′ and C′, at each end, the heads being pierced in the lower half to receive the tubes D′, that connect the two chambers. These tubes have a slight inclination downward from the front chamber, B′, to the back one, C′, sufficient to permit the flow of water produced by the condensation of the vapor that passes through them. The top is provided with a bonnet, E′, and within there is a pipe, F′, to take the vapor from the upper part of the bonnet to the front end, through which it passes into the hollow support G′ in front, to be conducted to another pan or boiler. Each pan or boiler is provided with a discharge-pipe, H′, at bottom, governed by a stop-cock, I′, for the purpose of discharging the contents of each boiler when necessary. The series of pans having been properly charged, steam from a boiler or the escape-steam of the engine enters the first hollow pillar, K′, through the pipe L′, passes through the valve M′ into the compartment N′ of the frame-work, which communicates with the front chamber, B′, of the first pan, A′. It circulates through the tubes, heating the saccharine juice in the pan or boiler outside the tubes, and passes off after communicating the required caloric from the back end chamber, C′, through a pipe, O′, which may be in connection with the feed-pump of the steam-boiler, to be pumped back into the steam-boiler, or otherwise used at discretion. The vapor arising from the heated juice in the boiler or pan A′ is drawn off from the upper part of the bonnet E′ by the pipe F′ and conducted to the compartment G′ of the hollow supporting-beam, and passes the valve *m*′ down the pillar *k*′ to a receiver, P′. A portion of the vapor from this receiver passes through a pipe, R′, to heat the last or striking pan, A⁗, as will be hereinafter described, and the remnant passes up the hollow pillar K″ through the valve *n*′, to circulate through the tubes D′ of the boiler A″, to heat and evaporate the more concentrated saccharine juice in the pan A″, which, after being partly evaporated in the first pan, passes to the second through the pipe *e*, governed by a valve, *f*. The water produced by the condensation of the steam in passing and heating these tubes in this second pan is carried off in like manner as in the preceding, but may be used for any desired purpose. From this second pan, A″, the vapor is drawn off to heat the third pan, A‴, by a like arrangement of parts as from the first to the second, and the vapor from the saccharine juice in this pan A‴ passes in the same manner as the preceding down the hollow pillar to a receiver, S′, which communicates by the pipes *c*′ *d*′ with a condenser, T′, of any desired construction. The sirup from pan A″ passes to the third through the pipe *g*′, governed by a valve, *h*′. From the pan A‴ the concentrated sirup passes through the pipe *i*′ to feed the striking-pan A⁗, which is heated during the operation of the apparatus by a portion of the vapor produced by the evaporation of the saccharine

juice in the first pan, A′, by means of the pipe R′, which connects the hollow pillar K‴ with the receiver P′; or it can be heated when the series of sirup-pans are not in operation, or when reboiling molasses by steam from the pipe Q′, which branches off from the pillar K′ at L′, and which may be provided with a valve to shut off this connection when the striking-pan is to be heated by vapor from the first sirup-pan, A′. The vapor from the striking-pan A⁗ is drawn off and condensed by connecting the hollow pillar X′ and valve *l′* with the condenser T′ by means of the pipe *d′* and receiver X⁗, by means of which arrangement the last of the series of sirup-pans, as well as the striking-pan, are connected with the condenser, and this connection can be broken at pleasure by closing either of the valves *m″*, in the hollow pillar X‴ or *l′* in pillar X⁗. The saccharine juice is supplied to the first pan through the pipe *o′*, governed by the valve *p′*, and, after being partly concentrated under the highest degree of temperature, it is drawn into the second pan, A″, to be evaporated *in vacuo* through the pipe *e′*, governed by the valve *f′*, and from this it is transferred to the third pan, A‴, to be still further concentrated through the pipe *g′*, governed by the valve *h′*, and from this it is delivered through the pipe *i′*, governed by a valve, *j′*, to the filters, in the usual manner; and from these it is drawn up and transferred to the striking-pan A⁗ through the pipe *q′*, governed by a valve, *r′*, to be reduced to the striking or crystallizing point. But if only two sirup-pans should be used instead of three, then the sirup can be drawn off to the filters from the second pan, A″, through the pipe *g′* by closing the valve *h′* and opening the one *h″*, the third pan and all its connections being closed or dispensed with. Each of the chambers G′ connected with the pans is provided with a cleansing and discharging pipe and valve, *s′*. By this arrangement it will be obvious that when the connection between the hollow pillar K′, which conducts steam from a boiler (or the exhaust-steam from an engine) to heat the first pan, A′, and the steam-pipe Q′, that leads to the striking-pan A⁗, the striking-pan will be heated by a portion of the vapor of the saccharine juice in the first pan, A′, by means of the connection between the receivers P′ and S″, and that therefore the last of the series of sirup-pans, A″, can be connected with the condenser, and that the striking-pan can be worked independent of the sirup-pans in consequence of its connection with the steam-pipe L′ or the first or second of the series of sirup-pans in such manner that either of these connections can be broken at pleasure.

It will be obvious that this boiling or evaporating apparatus can be employed in connection with my improved heater and cooler by adopting the connections pointed out in the description of the entire apparatus.

Having thus pointed out the principle or character of my improvements and the manner of constructing and applying the same, what I claim as my invention, and desire to secure by Letters Patent, is—

1. The method of heating the saccharine juice in a heater preparatory to its introduction in the evaporating-pans, by means of the waste hot water or escape steam from the evaporating-pans, substantially as described.

2. The method of clarifying saccharine juice by heating it in a heater provided with a spout for the discharge of the impurities in the form of scum, and a pipe for drawing off the clear liquid, the said pipe being so arranged as to receive the liquid from the heater below the level of the spout which discharges the scum, and then bending up above the said spout to cause the liquid in the heater to rise sufficiently high to discharge the scum, substantially as described.

3. The method of cooling and partially evaporating saccharine juice or other liquids by discharging the same in the form of spray or drops in a chamber, where it meets with a current of air, substantially as described; and this I also claim in combination with a condenser, substantially as herein described, whereby the liquid intended to be concentrated is prepared for the evaporating-pans and used as a means of condensing the vapor from the pans in which it is to be concentrated, or by means of which the water used for the condensing-jet is recooled, substantially as described.

4. The method, substantially as described, of combining a vacuum striking-pan with a series of evaporating-pans, the last of which is independent of the striking-pan, and the last of the series of evaporating-pans can be in connection with the condenser and work independently of each other, that either the striking-pan or the series of evaporating-pans can be worked without the other, as described.

N. RILLIEUX.

Witnesses:
CHS. M. KELLER,
CH. L. FLEISCHMANN, JR.